Collective Bargaining Networks and the Propagation of Shocks*

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Abstract

How does collective bargaining shape the labor market response to economic shocks? I use novel Argentine administrative data to uncover the network of firms linked by collective bargaining and show that positive product-demand shocks to firms within a bargaining unit raise wages at other non-shocked firms in the same unit. Heterogeneous wage and employment responses indicate that propagation operates via collectively bargained wage floors. I develop and estimate a structural model where wage floors are determined in bargaining equilibrium. The model shows that the network shapes the bite of wage floors, which in turn determines the magnitude of shock propagation.

Keywords: collective bargaining, unions, wage floors, monopsony power, trade shocks, shock propagation, rent-sharing.

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1 Introduction

Collective bargaining (CB) establishes common provisions for workers, such as wage floors, across all firms covered in a bargaining unit. CB can therefore influence how wages respond to changes in the economic conditions of employers. In Europe, for example, firm responses to the Great Recession and the rise of import competition from China have been linked to prevailing bargaining institutions (e.g., Ronchi and di Mauro 2017; Barth et al. 2023; Adamopoulou et al. 2025). Understanding these responses is important for the many public policies that seek to mitigate the effect of shocks on workers.[1] In the US, discussions about bargaining institutions have gained traction in recent years, and new bargaining policies have already been implemented.[2] These endeavors require an understanding of the trade-offs involved in different bargaining structures. While extensive research examines wage setting under CB (e.g., Cardoso and Portugal 2005; Bhuller et al. 2022; Card and Cardoso 2022) and the labor market effects of shocks (e.g., Van Reenen 1996; Autor et al. 2013; Garin and Silvério 2023), there is little direct evidence on how these institutions mediate the pass-through of these shocks to firms and workers.

CB typically defines a network of firms, with two firms connected in the network if they fall under the same CB unit and therefore share the same commonly bargained provisions. The structure of this network differs widely across countries, with some characterized by large sectoral CB units, and others by employer-level bargaining (Bhuller et al. 2022). When economic shocks affect firms in a particular region or sector, these different forms of CB network seem likely to respond differently.[3] For instance, if firms in an affected region are connected to firms in another region via CB, then updated negotiations in the CB unit may result in wage changes in the unaffected region as well. This could be a cause for concern if it results in low-wage regions covered by high wage floors that are not aligned with local conditions (Boeri et al. 2021). However, it could also be desirable if it dissipates the effects of concentrated shocks among firms, effectively smoothing the impact on workers.

Studying the role of the CB network in determining the responsiveness of wages to economic shocks is challenging for several reasons. First, it requires detailed information linking employment relationships to CB units, which is typically not available in administrative datasets. Second, it requires measurable and exogenously determined shocks to employers. Finally, it requires an economic model in which common CB provisions are determined in

[1] See, e.g., the US Trade Adjustment Assistance program or the EU Globalisation Adjustment Fund.

[2] See, e.g., the recent California law introducing a Fast Food Council to set provisions for fast-food workers. Pietsch (2022) notes that the "California law is widely seen as a step toward sectoral bargaining."

[3] As noted by Katz and Autor (1999, pp. 1540), "the same labor market shocks [...] may have different impacts on the wage structure depending on how unions and government regulations affect wage setting."

bargaining equilibrium, and in which the network structure can be varied to study its effects.

In this paper, I study how CB shapes the impact of economic shocks to firms. First, I leverage novel administrative data from Argentina to construct the network linking firms to CB units. This dataset, coupled with rich labor market data, allows me to study how shocks propagate through the CB network. Second, I construct plausibly exogenous product-demand shocks by exploiting changes in international demand for exported products, and compare the evolution of outcomes across firms that are shocked directly or via their CB unit. Finally, I develop and estimate a structural model where heterogeneous firms are connected by a CB network, and use it to study the incidence of shocks under counterfactual networks.

The case of Argentina around the 2008–09 Great Recession provides an excellent setting for this analysis. CB is widespread in the country, with 93% of workers covered by some agreement in 2014 (Secretaría de Trabajo 2023), and collective negotiations are frequent, leading to regular updates of wage floors. Furthermore, due to the country's legal structure, CB units are not entirely determined by region or economic sector. This results in an idiosyncratic network that allows me to compare otherwise similar firms that are nevertheless part of different CB units.

To construct product-demand shocks I leverage variation in world demand for products exported by Argentine firms between 2007 and 2013. Following Hummels et al. (2014) and Garin and Silvério (2023), firms are exposed to changes in world import demand via the share of their value exported to each country-product, as reflected in Argentine Customs data. CB units are also exposed to product-demand changes via their employment shares in firms that export to each country-product. I define firm and CB unit (CBU) shocks as the weighted average of changes in log world import demand, weighting by the appropriate exposure shares to each country-product.

I estimate the effects of these shocks on firms in a difference-in-differences setting. To identify the effect of *firm shocks* I compare the evolution of outcomes for firms in the same province and economic sector that are subject to a similar CBU shock but a different firm shock. To identify the effect of *CBU shocks* I proceed analogously, but comparing firms with a similar firm shock and a different CBU shock. The key assumption is that, within province and sector cells, growth in world import demand (WID) affected firms because of changes in their product demand and in the outcomes of bargaining, and not because growing firms sorted into markets with trending WID or were affected by changes in WID through channels other than their CB unit. Following Garin and Silvério (2023), I see this as a plausible assumption given that changes in WID were primarily driven by unexpected recessions and recoveries of varying magnitudes across countries following the Great Recession.

The main results show that both firm and CBU shocks affect wages, but only CBU shocks affect wage floors. A 10% increase in average world import demand at the firm level increases wages by 0.23% (SE=0.07%). An increase in the CBU shock equivalent to a 10% increase in firm-level demand increases wages by 0.44% (SE=0.18%) and wage floors by 1.15%. These effects imply a wage floor pass-through of 38%, suggesting that wage floors are impactful but there is also room for flexibility above the floor (as in Card and Cardoso 2022).

I provide further evidence that CBU shocks operate via wage floors by studying heterogeneity of effects by pre-period wages. First, I test the prediction that employment responses to wage floors depend on the firms' productivity, as in models of monopsonistic wage setting under minimum wages (Manning 2003; Ahlfeldt et al. 2022; Berger et al. 2025). According to this theory, low productivity firms are demand constrained by the wage floor, and so they should respond by decreasing employment as they move along their labor demand curve. Medium productivity firms are supply constrained, implying that they should increase employment. High productivity firms should not be affected. I proxy for productivity using pre-period wages. Consistently, I find evidence that low-wage firms respond to the CBU shock by decreasing employment, while medium-wage firms respond by increasing it. Second, I explore heterogeneity in the effects of CBU shocks on wages. Though estimates are imprecise, they are also consistent with a wage floor mechanism. I find that wage effects are larger for low-wage firms and close to zero for high-wage firms, even though wage floor effects are similarly strong across the wage distribution.

A threat to the interpretation of these results is that the causality runs through other channels correlated with CB units, such as input-output linkages. To address this concern I exploit a subset of firms that hire workers under multiple CB units, and estimate the effect of CBU shocks to the workers' CB unit (instead of the firm's most common CB unit, as in the baseline analysis). If CBU shocks actually propagate through other channels, then we should not observe CB unit-specific effects within the firm. Instead, I find that workers' wages respond to shocks to their own CB unit, relative to workers in the same firm but under a different CB unit. Notably, this exercise allows for time-varying heterogeneity at the firm level, ruling out alternative channels of shock propagation that operate through the firm.

I provide several additional robustness checks to address other concerns about the empirical strategy. The effects are similar when using a "leave-one-out" version of the CBU shock, addressing concerns of mechanical correlation between firm and CBU shocks. The results are also similar when I construct the country-product shocks as the symmetric growth rate in world import demand following Garin and Silvério (2023), when varying the time horizon used to define the shocks, and when using alternative measures of exposure shares.

In the final part of the paper, I develop a general equilibrium model to investigate how the CB network affects the incidence of shocks. The model allows for firm heterogeneity in productivity, spillovers through competition in local labor markets, and wage floors that are determined by collective bargaining. I use a "Nash-in-Nash" solution concept, introduced by Horn and Wolinsky (1988), to model the equilibrium of the bargaining game between unions and employers. I rely on the empirical exercise to quantify the key elasticity in the model, and estimate the parameters governing heterogeneity in productivity and bargaining power of unions by model inversion. As validation, I show that the estimated model replicates the effects of CBU shocks and quantitatively matches the pass-through from wage floors to wages found empirically, which was not targeted in estimation.

The model shows that the CB network plays a key role in determining the incidence of shocks. I define counterfactual networks with different degrees of centralization of bargaining, a key feature that varies widely across countries.[4] Then, I quantify the extent of shock propagation by comparing the effects of shocks in each network to a benchmark economy without bargaining. I find that shock propagation is hump-shaped in the centralization of bargaining, thus idiosyncratic shocks propagate the most at intermediate levels of centralization. This result can be explained by the extent of connections created by the network and the bite of wage floors. Decentralized bargaining results in high wage floors, but the lack of connections means that shocks do not propagate. Increasing centralization leads to more connections, but it also increases the dispersion of productivity within CB units, which endogenously results in a lower bite of wage floors. A lower bite, in turn, reduces the impact of wage floor changes on wages. Eventually, this effect dominates, and the extent of propagation decreases with further centralization.

The empirical and structural analyses establish that the structure of bargaining institutions determines the exposure of workers to economic shocks. Consequently, the design of effective countervailing policies should take into account the institutional context.

This article contributes to several strands of literature. First, to my knowledge, this is the first paper to show direct evidence that the wages paid by a given firm are affected by shocks to other firms in the same CB unit. Rose (1987) and Abowd and Lemieux (1993) find wage responses to shocks to all firms in a CB unit.[5] Gürtzgen (2009b) and Rusinek and Rycx (2013) find that wages are more responsive to shocks with decentralized bargaining. Card and Cardoso (2022) find an association between changes in mean value added in a CB unit and wage floors in Portugal. None of these papers distinguish between the effects of shocks to a firm and to other firms in the same CB unit, nor do they explore heterogeneity in firm responses by pre-period wage levels. Carlsson et al. (2016) study the effects of sectoral

[4] Examples of decentralized countries include the US and the UK, while examples of centralized countries include Italy and Portugal. See Bhuller et al. (2022) for a recent classification and discussion.

[5] Rose (1987) studies the effects of a deregulation episode in the US trucking industry. Abowd and Lemieux (1993) study the response of contract wages to changes in international prices in Canadian manufacturing.

shocks to physical productivity in Sweden, and Garin and Silvério (2023) study the effects of common export shocks to firms in a product market in Portugal. None of these papers, however, explicitly study propagation of shocks via CB.

Second, I bridge the gap between the literature on the labor market effects of shocks (e.g., Autor et al. 2013; Dix-Carneiro and Kovak 2017; Garin and Silvério 2023) and labor market institutions. Recent contributions study how shocks propagate via product and labor market linkages (Adão et al. 2025), and firms' internal networks (Giroud and Mueller 2019; García-Lembergman 2022). However, while prior research examines how shocks affect unionization rates (Ahlquist and Downey 2023), the role of bargaining institutions as an active transmission channel remains unexplored. I show that the CB network propagates shocks between otherwise unconnected firms, determining the incidence of shocks on workers.

Additionally, this is the first paper to incorporate endogenous wage floors in a tractable spatial economic model, allowing for counterfactual analysis of different CB networks. While prior work modeling bargaining institutions exists, it usually does not feature spatial linkages nor does it allow for wage flexibility above the wage floor.[6] Recent papers also construct general equilibrium models with unions and bargaining (Azkarate-Askasua and Zerecero 2025; Wong 2025), however they do not study variation in the CB network. In principle, this framework can be used to study other questions about the role of the CB structure, such as the connection between CB and regional inequality.

Finally, the paper contributes to a broad literature studying union behavior and collective bargaining (e.g., Nickell and Andrews 1983; Freeman and Medoff 1984; Teulings and Hartog 1998; Card 1996; Jäger et al. 2025). In particular, several papers have studied the properties of different bargaining regimes both theoretically and empirically (e.g., Calmfors and Driffill 1988; Holden 1988; Cardoso and Portugal 2005; Plasman et al. 2007; Boeri et al. 2021; Jäger et al. 2022). Bhuller et al. (2022) calls for "closing the gap between how economists tend to model wage setting and how wages are actually set." This paper takes a step in that direction by modeling collective bargaining institutions explicitly, and using an estimated model to evaluate the effects of different bargaining structures in a principled way.

The paper is organized as follows. Section 2 presents a stylized theoretical framework. Section 3 describes the context and data. Section 4 discusses the strategy to estimate the effects of shocks, and Section 5 presents the results. I introduce the structural model of the labor market with collective bargaining in Section 6, discuss its estimation and validation in Section 7, and use it to conduct counterfactual exercises in Section 8. Section 9 concludes.

[6] Prominent examples include Calmfors and Driffill (1988), on the relationship between bargaining centralization and unemployment, Davidson (1988), on the incentives to centralize bargaining in oligopolistic industries, and Moene and Wallerstein (1997), on the effects of centralized bargaining on wage compression and firm's profitability. Other examples include Corneo (1995), Naylor (1998), and Gürtzgen (2009a).

2 Theoretical Framework

This section presents a stylized framework with heterogeneous firms covered by a single CB unit. I show that shocks propagate through the negotiated wage floor, and that employment responses are heterogeneous across firms, yielding testable implications for the empirical analysis. The structural model of Section 6 will extend this framework to allow for multiple CB units and general equilibrium effects via labor market competition.

2.1 Firm heterogeneity and wage floors

Firms j maximize profits facing an upward-sloping labor supply curve and a wage floor set by collective bargaining. The supply of labor to j at wage w_j is given by $h_j(w_j)$, so their employment choice ℓ_j must satisfy $\ell_j \leq h_j(w_j)$. In Section 6, h_j will also depend on wages of other firms, capturing labor market competition. Firms' choice of wage w_j must satisfy the constraint $w_j \geq \underline{w}$, where $\underline{w}$ is the wage floor set by collective bargaining. Firms are heterogeneous in productivity φ_j with output given by $y_j = \varphi_j f(\ell_j)$, where $f(\cdot)$ is a standard production function. The output price is normalized to one. The firm's problem is then

$$\max_{w_j} \varphi_j f(\ell_j) - w_j \ell_j \quad \text{s.t.} \quad w_j \geq \underline{w} \quad \text{and} \quad \ell_j \leq h_j(w_j).$$

The solution (w_j^*, ℓ_j^*) is characterized by two thresholds that determine firms' behavior given their productivity, which I denote by $\underline{\varphi}_j$ and $\overline{\varphi}_j$. Firms with $\varphi_j > \overline{\varphi}_j$ are *unconstrained* by the wage floor. The first order condition then yields $w_j^* = (\eta_j/(\eta_j+1))\, \varphi_j f'\left(\ell_j^*\right)$, where $\eta_j > 0$ is the elasticity of labor supply. The unconstrained wage exhibits a wage markdown over the marginal product of labor, as in monopsonistic labor markets (Manning 2011; Card et al. 2018). Additionally, these firms are on the labor supply curve, so that $\ell_j^* = h_j(w_j^*)$. These firms will not be affected by marginal changes in the wage floor.

Firms with $\varphi_j \leq \overline{\varphi}_j$ are *constrained*, so that $w_j^* = \underline{w}$. These firms come in two varieties, depending on their productivity relative to a second threshold $\underline{\varphi}_j$ (Ahlfeldt et al. 2022; Berger et al. 2025). When $\varphi_j \in (\underline{\varphi}_j, \overline{\varphi}_j]$ firms are *supply constrained*, thus $\ell_j^* = h_j(\underline{w})$, and we have that $\partial \ell_j^*(\underline{w})/\partial \underline{w} > 0$. When $\varphi_j \leq \underline{\varphi}_j$ firms are *demand constrained*, thus ℓ_j^* is determined by the labor demand curve and $\ell_j^* < h_j(\underline{w})$. In this case, $\partial \ell_j^*(\underline{w})/\partial \underline{w} < 0$.[7]

Next, I turn to discussing how the wage floor is determined.

[7] Whether a firm is supply or demand constrained depends on the level at which their marginal revenue product of labor (MRPL) and marginal cost of labor (MCL) intersect in the equilibrium without a wage floor. For demand-constrained firms the equality occurs at a level below $\underline{w}$. Thus, as the MCL goes up to $\underline{w}$, these firms increase the MRPL by lowering employment. For supply-constrained firms the equality occurs at a level above $\underline{w}$. The $\underline{w}$ lowers the MCL, inducing these firms to lower the MRPL by increasing employment.

2.2 Nash bargaining problem

I introduce a CB unit that determines the wage floor. Let $\mathcal{J}$ be the set of covered firms. The union objective is $U(\underline{w}) = WB(\underline{w})$, where $WB(\underline{w}) = \sum_{j\in\mathcal{J}} w_j^* \ell_j^*$ is the aggregate wage bill. The employer objective is $\Pi(\underline{w}) = R(\underline{w}) - WB(\underline{w})$, where $R(\underline{w}) = \sum_{j\in\mathcal{J}} \varphi_j f\left(\ell_j^*\right)$ gives the aggregate revenue. In Argentina, unions receive a fee proportional to each payslip, so the functional form of $U(\underline{w})$ is equivalent to assuming that unions maximize their total income.[8]

Unions and employers have adversarial objectives in contracting over a wage floor. First, note that the unconstrained solution yields maximum profits for each firm, and a binding wage floor can only force a firm away from this optimum. Consequently, aggregate profits $\Pi(\underline{w})$ are maximized when $\underline{w}$ does not bind for any firm. Second, the heterogeneity in φ_j implies that the wage bill (and also employment) is hump-shaped in the wage floor, so there exists a binding $\underline{w}$ that maximizes the wage bill. I discuss this result in Section 6.2.3.

The wage floor $\underline{w}$ is the solution to the following Nash bargaining problem, where $\beta \in [0,1]$ represents the bargaining power of the union:

$$\max_{\underline{w}} U\left(\underline{w}\right)^{\beta} \Pi\left(\underline{w}\right)^{1-\beta}. \tag{1}$$

If $\beta = 0$ the solution is given by any non-binding $\underline{w}$, whereas if $\beta = 1$ the problem amounts to selecting the wage bill-maximizing $\underline{w}$. Now consider the case $\beta \in (0,1)$. In an interior solution the optimal wage floor $\underline{w}^*$ is implicitly given by

$$WB(\underline{w}^*) = \omega(\underline{w}^*)R(\underline{w}^*) \tag{2}$$

where $\omega \in (0,1)$ is a weight given by

$$\omega(\underline{w}^*) = \frac{\beta}{\beta + (1-\beta)\left(-\frac{d\Pi}{d\underline{w}}(\underline{w}^*)/\frac{dU}{d\underline{w}}(\underline{w}^*)\right)}, \tag{3}$$

$\frac{d\Pi}{d\underline{w}}(\underline{w}^*) < 0$ is the derivative of profits with respect to $\underline{w}$, and $\frac{dU}{d\underline{w}}(\underline{w}^*) > 0$ is the derivative of the wage bill with respect to $\underline{w}$, both evaluated at the solution $\underline{w}^*$.[9]

At the optimum, the wage bill is a fraction ω of total revenue, similar to the classical Nash bargaining problem in which unions set wages instead of wage floors (e.g., Nickell and Andrews 1983; Abowd and Lemieux 1993). In fact, allowing for an outside option for workers when defining U, and dividing (2) by total employment, delivers the familiar result that the

[8]The assumption that unions maximize the wage bill is common in the literature (e.g., Gürtzgen 2009a).

[9]Note that, at $\underline{w}^*$, $dU/d\underline{w}$ must be positive. The union will never choose a wage floor in the region where $U(\underline{w})$ is decreasing, as in that case it could increase the wage bill by lowering the wage floor.

mean wage is a weighted average of revenue per worker and the outside option. The main difference is in the weight ω, which may differ from β.[10] For instance, if the wage floor is relatively more "painful" for firms ($-d\Pi/d\underline{w} > dU/d\underline{w}$), then $\omega < \beta$.

2.3 Response to shocks

I now consider the response of wages and employment to shocks to firms, and how this response is mediated by the wage floor. I refer to productivity shocks, but the results apply to any shock that affects the revenue of firms, such as product demand shocks. Since I consider small changes in productivity $\{d \ln \varphi_j\}_{j \in \mathcal{J}}$, I assume that both the constraint status of firms and the equilibrium share ω remain fixed.

Proposition 1 (Response of wage floor to shocks)**.** *Assume a change in the productivity profile $\{d \ln \varphi_j\}_{j \in \mathcal{J}}$. Holding ω fixed, the resulting change in the wage floor is*

$$d \ln \underline{w} = \frac{1}{\Lambda} \left[\sum_{j \in \mathcal{J}} s_j^R d \ln \varphi_j - \sum_{j \in \mathcal{J}} \left(s_j^{WB} \xi_j^{WB} - s_j^R \xi_j^R \right) d \ln \varphi_j \right] \tag{4}$$

where Λ is the difference between the mean wage bill elasticity and the mean revenue elasticity to the wage floor, s_j^R is the share of revenue of firm j in the CB unit and s_j^{WB} is the analogous wage bill share, ξ_j^{WB} is the elasticity of the wage bill to productivity φ_j, and ξ_j^R is the elasticity of revenue to productivity φ_j.

Proofs are available in Online Appendix A.

Proposition 1 shows that the adjustment in the wage floor is proportional to a weighted average of the productivity shocks experienced by covered firms $\mathcal{J}$. The first term within the brackets, $\sum_j s_j^R d \ln \varphi_j$, captures the direct effect of shocks on aggregate revenue. The second term, $\sum_j \left(s_j^{WB} \xi_j^{WB} - s_j^R \xi_j^R \right) d \ln \varphi_j$, adjusts for the fact that the productivity shocks already affect the split between the wage bill and revenue. If the wage bill is already increasing more than revenue due to the shocks, then $\underline{w}$ needs to increase less to restore equilibrium. These effects are scaled by Λ^{-1}, which captures how effective the wage floor is at increasing the wage bill (relative to revenue). If the wage floor is very effective (Λ is large), then a smaller change in $\underline{w}$ is needed to restore the equilibrium split.

The following proposition shows how wages and employment respond to shocks.

Proposition 2 (Shock propagation through the wage floor)**.** *Assume a change in the productivity profile $\{d \ln \varphi_j\}_{j \in \mathcal{J}}$ that leads to the wage floor change given by (4). Let $\ell_j^*(\underline{w}, \varphi_j)$*

[10] Azkarate-Askasua and Zerecero (2025) consider a firm-level Nash bargaining problem in which the solution also features "bargaining shares" that may differ from the union's exogenous bargaining power.

and $w_j^*(\underline{w}, \varphi_j)$ denote the equilibrium employment and wage of firm j given wage floor $\underline{w}$ and productivity φ_j. Then, the wage floor change induces the following responses:

1. For demand constrained firms with $\varphi_j < \underline{\varphi}_j$ we have $d \ln w_j^* = d \ln \underline{w}$ and $d \ln \ell_j^* = \left(\partial \ell_j^* / \partial w\right) (\underline{w}/\ell_j^*) d \ln \underline{w}$. Wages respond in the same direction as $\underline{w}$ and, since $\partial \ell_j(\underline{w})/\partial \underline{w} < 0$, employment responds in the opposite direction.

2. For supply constrained firms with $\varphi_j \in [\underline{\varphi}_j, \overline{\varphi}_j]$ the expressions are the same as above but, since $\partial \ell_j(\underline{w})/\partial \underline{w} > 0$, employment responds in the same direction as $\underline{w}$.

3. Unconstrained firms with $\varphi_j > \overline{\varphi}_j$ are not directly affected by changes in the wage floor.

The key insight of Proposition 2 is that the wage floor acts as a channel for the propagation of shocks, creating spillovers across firms. For instance, a positive productivity shock concentrated among firms in one region can raise the bargained wage floor for everyone in the CB unit. If the wage floor bite is high enough, this can lead to reallocation of employment across firms, as demand-constrained firms reduce employment while supply-constrained firms increase it, similar to Dustmann et al. (2022). Unconstrained firms, in contrast, are insulated from this channel and respond only to their own productivity changes.[11]

This section developed a framework that predicts shock propagation across firms within a CB unit via the wage floor. In the model, the wage floor responds to the average shock experienced by covered firms, which motivates the empirical analysis where I study the effect of the average firm shocks within a CB unit. The model also predicts heterogeneous employment responses, which I test empirically by studying heterogeneous effects of CB unit shocks. Later, I extend this framework to allow for multiple CB units and general equilibrium effects, and study the role of the CB network in determining the propagation of shocks.

3 Context and Data

This section discusses Argentina's labor market institutions, the economic context of the period under study, and the data used in the analysis. I argue that this setting is well-suited to study the role of collective bargaining (CB) in the propagation of shocks.

3.1 Labor market institutions in Argentina

The collective bargaining (CB) system in Argentina sets minimum standards for wages and working conditions for most private-sector workers, established through negotiations between

[11] Unconstrained firms may be affected by the wage floor via spillovers through, e.g., labor market competition. For example, Cengiz et al. (2019) in the US and Engbom and Moser (2022) in Brazil find evidence of spillovers from minimum wage policies on wages well above the minimum wage level.

unions and employers. While thousands of unions exist, the government grants bargaining privileges to a single union per "area of representation," defining the scope of CB units. These units consist of one or more unions on the worker side and either employer associations or individual firms on the employer side, and can potentially span multiple sectors, geographies, and occupations. Typically, the union with bargaining privileges was historically assigned by the government, predating the period under study. Each CB unit negotiates independently and there is limited scope for cross-union coordination.

Unions and employers negotiate two types of agreements: "master" CB agreements (*convenios colectivos*) and CB "alterations" (*acuerdos laborales*). A master agreement is a comprehensive contract that establishes working standards for covered workers, ranging from monetary compensation to working hours, conditions for leaves, wage differentials across space and occupations, and others. Alterations, on the other hand, are typically narrower in scope and serve as amendments to master agreements. A CB unit can modify an existing master agreement either by negotiating a new one that supersedes it or by introducing alterations.[12] Master agreements are updated infrequently, with some dating back to the 1970s, whereas alterations under a given master agreement are negotiated more often.

Online Appendix B provides further details on the CB system and the negotiation process.

Coverage. Master agreements are extended to all workers and firms within a specified area of representation, leading to nearly universal CB coverage, with the explicit exclusion of managerial positions. In 2014, out of a total of 6.4 million formal workers, 80% were covered under the main private sector bargaining regime, 13% were covered under special regimes, and the remaining 7% were excluded (Secretaría de Trabajo 2023). Additionally, the law permits a single employer to hire employees under multiple master agreements, a scenario applicable to approximately 16% of private-sector firms.

The economic context in the study period. This paper focuses on the years 2005–2015, a period characterized by strong economic growth and rising inflation that encouraged negotiations between unions and employers. Panel (a) of Online Appendix Figure 1 illustrates that real GDP grew rapidly between 2005 and 2011, with the exception of a slowdown in 2009, and stagnated thereafter. Panel (b) shows that inflation increased from around 10% to 30% per year. Both developments prompted union activity: strong growth encouraged workers to demand higher real wages, while inflation required frequent updates to nominal wage floors.[13] Panel (c) shows a sustained appreciation of the real exchange rate, of almost

[12] Expired master agreements remain in force until renegotiated due to a clause known as "ultra-activity."

[13] Political factors were also prevalent. Palomino and Trajtemberg (2006) discusses the government's role in re-invigorating the CB system in the early 2000s, following a period of low activity in the 1990s.

50%, which could also affect collective negotiations. Panel (d) shows that the value of exports increased until 2011 (except for 2009) and subsequently declined. These dynamics are driven by both international demand for Argentine exports, which serves as a source of product demand shocks later in this paper, and local macroeconomic conditions.

3.2 Stylized facts about collective bargaining

I highlight three facts about CB in Argentina that are relevant for the analysis.

First, wage floors are strongly binding in the labor market, suggesting that CB negotiations may have a significant impact on the adjustment to shocks. To show this I compare the firm's average wage to the average wage floor in its CB unit to measure the bite of wage floors (Cardoso and Portugal 2005). Panel (a) of Figure 1 shows the distribution of the wage to the wage floor ratio in 2005–2007, by exporting status. The distribution shows visible spikes for both exporters and non-exporters at a value slightly above 1, and an additional spike for non-exporters slightly above 0.5. I estimate that 72.4% of firms pay less than 1.1 times the wage floor, and 32.5% of exporters do so.[14] The reason for the apparent non-compliance is that I do not observe hours worked, so the average monthly wage will be lower than the monthly wage floor for firms intensive in part-time workers.

Second, the legal structure results in an idiosyncratic CB network in which firms within the same local labor market often operate under different CB units, allowing for within-market comparisons to identify shock propagation effects. This is shown in Panel (b) of Figure 1, which plots the distribution of the HHI of the number of firms per CB unit within local labor markets, defined by 4-digit sector and province cells, for the manufacturing sector. Only 15% of these local labor markets operate under a single CB unit, and 65% of them have an HHI lower than 0.5 (equivalent to 2 equal-sized CB units).[15]

Third, the economic context, characterized by frequent negotiations, leads to flexible nominal wage floors, allowing for real wage floor adjustments to shocks. Panel (c) of Figure 1 presents the number of agreements signed in 2005–2015. As inflation increased, the number of alterations signed per year rose, up to a point where virtually all CB units signed at least one alteration every year. These negotiations mostly reflect updates in nominal wage scales.

[14] An approach more in line with Cardoso and Portugal (2005) is to compare the worker's wage to her occupation-specific wage floor. Online Appendix Figure 2 leverages granular wage floor data in 2012 and shows the distribution of this ratio, focusing on permanent workers. On average, the wage cushion, defined as the log ratio of the wage to the wage floor, is 17%, comparable to a 20% wage cushion in Portugal (Card and Cardoso 2022) and 15% among firms covered by CBAs in Norway (Bhuller et al. 2022).

[15] This fact stems from the inexact verbal descriptions used to define the scope of CBAs. Online Appendix Table 1 shows the description of three textile CBAs as an example. From the text it is clear that firms producing relatively similar textile products may operate under different CBAs.

3.3 Data

I obtain labor market data from two administrative registries. First, I obtain data from Argentina's social security records, the *Sistema Integrado Previsional Argentino*, covering the years 2005–2015. The key variable is total monthly compensation, which reflects all payments made by firms to workers, including the 13th-month salary, bonuses, and other benefits. The data also include the worker's gender and age, the contract type of the job, and the firm's fiscal location (province) and 4-digit economic sector.[16] Importantly, the data do not include hours or full-time status. Second, I use additional data from a system known as *Simplificación Registral*. The system, introduced in 2008, collects additional information on workers declared by their employers at hiring and termination dates, and is used by the government for several administrative purposes. I accessed a version of the data containing information on the code of the master Collective Bargaining Agreement (CBA, for short) and the within-CBA job category. See Online Appendix C.1 for further details.

Upon cleaning the CBA code variable, I assign a "primary CBA" to each firm, which defines the CB units of interest. To do so, I follow two steps. First, I develop several imputation steps to increase coverage of the CBA variable from 70% to 85% after 2011, the year when the system reached peak coverage.[17] Second, using data starting in 2011, I select the most common CBA code in the firm and, in cases where there is no worker with a valid CBA in the firm, I select the CBA code that is most common in the firm's economic sector and province. These steps ensure that all firms in the economy are assigned to a CB unit. Online Appendix C.2 provides further details. I exploit the fact that some workers have a different CBA code than the firm's CB unit in some empirical exercises.

To construct export shocks I rely on international trade flows data from BACI-CEPII (Gaulier and Zignago 2010) for the years 2007–2015, and data from Argentine Customs available for the years 2011–2015. I harmonize product codes, to the 6-digit HS classification, and country codes to match the datasets. Online Appendix C.3 provides further details.

Collecting data on wage floors. As this information is not readily available, I construct two novel datasets of yearly inflation-adjusted wage floors.[18] First, I construct a dataset of average CBA wage floors from resolutions of the Ministry of Labor since 2005. These data are useful for the empirical analysis, as they accurately reflect the outcomes of negotiations

[16] The economic sector codes are based on the ISIC Rev. 3.1. classification.

[17] The most important step involves imputing the CBA to workers with missing values in firms that only declare a single CBA. I also harmonized the CBA codes that change over time due to renegotiations of the master agreement, thus ensuring that the variable represents a single CB unit in these cases.

[18] Manually reviewing the text of agreements to extract wage floors is highly impractical as these are available as scanned PDFs and in inconsistent format over time.

during the study period. Second, I estimate wage floors for each CBA, allowing for within-CBA variation, since 2011. These data are useful in the estimation of the structural model as they more accurately reflect the actual wage floor bite in each firm.

These datasets are constructed from two different sources. The first dataset, on the average wage floor for each CBA, is obtained from resolutions issued by the Ministry of Labor between 2005 and 2015 (Secretaría de Trabajo 2022). By law, the Ministry of Labor must publish this information since it is used to compute a cap to be applied to severance payments for covered workers. The second dataset is constructed by estimating a wage floor for every CBA, CBA-region, CBA-occupation, and year-month cell, relying on the administrative records. Specifically, I develop a method to detect the bunching point in the distribution of total wages within each cell, starting in 2011 when the CBA codes are more reliable. I obtain $173,980$ monthly wage floors between 2011 and 2015, corresponding to 449 CBAs and $2,618$ CBA-occupations.[19]

Online Appendix D provides more details on the construction of the wage floor data.

4 Empirical Strategy

This section presents the empirical strategy used to study whether shocks propagate through CB units. The strategy leverages fluctuations in world import demand for granular products to construct economic shocks at the firm and CB unit levels. Then, I use these shocks in a difference-in-differences strategy. Additionally, I discuss the construction of the estimation sample and the identification assumptions underlying the analysis.

4.1 Overview

The central goal of this paper is to identify the causal effect of a change in the mean product demand conditions of firms in a CB unit, controlling for changes in the product demand of individual firms. Identifying these distinct channels requires an experimental design that generates exogenous variation at two levels. To estimate the direct firm-level effect, one would randomly assign demand shocks to individual firms. To estimate the propagation effect, one would also need random variation in the mean demand shock across all firms within a CB unit since, as the framework in Section 2 indicated, bargaining outcomes are approximately driven by average economic conditions across the bargaining unit. Then, comparing outcomes for firms that experience different shocks to their CB unit, conditional

[19] The estimated wage floors align well with a sample of manually collected wage floors: the correlation between the estimated and manually collected floors is 0.87.

on their own shocks, would identify the propagation effect.

To approximate this ideal experiment I construct shocks to firm and CB units using demand shocks arising from changes in world import demand for granular country-product pairs exported by Argentine firms between 2007 and 2013, interacted with exposure of firms and CB units to those country-products. The key argument is that the global Great Recession created variation in demand for specific country-products that is plausibly exogenous to pre-existing trends in Argentine firms' outcomes (Garin and Silvério 2023). The remainder of this section details the implementation of this empirical approach.

4.2 Identifying trade shocks

Building on Hummels et al. (2014) and Garin and Silvério (2023), I denote by WID_{pt} the inflation-adjusted sum of imports of country-product $p \in \mathcal{P}$ from the world (excluding Argentina) and define country-product shocks as $f_p = \frac{1}{2}\sum_{t=2012}^{2013} \ln WID_{pt} - \frac{1}{2}\sum_{t=2007}^{2008} \ln WID_{pt}$. The value of f_p could be undefined if either the pre- or post-period average WID_{pt} is zero. The baseline analysis drops those country-products, though I discuss alternative definitions in Section 4.5. Then, the *firm shock* is defined as

$$z_j = \sum_{p \in \mathcal{P}} s_{jp} f_p,$$

where $s_{jp} = EX_{pj} / \left(\sum_{p' \in \mathcal{P}} EX_{p'j}\right)$ are exposure shares, with $\sum_p s_{jp} = 1$, and $\mathcal{P}$ is the set of country-products. EX_{pj} is the sum of inflation-adjusted exports from firm j to country-product p in 2011 and 2012. The firm shock z_j should shift firm j's revenue, potentially affecting the firm's wage and employment levels.

To study shock propagation via CB units, I construct an aggregate *CBU shock* defined as the employment-weighted average of the firm shocks. Formally, for CB unit $c \in \mathcal{C}$,

$$z_c = \sum_{j \in \mathcal{J}} s_{cj} z_j = \sum_{j \in \mathcal{J}} s_{cj} \left(\sum_{p \in \mathcal{P}} s_{jp} f_p\right) = \sum_{p \in \mathcal{P}} s_{cp} f_p,$$

where $s_{cj} = L_{cj}^{EX} / \left(\sum_{j' \in \mathcal{J}} L_{cj'}^{EX}\right)$ is the share of workers in exporting firm j in CB unit c in 2011–12, and $s_{cp} = \sum_j s_{cj} s_{jp}$ denotes the contribution of p to c's shock. Note that $\sum_j s_{cj} = 1$, which implies $\sum_p s_{cp} = 1$. The motivation for using the average firm shock is that, as discussed in Section 2, wage floor changes are approximately determined by average economic conditions in the CB unit.[20] Then, the CBU shock z_c should shift mean revenue

[20]Relatedly, Card and Cardoso (2022) find that the best predictor of wage floor changes in Portugal is the

in the CB unit, potentially leading to changes in negotiated wage floors.

The appreciation of the Argentine peso during the study period may differentially affect CB units with more exporting firms, regardless of the CBU shock. To account for this I control for the share of employment in exporting firms S_c^{EX} in the empirical analysis.

Analysis sample. I impose several restrictions to the sample of firms used to construct the shocks. First, to focus on firms that are likely relevant for their CB units, I keep exporting firms with positive employment for at least four years between 2007 and 2011. Second, to capture as much of the CB network as possible, I keep firms with missing f_p for some p in the sample, as long as they have at least one non-missing f_p. Finally, to identify the effects of shocks within local labor markets, the baseline analysis focuses on CB units with enough exporting firms (at least 30).[21]

The firm and CBU shocks are positive on average and show significant variation that allows for separately identifying their effects. Online Appendix Figure 3 shows the distribution of the shocks, both for the unrestricted and the baseline sample. As expected, the firm shock is more dispersed than the CBU shock. Online Appendix Table 2 shows summary statistics of the baseline sample, which contains $7,922$ firms and 39 CB units. The mean firm and CBU shock are 0.48 and 0.49, respectively. The median CBU spans 11 4-digit sectors and 6 provinces, allowing for within-local labor market identification.

I implement several variations of the definition of the shocks, as well as the sample used in the analysis, which are discussed in Section 4.5.

Evolution of shocks and outcomes in the raw data. The raw data suggest a shift in international demand for different country-products that translated into heterogeneous shocks to firms and CB units. To see this I compute time-varying versions of the shocks relative to 2007. Panels (a) and (b) of Figure 2 visualize the evolution of the time-varying shocks for firms with above- and below-median z_j and z_c shocks, respectively. We observe a gap between the two groups that grows until 2012–13, and persists afterwards. The gap is wider for the firm shock, reflecting the larger dispersion in z_j relative to z_c.

The raw data also suggest that these shocks are related to wages and wage floors. Panels (c) and (d) of Figure 2 show the evolution of mean firm wages for firms with above- and below-median shocks. Wages in firms with above-median shocks, both at the firm and CBU levels, evolve similarly to those with below-median shocks before 2008, and diverge afterwards. Interestingly, even though the CBU shock appears less strong than the firm shock, the magnitude of the wage gap is similar, suggesting that the CBU shock may have

average change in value added per worker in the CB unit.

[21] I also restrict the baseline analysis to firms that are active in 2005 through 2007.

a stronger effect on wages. Panels (e) and (f) show the same exercise for wage floors. Only the CBU shock appears related to the wage floor, whereas the firm shock does not.

Re-scaling the CBU shock. To facilitate comparison of the effects of the firm and CBU shocks, I re-scale the CBU shock to have the same standard deviation (SD) as the firm shock in the estimation sample. Formally, I define $\tilde{z}_c = z_c \times (SD(z_j)/SD(z_c))$.

4.3 A difference-in-differences strategy

I estimate the effects of shocks in a difference-in-differences framework. The static model is

$$\ln y_{jt} = \theta \tilde{z}_{c(j)} I\{t \geq 2012\} + \eta z_j I\{t \geq 2012\} + \lambda S^{EX}_{c(j)} I\{t \geq 2012\} + \alpha_j + \delta_{k(j)t} + \varepsilon_{jt}. \quad (5)$$

where y_{jt} is firm j's outcome in year t, $I\{\cdot\}$ is the indicator function, $c(j)$ and $k(j)$ indicate the CB unit and local labor market of j, and $\tilde{z}_c$ and z_j are the CBU and firm shocks. The parameter η represents the elasticity of y_{jt} with respect to the firm-specific world demand shock. Since $\tilde{z}_c$ is re-scaled, θ captures the percentage change in y_{jt} associated with an increase in the CBU shock equivalent to one standard deviation of the firm shock distribution.

I control for several potential confounders. First, to control for fluctuations in the exchange rate I include the share of employment in exporting firms S^{EX}_c interacted with the post-period indicator. Second, time-invariant firm characteristics, such as baseline productivity differences, are controlled for via the firm fixed effects α_j. Third, local labor market by year fixed effects δ_{kt} control for common trends in the local labor market.[22]

To study treatment effect dynamics I use a specification analogous to (5) that includes interactions of year dummies with the shocks. In this dynamic specification I omit the 2007 year dummy and interpret the pre-2007 coefficients as placebo tests.

The static model is estimated using the years 2005–07 and 2011–15, whereas the dynamic model uses the full 2005–15. The idea is to capture only the post-shock period in the static model, after the effects have leveled off. I cluster standard errors at the CB unit level unless otherwise noted.

Identification. The identification argument of my analysis follows Borusyak et al. (2022) who study identification in shift-share designs. The authors present assumptions on the assignment process of the "shifts" (in my case, world import demand shocks f_p) that are sufficient for identification. Online Appendix E develops Borusyak et al.'s (2022) argument in my setting, extending it to a scenario with two shift-share variables.

[22] Local labor markets are defined as 4-digit sector by province cells.

The key assumption is that changes in world import demand for each country-product p are quasi-randomly assigned with respect to average residuals of firms that export to that country-product, both when weighted by exposure via firms and via CB units.[23] As argued by Garin and Silvério (2023) in Portugal, this assumption is plausible since the Great Recession generated unexpected changes in world import demand for different country-products that should be uncorrelated with underlying trends in Argentine firms.

The quasi-randomness assumption implies that firm and CBU shocks should not be correlated with pre-period firm performance, which can be tested in the data. Panel (a) of Online Appendix Figure 4 shows estimates of firm-level regressions of a pre-period outcome on the firm shock. Reassuringly, the firm shock is uncorrelated with trends in mean wages and employment between 2005 and 2007, both with and without local labor market controls. We observe small correlations with the pre-period level of wages and employment. While these are accounted for via the firm fixed effects, I show a robustness exercise that explicitly controls for pre-period firm characteristics interacted with year dummies. Panel (b) shows that the CBU shock is uncorrelated with the share of exporting firms in the CBU, the number of total and exporting firms, and the aggregate employment in the CBU. These results suggest that the quasi-randomness assumption is plausible.

Effects of shocks on exports. It is informative to benchmark the magnitude of the estimated effects on wages against the effects of the shocks on exports. Data on firm exports are only available since 2011, preventing a direct analysis using (5). As a result, I use estimates from Garin and Silvério (2023), who estimate the effect of firm shocks on exports in a similar setting, to benchmark my results. The "Baseline" results from Garin and Silvério (2023, Table 4) show an elasticity of exports to the mean world import demand of 0.635.

I also explore whether the country-product shocks affect exports using publicly available data on aggregate country-product exports published by the Argentine statistics agency (Instituto Nacional de Estadística y Censos 2021b). First, I regress log exports on the shocks f_p at the country-product level, controlling for country-product and year fixed effects. Second, I emulate the procedure outlined in Borusyak et al. (2022) as closely as possible given the available data to obtain the effects of firm and CBU shocks from a country-product analysis.[24] Panel (a) of Online Appendix Figure 5 shows that, at the country-product level,

[23] A condition for this interpretation to hold is that the shares sum to 1 (Borusyak et al. 2022).

[24] More precisely, I construct the average firm and CBU shock at the p level, weighting by the exposure shares s_{jp} or s_{cp}. Then, I instrument the average firm or CBU shock with f_p in a country-product level regression of log exports on the average shock, controlling for country-product and year fixed effects. There are two steps from Borusyak et al.'s (2022) procedure that I cannot implement. First, using the average log exports of firms exporting to p, weighted by the relevant exposure shares, as the outcome variable. Second, residualizing the firm-level shocks and outcomes by firm and local labor market fixed effects.

the elasticity of exports to mean world import demand is 0.2416. Panels (b) and (c) show the implied elasticities at the firm and CBU levels, of 0.4143 and 0.3350, respectively, smaller than those from Garin and Silvério (2023). I fully acknowledge that these exercises are only suggestive given the data limitations.

4.4 Additional evidence in favor of shock propagation via CB

I present additional analyses that provide evidence in favor of shock propagation.

Heterogeneity. The theoretical framework in Section 2 suggests that firms with different levels of productivity should respond differently to the CBU shock, as this determines the wage floor bite. I test this mechanism by exploring heterogeneous effects of the CBU shock. To do so, I estimate a version of (5) where I interact the CBU shock with indicators for different levels of pre-period firm wages, which I interpret as a proxy for the firm's wage floor bite. I also interact the fixed effects with these indicators, so that the coefficients of interest are identified by comparing firms with similar levels of pre-period wages.

Within-firm analysis. While the firm-level analysis controls for spillovers via local labor market competition, there could be additional concerns about unobserved heterogeneity at the firm level. For example, firms that share a CB unit may also share suppliers or customers, and the CBU shock could actually capture propagation through these other channels. To address this, I leverage the fact that some firms hire workers under multiple CB units to implement a within-firm analysis. Specifically, I estimate a worker-level model that includes firm-by-year fixed effects, controlling flexibly for any time-varying firm-level confounder, including other propagation channels. This within-firm analysis identifies the effect of the CBU shock by comparing workers in the same firm that are covered by different CB units.

4.5 Robustness

This section discusses analyses that explore the robustness of the baseline results.

Joint variation in shocks and leave-one-out analysis. The firm and CBU shocks show significant independent variation, which is key for separately identifying their effects. Online Appendix Figure 6 shows a scatter plot of the shocks, with Panel (a) showing the raw data and Panel (b) the data residualized on local labor market fixed effects. There is a small positive correlation in Panel (a), which is largely reduced in Panel (b).

While the shocks are weakly correlated, the fact that the CBU shock is constructed from firm shocks raises concerns about mechanical correlations that could affect the validity of the estimates. To address this, I re-estimate the main models using a leave-one-out version of the CBU shock, which excludes firm j when computing the CBU shock for that firm.

Measurement of country-product shocks. To construct the shocks f_p I rely on the log of WID_{pt}. Thus, the shocks f_p can take extreme values if WID_{pt} is small, which is why I winsorize f_p at the 1st and 99th percentiles. Additionally, WID_{pt} can be zero, either in the post- or pre-period, making f_p undefined. This is a small issue in practice, which is why as a baseline I simply drop those country-products, keeping firms and CBUs in the sample if they have at least one non-missing f_p. For robustness, however, I follow Garin and Silvério (2023) and compute f_p as the symmetric growth rate in the total world import demand for p (excluding Argentina) between 2007–08 and 2012–13, which accommodates zeros.

The baseline definition of f_p uses the change in the mean log WID_{pt} before (2007–08) and after (2012–13) the Great Recession hit Argentina. For robustness, I compute alternative versions of f_p changing the post-period years to 2011–12 and 2013–14.

Measurement of exposure shares. Since customs data are only available since 2011, I use 2011–12 data to compute the exposure shares s_{jp} and s_{cp}. Ideally, one would use 2007–08 data to avoid any potential correlation between the shares and the shocks f_p. This issue could invalidate the analysis if firms significantly change their export baskets between 2007–08 and 2011–12. To address this concern I construct two alternative versions of the shocks. First, I construct the CBU shock using 2011–12 firm shares s_{jp} but 2007–08 employment shares s_{cj} to compute the shares s_{cp}. Second, I additionally impose uniform shares for s_{jp}, fully shutting down any potential correlation between the shares and the shocks.

The model in Section 2 suggests that the relevant exposure shares of CB units to firms are revenue shares. As revenue data are not available I rely on employment shares. To explore sensitivity to this choice, I construct an alternative CBU shock using wage-bill shares.

Additional exercises. To mitigate potential measurement error from high worker turnover, I recompute firm-level outcomes after excluding workers with less than three quarters of tenure in each year. To address the concern that the results may be driven by differential trends across firms, I explicitly control for pre-period firm characteristics by year dummies. Lastly, I explore sensitivity of the results to changing the inclusion threshold for CB units to those with at least 20 or 40 exporting firms, instead of the baseline of 30.

5 Empirical Results

This section presents the results of the effects of trade shocks on firm outcomes and discusses their interpretation. First, I discuss the main empirical evidence on the responses to firm and CBU shocks, which indicate a large role for collective bargaining in determining the labor market adjustment to trade shocks. Next, I provide further results that support the view that shocks propagate through collective bargaining via a wage floor mechanism. Finally, I conclude with robustness checks to assess the validity of the empirical design.

5.1 Main evidence

5.1.1 Effects on wages and wage floors

The dynamic model shows that both firm wages and wage floors in the firm's CB unit increase in response to a CBU shock, and that firm wages increase in response to a firm shock. Figure 3 shows the estimates. Panel (a) shows a strong and stable increase in wages following both a firm shock and a CBU shock. As the CBU shock variable has been rescaled to match the dispersion of the firm shock, the figure suggests that a similarly-sized CBU shock has about twice the effect on wages as a firm shock. Panel (b) shows the effect of the shocks on wage floors. We observe a strong increase in wage floors following a CBU shock, of larger magnitude than the effect on wages, implying less than full pass-through. Interestingly, the timing of the effect of the CBU shock on wages and wage floors matches closely, with coefficients becoming significant after 2011.

The model also shows pre-2007 coefficients that are statistically indistinguishable from zero in the four panels of Figure 3, supporting the parallel trends assumption. Furthermore, estimates of the effect of the firm shock on wage floors are precise zeros, which is reassuring as wage floors are not determined at the firm level.

I summarize the magnitude of the estimates using the static model. Column (1) of Table 1 shows an estimated effect of the CBU shock on wages of 0.0439, and of the firm shock of 0.0225, both strongly significant ($t = 2.38$ and $t = 3.21$, respectively). Column (2) of Table 1 shows an effect of the CBU shock on wage floors of 0.1149 ($t = 2.15$), using only observations with valid wage floors. Column (3) of Table 1 shows that the CBU shock lowers the "wage cushion" (the log ratio between the wage and wage floor). Table 1 also shows the importance of controlling for the share of employment in exporting firms in the CB unit. Consistent with an appreciation of the Argentine peso making exporting firms less competitive, CB units with a larger share experienced lower wage and wage floor growth.

Wage floor pass-through. The estimates imply a pass-through of wage floors to wages of around 38% ($0.0439/0.1149 \approx 0.3820$). For comparison, Card and Cardoso (2022) find a pass-through of about 50% in Portugal. One reason for my estimate being lower than theirs is that I focus on exporting firms, for which the wage floor is less binding.

5.1.2 Interpreting the magnitude of the wage effects

The goal of this subsection is to assess the magnitude of the estimated wage effects. The most direct approach is to compare the firm shock effects in Table 1, equal to 0.0225, to estimates obtained in similar settings. Garin and Silvério (2023, Table 6) show estimates of similar product demand shocks in Portugal on log monthly earnings of about 0.022-0.026, quite similar to mine. Wang and Young (2025, Table 1, Panel A) find effects on workers' wages of 0.011 in the US, smaller but of the same order of magnitude.

Alternatively, the magnitude of the wage effects can be compared to the the effects on exports which, under simplifying assumptions, can be used to back out implied rent-sharing elasticities. The "Baseline" results in Garin and Silvério (2023, Table 4) show an effect of the firm shock on log exports of 0.635. Panel (b) of Online Appendix Figure 5 suggests an estimate of 0.4143 in my setting. Assuming that the share of exports in sales is 0.5, then the ratio of the wage effect to the sales effect is either 0.071 (using Garin and Silvério's estimate) or 0.108 (using my estimates). The magnitude of these values is in line with the literature.[25]

It is informative to benchmark the effect of CBU shocks as well, acknowledging that this exercise is highly tentative. Panel (c) of Online Appendix Figure 5 suggests an effect of the CBU shock on log exports of 0.3350. Recall the wage effect of 0.0439 from Table 1. Assuming again that the share of exports in sales is 0.5, the implied rent-sharing elasticity is around 0.262, economically larger than the firm-level estimate, and consistent with industry-level rent-sharing typically exceeding worker-level estimates (Card et al. 2018; Jäger et al. 2020).[26]

5.1.3 Effects on employment, wage bill, and firm exit

The estimates show increases in employment following a firm shock, and a noisy, insignificant response to the CBU shock. Figure 4 shows the dynamic estimates, and column (4) of Table 1 summarizes the effects. The noisy estimates of the CBU shock are consistent with the framework in Section 2, which suggests systematic heterogeneity in employment responses across firms. I provide evidence of heterogeneous responses later in this section.

[25] Jäger et al. (2020, Figure II) review the rent-sharing literature and find that elasticity estimates using worker-level micro-data are on average 0.099. Card et al. (2018, Table 1) find an average rent-sharing elasticity of studies using worker-level specifications of 0.08.

[26] For example, Abowd and Lemieux (1993) use contract wages from CB agreements and shocks to international prices in Canadian manufacturing, obtaining a rent-sharing elasticity of around 0.2.

Columns (5) and (6) of Table 1 show the responses of the wage bill and firm exit to both shocks. As both employment and wages increase following a firm shock, the wage bill shows a strong and significant increase as well. The CBU shock also seems to increase the wage bill, but consistent with the noisy employment estimates, the effect is not statistically significant. Finally, I find a small but statistically significant decrease in firm exit following a firm shock, and no significant effect of the CBU shock.

5.2 Further evidence in favor of propagation through CB units

5.2.1 Firm-level heterogeneity by pre-period wage level

The evidence so far is consistent with shock propagation through CB units. A threat to this conclusion is that CBU shocks are correlated with other unobserved shocks that may affect firms, such as local demand shocks. I use the framework in Section 2 to distinguish between these hypotheses. If the CBU shock captures an increase in local demand, for example, we would expect employment and wages responding positively across all firms. However, as the CBU shock operates via wage floors, we would expect heterogeneous employment and wage responses depending on how binding the floor is for each firm. This motivates estimating models that interact the shocks with quartiles of pre-period (2005–07) firm wages.

The heterogeneity in employment responses is consistent with the propagation of shocks operating via wage floors. Column (1) of Table 2 shows that the effect of the CBU shock on employment for firms in the bottom quartile is -0.1900, statistically significant at the 10% level ($t = -1.94$). The effects for the second, third, and fourth quartiles are positive, at 0.1085 ($t = 0.73$), 0.1937 ($t = 1.93$), and 0.1366 ($t = 1.55$), respectively. The hypothesis that the effect in the first quartile is equal to the third and fourth quartiles is rejected at the 1% level ($p = 0.0046$ and $p = 0.0050$, respectively). This is exactly the pattern we would expect when a binding wage floor is increased: low-productivity firms reduce employment as they move along the labor demand curve, whereas medium-productivity firms increase it. These effects are consistent with Dustmann et al. (2022), who find relocation of workers from lower- to higher-paying firms with a minimum wage increase in Germany.

The heterogeneity in wage responses shows patterns that are somewhat noisier but also line up with the wage floor mechanism. Column (2) of Table 2 shows larger point estimates of the firm shock on higher-wage firms, consistent with these firms being less constrained. The effect of the CBU shock is positive for firms in the first and second quartiles, and declines to around zero in the third and fourth quartiles, though the hypothesis of equal effects cannot be rejected. Interestingly, CBU shocks have strong effects on wage floors even at top-quartile firms, as shown in column (3). This suggests that these firms are not constrained, which is why actual wages do not seem to respond even though wage floors do. Finally, column (4) shows that the wage cushion increases significantly following a firm shock for higher-wage firms, as they move away from the wage floor, and it also appears to decrease more in response to the CBU shock for these firms, as the wage floor gets closer to the firm wage.

Online Appendix Figure 7 shows dynamic model estimates. Panel (a) focuses on employment, showing a clear decline for bottom-quartile firms. Panel (b) shows the noisier wage effects, and Panel (c) shows strong effects on wage floors across all quartiles.

5.2.2 Worker-level evidence within firms with multiple CB units

A subsample of firms declare workers under multiple CB units, presenting an opportunity to test whether the relevant factor is the CB unit covering the worker or other unobserved channels that may propagate the shocks. If firm shocks propagate through channels other than the CB network, we should not observe CB unit-specific effects within the firm.

The wage effects of CBU shocks are similar when comparing workers that belong to different CB units within a firm while, notably, controlling flexibly for firm-level shocks through firm-by-year fixed effects. Table 3 shows the results of static models. Columns (1) through (3) replicate the baseline estimates using all workers in the baseline sample of firms that are employed in 2005–07, stayers (workers that stay in the same firm between 2005 and 2015), and stayers in firms with multiple CB units, respectively. In all three columns, the 95% confidence intervals of the estimated effects of firm and CBU shocks contain the point estimates of the wage effects in column (1) of Table 1. Column (4) breaks the coefficient of the CBU shock by whether the worker's CB unit coincides with the primary CB unit in the firm or not, showing that the effect is concentrated among workers in the primary CB unit. Column (5) shows that the effect of the CBU shock is very similar when we compare workers in different CB units *within the same firm*. This model flexibly controls for any unobserved firm-level shocks, including possible propagation across firms through unobserved channels.

Online Appendix Figure 8 shows the dynamic effects corresponding to columns (3) and (5) of Table 3. The dynamic estimates are similar to the baseline analysis in Figure 3.

5.3 Robustness checks

Leave-one-out CBU shock. The results are virtually unchanged when using a leave-one-out CBU shock, which mitigates concerns of mechanical correlation between the CBU and firm shocks. Panels (a) and (b) of Figure 5 show the dynamic wage and wage floor results for the CBU shock, respectively, and Panel (b) of Online Appendix Table 3 shows the complete static estimates, with the addition of the employment results. This is to be expected as the median number of exporting firms per CB unit is large (77, see Online Appendix Table 2), making the leave-one-out CBU shock highly correlated with the baseline CBU shock.

Measurement of country-product shocks. The results are robust to alternative definitions of the country-product shocks. Panels (c) and (d) of Figure 5 show very similar patterns to our baseline when using the symmetric growth rate in world import demand to compute the shocks, following Garin and Silvério (2023). Panel (c) of Online Appendix Table 3 shows that both the magnitude of the point estimates and the standard errors are slightly larger, so the estimates remain strongly significant.

Changing the post-period years to 2011–12 reduces the significance of the estimates, and changing them to 2013–14 increases it, as shown in Panels (b) and (c) of Online Appendix Table 4, respectively. This is consistent with the raw data trends in Figure 2, which show that the shocks seem to fully materialize by 2013–14.

Measurement of exposure shares. The CBU effects are similar, and even stronger, when using alternative definitions of the exposure shares. Panel (e) of Figure 5 show dynamic effects when using 2007–08 employment shares s_{cj}, whereas Panel (f) additionally uses uniform firm-level exposure shares s_{jp} (which are by construction independent of the country-product shocks). The results are similar to the baseline in the former case, and get larger in the latter. Panels (d) and (e) of Online Appendix Table 3 show the static results.

Panel (f) of Online Appendix Table 3 shows that the results are also similar to baseline when using wage-bill instead of employment to construct the exposure shares s_{cj}.

Additional exercises. Panels (d) through (g) of Online Appendix Table 4 show additional estimates, all displaying results similar to baseline. Panel (d) uses workers with at least three quarters of tenure in each year, mitigating potential measurement error from high worker turnover. Results are also robust to focusing on stayers in a worker-level analysis, as already discussed in Section 5.2.2. Panel (e) controls for firm characteristics interacted with year dummies, showing that the results are similar when allowing for heterogeneous trends by firm characteristics. Panels (f) and (g) change the sample to CB units with at least 20 and 40 exporting firms, respectively. While coefficients are always strongly significant, the estimates of CBU effects are slightly smaller when including smaller CB units, suggesting heterogeneity of responses by CB unit size.

5.4 Summary

This section shows that product demand shocks propagate through the CB network, and that this propagation operates through a wage floor mechanism. Positive CBU shocks lead to significant increases in collectively bargained wage floors, which then translate to firm wages with an estimated pass-through of 38%. Heterogeneous wage and employment responses across firms are consistent with the theoretical framework in Section 2. These findings provide the motivation for the structural model in the next section.

6 Structural Model

While the empirical estimates show evidence of shock propagation via CB units, they do not speak to the effects of the CB network itself. To study this question I develop an economic model where heterogeneous firms located in different local labor markets are connected by a network of CB units that negotiate wage floors. The model is estimated and used to analyze counterfactual CB networks in the upcoming sections.

6.1 Set-up

The economy is divided into sub-markets $g \in \mathcal{G}$, each belonging to a single local labor market $k(g) \in \mathcal{K}$ and CB unit $c(g) \in \mathcal{C}$, where $\mathcal{K}$ and $\mathcal{C}$ are finite sets. An exogenous measure of firms M_g in each g demand labor to produce a homogeneous good, which is traded in a perfectly competitive market at price $p = 1$, the numeraire of the model. The economy is populated by a measure N of homogeneous working-age adults who choose whether to work formally and which firm and local labor market to work for. The CB network $\mathcal{C}$ is defined as a partition of $\mathcal{G}$, and each CB unit $c \in \mathcal{C}$ is composed of a union and an employer association that bargain over a wage floor $\underline{w}_c$ binding for covered firms. This formulation allows local labor markets to be covered by multiple CB units, as in the empirical analysis.

The timing of the model is as follows. First, unions and employer associations play a simultaneous-move game to determine wage floors $\{\underline{w}_c\}_{c\in\mathcal{C}}$. Second, firms j draw productivities $\varphi(j)$ from a distribution $F_g(\varphi)$. Third, workers i make labor supply decisions and firms decide employment and wages under monopsonistic competition. Aggregate wage indexes $\{W_k\}_{k\in\mathcal{K}}$ adjust to clear local labor markets. Finally, production takes place and employed workers earn their wage $w(j)$ at firm j.

6.2 Solving the model

I solve the model backwards starting with the decisions of workers and firms, and then moving to the bargaining game between CB units.

6.2.1 Labor supply

Workers make two choices. First, they decide whether to enter the formal labor market. Second, conditional on entering, they choose a local labor market and firm. I provide an overview of the problem here and Online Appendix F.1 provides exact derivations.

Let us start with the second stage. Worker i's indirect utility from working at firm j in local labor market $k(j)$ is $V_i(j) = \psi(j)w(j)u_i(k(j))\xi_i(j)$. Here, $\psi(j)w(j)$ is the wage $w(j)$ adjusted for the hiring probability $\psi(j)$, and $u_i(k(j))$ and $\xi_i(j)$ are idiosyncratic preference shocks. Following a large literature in trade, as well as recent work in labor economics (e.g., McFadden 1978; Card et al. 2018), I assume that $u_i(k(j))$ and $\xi_i(j)$ are independently Fréchet distributed with cdfs given by, respectively, $F(u) = \exp\left(-A_k u^{-\theta}\right)$ and $F(\xi) = \exp\left(-\xi^{-\eta}\right)$. The parameters $\{A_k\}_{k\in\mathcal{K}}$ capture heterogeneous amenities across markets k, while θ and η govern the elasticity of labor supply *across* and *within* local labor markets, respectively (Berger et al. 2022). I assume $\eta > \theta > 1$.

In this model, the ex-ante expected utility of entering the formal labor market $\bar{V}$ is

$$\bar{V} = \Gamma\left(\frac{\theta - 1}{\theta}\right)\Gamma\left(\frac{\eta - 1}{\eta}\right)W^{1/\theta} \tag{6}$$

where $W = \sum_{k\in\mathcal{K}} A_k W_k^{\theta}$ is an aggregate wage index, W_k is a wage index that aggregates wages for firms in local labor market k, and $\Gamma(\cdot)$ is the gamma function.

At the initial stage, workers choose whether to enter the formal labor market by comparing the expected utility $\bar{V}$ with the value of the exogenous outside option b. I model this decision using Fréchet preference shocks, resulting in the formal employment share

$$\iota = \frac{\bar{V}^{\zeta}}{\bar{V}^{\zeta} + b}, \tag{7}$$

where ζ governs the elasticity of the extensive-margin labor supply.

Putting the results above together, I obtain labor supply curves to firms of the form

$$h_{k(j)}\left(\psi(j)w(j), W_{k(j)}\right) = \left(\frac{\psi(j)w(j)}{W_{k(j)}}\right)^{\eta}\left(\frac{A_{k(j)}W_{k(j)}^{\theta}}{W}\right)(\iota N), \tag{8}$$

where ιN is total formal employment in the economy. Labor supply to firm j is increasing in the firm's expected wage ($\psi_j w(j)$) and, since $\eta > \theta$, decreasing in the wage index $W_{k(j)}$.

6.2.2 Labor demand

Firms choose employment and wages to maximize profits, facing labor supply and wage floor constraints. See Online Appendix F.2 for derivations and exact solutions.

Upon entry into sub-market g, firm j draws a productivity $\varphi(j)$ from a g-specific distribution $F_g(\varphi)$ defined over $[\varphi_{g0}, \infty)$ and maximizes profits according to

$$(\ell(j), w(j)) = \arg\max_{\ell, w} \left\{ \varphi(j)\ell^{\alpha} - w\ell \;\middle|\; \ell \leq h_{k(g)}\left(\psi(j)w, W_{k(g)}\right),\; w \geq \underline{w}_{c(g)} \right\}, \tag{9}$$

where $\alpha \in (0,1)$ is the output elasticity of labor, $c(g)$ and $k(g)$ are the CB unit and local labor market of the firm, and $\underline{w}_{c(g)}$ is the relevant wage floor. The firm is infinitesimal, so it takes the wage index $W_{k(g)}$ as given.

The solution to this problem depends on the set of constraints that are binding. If the wage floor is not binding we say that the firm is *unconstrained*, in which case $w(j) = \mu MRPL$, where $\mu = \eta/(\eta+1)$ is the markdown factor and $MRPL$ is the marginal revenue product of labor. If the wage floor is binding we say that the firm is *constrained*, so that $w(j) = \underline{w}_{c(g)}$. In this case the labor supply constraint may or may not bind. For *supply-constrained* firms, labor supply binds and they hire all workers willing to work at the wage floor. *Demand-constrained* firms, on the other hand, choose an employment level below the labor supply at the wage floor, resulting in a hiring probability $\psi(j) < 1$.

The wage floor determines the constraint status of firms in the sub-market. A low $\underline{w}_c$ results in unconstrained firms only. As $\underline{w}_c$ increases, some firms become supply-constrained. The lowest-productivity unconstrained firm, which sets a wage equal to the wage floor, pins down the threshold productivity $\overline{\varphi}_g$ above which firms are unconstrained, given by

$$\overline{\varphi}_g(\underline{w}_{c(g)}) = \frac{1}{\mu\alpha}\left(\ell_g^s\right)^{(1-\alpha)} \underline{w}_{c(g)}, \tag{10}$$

where $\ell_g^s = h_{k(g)}(\underline{w}_{c(g)}, W_{k(g)})$. Increasing $\underline{w}_c$ further will result in demand-constrained firms as well. The highest-productivity demand-constrained firm, which chooses a labor quantity equal to ℓ_g^s, determines the threshold $\underline{\varphi}_g$ below which firms are demand-constrained:

$$\underline{\varphi}_g(\underline{w}_{c(g)}) = \left(\frac{1}{\alpha}\right)\left(\ell_g^s\right)^{1-\alpha} \underline{w}_{c(g)}. \tag{11}$$

Let $MPL^s = \alpha(\ell^s)^{\alpha-1}$. Then, the thresholds can be written as $\mu\overline{\varphi}_g MPL^s = \underline{w}_{c(g)}$ and $\underline{\varphi}_g MPL^s = \underline{w}_{c(g)}$. Intuitively, the thresholds make the marginal condition for unconstrained and for demand-constrained firms hold at the employment level of supply-constrained firms.

6.2.3 Aggregation

I aggregate firm-level decisions by integrating over all firms in g to obtain aggregate labor demand L_g, the aggregate measure of workers who supply labor to firms H_g, revenue R_g, wage bill WB_g, and profits Π_g. To do so, I assume that productivities in g are drawn from a Pareto distribution with shape parameter q and cdf given by

$$F_g(\varphi) = 1 - \left(\frac{\varphi_{g0}}{\varphi}\right)^q \tag{12}$$

for $\varphi \geq \varphi_{g0}$ and zero otherwise. For example, aggregate labor demand is defined as $L_g = M_g \int_{\varphi_{g0}}^{\infty} \ell(\varphi) dF_g(\varphi)$, where M_g is the measure of firms in g and $\ell(\varphi)$ is labor demand for a firm with productivity φ. The integrals depend on the firm's constraint status, which in turn depends on the level of the thresholds $\overline{\varphi}_g$ and $\underline{\varphi}_g$—functions of the wage floor $\underline{w}_{c(g)}$—relative to φ_{g0}. Online Appendix F.3 provides exact expressions for aggregate quantities.

An important result from this labor market model is that the aggregates L_g, H_g, and WB_g are hump-shaped in the wage floor $\underline{w}_{c(g)}$. This result is intuitive. Consider aggregate employment L_g as an example: at a low $\underline{w}_{c(g)}$ there are no demand-constrained firms, so the wage floor increases L_g by increasing employment among supply-constrained firms. At a high $\underline{w}_{c(g)}$ most firms are demand-constrained, so wage floor hikes reduce L_g as the negative employment response of demand-constrained firms dominates.[27] On the other hand, aggregate profits Π_g are strictly decreasing in the wage floor when the wage floor is binding.

It is useful to note that the aggregate quantities depend on the wage floor of all CB units. The wage floor $\underline{w}_{c(g)}$ affects them directly as it determines the constraint status of firms and the optimal choices of constrained firms. Additionally, the entire set of wage floors affects them indirectly as they influence the aggregate wage indexes $\{W_k\}_{k\in\mathcal{K}}$.

I will use data on the share of firms constrained by the wage floor in estimation, which can be easily computed in the model as $F_g(\overline{\varphi}_g)$. Since $\overline{\varphi}_g$ is an increasing function of the wage floor, a higher $\underline{w}_{c(g)}$ increases the share of firms that are constrained.

6.2.4 Nash bargaining

Unions and employer associations negotiate over wage floors. I assume that both parties are risk neutral, and that they have rational expectations in the sense that they know the distributions $\{F_g(\varphi)\}_{g\in\mathcal{G}}$ and correctly anticipate the outcomes following their choice of $\underline{w}_c$. As a result, I do not use expectations in the computations below.

[27] Manning (2003) derives the hump-shaped employment pattern in the case of a single monopsonist. Ahlfeldt et al. (2022) present a proof of this result assuming Pareto-distributed productivities. Berger et al. (2025) present a model with strategic interactions between firms that displays a similar property.

Following Section 2, the union's objective in CB unit c is the aggregate wage bill, $U_c(\underline{\mathbf{w}}) = \sum_{g:c(g)=c} WB_g(\underline{\mathbf{w}})$, whereas the employer's objective is aggregate profits, $\Pi_c(\underline{\mathbf{w}}) = \sum_{g:c(g)=c} (R_g(\underline{\mathbf{w}}) - WB_g(\underline{\mathbf{w}}))$. The dependency of aggregate quantities on the entire vector of wage floors $\underline{\mathbf{w}} = \{\underline{w}_c\}_{c\in\mathcal{C}}$ generates strategic interactions between the CB units.

Solving a bilateral Nash bargaining problem. Letting β_c denote the bargaining power of the union in CB unit c, a necessary condition for maximization is given by (2). Namely, the optimal wage floor sets the aggregate wage bill as a share of aggregate revenue. Importantly, if c covers multiple sub-markets, the necessary condition is not sufficient. As discussed in the appendix, the objective function may exhibit local maxima if the distance between minimum productivities φ_{g0} across covered sub-markets is large enough. To solve the equilibrium of the model I devise a robust algorithm that takes into account this possibility.

Nash-in-Nash solution. I solve the simultaneous-move game between CB units using a Nash-in-Nash solution concept (Horn and Wolinsky 1988). In a Nash-in-Nash solution each individual bargain results in a Nash equilibrium given that the wage floors of other CB units are in Nash equilibrium as well. The solution assumes that players in a given CB unit do not take into account the effect of their decision on the choice of other CB units.[28] Formally, the wage floor vector $\underline{\mathbf{w}}^* = \{\underline{w}_c^*\}_{c\in\mathcal{C}}$ is a Nash-in-Nash equilibrium if, for all $c \in \mathcal{C}$,

$$\underline{w}_c^* = \arg\max_{\underline{w}_c} U_c\left(\underline{w}_c, \underline{\mathbf{w}}_{-c}^*\right)^{\beta_c} \Pi_c\left(\underline{w}_c, \underline{\mathbf{w}}_{-c}^*\right)^{1-\beta_c}, \tag{13}$$

where $\underline{\mathbf{w}}_{-c}^*$ is the vector of equilibrium wage floors excluding CB unit c.

6.3 Equilibrium

Given a CB network $\mathcal{C}$ and a set of parameters, an equilibrium is defined as a set of wage floors $\{\underline{w}_c^*\}_{c\in\mathcal{C}}$ and wage indexes $\{W_k^*\}_{k\in\mathcal{K}}$ such that: (1) the Nash-in-Nash bargaining game is solved, and (2) labor markets clear. The equilibrium accommodates unemployment, which may arise due to demand-constrained firms. Online Appendix F.4.1 formally defines the equilibrium and shows that it exists and is unique. In general, there is no closed form solution for the equilibrium. Online Appendix F.4.2 discusses the algorithm I use to numerically compute the equilibrium. Even though the model features multiple CB units that internalize the effects of their negotiations across local labor markets, and non-linear effects of the wage floors, the algorithm is still capable of finding a solution efficiently.

[28] This assumption may be debatable if unions participate in multiple CB units. While I assume separate unions for simplicity, Collard-Wexler et al. (2019) show that the Nash-in-Nash solution can be micro-founded in a non-cooperative game where players internalize the interdependence of potentially multiple bargains.

6.4 Discussion

The model provides a tractable framework to study how the CB network propagates local shocks, balancing realistic economic mechanisms with computational efficiency. To do so, I simulate local profitability shocks by shifting the sub-markets' minimum productivities φ_{g0}. These shocks endogenously alter collectively bargained wage floors, propagating the shock across the network in a context with wage flexibility above the floor (Card and Cardoso 2022). Importantly, the model allows for realistic labor market effects of the wage floors, including hump-shaped employment responses (e.g., Manning 2003), negative profit effects (e.g., Harasztosi and Lindner 2019), and worker reallocation (e.g., Dustmann et al. 2022). The segmentation into sub-markets enables the construction of well-defined counterfactual CB networks, permitting an analysis of how these alternative structures mediate shock transmission.

The model relies on several necessary simplifications. First, it assumes that firms are atomistic in their local labor markets. While the non-monotonic response of employment to wage floors is robust to models with strategic interactions (see, e.g., Berger et al. 2025), abstracting from them might affect the estimated magnitude of these responses. Similarly, aggregating outcomes to the sub-market level precludes the analysis of firm-specific shocks. However, because I compare counterfactual CB networks while holding the labor market structure constant, I can still draw meaningful conclusions about the relative strength of the shock propagation mechanism of interest.

Second, the framework holds the measure of firms M_g fixed, abstracting from firm entry and exit. Two factors motivate this choice. Theoretically, even without an extensive margin, the negative consequences of an excessive wage floor are internalized through the intensive margin, i.e., via declining employment and profits. This ensures that CB units face the correct economic trade-offs. Empirically, the estimates in Section 5 suggest that entry and exit are not first-order channels of adjustment for the shocks I study. Thus, this assumption preserves tractability while retaining the meaningful trade-offs in the bargaining game

7 Identification, Estimation, and Validation

In this section I estimate and validate the structural model. I start by discussing the data used for estimation, the identification strategy for the model parameters, and the resulting estimates. Then, I show that the model quantitatively replicates the empirical estimates of shock propagation documented in Section 5, even though this moment was not used in estimation. I use the model to perform counterfactual exercises in the next section.

7.1 Identification and Estimation

Given an economy with labor markets $\mathcal{K}$, sub-markets $\mathcal{G}$, and a CB network $\mathcal{C}$, the model is fully characterized by the following set of parameters. First, elasticities of the worker problem $\{\eta, \theta, \zeta\}$. Second, amenity values of local labor markets $\{A_k\}_{k\in\mathcal{K}}$. Third, the production function parameter α, and parameters of the sub-market productivity distributions $\{q, \{\varphi_{g0}\}_{g\in\mathcal{G}}\}$. Fourth, the outside option b. Fifth, the bargaining power of unions $\{\beta_c\}_{c\in\mathcal{C}}$.

I identify these parameters using a combination of estimation and calibration, leveraging both firm-level micro-data and aggregate data, as summarized in Table 4. Next, I briefly discuss the data available, the identification approach for the different parameters, and the resulting values. I focus on the key details here, with Online Appendix F.5 providing more details on the data construction and Online Appendix F.6 on the estimation procedure.

7.1.1 Definitions and data

The economy is defined as follows. Local labor markets k are defined as interactions of 2-digit sectors and regions. Sub-markets g are defined as interactions of local markets k and CB units c. The baseline CB network $\mathcal{C}$ is then the partition of sub-markets that are covered by the same CB unit c. I take several steps to reduce the dimensionality of the sub-market dataset while maintaining a more granular structure for CB units that are large and are exposed to trade shocks. The resulting dataset contains 124 local labor markets, $1,342$ sub-markets, and 228 CB units (130 of which cover multiple sub-markets).

I use several data sources for estimation, spanning two periods: before (2005–07) and after (2011–14) the shocks. First, I leverage the employment and wage responses to firm shocks from Section 5. Second, I use firm-level data on employment and mean wages, denoted $\{\tilde{w}_{jt}, \tilde{\ell}_{jt}\}_{j\in\mathcal{J}}$ for each period t. Third, I construct the wage floors $\{\underline{w}_c\}_{c\in\mathcal{C}}$ in the post-period, which correspond to the objects of negotiation, as the average of firm-level mean wage floors.I adjust wage floors upward by 7.5% to align the definition of constrained firms with the empirical peak of the wage-to-floor ratio distribution, which is close to 1.075 (see Figure 1). I rely on the wage floor data inferred from the micro-data, as anticipated in Section 3.3, because it better reflects variation in wage floors within CB units.[29] Fourth, I compute the share of firms constrained $\{\tilde{SC}_g\}_{g\in\mathcal{G}}$ using the post-period firm-level data as the share of firms that pay a mean wage above the firm-level wage floor (which varies with the mix of occupations in the firm). As I do not observe hours worked, firms that rely heavily on part-time work are more likely to be classified as constrained.

[29] More precisely, the baseline wage floor is the minimum of the regional wage floors within the CB unit. Following common practice in negotiations, I assume that the regional wage floor differentials are fixed over time.

7.1.2 Elasticities of the worker problem

Identification. I estimate the within-market elasticity η using the response of employment and wages to the firm-level trade shocks, following the empirical analysis in Section 5.

The cross-market elasticity θ is identified by relating the component of firm wages driven by local labor markets to variation in local wage indexes. Specifically, equation (8) implies

$$\ln \psi_{jt} w_{jt} - \frac{1}{\eta} \ln h_{jt} = \left(\frac{\eta - \theta}{\eta}\right) \ln W_{k(j)t} - \frac{1}{\eta} (\ln A_k + \ln W_t) \equiv B_{kt},$$

assuming fixed amenity values A_k over time. Then, I proceed in two steps, both of which rely on the estimated η. First, using data $\{\tilde{w}_{jt}, \tilde{\ell}_{jt}\}_{j\in\mathcal{J}}$, I construct the left-hand side of this equation as $\ln \tilde{w}_{jt} - (1/\eta) \ln \tilde{\ell}_{jt}$. Regressing this variable on market-by-time fixed effects yields estimates of B_{kt}. I interpret the residuals from this model as measurement error, and maintain the identifying assumption that the measurement error is iid across markets.[30] Second, I construct the wage indexes $\{\tilde{W}_{kt}\}_{k\in\mathcal{K}}$ using $\{\tilde{w}_{jt}\}_{j\in\mathcal{J}}$, and estimate a regression of B_{kt} on $\ln \tilde{W}_{kt}$, conditional on market k and time t fixed effects.[31] Let the coefficient on $\ln \tilde{W}_{kt}$ be $\hat{b}$. Then, I obtain an estimate of θ as $\hat{\theta} = \eta(1 - \hat{b})$.

Finally, I calibrate ζ, the parameter governing preferences for formal employment, using evidence on the extensive-margin labor supply elasticity from Chetty et al. (2011) and data on the share of formal employment in the labor market from the National Household Survey (Instituto Nacional de Estadística y Censos 2021a).

Estimation results. I set η to 2.20. While Table 1 suggests a value of 1.64, when I flexibly control for CBU fixed effects and exclude workers with low tenure to compute wages, the estimates tend to be larger, which is why I select this value.[32] The estimated elasticity is similar when focusing on high-wage firms only, mitigating concerns of bias due to demand-constrained firms.

I estimate θ to be 1.42 (SE = 0.14). I can thus reject the hypotheses $\eta < \theta$ and $\theta = 1$ at the 1% significance level, which is consistent with the model assumption of $\eta > \theta > 1$. The gap $\eta - \theta$, which determines the pass-through of changes in the aggregate wage index in a

[30] There are two sources of measurement error. First, my wage variable corresponds to total monthly pay thus reflecting variation in hours worked. Second, I do not observe the expected wage $\psi_{jt} w_{jt}$ nor the labor supply h_{jt}, but rather $\tilde{w}_{jt}$ and $\tilde{\ell}_{jt}$, which may differ in the model due to demand-constrained firms.

[31] Following the definition in Online Appendix F.1.1, the wage index is computed as $\tilde{W}_{kt} = \sum_{j\in\mathcal{J}_k} \left(\tilde{w}_{jt}^{\eta}\right)^{1/\eta}$, where $\mathcal{J}_k$ is the set of firms in local labor market k.

[32] This estimate is comparable to other estimates in the literature. Parente (2024, Table 3) calibrates within-market elasticities of 4.52 (in 1996) and 4.22 (in 2012) in Brazil. Berger et al. (2022, Table) estimate a value of 10.85 in the US, and Azkarate-Askasua and Zerecero (2025, Table 1) estimate heterogeneous elasticities that range between 1.00 and 3.45 across local labor markets in France.

sub-market, equals 0.78 and is strongly statistically significant. The appendix shows that this gap is quite stable for values of η between 1.70 and 2.70.

I calibrate ζ to 1.64, relying on an extensive-margin elasticity of 0.20 from Chetty et al. (2011) and a share of formal employment of 0.288. I set the working-age population N to 12.55 million using data from the National Household Survey as well.

7.1.3 Shape of productivity distributions

The shape parameter q is estimated from 2011–14 firm-level data to match the distribution of firm wages for firms that pay a wage above their wage floor. I obtain a value of 5.30, which the appendix shows provides an excellent fit to the distribution of unconstrained wages.

7.1.4 Joint calibration of remaining labor market model parameters

Identification. Start with the output elasticity of labor α. Given the other model parameters, α is calibrated to replicate the aggregate labor share, which is close to 0.5 in Argentina (Instituto Nacional de Estadística y Censos 2017). More precisely, I embed the estimation procedure for the other parameters in an iterative algorithm that updates α until the ratio of the aggregate wage bill to aggregate output in the model equals 0.5.

Then, I turn to the joint estimation of amenity values $\{A_k\}_{k\in\mathcal{K}}$, minimum productivities $\{\varphi_{g0}\}_{g\in\mathcal{G}}$, and the outside option b, given α and parameters estimated previously. The goal is for the model to replicate the employment shares across local labor markets $\{\tilde{s}_k\}_{k\in\mathcal{K}}$, the shares of constrained firms $\{\tilde{SC}_g\}_{g\in\mathcal{G}}$, and the aggregate formal employment share $\tilde{\iota}$. Two challenges arise in this estimation. First, the employment shares in the model are $s_k = L_k / \sum_{k'\in\mathcal{K}} L_{k'}$, where aggregate demand $L_k = \sum_{g:k(g)=k} L_g$ includes demand-constrained firms for which employment does not depend on amenities, rather than the supply shares $A_k W_k^\theta / \sum_{k'} A_{k'} W_{k'}^\theta$. Second, the equations that determine these objects are interconnected. Both shares depend on the wage indexes, which are determined by the labor market-clearing conditions given amenity values and minimum productivities.

I devise a calibration approach that addresses these challenges. First, I numerically solve for amenities $\{A_k\}_{k\in\mathcal{K}}$ to match shares $\{\tilde{s}_k\}_{k\in\mathcal{K}}$. I start with an initial guess for A_k (and W_k) that allows me to solve the model. Then, I update A_k proportionally to the discrepancy between s_k and $\tilde{s}_k$, until convergence. Second, to address the interdependence, I jointly estimate $\{\varphi_{g0}\}_{g\in\mathcal{G}}$ within each iteration. To do so, I use the current A_k and W_k to construct the thresholds $\overline{\varphi}_g$ and then I invert the equation for the share of constrained firms using data $\tilde{SC}_g$. I obtain b by inversion of equation (7) within the loop as well, using data on $\tilde{\iota} = 0.288$ and the current value of $\bar{V}^\zeta$. In the end, the calibrated parameters generate a labor market equilibrium that exactly replicates the observed shares, given the observed wage floors.

Estimation results. The estimated elasticity of output to labor α is 0.70.[33] The estimated A_k range from 0.05 to 3.05, with a median of 0.53, and φ_{g0} range from 1.52 to 79.78, with a median of 8.21.[34] The absolute scale for these values is pinned down by the wage floors. The outside option b is 37.5, which is comparable to a value of 15.2 for $\bar{V}^{\zeta}$.

7.1.5 Bargaining power parameters

Identification. I numerically invert the model to obtain the parameters $\{\beta_c\}_{c\in\mathcal{C}}$ from the Nash bargaining problem for each of the 228 CB units. Given a value of β_c and all other model parameters, there is a unique wage floor $\underline{w}_c$ that solves the Nash bargaining problem for CB unit c. I thus estimate β_c by finding the value that equates the model-implied optimal wage floor to its empirical counterpart, which I observe in the data.

Estimation results. The estimated parameters show substantial heterogeneity across CB units, with a median of 0.075. Although the average estimate may seem low, it generates wage floors that are economically significant. In fact, the share of constrained firms at the median is 0.4975. I show how the share of constrained firms varies with β_c in the appendix.

7.2 Validation of estimated model

I validate the estimated model by checking its ability to replicate the responses of wages and wage floors to CBU shocks documented in Section 5.

Simulating the model. To simulate the effects of shocks I shift the sub-market's minimum productivities in proportion to the trade shocks studied in the empirical analysis and re-solve the model. The minimum productivity parameters are estimated in the post-period (2011–14). To obtain pre-shock (2005–07) values I compute trade shocks for each sub-market z_g, and the shares of exporting employment S_g, as in Section 4.2. Then, I define the pre-shock parameters as $\varphi_{g0}^{\text{Pre}} = \varphi_{g0}^{\text{Post}} / (1 + \chi z_g S_g)$, where χ is a scaling factor that transforms trade shocks into productivity terms, which I set to 0.35. Among sub-markets that experience a change, the median increase in φ_{g0} is 1.5%, though with substantial heterogeneity (the 25th and 75th percentiles are 0.2% and 6.4%, respectively). Since I lack information to calibrate

[33] This value aligns with other estimates in the literature. Lamadon et al. (2022, Table 1) estimate heterogeneous $1-\alpha$ values across sectors in the US by targeting their labor share, with a mean estimate of 0.21 (i.e., α equal to 0.79). Azkarate-Askasua and Zerecero (2025, Table 1) estimate heterogeneous parameters as well, which fall in the range 0.563 to 0.864.

[34] The baseline wage indexes W_k range from 3.20 to 614.54, with a median of 49.68, and the corresponding aggregate wage index W is $97{,}668.6$.

χ I focus on relative comparisons that are invariant to its scale. I solve the model using either $\varphi_{g0}^{\text{Pre}}$ or $\varphi_{g0}^{\text{Post}}$ and compare the resulting equilibria to derive the effects of shocks.

Propagation of shocks. The model replicates the magnitude of the propagation of shocks through the CB network which, notably, was not targeted in estimation. Columns (1) and (2) of Table 5 replicate the estimates from Table 1. Columns (3) and (4) present the analogous model-based estimates, obtained from regressions of the change in a sub-market outcome on the model-based CBU shock and the sub-market shock, controlling for local labor market fixed effects, and weighting by the number of firms so that the estimates reflect average firm-level responses. As in the data, the effect of the CBU shock on wage floors is larger than the effect on wages. Section 5.1 estimated a pass-through of wage floors to wages of 0.3820, which is closely matched by a value of 0.3255 in the model-generated data.

Wage floor responses to CBU shocks. The model replicates the responses to shocks for individual CB units as well. Appendix Figure 9 compares the predicted wage floor increases from the empirical analysis, using estimates from Table 1, to the wage floor changes in the model.[35] Note that we would not expect a perfect match since, first, the CBU shocks are not defined identically in the actual and model-generated data, and second, the responsiveness of wage floors was not targeted in estimation. Yet, the correlation between the two is high, at 0.45, especially when compared to a correlation of 0.57 between the actual and model-based CBU shocks. The wage floor increases appear somewhat more dispersed in the actual data.

Summary. The estimated model quantitatively replicates key features of the propagation of shocks via the CB network documented in the empirical analysis, moments that were not targeted in estimation. This validation supports the counterfactual exercises in the next section, which explore how the extent of shock propagation varies with the structure of the CB network.

8 Counterfactuals Analysis

This section studies how the propagation of shocks depends on the structure of CB networks using the estimated model. I proceed as follows. First, I define the counterfactual networks. Second, I compare the effect of shocks in the baseline CB network relative to a non-CB economy without wage floors. Third, I explore how the different networks affect the propagation

[35] I focus on "predicted" wage floor increases rather than actual ones to hold constant other determinants of wage floors in the actual data, such as the exchange rate appreciation, which are absent from the simulation.

of shocks. Finally, I discuss the interpretation of the findings and their relationship to the literature.

8.1 Counterfactual CB networks

I modify the baseline CB network to create counterfactual networks that differ in the degree of centralization of bargaining, i.e., the typical size of CB units in the economy.[36] To this end, I manipulate the baseline network, which consists of 228 CB units, to construct three types of counterfactual networks.

First, I create more decentralized networks by dividing existing CB units according to the region or sector of each sub-market. The most decentralized network results in $1,342$ CB units, one per sub-market. Second, I create more centralized networks by assigning the most common CB unit in the local labor market to randomly selected sub-markets, without modifying the retail CB unit (which is the largest and provides stability to the economy). The rationale for this approach is to construct plausible networks, where nearby sub-markets are more likely to share the same CB unit. The most centralized network I consider contains 56 CB units. Third, I remove the CB network entirely and estimate the effects of shocks in a non-CB economy without wage floors. Overall, I consider 28 CB networks plus the non-CB economy.

To isolate the role of the network structure, other model parameters are held fixed at their estimated values. In particular, I keep the average bargaining power in the economy constant as follows. When dividing existing CB units, I assign the bargaining power of the original CB unit to each of the new CB units. When merging sub-markets into larger CB units, I define the bargaining power of each new CB unit as the employment-weighted average bargaining power across the original CB units.[37]

8.2 The effects of shocks under counterfactual CB networks

This subsection presents the main results on how the propagation of shocks varies with the structure of the CB network. I start by defining summary statistics to capture the degree of centralization and shock propagation, followed by a discussion of the results.

[36]Examples of countries with centralized bargaining are Italy and Portugal, whereas countries with decentralized bargaining are the US and the UK (Bhuller et al. 2022).

[37]I proceed analogously with proportional wage floor differentials across regions within multi-regional CB units. Namely, more decentralized networks inherit the differentials of the original CB units, whereas more centralized networks set the differentials as the employment-weighted average across the original CB units.

8.2.1 Measuring centralization and shock propagation

I introduce several summary statistics. First, I measure centralization of bargaining as the average number of firms per CB unit. Second, to capture the degree of shock propagation, I compare the pattern of changes in an outcome across sub-markets between each network and the non-CB economy. The non-CB economy serves as a useful benchmark because it reflects the counterfactual adjustment of the economy without any propagation via CB.

My baseline metric for shock propagation is the relative mean absolute deviation (RMAD) of changes in a given outcome, say the wage bill, which indicate average deviations between a CB network and the non-CB economy relative to the mean wage bill change under that CB network. Let $\Delta \ln WB_g^{\mathcal{C}}$ and $\Delta \ln WB_g^{\text{NCB}}$ denote the wage bill change in sub-market g under network $\mathcal{C}$ and the non-CB economy, Then, the RMAD for network $\mathcal{C}$ is

$$\text{RMAD}_{\mathcal{C}} = \frac{\sum_{g \in \mathcal{G}} M_g |\Delta \ln WB_g^{\mathcal{C}} - \Delta \ln WB_g^{\text{NCB}}|}{\sum_{g \in \mathcal{G}} M_g \Delta \ln WB_g^{\mathcal{C}}},$$

where I weight by the measure of firms M_g. The lowest possible value of this metric is zero, which occurs when $d \ln WB_g^{\mathcal{C}} = d \ln WB_g^{\text{NCB}}$ for all g, and larger values indicate more shock propagation. In practice, the economy-wide mean wage bill change varies little across networks (the mean is 0.0212 and the range is 0.0189 to 0.0230), so most of the variation in the metric arises from the numerator. I compute this metric for employment and mean wages as well, always dividing by the mean wage bill change.

In an appendix I also show an alternative relocation metric that captures the share of wage bill (or employment) creation that would need to be relocated across sub-markets to match the distribution of changes in the non-CB economy. This metric varies between 0 and 1, with larger values indicating more shock propagation as well.

8.2.2 Results for the baseline CB network

The baseline CB network results in similar aggregate responses to the shocks as the non-CB economy. Columns (1) and (2) in Panel (a) of Table 6 show that the aggregate wage index W increases by 4.20% in the non-CB economy and 4.13% in the baseline network, whereas aggregate employment increases by 0.58% and 0.57%, respectively. The aggregate magnitudes should be interpreted with caution, as they depend on the non-calibrated factor χ that translates trade shocks into productivity increases. However, the relative differences between the two economies are informative. Notably, the presence of wage floors does not lead to meaningfully lower aggregate employment responses to the shocks.

The employment and wage increases are concentrated among the most affected CB units.

Columns (4) and (5) in Panel (a) of Table 6 show that aggregate employment increases by 7.07% in the most affected CB units, comprising roughy one-fifth of employment, compared to a slight decrease in the rest. The increase in the aggregate wage bill is even larger, reflecting the increases in both employment and wages.

While aggregate responses are similar across the baseline CB network and the non-CB economy, there are large differences in the pattern of adjustment. Panel (b) of Table 6 shows that the mean absolute deviation in wage bill changes from the non-CB economy is 61.0% of the mean wage bill change under the baseline CB network. These deviations are concentrated among most affect CB units, where the RMAD is 1.9 times larger than in the less affected CB units, though we see significant deviations in both groups. Deviations in employment and mean wage changes are also significant. These results highlight that the CB network determines which firms and workers absorb the effects of shocks.

8.2.3 Shock propagation under counterfactual CB networks

Quantifying the extent of shock propagation across the counterfactual CB networks reveals a non-monotonic relationship with the degree of centralization of bargaining. Panel (a) of Figure 6 shows a hump-shaped pattern: both highly decentralized and highly centralized bargaining result in lower propagation, measured by the RMAD in wage bill changes, whereas medium levels of centralization result in more propagation. Online Appendix Figure 10 shows that this pattern also holds for employment and mean wages, and Online Appendix Figure 11 shows that it also holds when measuring propagation with the relocation metric.

The hump-shaped pattern can be explained by the extent to which wage floors constrain firms and the extent of connections created by the network. Panel (b) of Figure 6 shows that more centralized networks result in a lower share of firms constrained by wage floors. In decentralized networks the bite of the wage floor is high, but since there are not many connections across sub-markets, shocks do not propagate. As the network becomes more centralized there are more connections, leading to more propagation. However, the wage floor bite is smaller, so wage floor changes are less impactful and shocks propagate less. As centralization increases the bite declines further and the second effect dominates.

The key driver of the wage floor bite is the dispersion of productivity within CB units. Panel (c) of Figure 6 shows that more centralized networks tend to have more dispersion in minimum productivity φ_{g0} across sub-markets within each CB unit. This occurs because, with more dispersion, the derivative of aggregate profits with respect to the wage floor $d\Pi/d\underline{w}_c$ becomes more negative, as low-productivity sub-markets are hit harder by wage floor increases. As discussed in Section 2.2, a larger derivative leads to a Nash split that favors employers, which is achieved via a lower equilibrium wage floor.

The decline in shock propagation in highly centralized networks cannot be explained by weaker wage floor adjustments. In fact, Panel (d) of Figure 6 shows stronger wage floor increases in more centralized networks, going against the hump-shaped pattern.

Wage floor pass-through. A different way of understanding the hump-shaped pattern is through the wage floor pass-through, i.e., the average change in mean wages resulting from a change in the wage floor. Figure 7 shows estimates of the wage floor pass-through for each CB network against the degree of centralization, obtained as in Table 5. The estimated pass-through declines significantly with centralization. More centralized networks show a smaller wage floor bite and thus wage floor increases have a smaller effect on final wages.

8.3 Discussion

The model's key result is that the propagation of shocks through the CB network is hump-shaped in the degree of bargaining centralization. This non-monotonic relationship arises from the endogenous determination of wage floors which, in turn, depends on the dispersion of productivity within CB units. This novel mechanism relates to several strands of the literature and has implications for our understanding of the role of CB institutions.

First, this paper identifies a novel channel for the spatial contagion of shocks, contributing to a literature studying how labor markets adjust to shocks (e.g., Autor et al. 2013; Dix-Carneiro and Kovak 2017; Garin and Silvério 2023). The findings point to a benefit of moderate centralization in enhancing resilience to local shocks by dissipating their effects across a wider set of firms and workers. This complements studies on bargaining and spatial inequality, such as Boeri et al. (2021), who argue that centralized collective bargaining can create spatial misallocation in low-productivity regions. This suggests a trade-off between static efficiency and resilience to shocks in the design of bargaining institutions.

Second, the results speak to the debate around the optimal degree of bargaining centralization. The classic result of Calmfors and Driffill (1988) shows that intermediate centralization yields the worst unemployment outcomes. I show that intermediate centralization can also act as an insurance mechanism, dissipating the effects of local shocks. This complements Barth et al. (2023), who argue that European countries with coordinated bargaining were more resilient to import competition shocks.[38] The model also explains two empirical findings from the literature in a unified framework: the association between decentralization and higher wage levels (e.g., Plasman et al. 2007; Dahl et al. 2013), and the stronger responsiveness to shocks under decentralized bargaining (e.g., Gürtzgen 2009b; Rusinek and Rycx

[38] While Barth et al. (2023) focus on coordination across unions, I show that uncoordinated bargaining may also increase resilience as local responses depend on the average shock experienced by connected firms.

2013). In the model, decentralized bargaining reduces the dispersion of productivity within CB units, leading to higher wage floors and thus a stronger wage floor pass-through.

More broadly, by developing a tractable model that allows for endogenous wage floors, I provide a framework for analyzing how the structure of bargaining institutions affects economic outcomes. In this case, this approach allows for a principled evaluation of the role of CB institutions in shaping the incidence of shocks.

9 Conclusions

This paper shows that the structure of collective bargaining (CB) is a key determinant of the labor market adjustment to shocks. Using novel Argentine administrative data, I provide direct evidence that product-demand shocks propagate through the CB network: a positive shock to some firms within a CB unit raises wages for other firms in the same unit. This propagation operates through collectively bargained wage floors, which increase in response to shocks and affect wages and employment at constrained firms. I develop a structural model that endogenizes wage floors to analyze the role of the CB network in shaping this propagation mechanism. The findings indicate that the CB system acts as an insurance mechanism that dissipates the effects of local shocks across connected firms and workers, and that the strength of this mechanism is determined by the network structure. As a result, the design of effective policies to mitigate economic shocks must account for the institutional context in which they operate.

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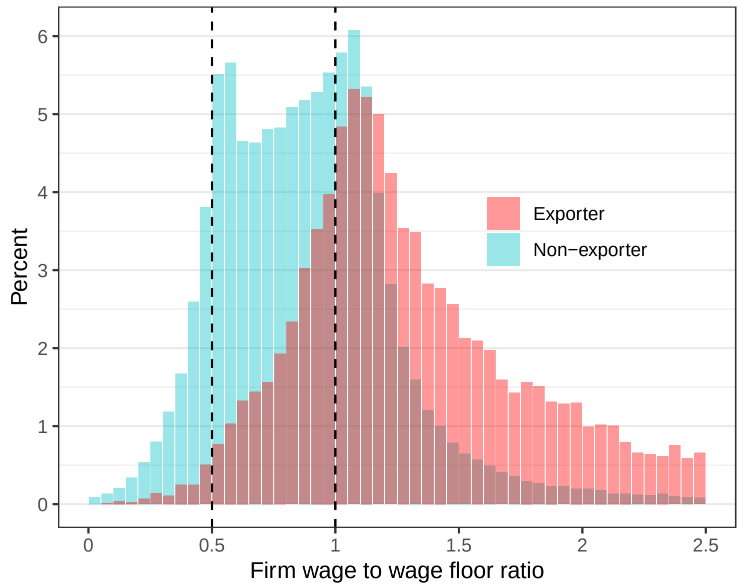
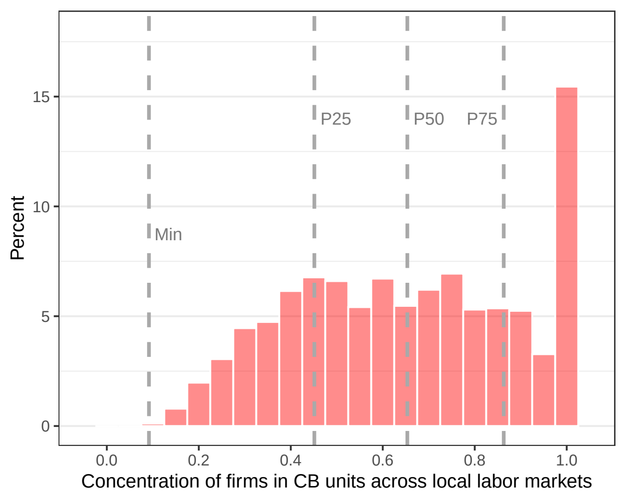
Figure 1: Facts about collective bargaining in Argentina

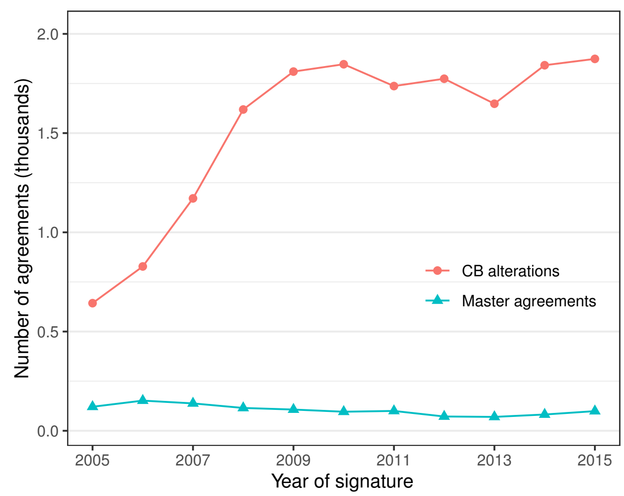
(a) Ratio of firm wage to CB unit wage floor, 2005–07



(b) CB coverage of local labor markets, 2005–07



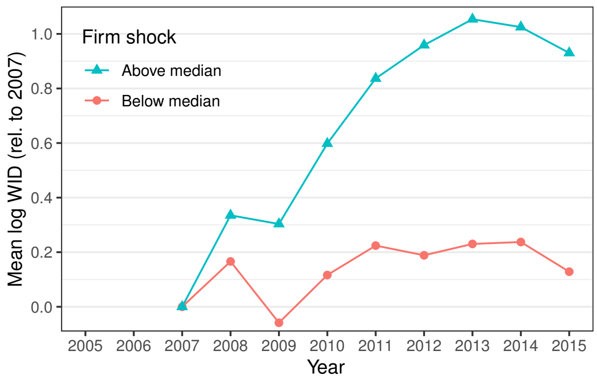
(c) Frequency of collective negotiations, 2005–15



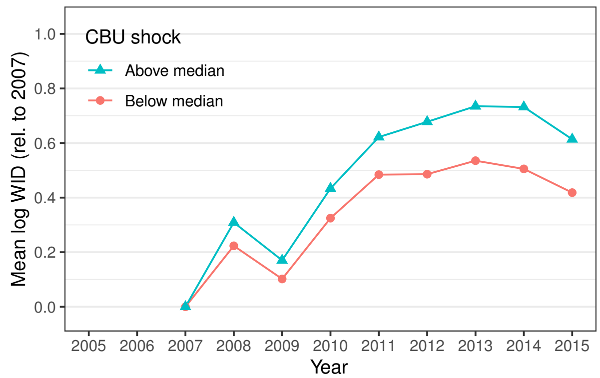
Notes: Data are from Argentina's administrative records and the national archive of collective bargaining agreements. The figure shows characteristics of collective bargaining institutions in Argentina between 2005 and 2015. Panel (a) shows the distribution of the ratio of the firm's mean wage to the mean wage floor in its CB unit, by whether the firm is an exporter, for the years 2005–07. The dashed vertical lines indicate the values corresponding to 0.5 and 1 times the wage floor. Panel (b) shows the distribution of the Herfindahl-Hirschman Index (HHI) of the number of firms across CB units within local labor markets, defined by 4-digit ISIC sector and province cells, for local labor markets with at least 2 firms and in the ISIC sectors "Manufacturing" and "Wholesale and Retail Trade." The index is computed as $HHI_k = \sum_c \upsilon_{ck}^2$, where υ_{ck} is the share of firms in CB unit c within local labor market k. Panel (c) shows the number of collective agreements signed between 2005 and 2015, by whether they are master agreements or CB alterations.

Figure 2: Evolution of outcomes by firm and CBU shocks

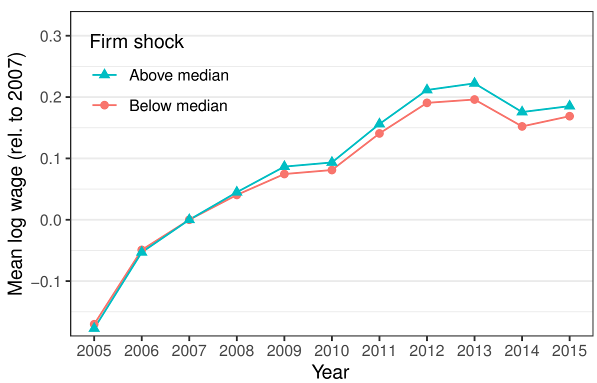
(a) World import demand – Firm shock



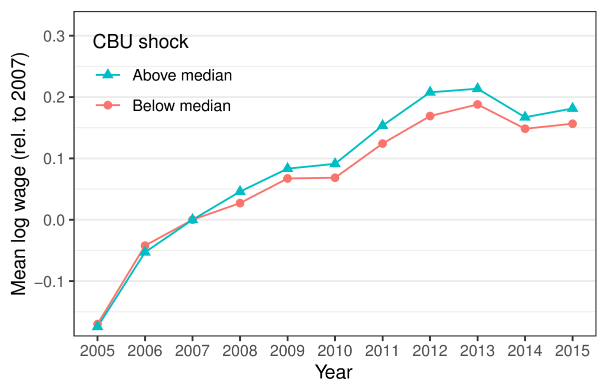
(b) World import demand – CBU shock



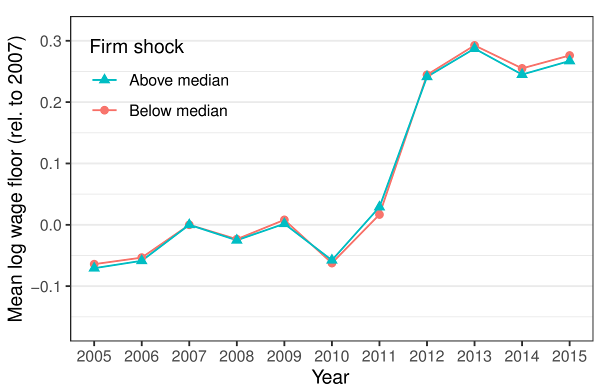
(c) Wages – Firm shock



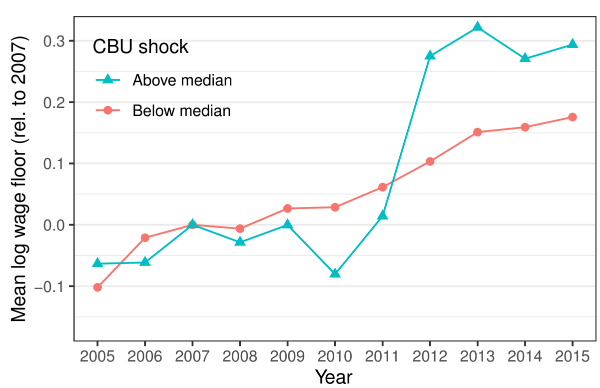
(d) Wages – CBU shock



(e) Wage floors – Firm shock



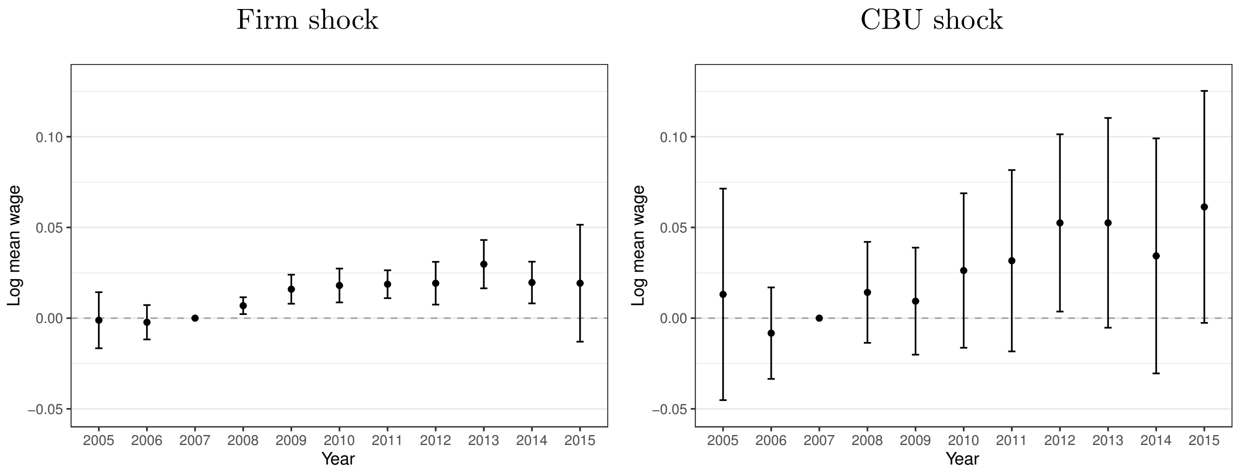
(f) Wage floors – CBU shock



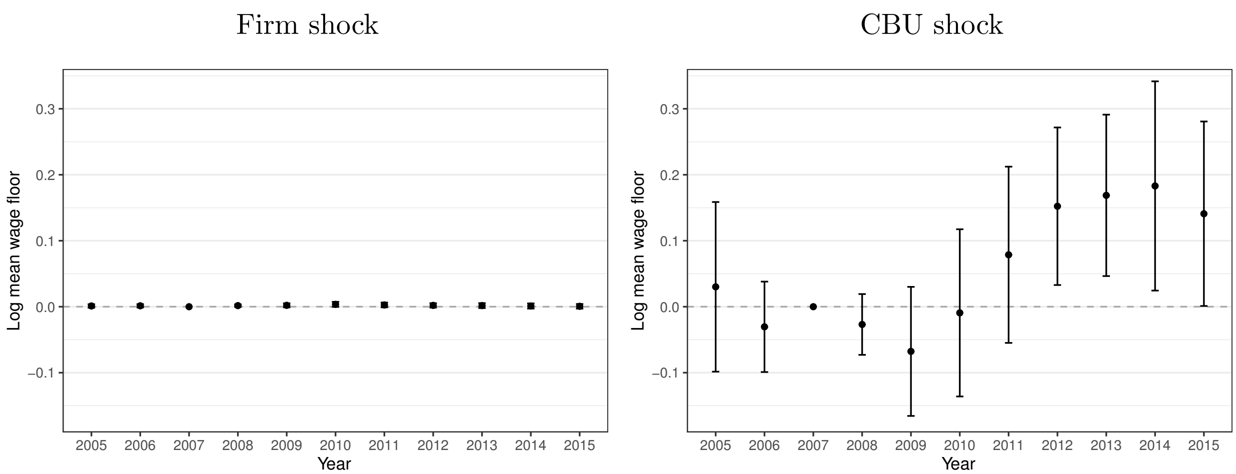
Notes: Data are from Argentina's administrative records and BACI-CEPII. The figure shows the evolution of firm-level time-varying outcomes, normalized to 2007, for exporting firms with above- and below-median levels of the static firm shock (left panels) and CBU shock (right panels). The static firm and CBU shocks, z_j and z_c, are defined as the mean change in world import demand between 2007–08 and 2012–13, weighting by appropriate exposure shares. Panels (a) and (b) shows the evolution of mean world import demand at the firm and CB unit levels, respectively. Panels (c) and (d) show the evolution of the mean log firm wage. Panels (e) and (f) show the evolution of the mean log wage floor of the CB unit of the firm.

Figure 3: Effect of export shocks on mean wages and mean wage floors

(a) Log mean wages

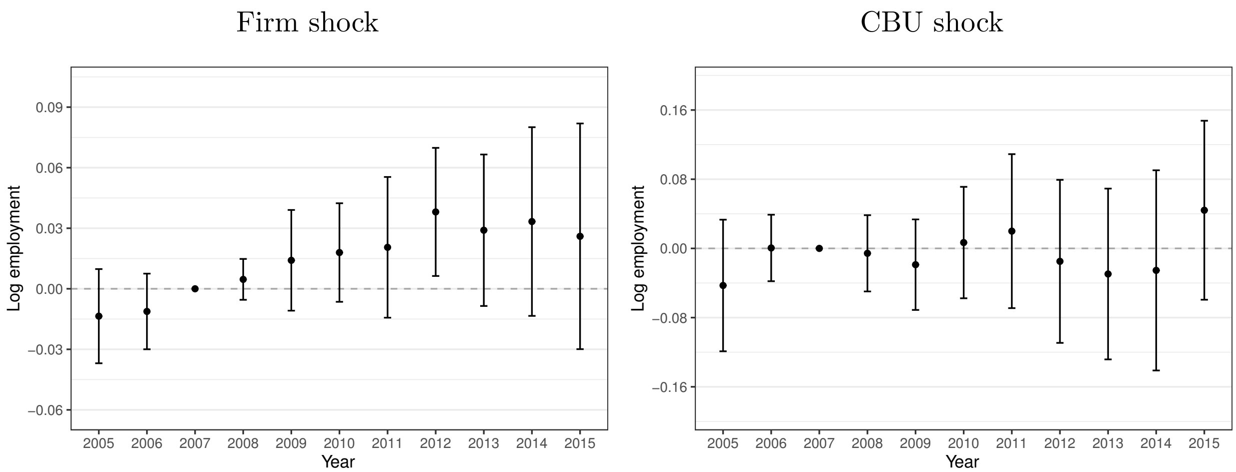


(b) Log mean wage floors



Notes: Data are from Argentina's administrative records and BACI-CEPII. The figure shows the dynamic effects of firm and CBU shocks on log mean wages (Panel a) and log mean wage floors (Panel b). The estimates are from a regression of the outcome on the firm shock, CBU shock, and the share of employment in exporting firms in the CB unit interacted with year dummies (excluding 2007), firm fixed effects, and local labor market by year fixed effects. The sample includes exporting firms with positive employment in 2005 through 2007 and part of a CB unit with at least 30 exporting firms. The firm and CBU shocks are defined as the average changes in world import demand between 2007–08 and 2012–13, weighting by appropriate exposure shares. Standard errors are clustered at the CB unit level.

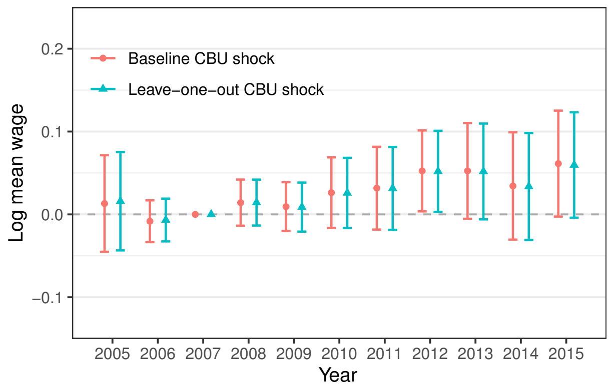
Figure 4: Effect of export shocks on employment



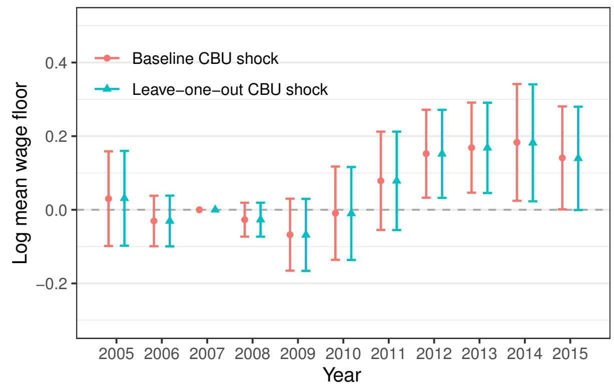
Notes: Data are from Argentina's administrative records and BACI-CEPII. The figure shows the dynamic effects of firm and CBU shocks on log employment. The estimates are from a regression of log employment on the firm shock, CBU shock, and the share of employment in exporting firms in the CB unit interacted with year dummies (excluding 2007), firm fixed effects, and local labor market by year fixed effects. The sample includes exporting firms with positive employment in 2005 through 2007 and part of a CB unit with at least 30 exporting firms. The firm and CBU shocks are defined as the average changes in world import demand between 2007–08 and 2012–13, weighting by appropriate exposure shares. Standard errors are clustered at the CB unit level.

Figure 5: Effects of CBU shock on wages and wage floors, robustness to shock construction

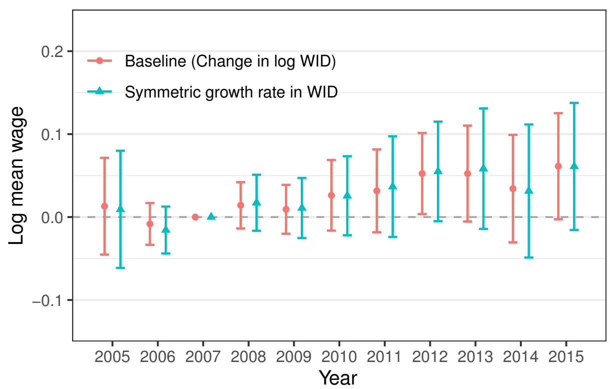
(a) Leave-one-out shock – Log mean wages



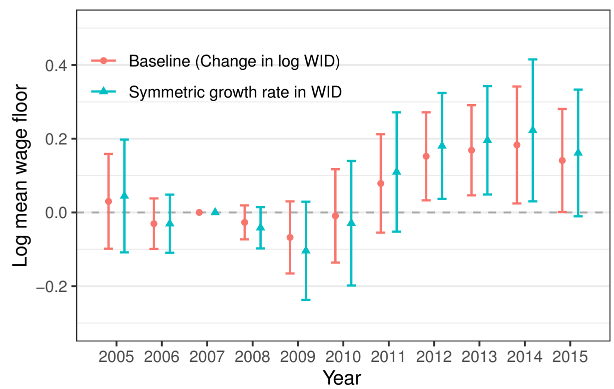
(b) Leave-one-out shock – Log mean wage floors



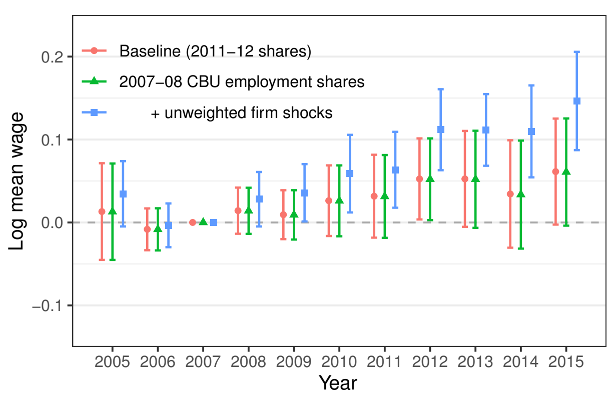
(c) Functional form – Log mean wages



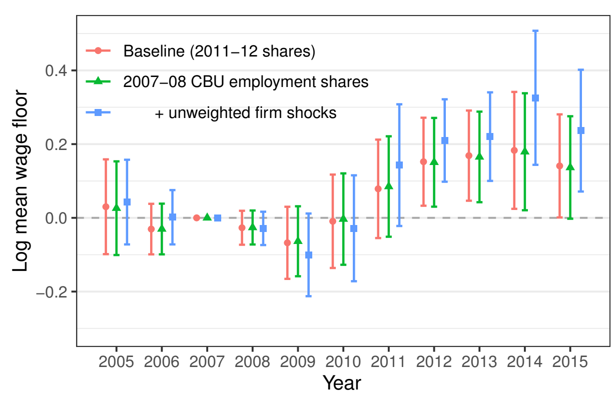
(d) Functional form – Log mean wage floors



(e) Exposure shares – Log mean wages



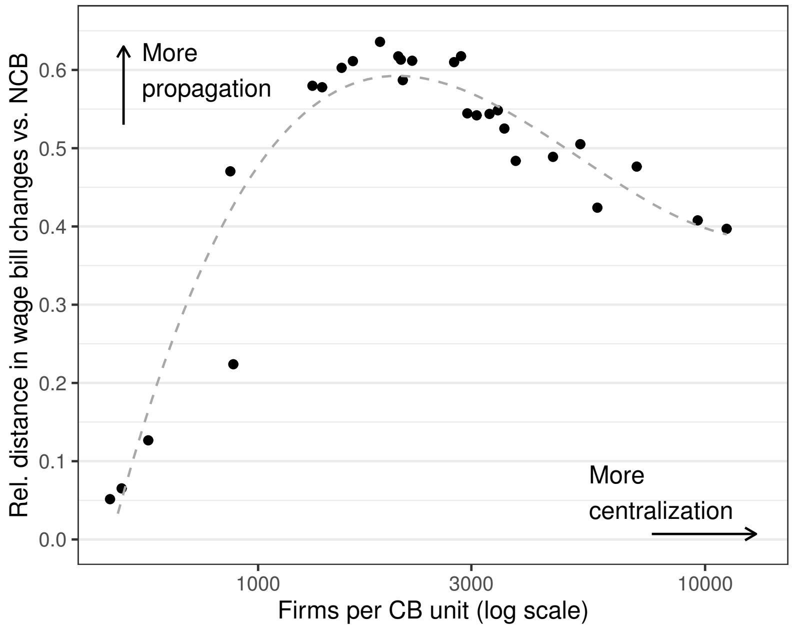
(f) Exposure shares – Log mean wage floors



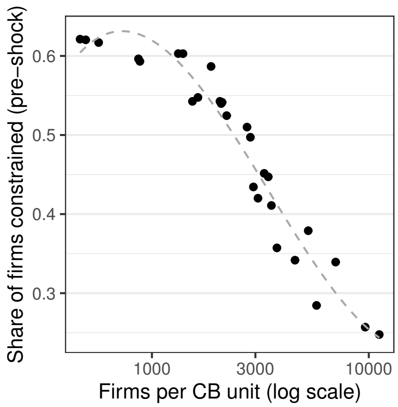
Notes: Data are from Argentina's administrative records and BACI-CEPII. This figure compares the baseline estimates of from Figure 3 to those obtained using alternative definitions of the CBU shock. Panels (a) and (b) use, for firm j, a leave-one-out CBU shock defined as the average of the firm shocks of all other firms in the same CB unit, excluding firm j. Panels (c) and (d) use a CBU and firm shock constructed from country-product shocks f_p that are defined as the symmetric growth rate in world import demand between 2007–08 and 2012–13, following Garin and Silvério (2023), thus using all country-products with non-zero world import demand in at least one year of 2007, 2008, 2012, or 2013. Panels (e) and (f) use 2007–08 employment shares to define the CBU shocks and additionally use firm shocks defined as unweighted averages of f_p.

Figure 6: Selected network-level outcomes and bargaining centralization

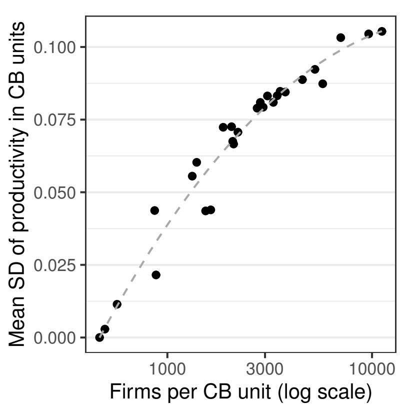
(a) Relative mean absolute deviation in wage bill changes



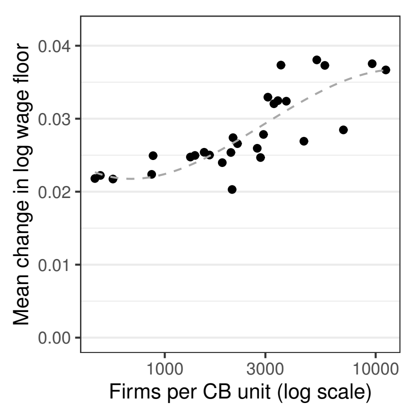
(b) Pre-shock wage floor "bite"



(c) Productivity dispersion

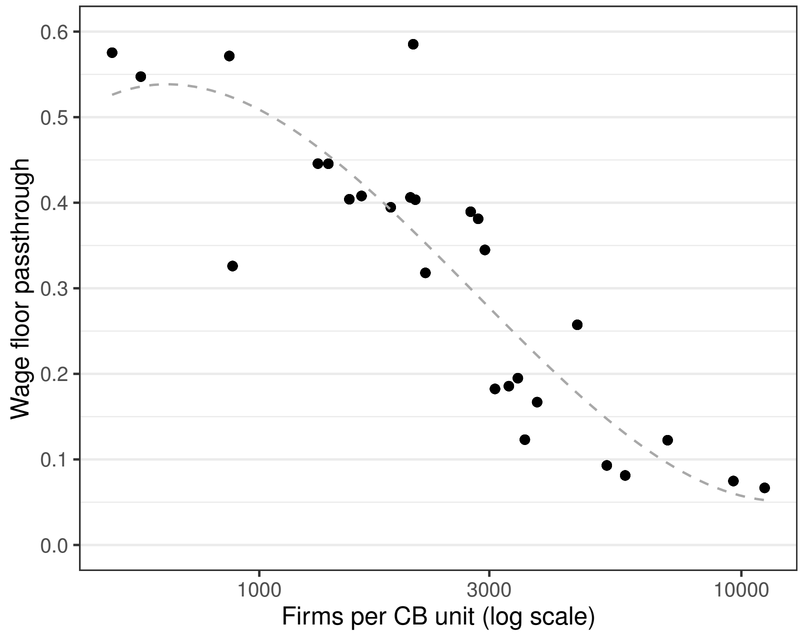


(d) Mean wage floor change



Notes: Data are from simulations of model equilibria before and after the trade shocks under different CB networks. This figure shows the relationship between bargaining centralization, in the x-axis, and several outcomes of interest, in the y-axis, across CB networks. Panel (a) shows the mean absolute deviation in wage bill changes between each CB network and the non-bargaining economy as a percentage of the mean wage bill change in the CB network. Panel (b) shows the share of firms constrained by the wage floor before the shock. Panel (c) shows the mean standard deviation in minimum productivity across sub-markets within each CB unit before the shock. Panel (d) shows the mean change in the log wage floor, weighted by the number of firms in each sub-market. The dashed gray lines in each panel show cubic fits to the data.

Figure 7: Wage floor pass-through and bargaining centralization



Notes: Data are from simulations of model equilibria before and after the trade shocks under different CB networks. This figure shows the relationship between bargaining centralization in the CB network and the estimated wage floor passthrough. The dashed gray line shows a cubic fit to the data.

Table 1: Static difference-in-differences estimates

	Log mean wage	Log mean wage floor	Log wage cushion	Log em-ployment	Log wage bill	Firm exit
	(1)	(2)	(3)	(4)	(5)	(6)
Firm shock × Post	0.0225	0.0008	0.0347	0.0369	0.0708	-0.0083
	(0.0070)	(0.0012)	(0.0093)	(0.0219)	(0.0218)	(0.0024)
CBU shock × Post	0.0439	0.1149	-0.0818	0.0121	0.0718	0.0092
	(0.0184)	(0.0534)	(0.0391)	(0.0542)	(0.0655)	(0.0096)
CBU expo. share × Post	-0.1295	-0.1825	-0.0211	-0.1065	-0.2852	-0.0080
	(0.0563)	(0.0308)	(0.0226)	(0.0506)	(0.0974)	(0.0101)
Firm FE	Y	Y	Y	Y	Y	Y
Local labor market×year FE	Y	Y	Y	Y	Y	Y
Num. firms	7,922	7,600	7,600	7,922	7,922	7,922
Num. fixed effects	15,001	13,694	13,694	15,001	15,001	15,082
Num. observations	62,156	49,961	49,961	62,156	62,156	63,376
Adjusted R^2	0.7820	0.9257	0.7557	0.9164	0.9094	0.3482

Notes: Data are from Argentina's administrative records and BACI-CEPII. The table shows the estimated effects of the firm shock, CBU shock, and CBU share of employment in exporting firms ("CBU expo. share"), on various firm-level outcomes. The estimates are from a regression of the outcome on the firm shock, CBU shock, and CBU expo. share interacted with a post-2011 indicator, firm fixed effects, and local labor market by year fixed effects. The sample includes firms with positive employment in 2005 through 2007 and part of a CB unit with at least 30 exporting firms, and data from 2005–07 and 2011–15 only. Additionally, columns (2) and (3) use observations for CB units with valid wage floor data. The firm and CBU shocks are defined as the average changes in world import demand between 2007–08 and 2012–13, weighting by appropriate exposure shares. Standard errors are clustered at the CB unit level.

Table 2: Static difference-in-differences estimates, heterogeneity by pre-period mean wage

	Log employment	Log mean wage	Log mean wage floor	Log wage cushion
	(1)	(2)	(3)	(4)
Firm shock × Post × $Q1\&Q2$	0.0405	0.0140	0.0007	0.0125
	(0.0287)	(0.0088)	(0.0027)	(0.0146)
Firm shock × Post × $Q3\&Q4$	0.0359	0.0242	-0.0002	0.0390
	(0.0246)	(0.0106)	(0.0009)	(0.0144)
CBU shock × Post × $Q1$	-0.1900	0.0534	0.1080	-0.0790
	(0.0981)	(0.0442)	(0.0687)	(0.0442)
CBU shock × Post × $Q2$	0.1085	0.0570	0.1020	-0.0368
	(0.1477)	(0.0340)	(0.0674)	(0.0444)
CBU shock × Post × $Q3$	0.1937	0.0160	0.1378	-0.1419
	(0.1003)	(0.0254)	(0.0598)	(0.0790)
CBU shock × Post × $Q4$	0.1366	0.0035	0.1426	-0.1402
	(0.0878)	(0.0396)	(0.0502)	(0.0720)
Firm: p-value $Q1\&Q2 = Q3\&Q4$	0.8756	0.4675	0.7593	0.0382
CBU: p-value $Q1 = Q2$	0.1050	0.8939	0.8267	0.3729
CBU: p-value $Q1 = Q3$	0.0046	0.4660	0.4454	0.3841
CBU: p-value $Q1 = Q4$	0.0050	0.4760	0.6200	0.4809
CBU exposure share×Q×year	Y	Y	Y	Y
Local market×Q×year FE	Y	Y	Y	Y
Num. fixed effects	21,855	21,855	19,454	19,454
Num. observations	59,662	59,662	48,029	48,029
Adjusted R^2	0.9147	0.7960	0.9219	0.7789

Notes: Data are from Argentina's administrative records and BACI-CEPII. The table shows the estimated effects of the firm and CBU shocks on various firm-level outcomes, allowing for heterogeneity by pre-period mean wage. The estimates are from a regression of the outcome on the firm shock interacted with a post-2011 indicator and an indicator for above- or below-median pre-period mean wage ($Q1$-$Q2$ vs. $Q3$-$Q4$), the CBU shock interacted with a post-2011 indicator and pre-period mean wage quartile indicators ($Q1$, $Q2$, $Q3$, $Q4$), the share of employment in exporting firms in the CB unit interacted with a post-2011 indicator and pre-period mean wage quartile indicators, firm fixed effects, and local labor market by pre-period mean wage quartile by year fixed effects. The "Firm" p-value tests the null hypothesis that the firm shock effects for $Q1$-$Q2$ and $Q3$-$Q4$ firms are equal, and the "CBU" p-values test the null hypotheses that the CBU shock effects between $Q1$ and each of $Q2$, $Q3$, and $Q4$ are equal. The sample includes firms with positive employment in 2005 through 2007 and part of a CB unit with at least 30 exporting firms, and data for the years 2005–07 and 2011–15 only. Standard errors are clustered at the CB unit level.

Table 3: Static difference-in-differences estimates, worker-level estimates

	Log mean wage				
	All	Stayers	Stayers in multi CBU firms		
	(1)	(2)	(3)	(4)	(5)
Firm shock × Post	0.0182	0.0127	0.0134	0.0134	
	(0.0107)	(0.0099)	(0.0129)	(0.0128)	
CBU shock × Post	0.0266	0.0310	0.0490		0.0485
	(0.0183)	(0.0187)	(0.0237)		(0.0206)
CBU shock × Post					
× Primary CBU				0.0588	
				(0.0243)	
× Other CBU				0.0238	
				(0.0300)	
CBU expo. share × Post	Y	Y	Y	N	Y
CBU expo. share × Post					
× Primary CBU	N	N	N	Y	N
Worker×firm FE	Y	Y	Y	Y	Y
Local labor market×year FE	Y	Y	Y	Y	N
Firm×year FE	N	N	N	N	Y
Num. fixed effects	443,545	221,590	131,518	131,518	176,359
Num. observations	2,818,128	1,728,367	1,005,122	1,005,122	999,284
Adjusted R^2	0.8271	0.8917	0.8715	0.8715	0.8946

Notes: Data are from Argentina's administrative records and BACI-CEPII. The table shows estimates of the effect of the firm and CBU shock on the mean log wage at the worker level, using different samples and regression specifications. Column (1) uses all workers that worked in the firm between 2005 and 2007, column (2) restricts to stayers—workers that remained in the firm between 2005 and 2015—, and columns (3) through (5) restrict to stayers in firms with multiple CB units. All estimates use firms within a CB unit with at least 30 exporting firms, and data from 2005–07 and 2011–15 only. Columns (1) through (3) show the effect of firm and CBU shocks, controlling for the share of employment in exporting firms in the CB unit (the "CBU expo. share"), worker-firm fixed effects, and local labor market-year fixed effects. Column (4) replicates column (3) but interacting the CBU shock with an indicator for whether the worker's CB unit coincides with the firm's (recall that the firm CB unit is defined as the modal CB unit in the firm). Column (5) estimates the effect of shocks to the worker's CBU, controlling for the worker's CBU expo. share, and worker-firm and firm-year fixed effects, in the sample of stayers that belong to a CB unit with a valid CBU shock. Standard errors are clustered at the CB unit level.

Table 4: Estimation strategy for different model parameters

Parameter	Description	Estimate	Source
Worker problem			
η	Within local labor market elasticity	2.20	Estimation
θ	Across local labor market elasticity	1.42	Estimation
ζ	Extensive-margin preference param.	1.64	Literature
$\{A_k\}$	Amenity values of local labor markets	$\{0.05, 0.53, 3.05\}$	Model inversion
b	Outside option of workers	37.5	Model inversion
Supply-side parameters			
α	Parameter of production function	0.70	Calibration
q	Curvature of productivity processes	5.30	Estimation
$\{\varphi_{g0}\}$	Minimum productivities	$\{1.52, 8.21, 79.78\}$	Model inversion
Bargaining parameters			
$\{\beta_c\}$	Bargaining power parameters	$\{0.01, 0.07, 0.99\}$	Model inversion

Notes: This table summarizes the parameters of the structural model, the estimated values, and the estimation strategy or source for each parameter. The figure reports point estimates or calibrated values for parameters that are homogeneous across markets, and the minimum, median, and maximum values for the parameters that vary across local labor markets, sub-markets, or CB units.

Table 5: Effects of CBU shocks on wages and wage floors, data vs. model

	Data		Model	
	Log wage floor	Log mean wage	Log wage floor	Log mean wage
	(1)	(2)	(3)	(4)
CBU shock, data	0.1149	0.0439		
	(0.0534)	(0.0184)		
CBU shock, model			0.9105	0.2964
			(0.1273)	(0.0385)
Wage floor pass-through		0.3820		0.3255
Sub-market shock			Y	Y
Local labor market FE			Y	Y
Obs. (firms/sub-markets)	49,961	62,156	640	640

Notes: Data are from previous estimates and simulations of model equilibria before and after trade shocks in the baseline CB network. The table shows the effect of CBU shocks on log wage floors and log wages, as estimated in the actual and model-generated data. The row "Wage floor pass-through" shows the ratio of the wage to wage floor effects. Columns (1) and (2) replicate the estimates from Table 1, focusing on CB units with at least 30 exporting firms and valid wage floor data. Columns (3) and (4) present the model-based estimates, focusing on sub-markets that belong to CB units with at least 30 exporting firms. The model-based columns show the results of sub-market level regressions of the difference in a sub-market level outcome on the CBU shock and the sub-market shock, weighted by the number of firms in the sub-market and controlling for local labor market fixed effects. The CBU shock is defined as the mean change in $\ln \varphi_{g0}$ among covered sub-markets, weighting by pre-period employment. The sub-market shock is defined as the change in $\ln \varphi_{g0}$. Standard errors in parenthesis are clustered at the CB unit level.

Table 6: Labor market adjustment to trade shocks, model-generated data

	All firms			Affected CBUs	Non-affected CBUs
	NCB	Base	(Ratio)	Baseline	
	(1)	(2)	(3)	(4)	(5)
(a) Percent increase in					
Formal market welfare W	4.20	4.13	(0.98)		
Aggregate employment L	0.58	0.57	(0.98)	7.07	-0.82
Aggregate wage bill WB	3.34	3.28	(0.98)	14.60	1.12
(b) Deviation from NCB (pct.)					
Wage bill WB_g		61.0		103.6	55.2
Employment L_g		42.8		77.4	38.1
Mean wage $\bar{w}_g$		26.2		42.4	24.0
(c) Descriptives					
Share of pre-shock employment		1.00		0.18	0.82
Pct. increase in min. productivity φ_{g0}		2.99		8.63	1.78

Notes: Data are from simulations of model equilibria before and after the trade shocks under the baseline CB network and in an economy without collective bargaining ("NCB"). The table compares the effects of the trade shocks on several aggregate and distributional labor market outcomes between the two economies. Columns (1) to (3) report results for all firms, while columns (4) and (5) report results separately for affected and non-affected CB units. Affected CB units are those with an employment-weighted average increase of at least 2.5% in the minimum productivity. Panel (a) shows the percent increase in the aggregate wage index W, aggregate employment L, and aggregate wage bill WB. Panel (b) shows the deviation from NCB, defined as the mean absolute deviation in wage bill, employment, or mean wage changes between the baseline and NCB economies, as a percentage of the average change in the wage bill in the baseline economy. In columns (4) and (5), these statistics are shown separately for affected and non-affected CB units, but always as a percentage of the average change in the wage bill in the entire economy. Panel (c) shows the following descriptive statistics: "Share of pre-shock employment" is the share of employment in affected CB units before the shock, and "Pct. increase in min. productivity φ_{g0}" is the employment-weighted average percent increase in minimum productivity.

Online Appendix for
"Collective Bargaining Networks and the Propagation of Shocks"

(Not for publication)

Santiago Hermo

December 2025

A Proofs for Theoretical Framework

Proof of Proposition 1. The Nash split equation is given by

$$\sum_{j\in\mathcal{J}} w_j\ell_j = \omega \sum_{j\in\mathcal{J}} \varphi_j f\left(\ell_j\right), \tag{A.1}$$

where $w_j = \underline{w}$ and $\ell_j = \ell_j(\underline{w}, \varphi_j)$ for constrained firms and $w_j = w(\varphi_j)$ and $\ell_j = \ell_j(w_j)$ for unconstrained ones. As I study small changes in productivity $\{d\ln\varphi_j\}_{j\in\mathcal{J}}$, I assume that ω and the constraint status of firms remain fixed. This allows me to totally differentiate (A.1) with respect to φ_j and $\underline{w}$. After rearranging terms, this yields

$$\begin{aligned}\sum_{j\in\mathcal{J}^{\text{co}}}\left(\ell_j + \underline{w}\frac{d\ell_j}{d\underline{w}} - \omega\varphi_j f_\ell \frac{d\ell_j}{d\underline{w}}\right) d\underline{w} &= \omega\sum_{j\in\mathcal{J}} f(\ell_j)d\varphi_j \\ &- \sum_{j\in\mathcal{J}^{\text{co}}} \underline{w}\frac{d\ell_j}{d\varphi}d\varphi_j - \sum_{j\in\mathcal{J}^{\text{uco}}}\left(\ell_j + w_j\frac{d\ell_j}{dw_j}\right)\frac{dw_j}{d\varphi_j}d\varphi_j, \\ &+ \omega\sum_{j\in\mathcal{J}^{\text{co}}}\varphi_j f_\ell\frac{d\ell_j}{d\varphi_j}d\varphi_j + \omega\sum_{j\in\mathcal{J}^{\text{uco}}}\varphi_j f_\ell\frac{d\ell_j}{dw_j}\frac{dw_j}{d\varphi_j}d\varphi_j,\end{aligned} \tag{A.2}$$

where $\mathcal{J}^{\text{co}}$ is the non-empty set of constrained firms, and $\mathcal{J}^{\text{uco}} = \mathcal{J}\setminus\mathcal{J}^{\text{co}}$ the set of unconstrained firms. Denote the wage bill and revenue of j as WB_j and R_j, respectively. Define the elasticity of employment to the wage η_j as $\frac{\underline{w}}{\ell_j}\frac{d\ell_j}{d\underline{w}}$ for constrained firms and $\frac{w_j}{\ell_j}\frac{d\ell_j}{dw_j}$ for unconstrained firms, and the elasticity of revenue to $\underline{w}$ for constrained firms as $\rho_j = f_\ell\frac{d\ell_j}{d\underline{w}}\frac{\underline{w}}{f(\ell_j)}$. Additionally, define the elasticities of the wage bill and revenue to productivity as

$$\xi_j^{WB} = \begin{cases}\frac{\varphi_j}{\ell_j}\frac{d\ell_j}{d\varphi_j} & j\in\mathcal{J}^{\text{co}} \\ (1+\eta_j)\frac{\varphi_j}{w_j}\frac{dw_j}{d\varphi_j} & \text{if } j\in\mathcal{J}^{\text{uco}}.\end{cases} \quad\text{and}\quad \xi_j^{R} = \begin{cases} f_\ell\frac{d\ell_j}{d\varphi_j}\frac{\varphi_j}{f(\ell_j)} & \text{if } j\in\mathcal{J}^{\text{co}} \\ f_\ell\frac{d\ell_j}{dw_j}\frac{dw_j}{d\varphi_j}\frac{\varphi_j}{f(\ell_j)} & \text{if } j\in\mathcal{J}^{\text{uco}}.\end{cases}.$$

Replacing $d\underline{w} = \underline{w} d \ln \underline{w}$ and $d\varphi_j = \varphi_j d \ln \varphi_j$ and multiplying and dividing by appropriate objects in each term, I can rewrite (A.2) as

$$\begin{aligned}\sum_{j\in\mathcal{J}^{\text{co}}} \left[WB_j\left(1+\eta_j\right) - \omega R_j \rho_j\right] d\ln \underline{w} = \omega \sum_{j\in\mathcal{J}} R_j d\ln\varphi_j \\ - \sum_{j\in\mathcal{J}} WB_j \xi_j^{WB} d\ln\varphi_j + \omega \sum_{j\in\mathcal{J}} R_j \xi_j^{R} d\ln\varphi_j,\end{aligned} \tag{A.3}$$

Now, let $R = \sum_{j\in\mathcal{J}} R_j$ and $WB = \sum_{j\in\mathcal{J}} WB_j$ be the total revenue and wage bill in the CB unit, respectively, and recall that in equilibrium $WB = \omega R$. Multiplying and dividing appropriately in (A.3), and cancelling terms, yields

$$\begin{aligned}\sum_{j\in\mathcal{J}^{\text{co}}} \left(s_j^{WB}\left(1+\eta_j\right) - s_j^{R} \rho_j\right) d\ln \underline{w} = \sum_{j\in\mathcal{J}} s_j^R d\ln\varphi_j \\ - \sum_{j\in\mathcal{J}} \left(s_j^{WB}\xi_j^{WB} - s_j^R\xi_j^R\right) d\ln\varphi_j,\end{aligned} \tag{A.4}$$

where $s_j^R = R_j/R$ and $s_j^{WB} = WB_j/WB$ are revenue and wage bill shares. Finally, define

$$\Lambda = \sum_{j\in\mathcal{J}^{\text{co}}} \left(s_j^{WB}\left(1+\eta_j\right) - s_j^{R}\rho_j\right).$$

Note that, as described in the main text, Λ is the mean wage bill elasticity minus the mean revenue elasticity to the wage floor. This is so because the response of unconstrained firms to changes in $\underline{w}$ is zero. Replacing Λ into (A.4) and solving for $d\ln\underline{w}$ yields the result.

□

Proof of Proposition 2. The results follow directly from the effects of the wage floor on firms discussed in Section 2.1. □

B Details on Labor Market Institutions

The *Law of Labor Contracts* (N° 20.744) establishes the foundational standards for all labor relations in Argentina. Building upon this, *Collective Bargaining Agreements* (CBAs) set standards for specific groups of workers across various industries, occupations, and firms. Private-sector CBAs operate under the regime of Law N° 14.250, originally enacted in 1953. Separate legal frameworks govern CBAs for government employees and educators.

CBAs are negotiated between *unions* and *employer associations* or individual employers. Sometimes, other unions that did not directly participate in the negotiations may adhere to these agreements after they are signed. The government acts as a mediator and legally validates these agreements. The terms outlined in CBAs establish *minimum standards* for workers, which individual firms cannot alter to the workers' detriment.

Types of unions. Argentine law permits any group of workers to form a union. Unions can take three legal forms: basic unions (*sindicatos*), which directly represent workers and are the most common; federations (*federaciones*), which are groups of unions; and confederations (*confederaciones*), which comprise both federations and basic unions.

Despite this freedom of association, not all unions are legally authorized to negotiate CBAs. Only one union per "area of representation" is granted bargaining privileges. The government confers these privileges to the union that fulfills specific criteria, such as having the largest number of affiliates among the workers it seeks to represent.[1] Most unions received bargaining privileges historically, after having formally requested them from the government following the procedures established by law. It is common for unions with bargaining privileges to simply adhere to existing CBAs. For instance, in the retail and wholesale sector (*comercio*), its most significant CBA (0130/75) is adopted by numerous regional basic unions. Furthermore, a single union can participate in multiple CBAs, and a single CBA can have multiple adhering unions. The main paper focuses on the role of *collective bargaining units*, abstracting from the complexities of union structures.

Areas of representation and coverage. An "area of representation" can be defined by industry, occupation, geographical location, or even a single employer. It is formally established when the government grants bargaining privileges to a union. While the government has the authority to modify these areas by granting new bargaining privileges or revoking existing ones, areas of representation have remained stable in the recent past. CBAs signed within these areas of representation are binding for all workers and firms operating within them. This is due to the legal principle of "universal coverage," which means CBAs are automatically extended to non-affiliated workers, and "automatic extension," meaning that CBAs are automatically applied to all firms within the designated area of representation.

Master agreements, CB alterations, and the negotiation process. A union with bargaining privileges and an employer negotiate a comprehensive CBA that outlines the working conditions for all covered workers. We refer to these as *master agreements*, or simply CBAs when the context is clear. The law defines protocols for unions to formally request

[1]Unions without bargaining privileges are known as *sindicatos simplemente inscriptos* (roughly, "only registered unions"), while unions with privileges are *sindicatos con personería gremial* ("unions with legal recognition"). The criteria for assigning *personería gremial* are detailed in Law N° 23.551.

meetings with employers and facilitate information exchange (e.g., employers providing details about labor costs and organizational structures), among other considerations.[2] The use of strikes, as well as the procedure in cases of employer crisis, are also regulated by law. If an agreement is not reached, the government can issue an arbitral award to determine the regulations for the labor contracts of the involved workers.

New agreements are legally validated by the Ministry of Labor through a process known as *homologación*. The government archives these CBAs under unique codes, which correspond to the CBA codes I observe in the data. A master agreement may be modified either by a new master agreement that supersedes it or by a "CB alteration" that simply updates some of its provisions.[3] While master agreements have an expiration date, they remain in force even if not renegotiated thanks to a clause known as "ultra-activity." CB alterations act as amendments to master agreements and are negotiated more frequently. They primarily concern updates to wage scales, though they may also modify other provisions.

The dynamics of negotiations. CB in Argentina experienced a resurgence between 2003 and 2015, following a period of low activity in the 1990s.[4] This revival was catalyzed by the recovery from the 2001–2002 crisis, which prompted government interventions affecting private sector wages, including minimum wage increases and decree-based wage supplements. These measures stimulated negotiations, initially incorporating government legislation into existing CBAs. Furthermore, the new ruling party elected in 2003 introduced legislation that encouraged negotiations. These factors contributed to a peak of 150 new master CBAs signed in 2006 and, by 2014, 52% of active master CBAs had been signed in 2003 or later (Pontoni and Trajtemberg 2017). Additionally, soaring inflation since 2007 prompted frequent negotiations to revise wages, resulting in a steep increase in the number of CB alterations.

C Details on Data

C.1 Main labor market data

The primary source of data is Argentina's matched employer-employee dataset. The data are collected by the tax authority for social security purposes under a system known as *Sistema Integrado Previsional Argentino* (SIPA). I have gained access to a version of these data maintained by the Ministry of Labor, covering 2005–15. The data contain worker identifiers,

[2] The procedural rules for collective bargaining are established in Law N° 23.546.

[3] If a CBA is completely revised, its code in the data also changes. These cases were reviewed to ensure a consistent code for the same CB unit.

[4] The 1990s negotiations took place in a context of pro-market reforms that weakened traditional unions. See Palomino and Trajtemberg (2006) for a discussion of the dynamics of negotiations in 1991–2006.

worker monthly compensation, and worker characteristics such as age and gender. I also observe firm identifiers, fiscal province and postal code, and their 4-digit economic sector code based on the ISIC Rev. 3.1 classification. While the dataset does not contain information on hours or full-time status, it does contain the contract type of the job. This variable contains tens of categories, but the most common one usually corresponds to full-time workers under a permanent contract. However, as suggested by Online Appendix Figure 2, part-time workers are sometimes declared under the main contract type as well.

A second administrative dataset provides additional information on labor relations (Secretaría de Trabajo 2022). This dataset, collected by the tax authority under a system known as *Simplificación Registral*, is constructed from employers' declarations during hiring or termination dates of workers. The system was introduced progressively from 2008. Appendix Table C.1 lists the size thresholds that determined whether firms were required to or had the option of entering the system at different times. The goal of the system is to collect information not available in SIPA that could be used to, for example, determine eligibility for government programs or family allowances. The dataset contains the CBA code, the within-CBA category, and an occupation code, among other variables.

Appendix Table C.1: Mandatory usage of *Simplificación Registral* by firm employment

Period	Threshold (employment)
January 2008 to July 2012	10
August 2012 to March 2013	25
April 2013 to March 2014	100
April 2014 to March 2015	200
April 2015 to April 2016	300
May 2016 to July 2017	400
August 2017 to November 2017	600
December 2018 to July 2018	2000
August 2018 onwards	Any

Source: Resolución general AFIP 4265/2018.

Importantly, both datasets contain the same worker and firm identifiers. As a result, I can use *Simplificación Registral* to add information on the CBA code to the matched employer-employee dataset, as described below.

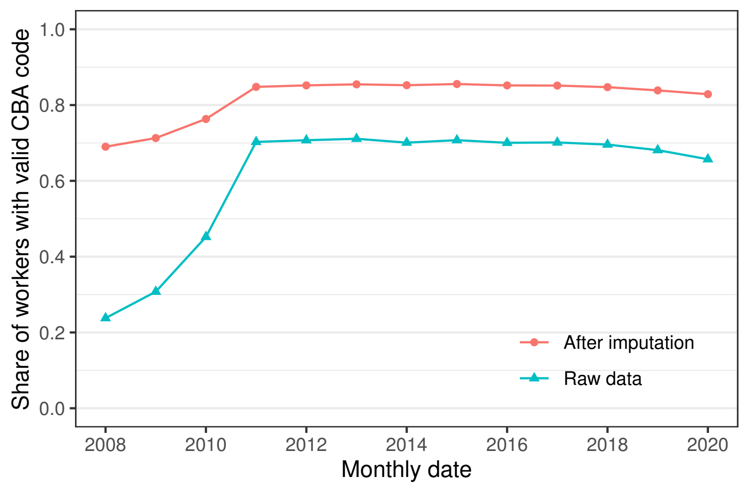
C.2 Imputation of CBA codes

Cleaning CBA codes at worker-firm level. Due to the progressive introduction of *Simplificación Registral*, many workers in SIPA do not have a CBA code. Additionally, the

CBA code may be outdated because the CB unit updated the master agreement, resulting in a new CBA code.

To increase the number of workers with a CBA code and update the codes so that they reflect a constant CB unit, I proceed in three steps. First, I fill in missing CBA codes backwards in time within each worker's employment spell, which is important in the early years of the system as many workers' hiring dates are not observed in the data. Second, I impute the CBA code to workers with a missing code in a firm-year cell if a single code is observed. If a single CBA code is observed in increasingly broad cells (such as firm-occupation, 6-digit ISIC-postal code, and occupation-postal code), I impute that code to workers with a missing code in that cell. Finally, I update the CBA codes forward to take into account updates to master CBAs that result in a new code. To do so, I scraped data from the website of the national archive of CBAs, which indicates linked CBA codes.

Appendix Figure C.1: Share of workers with non-missing CBA code, raw data



Notes: The figure shows the share of workers in the employer-employee dataset that can be matched to a valid CB agreement code.

Appendix Figure C.1 shows the share of workers in the employer-employee dataset with a non-missing CBA code in the raw data and after the imputation described above. The imputation increases coverage significantly. The most important steps in the imputation are the backwards filling, which raises coverage in the early years, and the imputation using firm-year cells, which increases coverage by around 13% after 2010.

Defining CB units. I use the imputed CBA codes to define the CB unit of each firm. If the firm has a single CBA code, I use that code as the firm's CB unit. For firms employing workers across multiple CBAs, I assign the CB unit based on the modal CBA code. If a firm does not have any workers associated with a CBA code, I assign the most frequent CBA code in the postal code and 4-digit economic sector. If no workers are present in these cells, I use wider cells defined by province and 4-digit economic sector. About 25% of the CB units are imputed. Among firms with a non-imputed CB unit, the average share of workers for whom the CBA code coincides with the assigned CB unit is 97%.

C.3 International trade flows data

First, I obtained the publicly available BACI-CEPII dataset (Gaulier and Zignago 2010), which contains yearly trade flows between any pair of countries in each 6-digit product from the Harmonized System (HS) of product classification. In particular, I use the data coded with the 2007 version of the HS system, which covers 2007–2020. Second, I obtained data from Argentine customs (*Dirección General de Aduanas*) which details the value exported to each country and product for every Argentine firm. As a member of Mercosur, Argentina's product classification system is based on the *Nomenclatura Común del Mercosur* (NCM), which is an 8-digit code that is compatible with the HS. Using concordance tables from Liao et al. (2020), I convert NCM codes into 6-digit 2007 HS codes.[5] I use names to match country codes between the Customs data and BACI-CEPII. Then, I join the datasets using country and HS codes. Because this matching is imperfect, a marginal number of country-product pairs in the Customs data do not have a corresponding value in BACI-CEPII.

D Collection of Wage Floor Data

This appendix details the construction of the two wage floor datasets used in the analysis. The first one measures the average wage floor for each CBA over time. I collect these data from resolutions issued by the Ministry of Labor, which have been published since 2004. Their primary advantage is that they accurately reflect time variation in wage floors, which is why I use them to estimate the response of wage floors to export shocks. However, because they are averages, they do not capture the variation in floors *within* a CBA across regions or worker categories, making them less suitable for estimating the bite of wage floors. The second dataset provides a more granular measure of wage floors, inferred from the distribution of wages. I construct these floors for each CBA, CBA-region, and CBA-occupation using the administrative data, available since 2011. This dataset is useful for estimating the share of firms bunching at the wage floor and quantifying the structural model.

[5] To convert codes I proceed as follows. First, I convert NCM 8-digit to NCM 6-digit by keeping the first 6 digits. These 6 digits directly correspond to the HS, although not necessarily the 2007 version. I then convert codes in different years to HS 6-digit version 2007 using the appropriate concordance table. I impute a handful of codes that are not present in the concordance manually to minimize missing values.

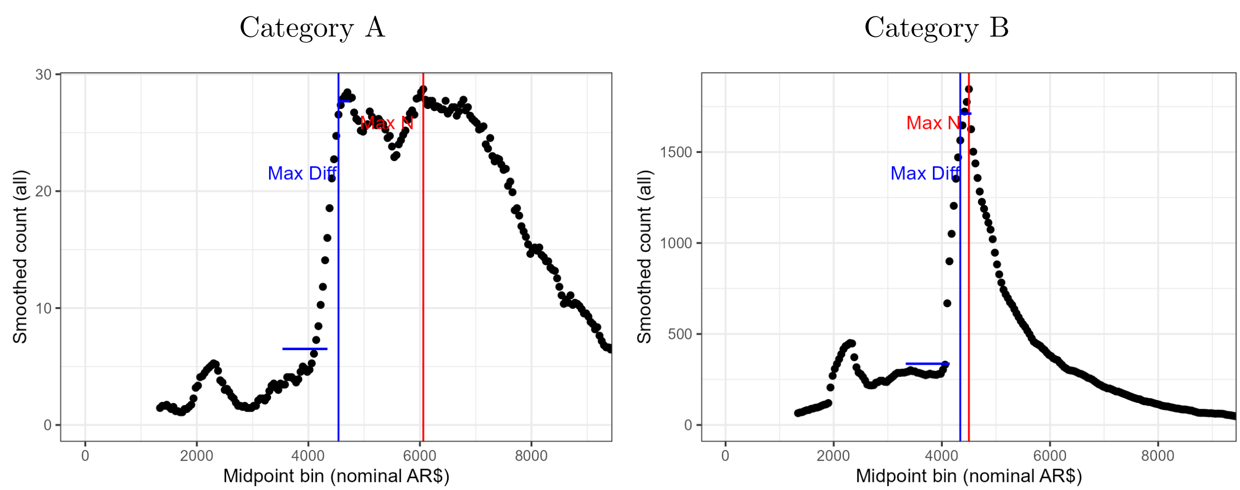
D.1 Average wage floor for each CB unit, 2004–2022

To construct this dataset, I first digitize a series of PDF files published by the Ministry of Labor between 2004 and 2022. These files contain a list of average wage floors and their corresponding severance caps for each CBA. The data also include information on the signatory unions and employers, and in some cases, specify different floors for distinct categories of workers (e.g., truck drivers transporting different types of goods). Then, from the digitized information, I construct a monthly time series of nominal wage floors for each CBA that has at least 10 exporting firms in 2011-–2012. I then deflate these nominal floors using the Consumer Price Index (CPI) to obtain the real wage floor for each CBA.

D.2 Within-CBA wage floors, 2011–2019

I observe the CBA, the within-CBA occupational category, and the region of employment for each worker in the administrative data. This information allows me to devise a methodology to infer the wage floors from the distribution of wages within cells defined by these variables.[6]

Appendix Figure D.2: Distribution of wages within a CBA and CBA-region, Jan. 2012



Notes: The figures show the distribution of wages within a CBA, category, CBA region, and month. The binwidth is 20 pesos in 2012. The bins were smoothed using a moving average with a window of 5 bins at each side. The blue line shows the "maximum difference" between a 20-bin average and the subsequent 5-bin average. The red line shows the mode.

I start by selecting wage observations that are likely to reflect the wage floor. I focus on workers employed under the main contract type. To avoid contamination from sever-

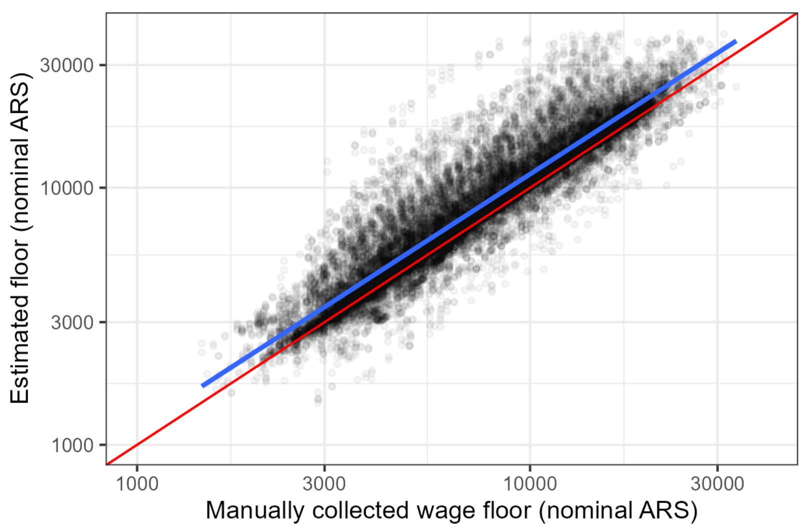
[6] Card and Cardoso (2022) observe wage floors but not within-CBA occupations. Instead, they rely on a lengthy matching process of within-CBA occupations to occupations in the administrative data to assign wage floors to workers.

ance or bonus payments, I exclude the first and last month of employment spells and drop observations from June and December which also include the 13th-month salary.

The inference method relies on the fact that the wage floor creates a bunching point in the wage distribution. Appendix Figure D.2 illustrates by showing the wage distribution for two occupations within the same CBA, region, and year-month. Both panels show a clear spike at the wage floor. The figure also shows a mass of workers earning below the floor, which is expected given that the data reflect total monthly pay.[7] A second bunching point is visible at approximately half the wage floor, which corresponds to part-time workers.

To identify the wage floor, I implement an algorithm that locates the point of the steepest increase in the wage distribution. While a simpler approach would be to select the mode of the distribution (Cardoso and Portugal 2005), this can be inaccurate. In fact, the left panel of Appendix Figure D.2 shows that cases where the mode is higher than the true floor are possible. My preferred approach selects the bin where the difference between a 20-bin moving average and the subsequent 5-bin moving average is maximized. This method robustly captures the start of the bunching across a variety of distributions.

Appendix Figure D.3: Validation of wage floors with manually-collected wage floor data



Notes: The figure compares the manually-collected wage floors and the data-inferred wage floors at the year-month level. For multi-region CBAs the figure only shows data for the baseline CBA-region category (usually including Buenos Aires).

After identifying the raw floors, I clean the resulting time series as follows. I drop any CBA-occupation-region cell that appears for less than 3.5 years and those that exhibit implausible behavior, such as nominal wage floors that decrease for a period before rising

[7]Reasons for earning less than the full monthly wage floor include being a part-time worker declared under the main contract type or being on vacation and not receiving attendance-related pay supplements.

again. Then, I smooth the series using a fixed-effects model that imposes that log wage floors are linear in CBA-by-occupation-by-CBA-region fixed effects and CBA-region-by-year-month fixed effects. This specification reflects the structure of most CBAs, in which relative wage differences between occupations and regions are constant and all wage floors increase at a common rate. Finally, I smooth each series with a 1-month moving average.

As validation, I compare the resulting wage floors to a manually collected set of wage floors for a subsample of CBAs. Appendix Figure D.3 shows this comparison. The manual collection is challenging, as it requires interpreting legal agreements in PDF format that often lack a consistent structure and may include complex non-compensatory or one-time payments. The figure shows that the levels of the estimated and manual floors are very similar, with the estimated floors being slightly higher, perhaps because the manual collection missed some mandatory non-compensatory payments. The correlation between the two series is strong, at 0.872. The close agreement suggests that the inferred wage floors are reliable.

E Shift-share Identification with Two Treatments

In this section, I show that identification of equation (5) can be cast in terms of country-product shocks, following Borusyak et al. (2022). For simplicity, I consider two time periods and assume a single intercept for all firms. The reasoning would go through with more time periods and local labor market intercepts, but the notation would be more cumbersome.

Consider the following causal model for the change in outcome y_j:

$$\Delta y_j = \beta_1 z_{j1} + \beta_2 z_{j2} + \varepsilon_j, \tag{E.1}$$

where Δy_j is the demeaned change in y for firm j and z_{j1} and z_{j2} are defined as:

$$z_{jn} = \sum_{p \in \mathcal{P}} s_{jpn} f_p$$

for $n \in \{1, 2\}$. s_{jpn} are exposure shares (with $\sum_{p \in \mathcal{P}} s_{jpn} = 1$) and f_p are common shifts. This setting aligns with the paper as it includes two shift-share variables (the firm and CBU shocks) that differentially weight the same set of country-product shocks. Like Borusyak et al. (2022), I consider identification of β_1 and β_2 by the full-data moment conditions:

$$\mathbb{E}\left[\frac{1}{|\mathcal{J}|}\sum_{j \in \mathcal{J}} z_{j1}\varepsilon_j\right] = 0 \quad \text{and} \quad \mathbb{E}\left[\frac{1}{|\mathcal{J}|}\sum_{j \in \mathcal{J}} z_{j2}\varepsilon_j\right] = 0 \tag{E.2}$$

where ε_j is the residual from (E.1) and $\mathcal{J}$ is the set of firms. When these conditions hold, the parameters are identified (provided the shift-share variables are not perfectly collinear).

To show that an assumption on shocks f_p allows identification of the parameters β_1 and β_2, rewrite the moment conditions as:

$$
\begin{aligned}
0 &= \mathbb{E}\left[\frac{1}{|\mathcal{J}|}\sum_{j\in\mathcal{J}} z_{jn}\varepsilon_j\right] = \mathbb{E}\left[\frac{1}{|\mathcal{J}|}\sum_{j\in\mathcal{J}}\left(\sum_{p\in\mathcal{P}} s_{jpn}f_p\right)\varepsilon_j\right] = \mathbb{E}\left[\sum_{p\in\mathcal{P}} f_p \frac{1}{|\mathcal{J}|}\sum_{j\in\mathcal{J}} s_{jpn}\varepsilon_j\right] \\
&= \mathbb{E}\left[\sum_{p\in\mathcal{P}} s_{pn}f_p r_{pn}\right],
\end{aligned}
$$

where $n \in \{1,2\}$, $s_{pn} = (1/|\mathcal{J}|)\sum_{j\in\mathcal{J}} s_{jpn}$ are shock-level weights (where $\sum_p s_{pn} = 1$ as well), and $r_{pn} = \frac{(1/|\mathcal{J}|)\sum_{j\in\mathcal{J}} s_{jpn}\varepsilon_j}{(1/|\mathcal{J}|)\sum_{j\in\mathcal{J}} s_{jpn}}$ are average residuals for each category p weighted by the appropriate shares. These conditions define a p-level GMM problem.

The key sufficient assumption for identification is $\mathbb{E}\left[f_p|s,r\right] = \mu$, which amounts to a quasi-randomness assumption on the shocks f_p with respect to the shares $s = \{s_{pn}\}_{p,n}$ and residuals $r = \{r_{pn}\}_{p,n}$, and is analogous to Assumption 1 in Borusyak et al. (2022).[8] This assumption guarantees that the previous conditions hold since:

$$
\mathbb{E}\left[\sum_{p\in\mathcal{P}} s_{pn}f_p r_{pn}\right] = \mathbb{E}\left[\sum_{p\in\mathcal{P}} s_{pn}\,\mathbb{E}\left[f_p|s,r\right] r_{pn}\right] = \mu\,\mathbb{E}\left[\sum_{p\in\mathcal{P}} s_{pn}r_{pn}\right] = 0.
$$

The first equality follows from the law of iterated expectations, and the second from the fact that $\mathbb{E}\left[\sum_{p\in\mathcal{P}} s_{pn}r_{pn}\right] = 0$.[9] Given that the moment conditions of the p-level problem are equivalent to the moment conditions (E.2), the parameters β_1 and β_2 in (E.1) are identified.

The interpretation of the quasi-randomness assumption is that the shifts f_p have the same mean μ regardless of the realization of the unobservables r_{pn}. As discussed by Borusyak et al. (2022), this assumption can be relaxed. First, adding controls in (E.1) removes variation in the error term that may be correlated with the shift-share variables. For instance, if one thinks that firms in some industries tend to both grow faster and also experience increases in world demand, then controlling for industry fixed effects will mean that shocks f_p must be quasi-random with respect to the within-industry residuals. Second, controlling for average exposure to clusters of p's allows the average of f_p to differ by cluster, relaxing the assumption

[8]A second assumption, in the spirit of Assumption 2 in Borusyak et al. (2022), is required for consistency. Namely, that $\mathbb{E}[s_{pn}^2] \to 0$ for $n \in \{1,2\}$ and $\mathrm{Cov}\left(f_p, f_{p'}|s,r\right) = 0$ for all (p,p') with $p \neq p'$. This assumption requires a large effective number of shocks, and that shocks are uncorrelated given the unobservables and shares. The authors discuss ways in which these assumptions can be relaxed.

[9]To show this result recall that $\sum_{p\in\mathcal{P}} s_{jpn} = 1$ and $\mathbb{E}\left[(1/|\mathcal{J}|)\sum_{j\in\mathcal{J}}\varepsilon_j\right] = 0$ by construction. Then, $\mathbb{E}\left[\sum_{p\in\mathcal{P}} s_{pn}r_{pn}\right] = \mathbb{E}\left[\sum_{p\in\mathcal{P}}(1/|\mathcal{J}|)\sum_{j\in\mathcal{J}} s_{jpn}\varepsilon_j\right] = \mathbb{E}\left[(1/|\mathcal{J}|)\sum_{j\in\mathcal{J}}\varepsilon_j\left(\sum_{p\in\mathcal{P}} s_{jpn}\right)\right] = 0.$

as well. I take these two points as a motivation for the inclusion of controls in the main paper. We see that the logic of Borusyak et al. (2022) applies to the case of two shift-share variables that use the same set of shocks but are weighted by different shares.

F Details on Structural Model

F.1 Derivations for worker problem

F.1.1 Labor supply: supply to the firm decision

Following the main text, the indirect utility of worker i when working for firm j is $V_{ij} = w(j)u_i(k(j))\xi_i(j)$, where $w(j)$ is the (expected) wage paid by j, and $u_i(k(j))$ and $\xi_i(j)$ are idiosyncratic preference shocks. I let $u_i(k(j))$ and $\xi_i(j)$ be independent and distributed according to Fréchet distributions with cdfs $F(u) = e^{-A_k u^{-\theta}}$ and $F(\xi) = e^{-\xi^{-\eta}}$, where A_k is scale parameter for market k and θ and η are shape parameters. I assume $\eta > \theta > 1$.

We can think of the decision of worker i in two steps. First, she chooses a local labor market k after observing the shocks $u_i(k)$. Second, she chooses a firm j in k after observing the shocks $\xi_i(j)$. The probability that a worker i chooses a firm j in local labor market k is then the probability of choosing k times the probability of choosing j conditional on k. More formally, define the conditional utility of choosing j within k as $\nu_j = w(j)\xi_i(j)$, and let $\nu(k) = \mathbb{E}(\max_j \nu_j)u(k)$ be the utility derived from k. Then, the labor supply to firm j is

$$h_k(j) = \Pr\left(\nu_j > \nu_{j'}\ \forall j' \neq j\right)\Pr\left(\nu_{k(j)} > \nu_{k'}\ \forall k' \neq k\right)(\iota N) \tag{F.1}$$

where ιN is the measure of workers in the formal labor market.

I solve for each probability in (F.1) separately, starting with $\Pr(\nu_j > \nu_{j'}\ \forall j' \neq j)$. It is useful to define the set of firms in k as Ω_k, and the set of firms excluding firm j as $\Omega_{k,-j} = \Omega_k \backslash \{j\}$. Define the distribution $G_j(\nu) = \Pr(w_j\xi_i(j) \leq \nu) = \Pr(\xi_i(j) \leq \nu/w(j)) = e^{-w(j)^\eta \nu^{-\eta}}$. Given a value ν, the probability that it is the maximum among $j' \neq j$ is

$$G_k^{-j}(\nu) = \Pr\left(\nu > \nu_{j'}\ \forall j' \neq j\right) = \prod_{j' \in \Omega_k \backslash \{j\}} G_{j'}(\nu) = e^{-\nu^{-\eta}\int_{\Omega_{k,-j}} w(j')^\eta dj'} = e^{-\left(W_k^{-j}\right)^\eta \nu^{-\eta}},$$

where $W_k^{-j} = \left(\int_{\Omega_{k,-j}} w(j')^\eta dj'\right)^{1/\eta}$ is a k-specific wage index that excludes firm j. Similarly, the probability that conditional utility is at most ν is $G_k(\nu) = e^{-W_k^\eta \nu^{-\eta}}$ where

$W_k = \left(\int_{\Omega_k} w(j')^\eta dj'\right)^{1/\eta}$. I integrate G_k^{-j} over all possible shocks to obtain the result:

$$\begin{aligned}
\Pr\left(\nu_j > \nu_{j'}\ \forall j' \neq j\right) &= \int_0^\infty e^{-\left(W_k^{-j}\right)^\eta \nu^{-\eta}} dG_j(\nu) \\
&= \int_0^\infty e^{-\left(W_k^{-j}\right)^\eta \nu^{-\eta}} w(j)^\eta \eta \nu^{-\eta-1} e^{-w_j^\eta \nu^{-\eta}} d\nu \\
&= \left(\frac{w(j)}{W_k}\right)^\eta \int_0^\infty \eta \nu^{-\eta-1} W_k^\eta e^{-W_k^\eta \nu^{-\eta}} d\nu = \left(\frac{w(j)}{W_k}\right)^\eta,
\end{aligned}$$

where the last line uses the fact that the integral equals one as $G_k(\nu)$ is a valid cdf with support on $(0, \infty)$.

To find the second term in equation (F.1) we need the expected utility of k, given by

$$\mathbb{E}\left[\max_j \nu_j\right] = \int_0^\infty \nu dG_k(\nu) = \int_0^\infty W_k^\eta \eta \nu^{-\eta} e^{-W_k^\eta \nu^{-\eta}} d\nu.$$

Change variables to $x = W_k^\eta \nu^{-\eta}$, implying $W_k x^{-1/\eta} dx = -\eta W_k^\eta \nu^{-\eta} d\nu$. Then, the expected utility of k is given by

$$\mathbb{E}\left[\max_j \nu_j\right] = \int_0^\infty W_k x^{-1/\eta} e^{-x} dx = \Gamma\left(\frac{\eta - 1}{\eta}\right) W_k,$$

where I used the definition of the gamma function.

Let us now compute the probability of choosing local labor market k. Note that, since η is common to all markets, the term $\Gamma\left(\frac{\eta-1}{\eta}\right)$ cancels out. Similarly to before, define $G_k(u) = \Pr(W_k u_k < u) = e^{-A_k W_k^\theta u^{-\theta}}$. The probability of choosing k is then given by

$$\begin{aligned}
\Pr\left(\nu_{k(j)} > \nu_{k'}\ \forall k' \neq k\right) &= \int_0^\infty \prod_{k' \neq k} e^{-A_{k'} W_{k'}^\theta u^{-\theta}} dG_k(u) \\
&= \int_0^\infty A_k \theta W_k^\theta u^{-\theta-1} e^{-A_k W_k^\theta u^{-\theta}} \prod_{k' \neq k} e^{-A_{k'} W_{k'}^\theta u^{-\theta}} du \\
&= A_k W_k^\theta W^{-1} \int_0^\infty \theta W u^{-\theta-1} e^{-u^{-\theta} \sum_{k'} A_{k'} W_{k'}^\theta} du \\
&= \frac{A_k W_k^\theta}{W} \int_0^\infty \theta W u^{-\theta-1} e^{-W u^{-\theta}} du = \frac{A_k W_k^\theta}{W},
\end{aligned}$$

where $W = \sum_{k'} A_{k'} W_{k'}^\theta$ is an aggregate wage index.

Finally, multiplying the two probabilities we get the unconditional probability of choosing firm j, and multiplying by the measure of workers gives the labor supply to firm j:

$$h_k(j) = \left(\frac{w(j)}{W_{k(j)}}\right)^{\eta} \left(\frac{A_{k(j)} W_{k(j)}^{\theta}}{W}\right) (\iota N)\,.$$

F.1.2 Expected utility in the formal labor market

I am interested in computing the expected utility of V_{ij}, defined as $\bar{V} = \mathbb{E}\left[\max_j V_{ij}\right]$. I already showed that, within a local labor market k, the expected utility is $\mathbb{E}\left[\max_j w(j)\xi_i(j)\right] = \Gamma\left(\frac{\eta-1}{\eta}\right) W_k$. By the law of iterated expectations, the expected utility is then

$$\bar{V} = \mathbb{E}\left[\max_k \mathbb{E}\left[\max_j w(j)\xi_i(j)|k\right] u_k\right] = \Gamma\left(\frac{\eta-1}{\eta}\right) \mathbb{E}\left[\max_k W_k u_k\right].$$

I derive the distribution of $\max_k W_k u_k$ and use this knowledge to compute the expected utility. The probability that v is the maximum among local labor markets $k \in \mathcal{K}$ is

$$\Pr(v > W_k u_k \ \forall k \in \mathcal{K}) = \prod_k e^{-A_k W_k^{\theta} v^{-\theta}} = e^{-v^{-\theta}\sum_k A_k W_k^{\theta}} = e^{-v^{-\theta} W},$$

where, as before, $W = \sum_k A_k W_k^{\theta}$ is the aggregate wage index. This means that $\max_k W_k u_k$ is distributed according to a Fréchet distribution with shape parameter θ and scale parameter $W^{1/\theta}$, and so its expectation is given by $\Gamma(1 - 1/\theta) W^{1/\theta}$. Hence, the expected utility is

$$\bar{V} = \Gamma\left(\frac{\eta-1}{\eta}\right) \Gamma\left(\frac{\theta-1}{\theta}\right) W^{1/\theta}.$$

F.1.3 Labor supply: Formal employment decision

Workers decide whether to enter the formal labor market by comparing the ex-ante expected utility, $\bar{V}$, with the utility derived from an exogenous outside option, with value b_0. I assume that this choice is subject to idiosyncratic preference shocks. The utility for a worker choosing option $o \in \{\text{emp}, \text{out}\}$ is given by:

$$\tilde{U}_o = \tilde{V}_o \tilde{\varepsilon}_o$$

where $\tilde{V}_{\text{emp}} = \bar{V}$ and $\tilde{V}_{\text{out}} = b_0$. The terms $\tilde{\varepsilon}_{\text{emp}}$ and $\tilde{\varepsilon}_{\text{out}}$ are i.i.d. shocks drawn from a Fréchet distribution with cdf given by $F(\varepsilon) = \exp(-\varepsilon^{-\zeta})$. The shape parameter ζ governs the dispersion of preferences for formal work and thus controls the elasticity of the extensive-margin labor supply. This setup with multiplicative Fréchet shocks is equivalent to a model with additive Gumbel shocks on log utilities, as in Ahlfeldt et al. (2022).

A worker chooses to enter the formal labor market if $\tilde{U}_{\text{emp}} > \tilde{U}_{\text{out}}$. The probability of this event, which defines the share of the population in formal employment, ι, is given by the standard formula $\iota = \Pr(\tilde{U}_{\text{emp}} > \tilde{U}_{\text{out}}) = \tilde{V}^{\zeta}_{\text{emp}} / \left(\tilde{V}^{\zeta}_{\text{emp}} + \tilde{V}^{\zeta}_{\text{out}}\right)$. Substituting the expressions for the deterministic components of utility, we obtain

$$\iota = \frac{\bar{V}^{\zeta}}{\bar{V}^{\zeta} + b_0^{\zeta}}$$

For notational simplicity, the main text defines the outside option parameter as $b \equiv b_0^{\zeta}$. This yields the expression for the formal employment share presented in equation (7).

F.2 Derivations for firm problem

F.2.1 Firm problem

This section derives exact solutions for the firm problem in the case where it is unconstrained, supply-constrained, or demand-constrained. To simplify notation, I omit indexes j and g.

Unconstrained firms will be on the labor supply curve, thus the probability of hiring is $\psi = 1$. Substituting the labor supply equation into the profit function we get the problem

$$\max_{w} \pi(w) = \varphi \left(\frac{w}{W_k}\right)^{\eta\alpha} \left(\frac{A_k W_k^{\theta}}{W}\right)^{\alpha} (\iota N)^{\alpha} - w^{\eta+1} W_k^{-\eta} \left(\frac{A_k W_k^{\theta}}{W}\right) (\iota N)$$

where, as in the main text, φ is firm productivity, A_k is the amenity value of sector k and W_k is k's wage index, $W = \sum_k A_k W_k^{\theta}$, and η and θ are the within- and across-market labor supply elasticities. The solution to this problem is

$$\begin{aligned} w^u &= \left[\mu\alpha\varphi \left(\frac{W}{A_k W_k^{\theta-\eta}}\right)^{1-\alpha} \left(\frac{1}{\iota N}\right)^{1-\alpha}\right]^{\frac{1}{\eta(1-\alpha)+1}} \quad \text{and} \\ \ell^u &= \left[(\mu\alpha\varphi)^{\eta} \left(\frac{A_k W_k^{\theta-\eta}}{W}\right) (\iota N)\right]^{\frac{1}{\eta(1-\alpha)+1}}, \end{aligned} \tag{F.2}$$

where $\mu = \eta/(\eta+1)$ is the markdown factor. Expressions for wage bill and revenue are

$$\begin{aligned} w\ell^u &= \left[(\mu\alpha\varphi)^{\eta+1} \left(\frac{A_k W_k^{\theta-\eta}}{W}\right)^{\alpha} (\iota N)^{\alpha}\right]^{\frac{1}{\eta(1-\alpha)+1}} \quad \text{and} \\ \varphi (\ell^u)^{\alpha} &= \varphi^{\frac{\eta+1}{\eta(1-\alpha)+1}} \left[(\mu\alpha)^{\eta} \left(\frac{A_k W_k^{\theta-\eta}}{W}\right) (\iota N)\right]^{\frac{\alpha}{\eta(1-\alpha)+1}}, \end{aligned}$$

respectively, which implies that profits are

$$\pi^u = \left[(\varphi)^{\eta+1} \left(\frac{A_k W_k^{\theta-\eta}}{W} \right)^{\alpha} \right]^{\frac{1}{\eta(1-\alpha)+1}} \left[(\mu\alpha)^{\frac{\eta\alpha}{\eta(1-\alpha)+1}} - (\mu\alpha)^{\frac{\eta+1}{\eta(1-\alpha)+1}} \right].$$

Note that, since $\mu \in (0,1)$ and $\alpha \in (0,1)$, profits are strictly positive.

Constrained firms take as given the wage at which they can hire, so the problem is

$$\max_{\ell} \pi \left(\ell, \underline{w}_c\right) = \varphi \ell^{\alpha} - \underline{w}_c \ell \quad \text{ s.t. } \quad \ell \leq h_k(\underline{w}_c) = \left(\frac{\psi \underline{w}_c}{W_k} \right)^{\eta} \left(\frac{A_k W_k^{\theta}}{W} \right) (\iota N).$$

Supply-constrained firms set $\psi = 1$, so the solution is

$$w^s = \underline{w}_c \quad \text{and} \quad \ell^s = \left(\frac{\underline{w}_c}{W_k} \right)^{\eta} \left(\frac{A_k W_k^{\theta}}{W} \right) (\iota N). \tag{F.3}$$

Profits for these firms are

$$\pi^s = \varphi \left[\left(\frac{\underline{w}_c}{W_k} \right)^{\eta} \left(\frac{A_k W_k^{\theta}}{W} \right) (\iota N) \right]^{\alpha} - \underline{w}_c \left(\frac{\underline{w}_c}{W_k} \right)^{\eta} \left(\frac{A_k W_k^{\theta}}{W} \right) (\iota N).$$

Note that we can also write profits as $\pi^s = \ell^s \left(\varphi (\ell^s)^{\alpha-1} - \underline{w}_c\right)$. By concavity of the production function, the average product of labor $\varphi(\ell^s)^{\alpha-1}$ is larger than the MRPL. And, since these firms are supply-constrained, the MRPL is larger than $\underline{w}_c$. Thus, profits are positive.

Finally, for *demand-constrained* firms the labor supply constraint will be slack, implying $\psi < 1$. Wages and employment are

$$w^d = \underline{w}_c \quad \text{and} \quad \ell^d = \left(\frac{\alpha\varphi}{\underline{w}_c} \right)^{\frac{1}{1-\alpha}}. \tag{F.4}$$

To pin down the hiring probability ψ we assume that workers correctly anticipate it when deciding their labor supply. Then, we assume that the expected hiring probability ψ is equal to the actual hiring probability implied by the firm's decision $\ell^d / \ell^s(\psi \underline{w}_c)$, which results in

$$\psi = \ell^d / \ell^s = \left(\frac{\alpha\varphi}{\underline{w}_c} \right)^{\frac{1}{(1-\alpha)(\eta+1)}} \left(\frac{W_k}{\underline{w}_c} \right)^{\frac{\eta}{\eta+1}} \left(\frac{W}{A_k W_k^{\theta}} \right)^{\frac{1}{\eta+1}} \left(\frac{1}{\iota N} \right)^{\frac{1}{\eta+1}}.$$

In equilibrium, labor supply for these firms is then

$$h^d = \left(\frac{\alpha\varphi}{\underline{w}_c} \right)^{\frac{\eta}{(1-\alpha)(\eta+1)}} \left(\frac{\underline{w}_c}{W_k} \right)^{\frac{\eta}{\eta+1}} \left(\frac{A_k W_k^{\theta}}{W} \right)^{\frac{1}{\eta+1}} (\iota N)^{\frac{1}{\eta+1}}.$$

Profits for demand-constrained firms are $\pi = \varphi^{\frac{1}{1-\alpha}} \underline{w}_c^{-\frac{\alpha}{1-\alpha}} \left[\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}}\right]$. Again, because $\alpha \in (0,1)$, profits are positive.

F.2.2 Thresholds

The threshold $\overline{\varphi}$ identifies the least-productive unconstrained firm, which sets a wage exactly equal to the wage floor, i.e., $w^u(\overline{\varphi}) = \underline{w}_c$. Using w^u from equation (F.2) we can solve

$$\overline{\varphi} = \frac{1}{\mu\alpha} \left(\frac{A_k W_k^{\theta-\eta}}{W} \iota N \right)^{1-\alpha} \underline{w}_c^{\eta(1-\alpha)+1} = \frac{1}{\mu\alpha} (\ell^s)^{1-\alpha} \underline{w}_c,$$

where we used the expression for ℓ^s in (F.3). The threshold $\underline{\varphi}$ identifies the most productive demand-constrained firm, i.e., the one that chooses a labor quantity equal to the labor supply at the wage floor, implying

$$\underline{\varphi} = \left(\frac{1}{\alpha}\right) (\ell^s)^{1-\alpha} \underline{w}_c.$$

It is easy to verify that, as $\eta > 0$, $\overline{\varphi}_g > \underline{\varphi}_g$.

F.3 Derivations of sub-market aggregates

This section proceeds as follows. First, I derive expressions for the share of constrained firms and the average wage in sub-market g. Second, I derive expressions for aggregate labor demand, labor supply, wage bill, and revenue, for each g. In the interest of brevity, I do not derive the full integrals but rather provide the final results. As I am integrating over φ, I make any dependence of the solutions from Appendix F.2.1 on φ explicit.

F.3.1 Share of firms constrained and average wage

The **share of firms that are constrained** can be obtained using the cdf of productivity in sub-market g. If $\varphi_{g0} > \overline{\varphi}_g$ then the share of constrained firms is zero, $S_g = 0$. Otherwise,

$$S_g = F(\overline{\varphi}_g) - F(\varphi_{g0}) = 1 - \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q \tag{F.5}$$

The **average wage** is computed from $\overline{w}_g = \int_{\varphi_{g0}}^{\infty} w(\varphi) f_g(\varphi) d\varphi$. Since demand- and supply-constrained firms pay the same wage, namely $\underline{w}_c$, we have two cases only:

$$\overline{w}_g = \begin{cases} w^u(\varphi_{g0}) \left(\frac{q}{q - \frac{1}{\eta(1-\alpha)+1}}\right) & \text{if } \varphi_{g0} > \overline{\varphi}_g, \\ \underline{w}_c \left[1 - \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q\right] + w^u(\overline{\varphi}_g) \left(\frac{q}{q - \frac{1}{\eta(1-\alpha)+1}}\right) \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q & \text{if } \overline{\varphi}_g > \varphi_{g0}. \end{cases}$$

F.3.2 Aggregate quantities

To compute **aggregate labor demand** in g we need to solve $L_g = M_g \int_{\varphi_{g0}}^{\infty} \ell(\varphi) f_g(\varphi) d\varphi$. There are three cases, depending on whether all firms are unconstrained ($\varphi_{g0} > \overline{\varphi}_g$), unconstrained and supply-constrained firms coexist ($\overline{\varphi}_g > \varphi_{g0} > \underline{\varphi}_g$), or the three types of firms are present ($\overline{\varphi}_g > \underline{\varphi}_g > \varphi_{g0}$). One needs to solve one, two, or three integrals, depending on the case. For instance, if unconstrained and supply-constrained firms are present, I solve $L_g = M_g \left[\int_{\varphi_{g0}}^{\overline{\varphi}_g} \ell^s f_g(\varphi) d\varphi + \int_{\overline{\varphi}_g}^{\infty} \ell^u(\varphi) f_g(\varphi) d\varphi\right]$. The solution is given by

$$L_g = M_g \begin{cases} \ell^u(\varphi_{g0}) \left(\frac{q}{q - \frac{\eta}{\eta(1-\alpha)+1}}\right) & \text{if } \varphi_{g0} \geq \overline{\varphi}_g, \\ \ell^s \left[1 - \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q\right] + \ell^u(\overline{\varphi}_g) \left(\frac{q}{q - \frac{\eta}{\eta(1-\alpha)+1}}\right) \left[\frac{\varphi_{g0}}{\overline{\varphi}_g}\right]^q & \text{if } \overline{\varphi}_g > \varphi_{g0} \geq \underline{\varphi}_g, \\ \ell^d(\varphi_{g0}) \frac{q}{q - \frac{1}{1-\alpha}} \left[1 - \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^{q - \frac{1}{1-\alpha}}\right] + \ell^s \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^q [1 - \mu^q] & \\ \quad + \ell^u(\overline{\varphi}_g) \left(\frac{q}{q - \frac{\eta}{\eta(1-\alpha)+1}}\right) \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q & \text{if } \overline{\varphi}_g > \underline{\varphi}_g > \varphi_{g0}. \end{cases}$$

The **aggregate labor supply** is given by $H_g = M_g \int_{\varphi_{g0}}^{\infty} h_{k(g)}(\varphi) f_g(\varphi) d\varphi$. The results are identical to L_g for the cases with only unconstrained firms or with unconstrained and supply-constrained firms. For the case with $\overline{\varphi}_g > \underline{\varphi}_g > \varphi_{g0}$ the solution is

$$H_g = M_g \Bigg\{ h^d(\varphi_{g0}) \frac{q}{q - \frac{\eta}{(1-\alpha)(\eta+1)}} \left[1 - \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^{q - \frac{\eta}{(1-\alpha)(\eta+1)}}\right] + \ell^s \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^q [1 - \mu^q]$$
$$+ \ell^u(\overline{\varphi}_g) \left(\frac{q}{q - \frac{\eta}{\eta(1-\alpha)+1}}\right) \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q \Bigg\}$$

The only difference between this expression and the one for aggregate labor demand is in the term for demand-constrained firms.

To compute the **aggregate wage bill** in g I solve $WB_g = M_g \int_{\varphi_{g0}}^{\infty} w\ell(\varphi) f_g(\varphi) d\varphi$ to get

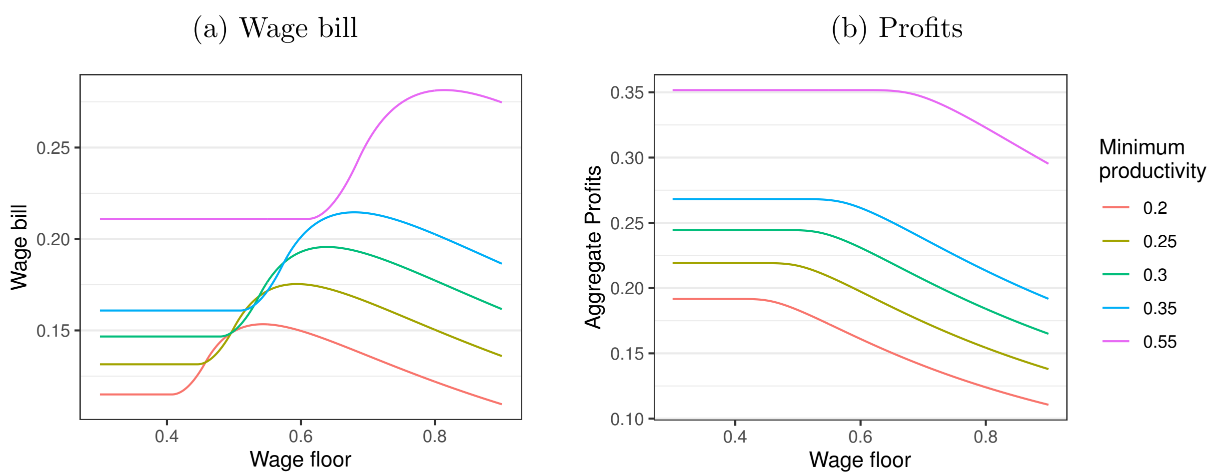
$$WB_g = M_g \begin{cases} w\ell^u(\varphi_{g0}) \left(\frac{q}{q - \frac{\eta+1}{\eta(1-\alpha)+1}}\right) & \text{if } \varphi_{g0} \geq \overline{\varphi}_g, \\ \underline{w}_c \ell^s \left[1 - \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q\right] + w\ell^u(\overline{\varphi}_g) \left(\frac{q}{q - \frac{\eta+1}{\eta(1-\alpha)+1}}\right) \left[\frac{\varphi_{g0}}{\overline{\varphi}_g}\right]^q & \text{if } \overline{\varphi}_g > \varphi_{g0} \geq \underline{\varphi}_g, \\ \underline{w}_c \ell^d(\varphi_{g0}) \frac{q}{q - \frac{1}{1-\alpha}} \left[1 - \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^{q - \frac{1}{1-\alpha}}\right] + \underline{w}_c \ell^s \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^q [1 - \mu^q] & \\ \quad + w\ell^u(\overline{\varphi}_g) \left(\frac{q}{q - \frac{\eta+1}{\eta(1-\alpha)+1}}\right) \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q & \text{if } \overline{\varphi}_g > \underline{\varphi}_g > \varphi_{g0}. \end{cases}$$

To compute **aggregate revenue** in g I solve $R_g = M_g \int_{\varphi_{g0}}^{\infty} \varphi \ell(\varphi)^\alpha f_g(\varphi) d\varphi$ to get

$$R_g = M_g \begin{cases} \varphi_{g0} \left(\ell^u(\varphi_{g0})\right)^\alpha \left(\frac{q}{q-1-\frac{\eta\alpha}{\eta(1-\alpha)+1}}\right) & \text{if } \varphi_{g0} \geq \overline{\varphi}_g, \\ \varphi_{g0} \left(\ell^s\right)^\alpha \frac{q}{q-1} \left[1 - \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^{q-1}\right] + \overline{\varphi}_g \left(\ell^u(\overline{\varphi}_g)\right)^\alpha \left(\frac{q}{q-1-\frac{\eta\alpha}{\eta(1-\alpha)+1}}\right) \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q & \text{if } \overline{\varphi}_g > \varphi_{g0} \geq \underline{\varphi}_g, \\ \varphi_{g0} \left(\ell^d(\varphi_{g0})\right)^\alpha \frac{q}{q-\frac{1}{1-\alpha}} \left[1 - \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^{q-\frac{1}{1-\alpha}}\right] & \\ \quad + \varphi_{g0} \left(\ell^s\right)^\alpha \frac{q}{q-1} \left(\frac{\varphi_{g0}}{\underline{\varphi}_g}\right)^{q-1} \left[1 - \mu^{q-1}\right] & \\ \quad + \overline{\varphi}_g \left(\ell^u(\overline{\varphi}_g)\right)^\alpha \left(\frac{q}{q-1-\frac{\eta\alpha}{\eta(1-\alpha)+1}}\right) \left(\frac{\varphi_{g0}}{\overline{\varphi}_g}\right)^q & \text{if } \overline{\varphi}_g > \underline{\varphi}_g > \varphi_{g0}. \end{cases}$$

Finally, **aggregate profits** are simply given by $\Pi_g = R_g - WB_g$.

Appendix Figure F.4: Illustration of effects of wage floors on sub-market aggregates



Notes: The figures show the relationship between the wage floor and aggregate outcomes within a given sub-market, for different levels of the minimum productivity φ_{g0}. Panel (a) shows the aggregate wage bill. Panel (b) shows aggregate profits. The figure uses uses the following parameter values: $\eta = 3$, $\theta = 0.5$, $q = 4$, $A_k = W_k = W = 1$, $\varphi_{g0} \in \{0.2, 0.25, 0.3, 0.35, 0.55\}$, and $M_g = 1/\varphi_{g0}$.

Illustration. Appendix Figure F.4 illustrates how the wage floor affects the aggregate wage bill and profits within a sub-market. The aggregate wage bill is hump-shaped in the wage floor and profits are non-increasing in the wage floor.

F.4 Equilibrium of structural model

F.4.1 Definition of equilibrium

Given a CB network $\mathcal{C}$, working-age population N and an outside option b, elasticities $\{\eta, \theta, \zeta\}$ with $\eta > \theta > 1$, amenity values $\{A_k\}_{k \in \mathcal{K}}$, productivity processes parameters

$\{q, \{\varphi_{g0}\}_{g\in\mathcal{G}}\}$, and bargaining power parameters $\{\beta_c\}_{c\in\mathcal{C}}$, an equilibrium is defined as a formal employment share ι^*, a set of wage floors $\{\underline{w}_c^*\}_{c\in\mathcal{C}}$, and a set of wage indexes $\{W_k^*\}_{k\in\mathcal{K}}$ (with $W^* = \sum_k A_k(W_k^*)^\theta$) such that:

1. The formal employment share satisfies equation (7), with expected utility given by (6).
2. Wage floors $\{\underline{w}_c^*\}_{c\in\mathcal{C}}$ solve the Nash-in-Nash problem given by (13).
3. Wage indexes $\{W_k^*\}_{k\in\mathcal{K}}$ equate labor supply to firms and labor supply in every local labor market k:

$$\sum_{g:k(g)=k} H_g\left(\{\underline{w}_c^*\}_{c\in\mathcal{C}}, \{W_k^*\}_{k\in\mathcal{K}}, \iota^*\right) = \frac{A_k\left(W_k^*\right)^\theta}{W^*}\iota^* N \tag{F.6}$$

The labor market clearing conditions (F.6) simply equate the supply of labor to firms in k, $\sum_{g:k(g)=k} H_g(W_k)$, to the aggregate labor supply in k given by total formal employment, ιN, times the share of workers going to k, $A_k W_k^\theta/W$. Note that the model allows for equilibrium unemployment as labor demand L_g may be lower than H_g.

Existence and uniqueness of equilibrium. I first show that, for any set of wage floors, equation (F.6) implies that a unique solution exists for W_k. Define $g(W_k) = \sum_{g:k(g)=k} H_g\left(W_k, W\right) - \frac{A_k W_k^\theta}{W}\iota N$. $W_k \to 0$ implies that $g(W_k) \to \infty$ as $H_g\left(W_k, W\right)$ diverges due to unconstrained and supply-constrained firms and $\left(A_k W_k^\theta\right)/W$ goes to zero. Similarly, $W_k \to \infty$ implies that $g(W_k) \to -N$ as $H_g\left(W_k, W\right)$ goes to zero and $A_k W_k^\theta/W$ and ι go to one. Finally, it is easy to see that $g(W_k)$ is continuous and decreasing in W_k. Thus, by the intermediate value theorem, there exists a W_k^* such that $g(W_k^*) = 0$.

I show that a unique set of wage floors solves the Nash-in-Nash problem. To prove this it is sufficient to show that each bilateral Nash problem has a unique solution given the wage floors of the other CB units $\underline{\mathbf{w}}_{-c}$. Recall that the Nash objective is $\left(\sum_{g:c(g)=c} WB_g\right)^{\beta_c}\left(\sum_{g:c(g)=c}\Pi_g\right)^{1-\beta_c}$. Since WB_g is hump-shaped in $\underline{w}_c$, and Π_g is non-increasing in $\underline{w}_c$, there will be two candidate global maxima: a non-binding wage floor and a binding wage floor.[10] If β_c is low, then the Nash objective will approximately equal aggregate profits and thus it will be non-increasing in the wage floor. If so, the maximizer is defined to be the highest non-binding wage floor. If β_c is high, then the Nash objective will approximately equal the wage bill and will attain its maximum at a binding wage floor. There exists a knife-edge case in which the non-binding wage floor yields equal value of the Nash objective as the binding wage floor. While this is unlikely in practice, I define the maximizer as the highest non-binding wage floor to ensure

[10]The Nash objective may also attain local maxima. See Appendix Figure F.5 and related discussion.

uniqueness. Thus, a unique $\underline{w}_c$ maximizes a bilateral Nash problem given the wage floors $\underline{\mathbf{w}}_{-c}$, implying that a unique solution exists for the Nash-in-Nash problem.

F.4.2 An algorithm to compute the equilibrium

I solve for the equilibrium wage floors using an approach based on a Gauss-Seidel coordinate update algorithm (Burden and Faires 2011; Galichon 2022). For each evaluation of the wage floor of a CB unit I compute the set of equilibrium wage indexes, ensuring that CB units internalize general equilibrium effects.[11] For this section, it is useful to explicitly define the set $\mathcal{C} = \{1, \ldots, C\}$ of CB units and $\mathcal{K} = \{1, \ldots, K\}$ of local labor markets.

The algorithm loops over CB units and updates the wage floors one at a time, using the most recent values available for the other wage floors. Iteration t of the algorithm starts with "old" values $\{\underline{w}_c^{t-1}\}_{c \in \mathcal{C}}$, which imply a set of wage indexes. In the first iteration, these will correspond to initial guesses. Namely:

1. For each c find the wage floor $\underline{w}_c^t$ solving the Nash problem. Use the new wage floors $\{\underline{w}_{c'}^t\}_{c'<c}$ and the previous values $\{\underline{w}_{c'}^{t-1}\}_{c'>c}$.
2. Update the set of wage indexes after each computed wage floor.
3. Once all wage floors are updated, compute $\text{mae}^t = \max_c |\log(\underline{w}_c^t) - \log(\underline{w}_c^{t-1})|$.
4. Iterate until mae^t is lower than a given tolerance.

Let us discuss some implementation details. First, I set the tolerance to 10^{-3} as a balance between accuracy and computational time. This maximum tolerance of a 0.1% error in wage floors is small relative to the average wage floor change due to the shock of 2 to 4%, shown in Panel (d) of Figure 6. Second, to prevent oscillations around the equilibrium I use damping. Namely, I do not fully update the wage floors at each iteration. Instead, I pick a new value that is a weighted average of the old and newly computed wage floors. Third, in practice I compute the wage floors by cluster parallelization. I divide the CB units into groups, compute the wage floors in parallel given the current set of wage indexes, and then update the wage indexes for the next group with the recently computed wage floors.

Next, I describe how I compute the wage indexes and the wage floors of each CB unit.

Finding the wage index for each k. The wage indexes are found for a given set of wage floors using a fixed-point algorithm. The algorithm proceeds as follows:

[11] Evaluating the labor market equilibrium for each wage floor that the program tries is computationally expensive. For that reason, while the main program was coded in `R`, the computation of the wage indexes was coded in `C++` and incorporated into the main program using the `Rcpp` package.

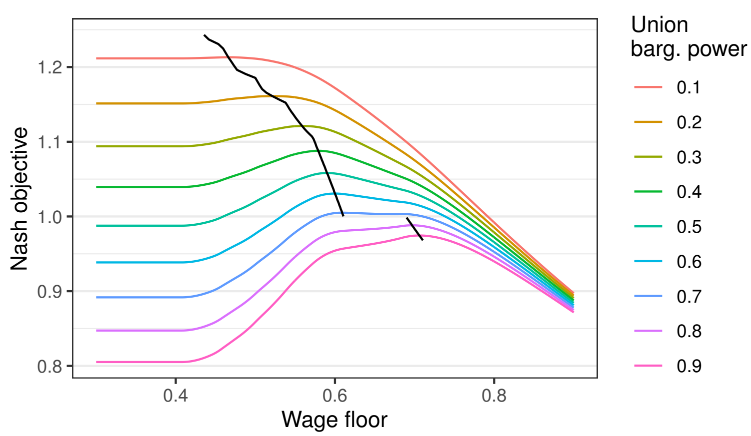
1. Loop over k and find the value of W_k^t that solves the labor market clearing equation (F.6). Use the new wage indexes $\{W_{k'}^t\}_{k'<k}$ and the old values $\{W_{k'}^{t-1}\}_{k'>k}$.
2. Iterate this process until the maximum absolute difference of log wage indexes between consecutive iterations, $\max_k \left|\log(W_k^t) - \log(W_k^{t-1})\right|$, is lower than a given threshold.

To find each wage index W_k I use a standard root-finding algorithm that searches for the value that makes $\sum_{g:k(g)=k} H_g(W_k, W) - \left(A_k W_k^{\theta}/W\right) \iota N$ equal to zero.

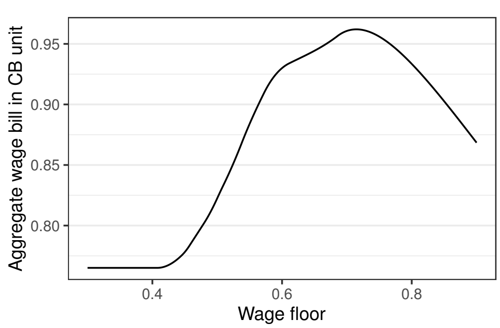
The tolerance for convergence is set to 10^{-6}, which is significantly lower than the tolerance for the wage floors. This is feasible because finding the wage indexes is significantly more computationally efficient than finding the wage floors.

Appendix Figure F.5: Illustration of the optimization for a single CB unit

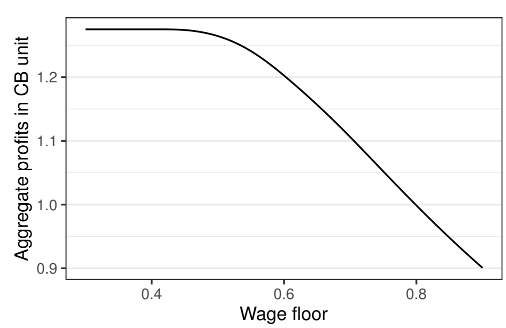
(a) Nash objective



(b) Wage bill



(c) Profits



Notes: The figures show the determination of the optimal wage floor for a CB unit comprised of the five local labor markets in Appendix Figure F.4. Panel (a) shows the Nash objective for different values of the bargaining power β_c, and the dark line shows the optimal wage floor for different β_c. Panels (b) and (c) show the aggregate wage bill and profits in the CB unit. For the illustration I assume that the wage index is not affected by the wage floor, i.e., $W_k = W = 1$.

Finding the wage floor of CB unit c. The algorithm to find the wage floor of a CB unit c relies on a "search-and-refine" approach. First, I evaluate the Nash objective in a grid of 25 evenly spaced points between a minimum and maximum wage floor that include the global maximum.[12] I use these evaluations to construct ranges where the Nash objective will attain local maxima. Second, I use a standard optimization algorithm to find the maximum within each range. The Nash objective is concave within these ranges, so the local maximum is robustly found. Third, I compare the value of the Nash objective at each local maximum and take the highest as the solution candidate. Finally, I compare the value of the Nash objective at the solution candidate with the value of the Nash objective at the highest non-binding wage floor. If the solution candidate has a higher or equal value, I take it as the solution. I keep the highest non-binding wage floor as the solution otherwise.

The algorithm was designed to be robust to the presence of local maxima, which might arise if the productivities of the covered sub-markets are sufficiently different. Appendix Figure F.5 illustrates the optimization process for a single CB unit. As noted, depending on the value of the union bargaining power we may have multiple local maxima. The algorithm, however, returns the unique wage floor that results in the highest value of the Nash objective.

F.5 Constructing aggregate data for structural estimation

This section details the construction of the sub-market-level dataset used to estimate the structural model. I begin with firm-level administrative data and aggregate it to the sub-market level for two distinct periods: a pre-period (2005–2007) and a post-period (2011–14). To ensure a sufficient number of firms in each cell and to reduce dimensionality, I use coarse sector and region definitions when defining sub-markets.

Defining local labor markets. I define local labor markets as the intersection of 2-digit sectors and geographic regions. To focus on private-sector collective bargaining, I exclude public-sector entities and sectors with distinct bargaining regimes, such as agriculture and education.[13] To further reduce dimensionality, I group all local labor markets not directly

[12] To obtain the minimum wage floor I first compute the maximum non-binding wage floor for each sub-market, denoted by $\underline{w}_{c,g}^{\min}$, adjusting by regional wage differentials when needed. Then, I define $\underline{w}_c^{\min} = \min_g \underline{w}_{c,g}^{\min}$, ensuring that the minimum wage floor is non-binding in all covered sub-markets. I proceed similarly to obtain the maximum wage floor. For each sub-market I compute the wage floor that results in 70% of firms being demand-constrained, denoted by $\underline{w}_{c,g}^{\max}$. Then, I define $\underline{w}_c^{\max} = \max_g \underline{w}_{c,g}^{\max}$. To ensure that $\underline{w}_c^{\max}$ is larger than the optimal wage floor I verify that a wage floor increase lowers the aggregate wage bill. If not, I continue to increase $\underline{w}_c^{\max}$ until this condition is met. The expressions for $\underline{w}_{c,g}^{\min}$ and $\underline{w}_{c,g}^{\max}$ are

$$\underline{w}_{c,g}^{\min} = \left[\left(\frac{W}{A_k W_K^{\theta-\eta}}\frac{1}{\iota N}\right)^{1-\alpha}(\alpha\mu\varphi_{g0})\right]^{\frac{1}{\eta(1-\alpha)+1}} \quad \text{and} \quad \underline{w}_{c,g}^{\max} = \left[\left(\frac{W}{A_k W_K^{\theta-\eta}}\frac{1}{\iota N}\right)^{1-\alpha}\left(\frac{\alpha\varphi_{g0}}{0.3^{1/q}}\right)\right]^{\frac{1}{\eta(1-\alpha)+1}}.$$

[13] Specifically, I drop the following subdivisions of the ISIC Rev. 3.1: A (Agriculture, hunting, and forestry), B (Fishing), M (Education), P (Private households with employed persons), and Q (Extra-territorial orga-

exposed to trade shocks into a single "Other" category. I group provinces into four broad regions based on geographical proximity: Buenos Aires, Center, North, and Patagonia.[14]

Defining CB units and sub-markets. Sub-markets are defined by the intersection of a local labor market, as defined above, and a CB unit. To manage dimensionality, I focus on major CB units, defined as those with either more than 500 firms or more than 10 exporting firms. Firms within a given local labor market that do not belong to one of these major CB units are grouped into a residual local CB unit.

Identifying constrained firms. I use the estimated wage floors from the post-period (2011–14), detailed in Appendix D.2, as the basis for my analysis. These data capture cross-regional and intra-firm occupational variation in wage floors, which results in a more accurate value for the share of constrained firms in a sub-market.

To define a firm as constrained I first establish a firm-specific mean wage floor. For most firms this is simply the observed mean wage floor across all workers in the firm. For firms with limited or no direct wage floor information, I impute this value. The imputed floor is the average firm-level mean wage floor at the 4-digit sector by province level.[15] I assign this imputed value to firms whenever the wage floor is missing or less than half of the workers have a valid wage floor observation. I classify a firm as constrained if its mean wage is less than a 1.075 times its mean wage floor in at least one year in the post-period.

Computing wage floors. I define a baseline wage floor $\underline{w}_c$ for each CB unit, which corresponds to the object of bargaining in the model, as follows. First, I compute a wage floor for each CB unit-region cell as the employment-weighted average of the mean wage floors of firms in the cell. I increase all wage floors by 7.5% as this is close to the value at which the distribution of the firm wage to wage floor ratio peaks (see Panel (a) of Figure 1). Second, I define $\underline{w}_c$ as the minimum wage floor across regions for each c. I compute regional wage differentials with respect to $\underline{w}_c$, which are kept constant throughout the analysis.

Aggregating data. I create a dataset at the sub-market level for both the pre- (2005–07) and post-period (2011–14). I include the number of firms and the average wage in both periods. I also compute the share of constrained firms only in the post-period.[16] To compute

nizations and bodies). I also drop the 4-digit sector that corresponds to national defense.

[14]The regions are defined as follows: Buenos Aires (including the province and autonomous city), Center (including Córdoba, Entre Ríos, Mendoza, Santa Fe, San Juan, and San Luis), North (including Catamarca, Chaco, Corrientes, Formosa, Jujuy, La Rioja, Misiones, Salta, Santiago del Estero, and Tucumán), and Patagonia (including Chubut, La Pampa, Neuquén, Río Negro, Santa Cruz, and Tierra del Fuego).

[15]I implement a handful of manual corrections to small CB unit-region pairs with implausible wage floors.

[16]I also compute the share using the dataset of wage floors collected from Ministry of Labor resolutions, discussed in Appendix D.1. I use this share in a small number of sub-markets, specifically, when the wage

the mean wage and the share of constrained firms, I exclude firms with a mean wage lower than 4/5ths and higher than 8 times the 2010 national minimum wage.

Filtering small sub-markets. The resulting dataset contains many small sub-markets, which are likely measured with error and, while not influential for the analysis, increase dimensionality. I therefore apply filters to drop small sub-markets. First, I drop sub-markets that represent less than 1% of a CB unit and have fewer than 50 workers. Second, I drop sub-markets with fewer than 10 firms and fewer than 25 workers, 2 to 9 firms and 150 workers, or 1 firm and 1,000 workers. Finally, I drop sub-markets that are not present in both periods.

Appendix Table F.2: Estimates of within-market labor supply elasticity, η

	Workers used to compute wages				
	All workers		3+ quarters		1+ years
Outcome variable	(1)	(2)	(3)	(4)	(5)
(a) Log employment	0.0369	0.0466	0.0466	0.0519	0.0466
	(0.0171)	(0.0200)	(0.0200)	(0.0299)	(0.0200)
(b) Log wage	0.0225	0.0211	0.0201	0.0276	0.0182
	(0.0081)	(0.0100)	(0.0091)	(0.0149)	(0.0102)
(c) Implied elasticity	1.6405	2.1946	2.3760	1.8797	2.5712
	(0.9593)	(1.3318)	(1.4356)	(1.4854)	(1.7079)
Post-period years used	2011–15	2012–15	2012–15	2012–15	2012–15
Pre-period wage restriction	None	None	None	Top 50%	None
CBU shock and CBU expo. share	Y	N	N	N	N
Local labor market-Year FE	Y	N	N	N	N
Local labor market-CBU-Year FE	N	Y	Y	Y	Y
Observations	62,156	54,303	54,303	27,328	54,303

Notes: Data are from the baseline sample of exporting firms. The table shows estimates of the response of employment (Panel a) and wages (Panel b) to firm shocks, and the implied within-market elasticity (Panel c). Column (1) replicates the baseline estimates from Table 1, whereas columns (2) through (5) show estimates from specifications that vary in several ways. First, instead of including the CBU shock and CBU exporting share, all rows include local-labor-market-by-year-by-CBU fixed effects. Second, they change the post-period years used in the estimation, from 2011–2015 to 2012–2015. Third, they change the sample of workers used to compute wages, from all workers (column 2) to workers employed at least three quarters within the year (columns 3 and 4) or workers that were also employed in the previous year (column 5). Finally, column (4) restricts the sample to firms with pre-period wages above median. Standard errors in parenthesis are clustered at the firm level.

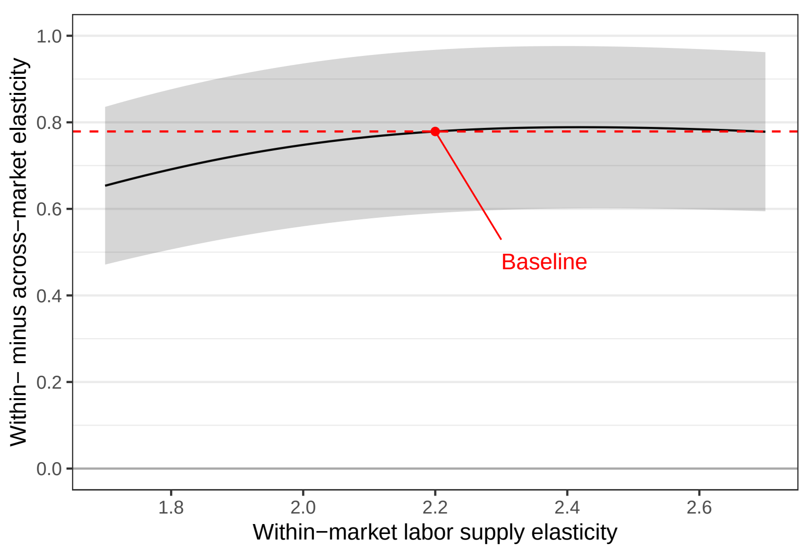
floor computed from the firm-level data is lower than 75% of the wage floor from the resolutions.

F.6 Estimating model parameters

Within-market elasticity η. I estimate the elasticity η as the ratio of the firm-level employment to the wage response following a firm shock. Appendix Table F.2 presents the estimates. Column (1) replicates the baseline specification in the main text, which implies an elasticity of 1.64. To better isolate idiosyncratic shocks to firms from local labor market or CB unit shocks, Columns (2) through (5) use a more saturated specification with local-labor-market-by-CB-unit-by-year fixed effects. They also remove 2011 from the sample to focus on longer-term labor adjustments, and they vary the samples of workers and firms used to compute wages. These estimates tend to be larger, ranging from 1.88 to 2.57, though they are noisy. Based on these results, I set a baseline value of $\eta = 2.20$ for the model.

A concern with the estimates is that they might be distorted by the presence of demand-constrained firms, as these firms' do not operate on the labor supply curve. To address this concern, I estimate the elasticity η using only the top 50% of firms in terms of pre-period wage levels, as these firms are less likely to be constrained. Column (4) of Appendix Table F.2 shows a similar value for the estimated elasticity in this case.

Appendix Figure F.6: Estimates of gap between within- and cross-market labor supply elasticity, $\eta - \theta$, across values of η



Notes: This figure shows how estimates of the gap between the within- and across-market labor supply elasticity, $\eta - \theta$, vary across values of η. I estimate θ and the gap $\eta - \theta$ for different values of η between 1.5 and 2.5, following the approach described in Section 7.1.2. The figure shows a line connecting 51 estimates using values of η evenly spaced between 1.5 and 2.5 by 0.02. 95% confidence intervals are computed with standard errors clustered at the local labor market level.

Across-market elasticity θ. As discussed in Section 7.1.2, I derive estimates of θ conditional on η from a two-step procedure. First, I obtain estimates of B_{kt}, which is the variation in $\ln \tilde{w}_{jt} - (1/\eta) \ln \tilde{\ell}_{jt}$ explained by local-labor-market-by-year-fixed effects. Second, I regress B_{kt} on $\ln \tilde{W}_{kt}$, local labor market effects and year effects, where $\tilde{W}_{kt}$ is the wage index in k computed from the firm-level data. For this analysis I cluster standard errors at the local labor market level. The estimated coefficient on $\ln \tilde{W}_{kt}$ is 0.3540 (SE = 0.0623), which implies an estimate of θ equal to 1.42 (SE = 0.14) when using the baseline value of η.

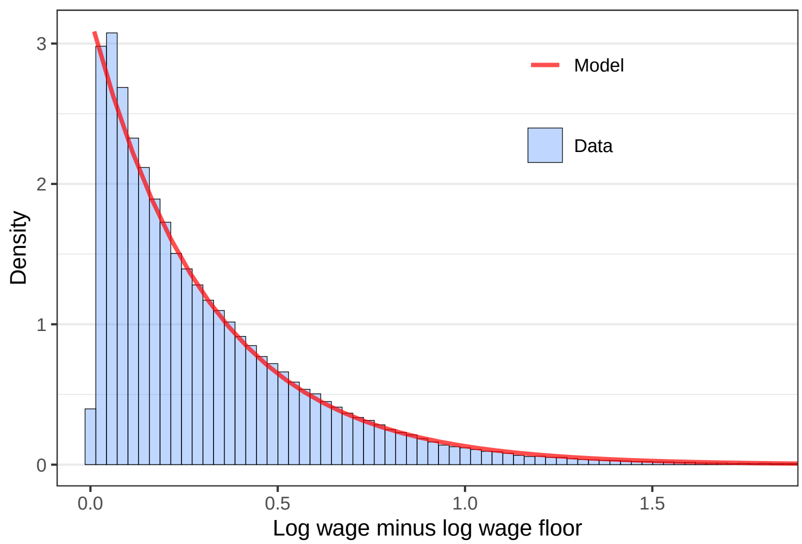
I explore robustness of the estimated gap between the elasticities $\eta - \theta$ to the assumed η. Appendix Figure F.6 shows that the gap is positive and statistically significant across a range of 1.7 to 2.7 for η. The gap is slightly increasing in η, though the gap implied by the baseline η of 2.20 is within the 95% confidence interval for the entire range. The implication is that the strength of general equilibrium effects is relatively stable for values of η in the range implied by Appendix Table F.2.

Preference for formal employment ζ. From equation (7) the extensive-margin labor supply elasticity can be computed to be $\frac{d\iota}{dV}\frac{V}{\iota} = \zeta(1-\iota)$. We take a value of 0.20 for the elasticity (Chetty et al. 2011). I compute the share of formal employment in the private sector using workers aged 20–55 using the household survey data. I compute an average share in the years 2011–14 equal to $\iota = 0.288$, which results in a value of $\zeta = 1.64$. I set the parameter N, which corresponds to the working-age population, to the average total urban population aged 20–55 in 2011–14 represented in the household survey data, which is $N = 12,550,416$.

Shape of productivity distribution q. I estimate the Pareto shape parameter q as follows. First, the model implies that, for unconstrained firms, the log wage follows an exponential distribution. I construct the empirical counterpart of this variable as the log of the firm's mean wage minus the log of its applicable wage floor, focusing on firms with a mean wage above the wage floor. I then estimate the rate parameter of this distribution, denoted q_w, via maximum likelihood. Second, I recover the parameter q from $q = q_w(\eta(1-\alpha)+1)$, which follows from the unconstrained wage equation (F.2). The estimated value of the Pareto shape parameter is $q = 5.30$. Appendix Figure F.7 assesses the validity of this approach by plotting the empirical distribution of the log wage cushion against the fitted exponential distribution. Overall, the fit is excellent. The mode of the distribution in the data is slightly above zero, resulting in small deviations for low values of the log wage cushion.

Production function parameter α, amenity values A_k, minimum productivities φ_{g0}, and outside option b. I devise a nested iterative procedure to jointly calibrate these parameters. I target the aggregate labor share, the employment shares across local labor markets $\{\tilde{s}_k\}_{k\in\mathcal{K}}$, the share of constrained firms across sub-markets $\{\tilde{SC}_g\}_{g\in\mathcal{G}}$, and the

Appendix Figure F.7: Distribution of unconstrained wages, model vs. data



Notes: This figure compares the empirical distribution of unconstrained wages (blue histogram) to the distribution implied by the structural model (red line).

aggregate formal employment share $\tilde{\iota}$, relying on the observed wage floors $\{\underline{w}_c\}_{c\in\mathcal{C}}$ and the parameters estimated before.

The algorithm involves two nested loops. The outer loop iterates over α. Starting with an initial guess of 0.5, I solve the other parameters in the inner loop and obtain the aggregate labor share as the ratio of total wage bill to total revenue. Then, I update α proportionally to the ratio of the target labor share of 0.5 and the model-implied labor share, repeating the process until convergence. In the inner loop, conditional on α, I iteratively update the amenity values A_k to minimize the distance between the model-implied and observed employment shares $\{\tilde{s}_k\}_{k\in\mathcal{K}}$ across local labor markets. Within each iteration of this loop, I obtain the outside option b to match the formal employment share $\tilde{\iota} = 0.288$ inverting equation (7), and I recover the minimum productivities φ_{g0} inverting the model's expression for the share of firms constrained by the wage floor, given by

$$S_g = 1 - \left(\frac{\varphi_{g0}}{\overline{\varphi}_g(A_k, W_k, b)}\right)^q.$$

More precisely, the inner loop proceeds as follows. I start each iteration with current amenity values and wage indexes.[17] I then compute the aggregate wage index W and obtain a value of b that matches the formal employment share $\tilde{\iota}$. These values allow me to compute the model-implied upper productivity thresholds $\overline{\varphi}_g(A_k, W_k, b)$, which I use to compute $\varphi_{g0} =$

[17] In the first iteration I set all amenity values to one and I use the data wage indexes $\{\tilde{W}_{kt}\}_{k\in\mathcal{K}}$.

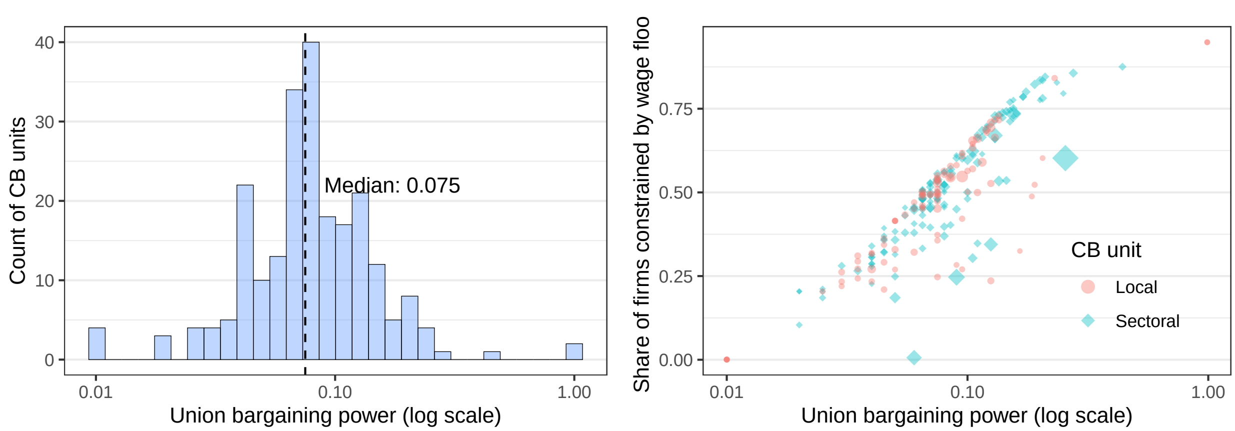
$\overline{\varphi}_g(1-\tilde{SC}_g)^{1/q}$ for $\tilde{SC}_g > 0$.[18] For sub-markets with $\tilde{SC}_g = 0$, I set φ_{g0} equal to the threshold $\overline{\varphi}_g$. I close the inner loop by solving for the market-clearing wage indexes $\{W_k\}_{k\in\mathcal{K}}$ given the updated parameters, and compute the model-implied employment shares s_k. I update the amenity values proportionally to the ratio of $\tilde{s}_k$ to s_k for the next iteration, and repeat the process until convergence.

Bargaining power parameters β_c. I estimate the parameters $\{\beta_c\}_{c\in\mathcal{C}}$ using a grid-search algorithm that seeks to match the model-implied optimal wage floor to its empirical counterpart. The procedure is as follows. First, I define a grid of values for β_c ranging from 0.01 to 0.99. For each candidate value, I solve for the optimal wage floor $\underline{w}_c(\beta_c)$ that maximizes the Nash bargaining objective. To do so, I follow the optimization procedure to find wage floors specified in Appendix F.4.2, ensuring that the model's general equilibrium structure is respected. After computing the optimal wage floor for each candidate β_c, I identify the interval on the grid that bounds the observed wage floor from the data. I then perform a finer search within this interval to obtain a more precise estimate of β_c, up to multiples of 0.005, selecting the value that minimizes the absolute difference between the model-implied and observed wage floor. If the minimum difference occurs at a boundary of the initial grid, I assign the corresponding boundary value as the estimate.

Appendix Figure F.8 displays the estimated bargaining power parameters and their correlation with the share of constrained firms. The figure suggests a frontier marking the maximum constrained share attainable for a given β_c.

Appendix Figure F.8: Estimates of bargaining power parameters β_c

(a) Distribution of β_c (b) β_c and the share of constrained firms



Notes: The figure shows model estimates of the bargaining power parameters $\{\beta_c\}_{c\in\mathcal{C}}$ in Panel (a) and their relationship with the share of firms constrained by the wage floor in the CB unit in Panel (b). Marker sizes in Panel (b) are proportional to the number of firms in each CB unit.

[18] I cap the observed shares $\tilde{SC}_g$ at 0.95 as a share of 1 would imply a minimum productivity of zero.

G Additional Tables and Figures

Appendix Table 1: Description of coverage of selected collective bargaining agreements in the textile industry

CBA	Spanish	English
0500/07	Obreros de la industria textil, son los ocupados en establecimientos cuya actividad principal comprenda procesos destinados a la confección de colchones, bolsas, tejer, lavar, clasificar, peinar, cardar, hilar, urdir, tramar, retrocer, estrusar, devanar, desfibrar, teñir, aprestar, texturizar, bordar, cortar, coser, atar, anudar, bobinar, planchar, estampar, terminar, o similares y que se lleve a cabo sobre cualquier tipo de fibras, sean naturales o manufacturadas, ya sea manualmente o mediante la utilización de maquinarias subordinadas al proceso industrial textil.	Workers in the textile industry are those engaged in establishments whose main activity involves processes intended for making mattresses, bags, knitting, washing, sorting, combing, carding, spinning, warping, weaving, twisting, extruding, winding, defibring, dyeing, finishing, texturing, embroidering, cutting, sewing, tying, knotting, spooling, ironing, stamping, completing, or similar activities, carried out on any type of fibers, whether natural or manufactured, either manually or through the use of machinery subordinate to the textile industrial process.
0501/07	Trabajadores, empleados, supervisores, encargados, mecánicos, personal auxiliar de ambos sexos, de administración, de comercialización y de fábrica únicamente de las empresas industriales de indumentaria y afines.	Workers, employees, supervisors, managers, mechanics, auxiliary staff of both genders, from administration, sales, and exclusively from clothing industrial companies and related fields.
0746/17	Todos los trabajadores de la industria de la confección de indumentaria y afines según se especifican en los respectivos capítulos de la misma, comprende también a las empresas que fabrican toldos en general y sus respectivos accesorios, en artículos con tela de lona, plástica, sintéticas y/o similares, empresas que confeccionan y arman colchones en general y con sus respectivos accesorios, con todo tipo de materiales. Están comprendidos también los lavaderos industriales de los procesos de producción, tanto internos como externos. También incluye las empresas que producen avíos y accesorios internos para todo tipo de prendas de vestir en general, cualquiera fuere el material empleado en su producción y/o elaboración.	All workers in the apparel manufacturing industry and related fields as specified in the respective [CBA] chapters. This also includes companies that manufacture awnings in general and their respective accessories, in articles made of canvas fabric, plastic, synthetic and/or similar materials. It also covers companies that make and assemble mattresses in general and their accessories, with all types of materials. Also included are industrial laundries involved in the production process, both internal and external. It also includes companies that produce fittings and internal accessories for all types of clothing in general, regardless of the material used in their production and/or manufacturing.

Notes: The figure shows the description of the areas of representation for three selected collective bargaining agreements (CBAs) in the textile industry. The three CBAs specify the entire country as their regional scope, and were signed by different unions. CBA 0500/07 was signed by *Asociación Obrera Textil*, CBA 0501/07 was signed by *Sindicato de Empleados Textiles de la Industria y Afines*, and CBA 0746/17 was signed by *Federación Obrera Nacional de la Industria del Vestido y Afines*. The description in Spanish is verbatim from the CBA, and the description in English is a translation obtained using GPT-4 and subsequently verified by the author.

Appendix Table 2: Summary statistics of baseline estimating sample

	N	Mean	SD	Min	Median	Max
(a) Firm unbalanced panel						
Year	85,820	2009.9	3.2	2005.0	2010.0	2015.0
Log mean wage	85,820	8.13	0.53	-5.85	8.09	12.82
Log mean wage floor	70,051	7.72	0.20	6.79	7.72	8.50
Log employment	85,820	3.41	1.41	0.00	3.37	10.10
Log wage bill	85,820	13.84	1.67	-5.83	13.79	20.89
(b) Firm cross section						
Firm shock	7,922	0.48	0.49	-2.13	0.47	3.28
Unique 4d sector	190					
Unique province	24					
Mean employment 2005–07	7,922	86.21	392.51	1.00	25.67	21528.67
Mean employment 2011–12	7,862	105.38	474.32	1.00	31.00	20903.00
Wage 2005–07 (2010 ARS)	7,922	3425.69	2589.36	273.08	2691.77	43905.58
(c) CB unit cross section						
CBU shock	39	0.49	0.17	0.08	0.50	0.77
N. 4d sectors	39	19.7	26.3	2.0	11.0	144.0
N. provinces	39	7.8	4.8	1.0	6.0	21.0
N. firms 2011–12	39	7,316.9	25,734.3	59.0	665.0	157,524.0
N. exporting firms 2011–12	39	261.8	637.3	30.0	77.0	3,127.0
Employment in exporting firms 2011–12						
Level	39	26,052.4	50,679.1	1,163.0	8,880.0	261,955.0
Share	39	0.516	0.258	0.042	0.556	0.932

Notes: Data are from Argentina's administrative records and BACI-CEPII. The table shows summary statistics for the baseline estimating sample of firms used in the empirical analysis. The sample includes firms with positive employment in 2005 through 2007 and that are part of a CB unit with at least 30 exporting firms. Panel (a) shows summary statistics of the unbalanced firm panel at the firm-year level. Panel (b) shows summary statistics of the cross section of firms. Panel (c) shows summary statistics of the cross section of CB units.

Appendix Table 3: Static difference-in-differences estimates, robustness to shock definition

	Shock definition	Outcome	Firm shock		CBU shock		CBU exp. share			
			Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Obs.	R^2
(a)	Baseline	Mean wage	0.0225	(0.0070)	0.0439	(0.0184)	-0.1295	(0.0563)	62,156	0.78
		Wage floor	0.0008	(0.0012)	0.1149	(0.0534)	-0.1825	(0.0308)	49,961	0.93
		Employment	0.0369	(0.0219)	0.0121	(0.0542)	-0.1065	(0.0506)	62,156	0.92
(b)	Leave-one-out CBU shock	Mean wage	0.0224	(0.0072)	0.0419	(0.0182)	-0.1308	(0.0557)	61,890	0.78
		Wage floor	0.0008	(0.0012)	0.1144	(0.0533)	-0.1828	(0.0306)	49,760	0.93
		Employment	0.0375	(0.0222)	0.0097	(0.0541)	-0.1093	(0.0497)	61,890	0.92
(c)	Country-product shock with symmetric growth rate	Mean wage	0.0299	(0.0092)	0.0495	(0.0234)	-0.1332	(0.0565)	62,156	0.78
		Wage floor	0.0008	(0.0014)	0.1285	(0.0617)	-0.1940	(0.0335)	49,961	0.93
		Employment	0.0401	(0.0269)	0.0326	(0.0619)	-0.1089	(0.0513)	62,156	0.92
(d)	2007–08 CBU employment shares	Mean wage	0.0226	(0.0070)	0.0435	(0.0185)	-0.1264	(0.0508)	62,156	0.78
		Wage floor	0.0009	(0.0012)	0.1148	(0.0536)	-0.1828	(0.0289)	49,961	0.93
		Employment	0.0371	(0.0219)	0.0116	(0.0542)	-0.1237	(0.0434)	62,156	0.92
(e)	Unweighted firm shock and row (d)	Mean wage	0.0293	(0.0104)	0.0963	(0.0201)	-0.0890	(0.0547)	62,156	0.78
		Wage floor	0.0005	(0.0011)	0.1625	(0.0553)	-0.1221	(0.0330)	49,961	0.93
		Employment	0.0339	(0.0267)	0.0492	(0.0657)	-0.0873	(0.0551)	62,156	0.92
(f)	2011–12 CBU wage-bill shares	Mean wage	0.0225	(0.0070)	0.0458	(0.0213)	-0.1317	(0.0509)	62,156	0.78
		Wage floor	0.0012	(0.0013)	0.1010	(0.0588)	-0.1896	(0.0311)	49,961	0.93
		Employment	0.0380	(0.0217)	-0.0319	(0.0534)	-0.1204	(0.0408)	62,156	0.92

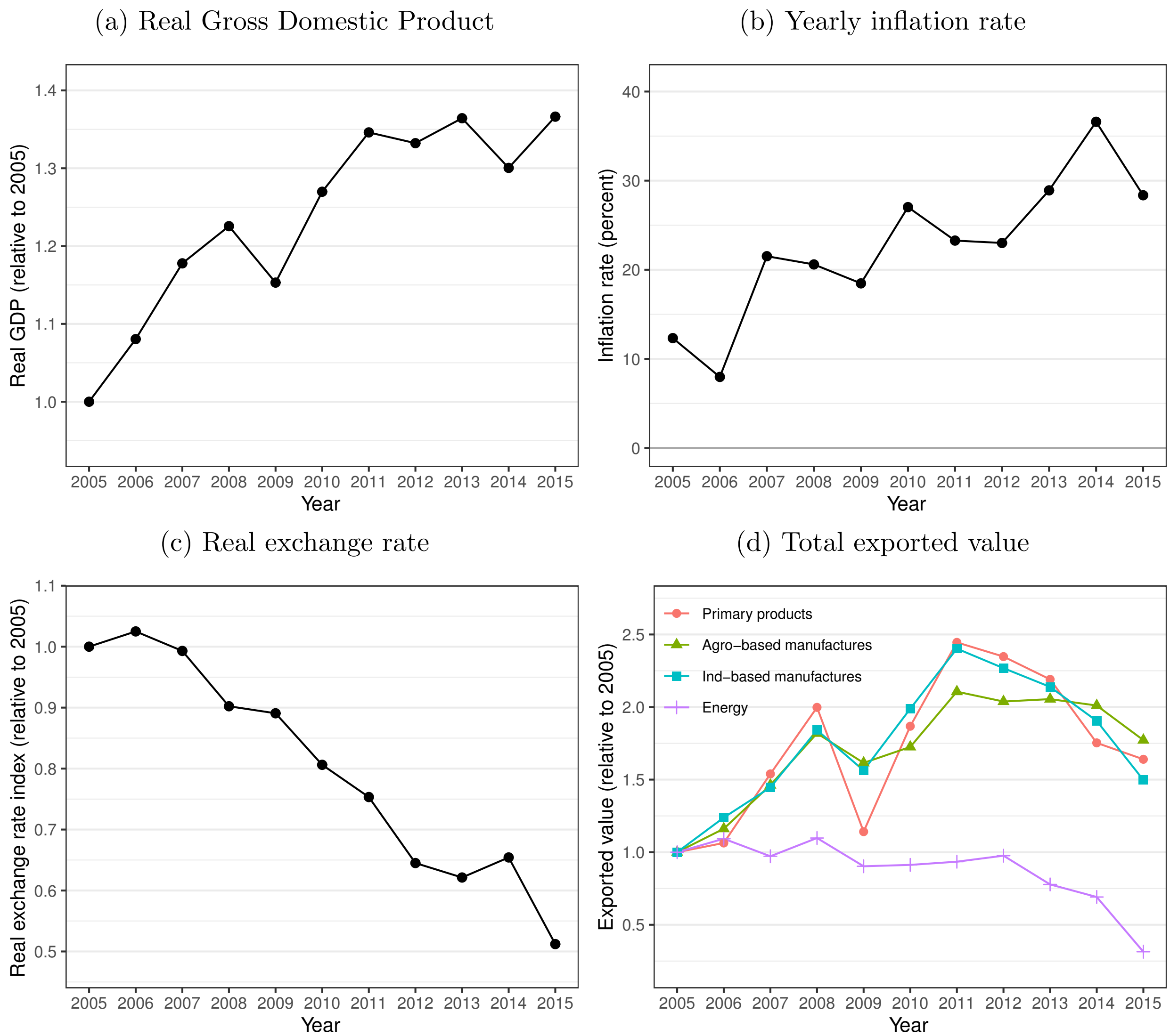
Notes: Data are from Argentina's administrative records and BACI-CEPII. The table compares the baseline estimates of the effects of firm and CBU shocks from Table 1 to those obtained using alternative definitions of the shocks, for three outcomes: log mean wage, log wage floor, and log employment. Panel (a) reproduces the baseline estimates. Panel (b) uses, for firm j, a leave-one-out CBU shock defined as the average firm shock across firms in the same CB unit, excluding firm j. Panel (c) uses firm and CBU shocks constructed from country-product shocks f_p computed as the symmetric growth rate in world import demand between 2007–08 and 2012–13, following Garin and Silvério (2023). Panel (d) uses 2007–08 CBU employment shares to define the CBU shock. Panel (e) uses 2007–08 CBU employment shares and, additionally, firm shocks defined as unweighted averages of f_p. Panel (f) uses 2011–12 CBU wage-bill shares to define the CBU shock.

Appendix Table 4: Static difference-in-differences estimates, other robustness exercises

	Shock definition	Outcome	Firm shock		CBU shock		CBU exp. share			Num.	
			Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Obs.	CBUs	R^2
(a)	Baseline	Mean wage	0.0225	(0.0070)	0.0439	(0.0184)	-0.1295	(0.0563)	62,156	39	0.78
		Wage floor	0.0008	(0.0012)	0.1149	(0.0534)	-0.1825	(0.0308)	49,961	39	0.93
		Employment	0.0369	(0.0219)	0.0121	(0.0542)	-0.1065	(0.0506)	62,156	39	0.92
(b)	2011–2012 end years	Mean wage	0.0186	(0.0075)	0.0259	(0.0253)	-0.1310	(0.0549)	62,156	39	0.78
		Wage floor	0.0002	(0.0010)	0.0790	(0.0665)	-0.1715	(0.0307)	49,961	39	0.92
		Employment	0.0266	(0.0254)	-0.0110	(0.0862)	-0.1048	(0.0487)	62,156	39	0.92
(c)	2013–2014 end years	Mean wage	0.0175	(0.0060)	0.0484	(0.0167)	-0.1271	(0.0560)	62,148	39	0.78
		Wage floor	0.0002	(0.0011)	0.1114	(0.0426)	-0.1814	(0.0303)	49,953	39	0.93
		Employment	0.0398	(0.0177)	0.0272	(0.0424)	-0.1062	(0.0505)	62,148	39	0.92
(d)	Workers with 3+ quarters in firm	Mean wage	0.0214	(0.0097)	0.0465	(0.0150)	-0.1194	(0.0432)	61,247	39	0.85
		Employment	0.0390	(0.0213)	0.0345	(0.0575)	-0.1749	(0.0525)	61,247	39	0.92
(e)	Control for firm characteristics	Mean wage	0.0207	(0.0065)	0.0533	(0.0285)	-0.1235	(0.0705)	62,156	39	0.73
		Wage floor	0.0007	(0.0015)	0.1104	(0.0633)	-0.1860	(0.0320)	49,961	39	0.91
		Employment	0.0266	(0.0353)	-0.0191	(0.0755)	-0.0466	(0.0581)	62,156	39	0.91
(f)	CB units with at least 20 exporting firms	Mean wage	0.0245	(0.0073)	0.0378	(0.0170)	-0.1110	(0.0580)	64,135	56	0.79
		Wage floor	0.0027	(0.0021)	0.1028	(0.0423)	-0.1632	(0.0324)	51,284	56	0.92
		Employment	0.0363	(0.0214)	0.0482	(0.0465)	-0.1126	(0.0468)	64,135	56	0.92
(g)	CB units with at least 40 exporting firms	Mean wage	0.0229	(0.0073)	0.0481	(0.0183)	-0.1218	(0.0606)	60,314	30	0.78
		Wage floor	0.0003	(0.0010)	0.1202	(0.0560)	-0.1667	(0.0339)	48,332	30	0.92
		Employment	0.0350	(0.0233)	0.0070	(0.0576)	-0.1043	(0.0529)	60,314	30	0.92

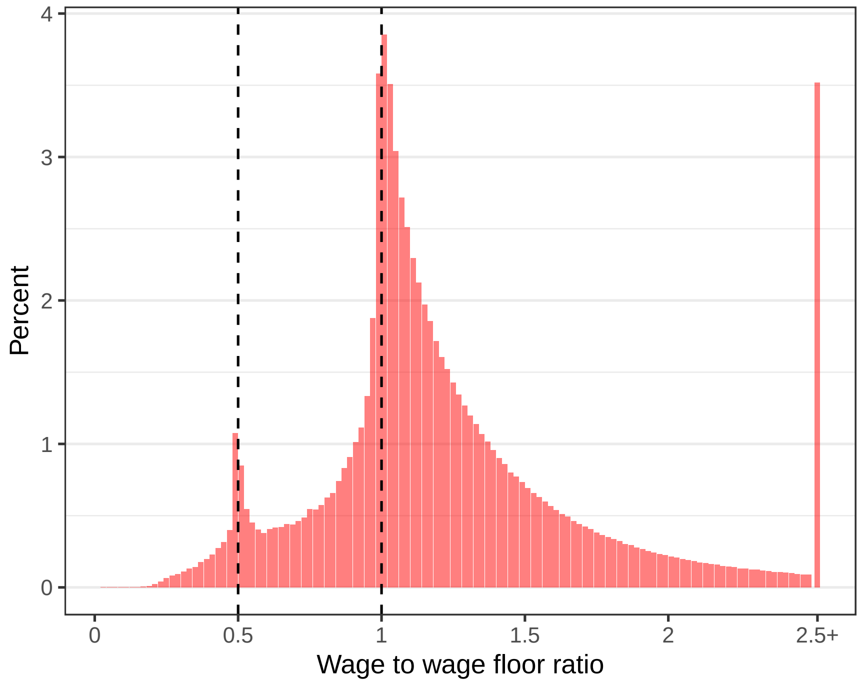
Notes: Data are from Argentina's administrative records and BACI-CEPII. The table compares the baseline estimates of the effects of firm and CBU shocks from Table 1 to those obtained using variations in the sample and specification, for three outcomes: log mean wage, log wage floor, and log employment. Panel (a) reproduces the baseline estimates. Panels (b) and (c) change the post-period years to compute the country-product shocks f_p to 2011–12 and 2013–14, respectively. Panel (d) uses workers that worked in the firm for at least 3 quarters in each year to compute firm wages and employment. I omit the wage floor outcome as it is identical to the baseline in this case. Panel (e) adds controls for pre-period firm wage quartile by pre-period firm size quartile by year fixed effects in the regression specification. Panels (f) and (g) restrict the sample to CB units with at least 20 and 40 exporting firms, respectively.

Appendix Figure 1: Performance of Argentine economy between 2005 and 2015



Notes: The figure shows the evolution of key macroeconomic indicators in Argentina between 2005 and 2015. Panel (a) shows the evolution of the real gross domestic product (GDP), using data from the National Institute of Statistics and Censuses (INDEC). The GDP is measured in constant 2004 Argentine pesos, and normalized to 1 in 2005. Panel (b) shows the annual inflation rate using data from INDEC between 2005–06 and regional statistics offices between 2007–15. The inflation rate is measured as the percentage change in the consumer price index as of December of each year. Panel (c) shows the evolution of the annual mean of the multilateral real exchange rate index, using data from the Central Bank of Argentina (BCRA). Panel (d) shows the total exported value, using data from INDEC, measured in millions of current US dollars and normalized to 1 in 2005.

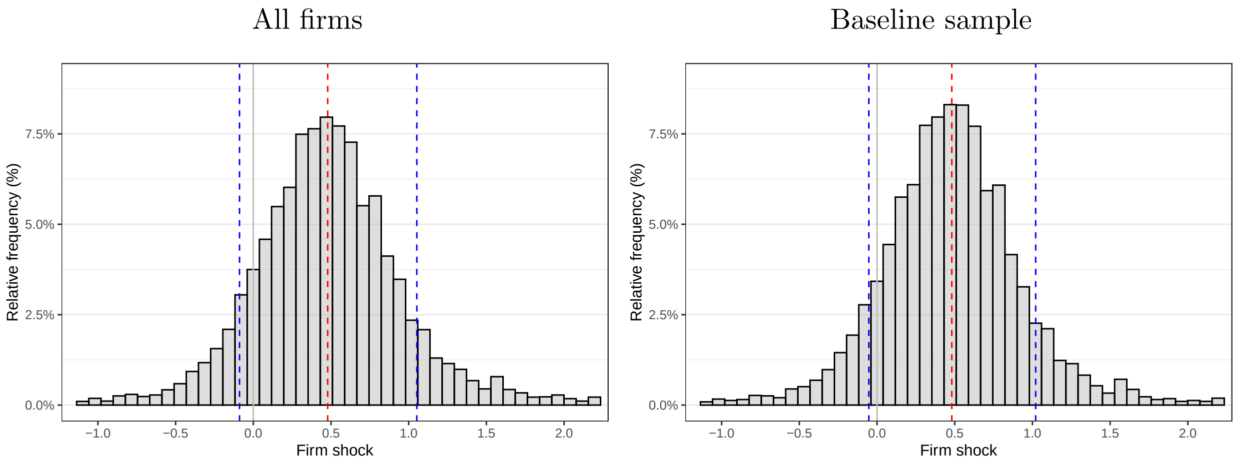
Appendix Figure 2: Ratio of worker's wage to CBA-occupation wage floor, 2012



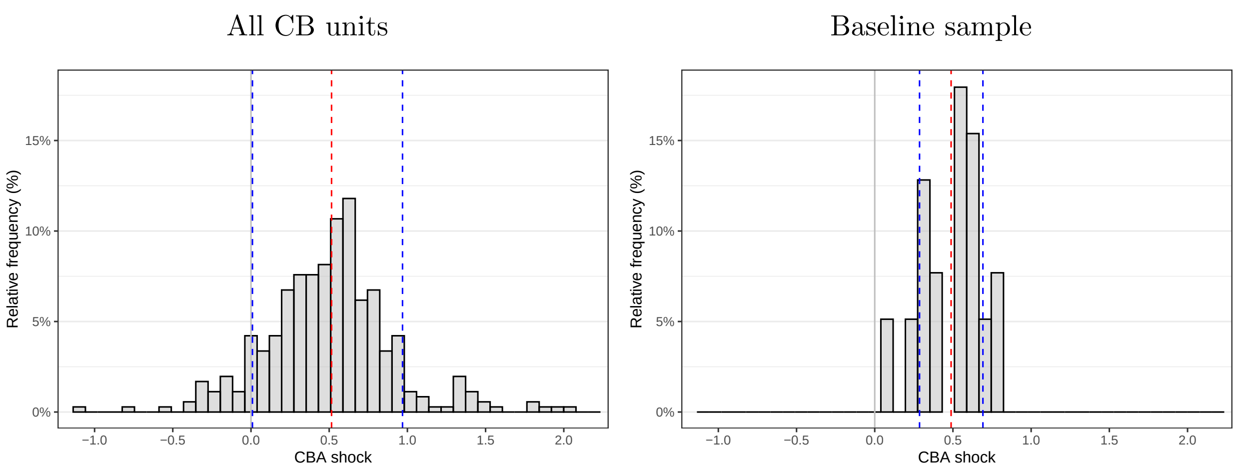
Notes: Data are from Argentina's matched employer-employee dataset (SIPA) and Argentina's Employee Registry (Simplificación Registral). The figure shows the distribution of the ratio of the worker's wage to the wage floor in 2012, for workers in the private sector with a valid wage floor value and under the main contract type. The dashed vertical lines indicate the values corresponding to 0.5 and 1 times the wage floor. The main contract type can be interpreted as a proxy for full-time status.

Appendix Figure 3: Distribution of export shocks

(a) Firm shock



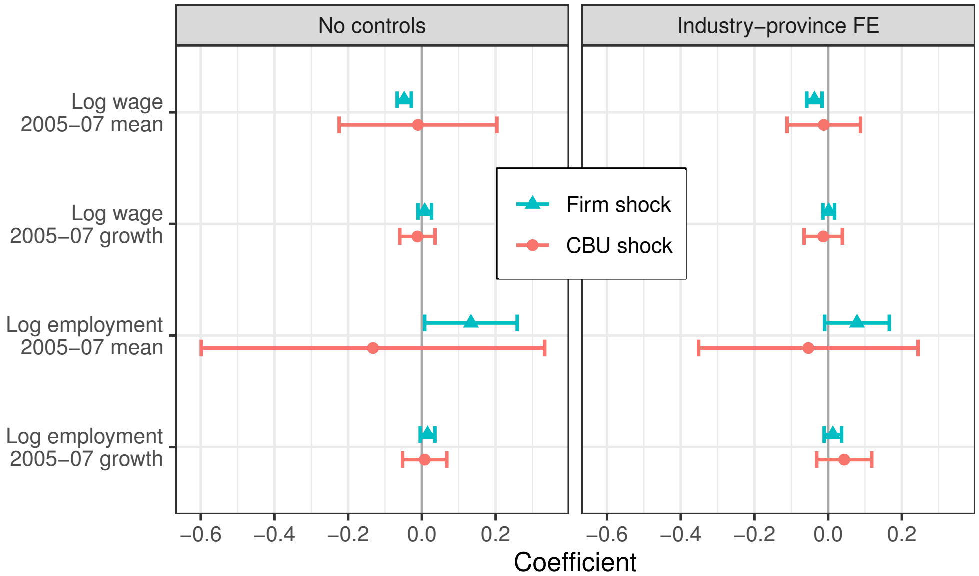
(b) CBU shock



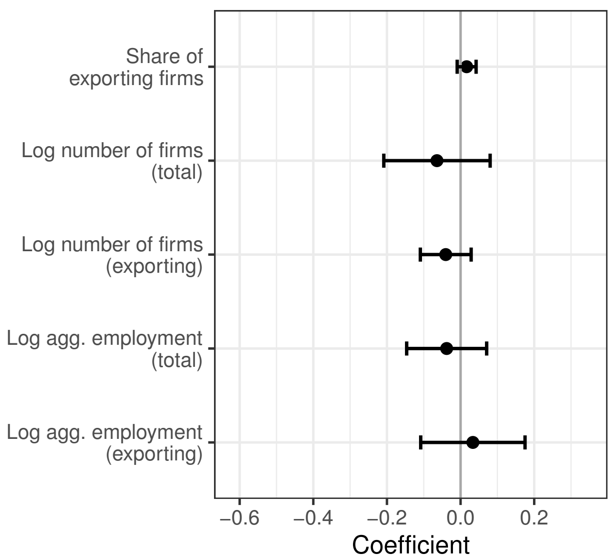
Notes: Data are from Argentina's administrative records and BACI-CEPII. The figure shows the histogram of the firm shock (Panel a) and the CBU shock (Panel b). The y-axis is limited to values between -1 and 2 to increase visual clarity. The central red dashed line shows the average shock, whereas the blue dashed lines on the sides show the 10th and 90th percentiles, respectively.

Appendix Figure 4: Correlation of export shocks with firm and CB unit characteristics

(a) Pre-period firm-level characteristics



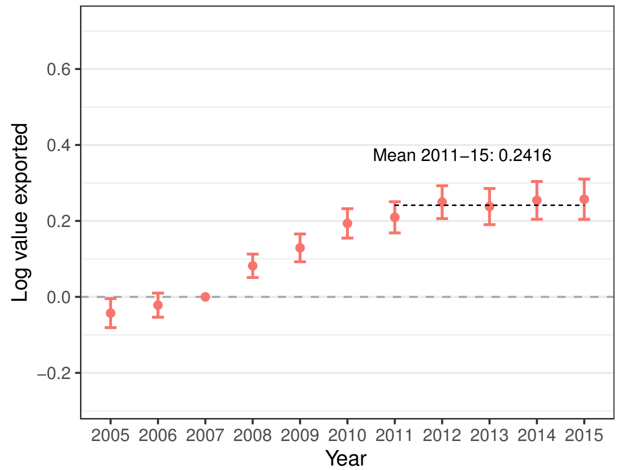
(b) 2011–2012 CB unit aggregate characteristics



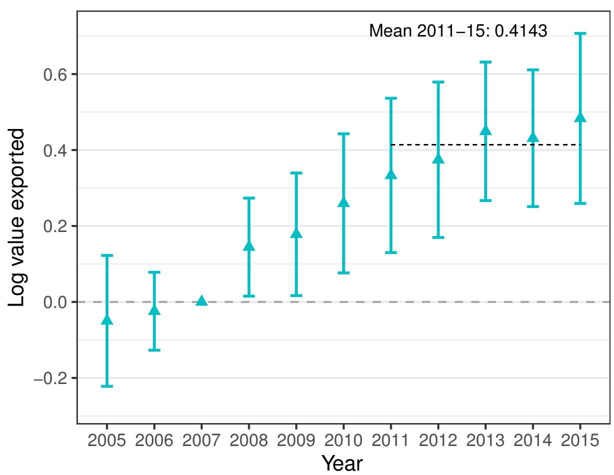
Notes: Data are from Argentina's administrative records and BACI-CEPII. The figure shows the correlation between the export shocks and firm and CB unit characteristics. Panel (a) shows the estimated coefficient on the firm shock from a regression of pre-period firm-level characteristics on the firm shock, controlling for 4-digit sector by province fixed effects. Panel (b) shows the estimated coefficient on the CBU shock from a regression of 2011–2012 CB unit aggregate characteristics on the CBU shock. Standard errors are clustered at the CB unit level.

Appendix Figure 5: Effect of shocks on log value exported, country-product data

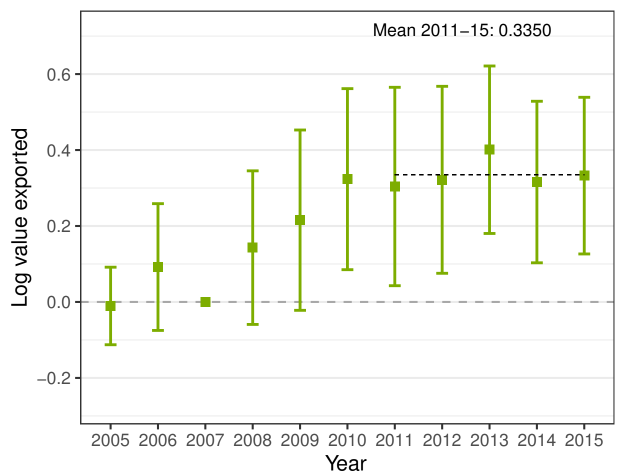
(a) Country-product level



(b) Firm level



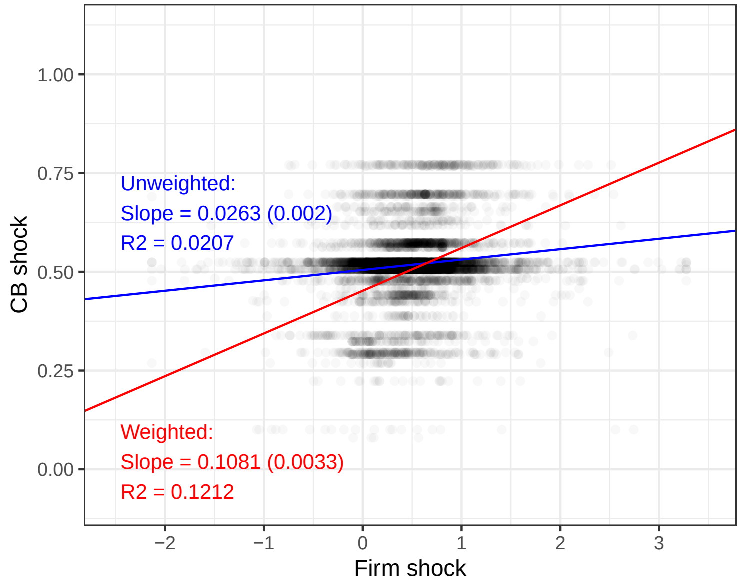
(c) CBU level



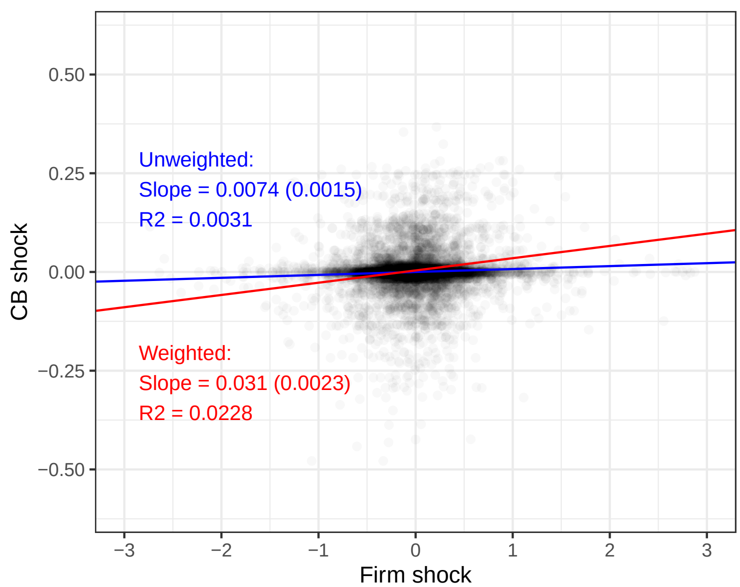
Notes: Data are from Argentina's administrative records, BACI-CEPII, and country-product aggregates from the National Institute of Statistics and Censuses (Instituto Nacional de Estadística y Censos 2021b). The figure shows the effects of various definitions of export shocks on log value exported, always conditional on country-product and year fixed effects. Panel (a) shows the effects of the country-product shock f_p, defined as the mean change in log world import demand for p between 2007–08 and 2012–13. Panels (b) and (c) show the estimated effects of the firm and CBU shocks, respectively, obtained at the country-product level. More precisely, the p-level mean firm and CBU shock, weighting by the exposure shares s_{jp} or s_{cp} defined in Section 4.2, is constructed as $\bar{z}_p^j = \sum_j s_{jp} z_{jp} / \sum_j s_{jp}$ and $\bar{z}_p^c = \sum_c s_{cp} z_{cp} / \sum_c s_{cp}$. Then, the mean firm or CBU shock is instrumented with f_p in a country-product regression of log exports on the mean shock. See Footnote 24 in the main text for discussion on how this procedure relates to Borusyak et al. (2022). Standard errors are clustered at the country-product level.

Appendix Figure 6: Correlation of export shocks to firms with export shocks to CB units

(a) Raw data



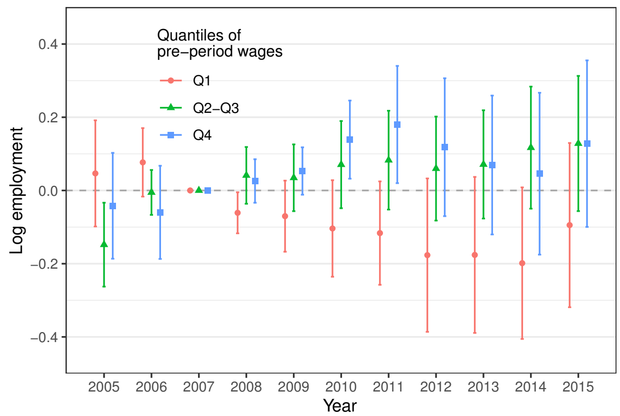
(b) Residualized on local labor market effects



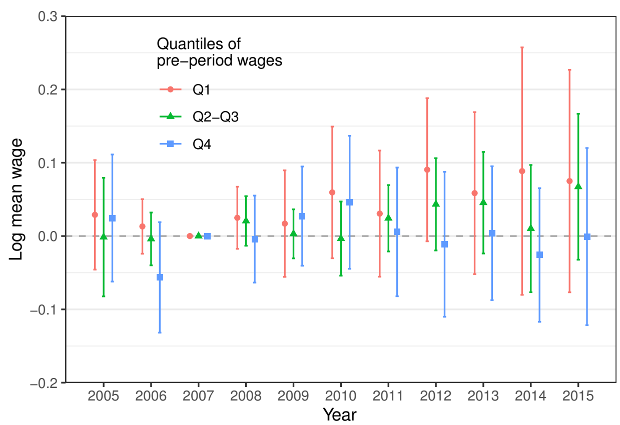
Notes: Data are from Argentina's administrative records and BACI-CEPII. Panel (a) shows the correlation of the firm shock and the CBU shock at the firm-level. Panel (b) shows the same correlation after residualizing for 4-digit sector by province fixed effects. The firm and CBU shocks are defined as the average changes in world import demand between 2007–08 and 2012–13, weighting by appropriate exposure shares. To enhance visual clarity, the x-axis and y-axis are centered around the mean and have a range of −3 to 3 units for the x-axis, and −0.6 to 0.6 for the y-axis, around the mean. The lines and annotations in each panel show two linear fits, with and without firm-size regression weights.

Appendix Figure 7: Dynamic effects of the CBU shock, heterogeneity by pre-period mean wage

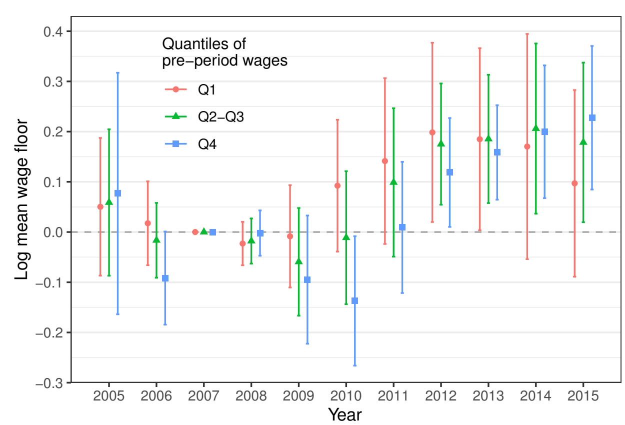
(a) Log employment



(b) Log mean wage



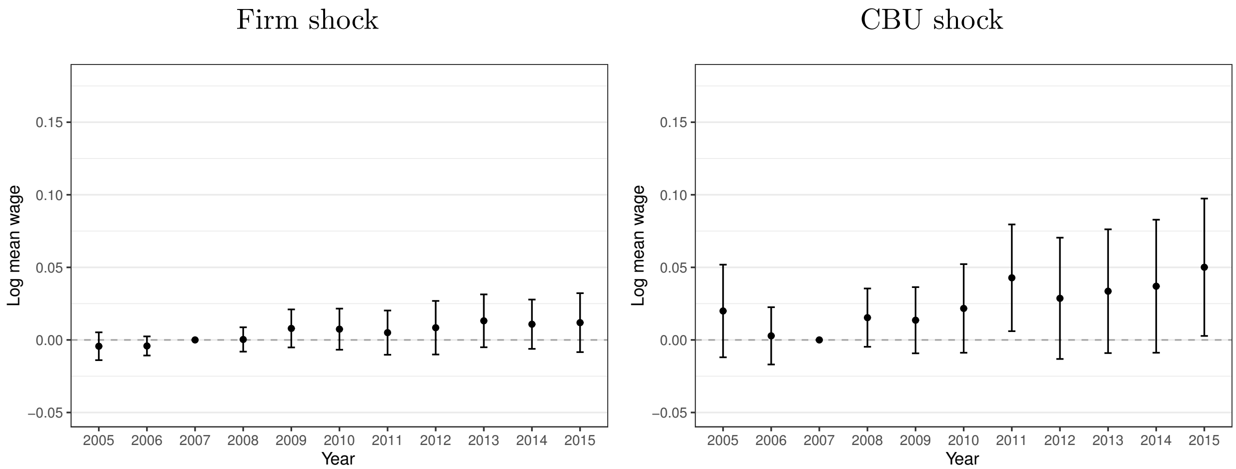
(c) Log mean wage floor



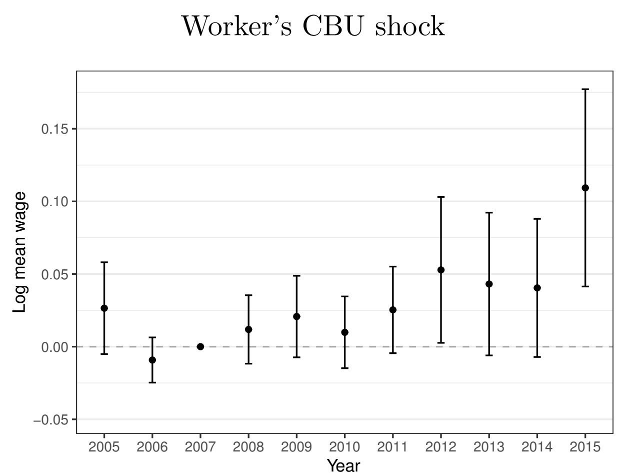
Notes: Data are from Argentina's administrative records and BACI-CEPII. The figure shows the estimated dynamic effects of the CBU shock on employment (Panel a), mean wage (Panel b), and mean wage floor (Panel c), for different pre-period mean wage quartiles. The estimates are from a regression of the outcome on the firm shock interacted with year dummies and an indicator for above- or below-median pre-period mean wage ($Q1$-$Q2$ vs. $Q3$-$Q4$), the CBU shock interacted with year dummies and pre-period mean wage quartile indicators ($Q1$, $Q2$-$Q3$, $Q4$), the share of employment in exporting firms in the CB unit interacted with year dummies and pre-period mean wage quartile indicators, firm fixed effects, and local labor market by pre-period mean wage quartile by year fixed effects. The sample includes firms with positive employment in 2005 through 2007 and part of a CB unit with at least 30 exporting firms, and data for the years 2005–07 and 2011–15 only. Standard errors are clustered at the CB unit level.

Appendix Figure 8: Effect of export shocks to CB units, worker-level estimates

(a) Shock to firm's CB unit

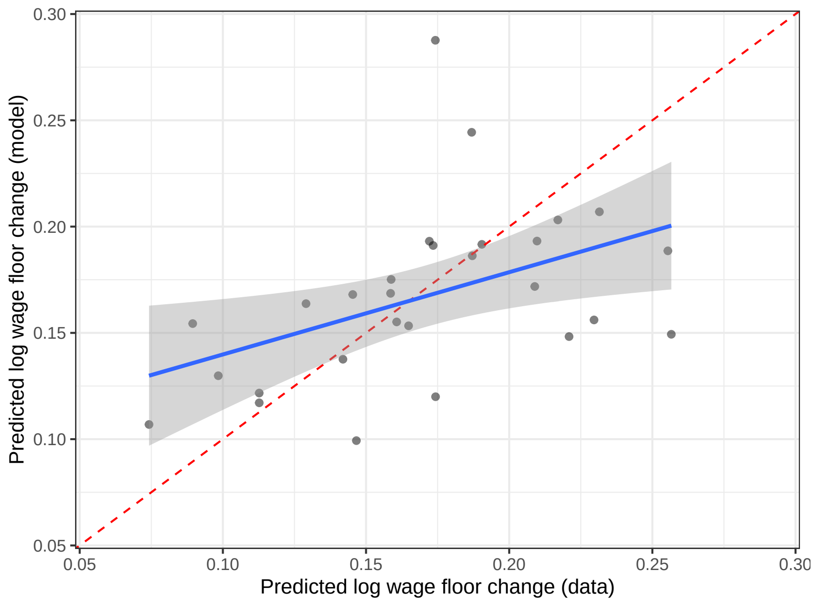


(b) Shock to worker's CB unit, controlling for firm-year effects



Notes: Data are from Argentina's administrative records and BACI-CEPII. The figure shows the estimated dynamic effects of the firm and CBU shock on the mean log wage at the worker level, using different samples and regression specifications. The sample includes workers who stayed in baseline sample firms from 2005 through 2015. Panel (a) shows estimates of the firm and the firm CBU shock, and correspond to column (3) of Table 3. Panel (b) shows estimates of the worker's CBU shock, and correspond to column (5) of Table 3. Standard errors are clustered at the CB unit level.

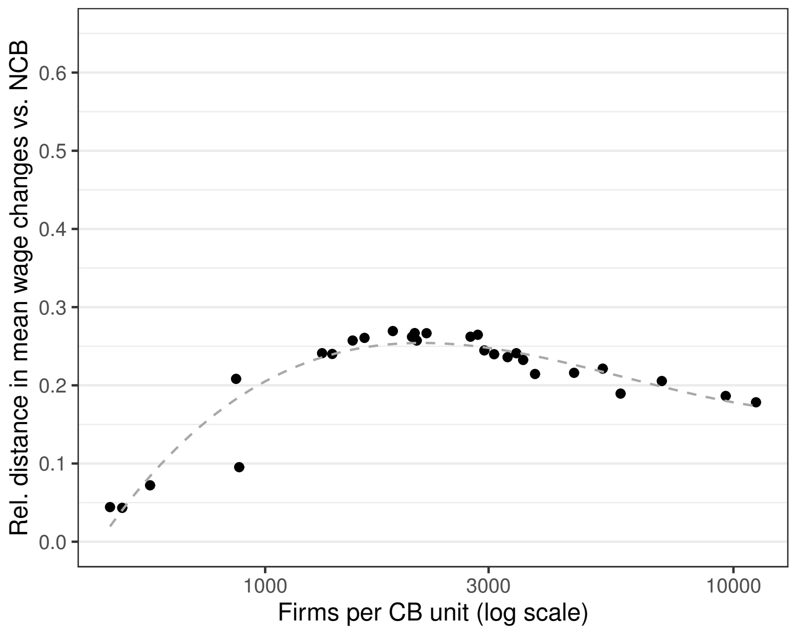
Appendix Figure 9: Changes in wage floors due to CBU shocks, data vs. model simulations



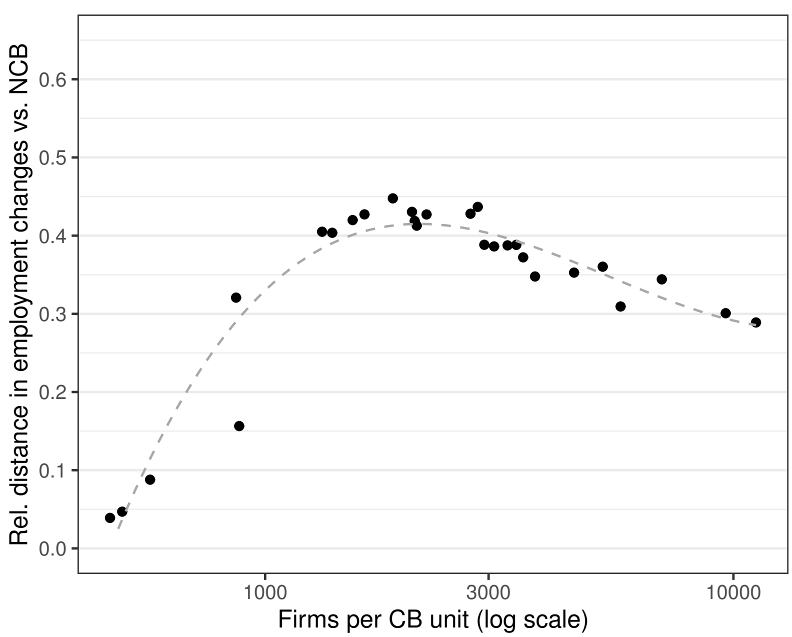
Notes: Data are from Argentina's administrative records and from simulations of model equilibria. This figure shows the correlation between the predicted changes in wage floors from the empirical analysis and the wage floor changes in the model-generated data. The predicted wage floor changes are constructed by multiplying the coefficient on the CBU shock from Table 1 and the CBU shock value for that CB unit. The wage floor changes from the model-generated data were re-scaled to match the mean and standard deviation of the predicted wage floor changes in the actual data. The dashed line is the 45-degree line.

Appendix Figure 10: Wage and employment changes vs. non-bargaining economy and bargaining centralization

(a) Relative mean absolute deviation in mean wage changes



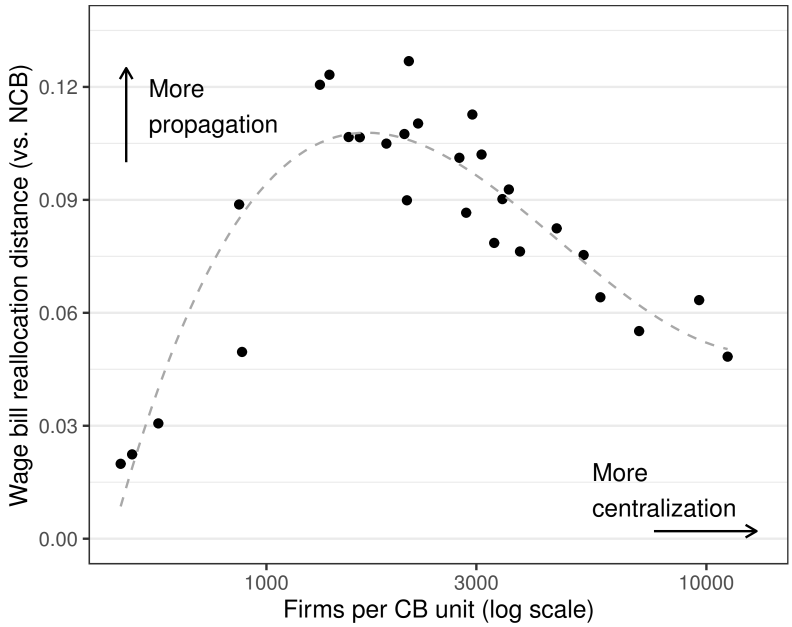
(b) Relative mean absolute deviation in employment changes



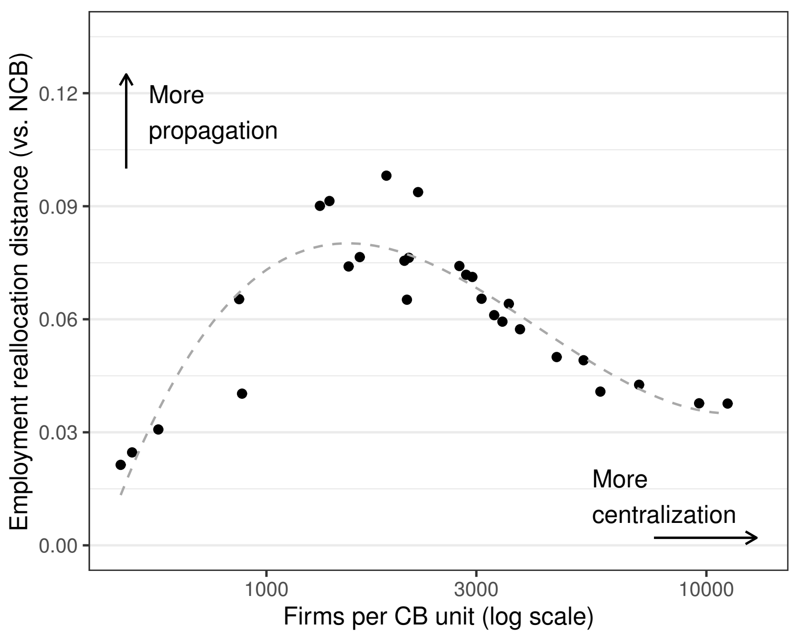
Notes: Data are from simulations of model equilibria before and after the trade shocks under different CB networks. This figure shows the relationship between bargaining centralization in the CB network and the relative mean absolute deviation in mean wage changes (Panel a) and employment changes (Panel b). The relative mean absolute deviation is defined as the mean absolute deviation in changes in mean wages or employment between the given CB network and a non-bargaining economy as a percentage of the mean change in the wage bill in the economy.

Appendix Figure 11: Wage bill and employment changes vs. non-bargaining economy and bargaining centralization

(a) Relocation distance in wage bill changes



(b) Relocation distance in employment changes



Notes: Data are from simulations of model equilibria before and after the trade shocks under different CB networks. This figure shows the relationship between bargaining centralization in the CB network and the relocation distance in wage bill changes (Panel a) and employment changes (Panel b) between the CB network and a non-bargaining economy. The relocation distance is measured as the fraction of total increases in wage bill or employment that would need to be reallocated across sub-markets to transform the distribution of changes in the CB network into that in the non-bargaining economy.

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