Labor and Product Market Effects of Mergers*

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Abstract

We use a two-level vertical supply chain model to forecast the labor and product market impact of mergers. In the model, firms and workers collectively bargain over wages upstream, and firms sell differentiated products and engage in Bertrand competition downstream. We illustrate how the model can be used to simulate product and labor market effects using data from the U.S. hospital industry and the Colombian Manufacturing Census. In our simulations, we find that mergers can substantially lower workers' welfare by reducing workers' bargaining leverage and/or increasing firm's bargaining leverage. We also find that worker harm is strongly related to the change in concentration caused by the merger in product and labor markets. Finally, we find that conventional merger simulation screens that only consider downstream competition frequently identify the mergers that harm workers when the merging firms are in the same product market.

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1 Introduction

The recent empirical literature finds that labor markets are not perfectly competitive (see, e.g.,Sokolova and Sorensen (2021)), and, in particular, there is evidence that mergers of competing employers in highly concentrated employer markets can reduce workers' wages (Prager and Schmitt, 2021b; Arnold, 2021). In response to growing evidence that some employers have power over workers and concerns that mergers could enhance this power, a number of scholars have suggested antitrust authorities and economists more generally should also consider how horizontal mergers affect workers in evaluating the competitive impact of mergers (see, for example, Naidu et al. (2018), Marinescu and Hovenkamp (2019), and Card (2022)). However, the labor market effects of mergers do not occur in isolation, but as a result of the interaction between workers negotiating wages with their employers and firms setting prices to their customers. To our knowledge, there are few model-based methodological approaches that attempt to jointly forecast the labor and product market effects of mergers using inputs available to antitrust authorities.[1]

Over the last forty years, industrial organization economists have developed tools to forecast the product market effects of horizontal and vertical mergers. For example, in markets where prices are set by producers charging a single price to a large number of consumers, competition is typically modeled as differentiated Bertrand (Werden and Froeb, 1994), and the impact of mergers can be simulated by forecasting how changes in product ownership affects equilibrium pricing. Alternatively, in markets where buyers and sellers are engaged in negotiations, price setting is typically modeled as the outcome of Nash bargaining (Gowrisankaran et al., 2015). In this modeling approach, a merger of sellers affects competition by increasing the bargaining leverage of sellers relative to buyers, likely resulting in an increase in prices paid to sellers. In this paper, we adapt modeling tools frequently used to study the competitive impact of horizontal and vertical mergers on the product market to simulate the labor

[1]Berger et al. (2023) have recently developed a merger simulation technique related to Berger et al. (2022) to forecast the effects of mergers on workers.

market effects of mergers.

We use a two-level vertical supply chain to examine how a merger of producers affects both competition in the final goods market and the welfare of production workers. Our model, which is analytically similar to that used by Sheu and Taragin (2021), assumes that upstream workers collectively bargain over linear wages with downstream manufacturers who employ Leontief production technology to manufacturer differentiated products.[2] In particular, our model allows mergers to affect the bargaining leverage of the merging parties as well as workers. To close the model, we assume that downstream manufacturers sell differentiated products where prices are determined via a Bertrand game with logit demand (Werden and Froeb, 1994).

An advantage of our modeling approach is that it can accommodate a variety of product and labor market configurations corresponding to mergers taking place in the economy. For instance, many mergers involve firms that produce non-tradeable goods such as healthcare or retail services. In these mergers, the geographic markets corresponding to the products produced are typically fairly narrow, corresponding to the region defined by consumers' willingness to travel for the service. The geographic market for mergers involving producers of tradeable goods, such as manufactured products, are typically much larger. In these cases, the geographic market is typically determined by shipping costs and/or product perishability, and markets can be regional, national, or even global. By contrast, the geographic market for labor is determined by workers' willingness to commute for a given job.[3] As a result, in tradeable good markets, it is common for workers to be employed in many distinct geographic labor markets corresponding to the regions where production takes place. Alternatively, in non-tradeable goods markets the geographic markets for products and labor typically overlap.

In our model, mergers of employers can have up to four different effects on worker welfare

[2]The assumption of Leontief production technology generates the constant marginal cost assumption that is standard in virtually all models used to simulate mergers.

[3]In some circumstance, workers may consider moving to seek employment, e.g., workers with highly specialized skills in thin local labor markets. In our application, we assume that moving costs are sufficiently high such that workers limit their job search to those employers located close to their residence.

depending on the relationship between the geographic market for the products produced by the merging firms and the labor markets for workers. First, when the merging firms sell in the same geographic market, a merger will result in a reduction in output (and thus labor demanded) reducing worker welfare. Second, mergers that reduce product market competition increase the rents over which firms and workers negotiate, which can increase workers' wages. Third, mergers that reduce product market competition increase firms' leverage: post-merger if negotiations at one manufacturing location fail the firm can recapture some of those sales at another location. Finally, mergers involving employers in the same labor market reduce workers leverage. In our model, we follow the assumption of Jarosch et al. (2024) and assume that mergers reduce the number of independent employment options in the labor market. The net effect of a merger on workers will depend on all of these effects.

Because our model cannot be analytically solved, we conduct a series of merger simulations to illustrate how our model can be used to simulate the labor and product market effects of mergers using the types of data that would be available in a merger investigation. We conduct these simulations using publicly available data for a non-tradeable good industry, inpatient medical services, using data describing the U.S. hospital industry and for tradeable goods industries use data from the Colombian Manufacturing Census. Although our model is very flexible, to illustrate the different mechanisms whereby mergers can affect the labor market, we conduct simulations corresponding to specific types of mergers with three configurations of the geographic markets for labor and products: merging parties with labor and product overlap ($\Delta\text{HHI}_L > 0$ and $\Delta\text{HHI}_P > 0$), only labor overlap ($\Delta\text{HHI}_L > 0$ and $\Delta\text{HHI}_P = 0$), and only product overlap ($\Delta\text{HHI}_L = 0$ and $\Delta\text{HHI}_P > 0$).[4]

In the first case, we use data from the U.S. hospital industry to simulate mergers where the geographic market for the service produced is the same as assumed geographic market

[4]The HHI is the Herfindahl index defined as the sum of the squared market shares of market participants and the (ΔHHI is the change in the Herfindahl index caused by a merger. In our model, mergers can change the HHI in both the product market and the labor market.

for labor.[5] In these simulations, we assume that the wages of nurses and pharmacists are negotiated, and examine how mergers of hospitals that compete in both the product and labor market change negotiated wages.[6]

Next, we consider mergers that directly affect the labor market but not the product market also using data from the hospital industry. In this scenario, we assume that the geographic market for inpatient services is highly localized as in the first case, but that the geographic market for labor is broader (roughly corresponding to a commuting zone rather than the narrow draw area of hospitals). In this case, we simulate mergers between hospitals in different geographic markets for the product market but assume that both hospitals hire nurses and pharmacists from a common labor market.

Finally, we examine mergers that directly affect the product market but not the labor market. This situation can occur in industries where the product produced by the merging firms is tradeable: consumption of the merging firms' product can take place in regions different than those where the product is produced. In this scenario, we simulate mergers between Colombian manufacturing firms in the same industry but limit the set of mergers simulated to those with of firms with production facilities in different parts of Colombia. That is, mergers where the merging firms are not direct competitors in the labor market.[7] In these simulations, we assume that only skilled workers' wages can be affected by mergers.[8]

[5]In all of the simulations, we use publicly available data describing market shares, margins, employment levels and wages to calibrate the demand parameters of our model and determine the relative bargaining power of workers to firms. Using the calibrated model, we then simulate the impact of randomly generated mergers on downstream prices and the wages of affected workers using our model. In the simulation study, we examine the set of all possible mergers between two competing firms within the specified geographic markets where we have sufficient data, and where the merger would increase HHI by at least 100 and result in a post-merger HHI of at least 1500.

[6]Prager and Schmitt (2021b) find that nurse and pharmacist wages are the most negatively affected by mergers. For this reason, we focus on nurses and pharmacists as the group most likely to be affected by mergers.

[7]To be clear, our model can accommodate tradeable goods mergers could involve firms with production facilities in the same labor market. We limit the set of mergers here to isolate a mechanism affecting bargaining in our framework.

[8]Prager and Schmitt (2021b) also find that skilled workers but not unskilled workers were affected by hospital mergers suggesting that skilled workers are more likely to have industry specific human capital. For this reason, we model skilled workers as those most likely to be harmed by mergers in manufacturing industries.

To illustrate the different mechanisms that cause mergers to affect worker welfare, we first simulate mergers using our full model and two alternative nested models. We begin with the canonical merger simulation model that assumes that mergers only directly affect product market and only affect workers through a reduction in employment in what we call the 'downstream only' model, see e.g., Werden and Froeb (1994). Next, we allow mergers to also affect workers' negotiated wage, but assume that the threat point of the worker is exogenously determined as in Horn and Wolinsky (1988). Finally, we simulate the merger using the full model, where the merger removes an option from the workers threat point, further affecting the negotiated wage. In our simulations, we find that mergers have negative, though relatively small, impacts on worker surplus in the first two models where workers do not lose an option from their threat point.[9] By contrast, the predicted labor market impact of mergers is typically much larger in the full model for all three configurations of product and labor markets we examine. We take this finding as providing suggestive evidence that mergers can harm workers by reducing workers' leverage (through losing a rival employer in the labor market) as well as through reducing labor demand and increasing employer leverage (through allowing the firm to recapture sales at another outlet should negotiations fail).

We next examine how the change in worker surplus under our full model is related to the change in labor or product market concentration (ΔHHI_L, ΔHHI_P). For each of the labor and product market configurations we study, we find that there is a negative relationship between the change in concentration caused by the merger and worker welfare. Interestingly, we see that worker surplus falls much more quickly with ΔHHI_L in the hospital simulations where the merger removes an independent employment option from workers' local labor market than in the tradeable goods case (using Colombian manufacturing data) where the mergers we examine only affect the product market (ΔHHI_P). However, even these mergers

[9] In all but the full model the impact of the mergers that only affect the labor market is effectively zero, in large part because the predicted change in labor demand is negligible. In cases where there is product market overlap, the impact on workers is larger because of the reduction in employment.

are predicted to result in large reductions in worker surplus following large changes in market structure ($\Delta\text{HHI}_P > 1000$).

We then separately examine the effects of mergers on employment and wages for each of the three cases we study. For the hospital mergers that only affect the labor market, we find that mergers only reduce wages. Moreover, the reduction in wages is strongly negatively associated with the ΔHHI_L.[10] The simulated hospital mergers that affect both the product and labor market are always predicted to lower wages and output. In principal, these mergers could increase worker wages. While employment falls (because of the reduction in product market competition), workers may benefit as increased rents are partially passed through as higher wages. In this case, however, the reduction in worker leverage caused by the merger more than offsets any benefit the workers from the increased rents transferred from consumers. The findings from the simulations of manufacturing mergers from the Colombian Manufacturing Census are, perhaps, the most interesting. Here we see that for mergers with smaller impacts on competition ($\Delta\text{HHI}_P < 1000$) the change in wages is very small and in some cases positive. In this case, where mergers only affect the product market, the increase in rents available to workers effectively offsets the increase in firm's leverage in bargaining when the mergers impact on competition is relatively modest.[11] However, as the mergers become more competitively significant, i.e., ΔHHI_P increases, we see that simulated wages begin to fall substantially.

The results of our merger simulations indicate that if wages are determined by a bargaining process like ours, traditional 'downstream only' merger screens will underestimate, often severely, the welfare effects of mergers for workers. However, it does not follow that traditional downstream only merger simulation models cannot play an important role in identifying the mergers that would harm workers. In our final analysis, we estimate the

[10] In principal, these mergers could have increased labor demand (as reduced wages are passed through to lower inpatient prices). However, because nurse and pharmacist wages account for a very small fraction of a hospital's costs (2%) the change in labor demand caused by the reduction in wages was effectively zero.

[11] In our model, a firm's leverage increases in this case because post-merger the firm will continue to make sales at its newly acquired plant should negotiations fail at its original plant (and vice-versa).

efficacy of a conventional merger screen in identifying mergers that would harm workers. In cases where hospital mergers directly affect the product and labor market (the geographic markets for inpatient services and labor coincide), we find that traditional screens frequently identify the mergers that harm workers. For example, when the geographic market for the labor and product markets are identical, 77% of mergers that harm workers by at least 1% and 99% of mergers that harm workers by 5% are flagged as harmful by the downstream only merger simulation screen. However, by construction, if the merger being studied does not have a product market overlap (that is, if the merger only reduces competition in the labor market), downstream merger screens will never identify the mergers that harm workers.

The remainder of our paper is organized as follows. Section 2 discusses how our paper relates to the literatures on labor market competition, bargaining, and merger simulation. Section 3 describes our modeling approach. Section 4 gives details about the labor and product market configurations that we analyze and simulation results from calibrations to the US hospital industry and Colombian manufacturing. Section 5 examines the extent to which a downstream only model is effective at identifying mergers that harm workers. Section 6 concludes.

2 Literature Review

Our paper is related to a rapidly growing literature that examines departures from perfect competition in labor markets.[12] Multiple studies have found that firms can substantially increase the number of employees they hire by raising the offered wage, a finding inconsistent with the infinite firm labor supply elasticity predicted by a model of perfect competition, e.g., Sokolova and Sorensen (2021). Other research finds evidence of rent sharing between workers and firms: firms experiencing profit shocks appear to share some of those rents with employees. If labor markets were perfectly competitive, firms would have no incentive to

[12]See Card (2022) for a recent review.

share rents with their employees. Labor economists have developed a number of models to explain the source of employer power, most prominently those viewing search frictions as the source of employer power (Burdett and Mortensen (1998) and Manning (2003)). Existing theoretical models of employer power rarely allow for employers to take into account the behavior of rival employers in setting wages.[13] Interestingly, a handful of recent empirical papers find that mergers of competing employers in highly concentrated employer markets reduced worker's wages (Prager and Schmitt, 2021b; Arnold, 2021). These results suggest that in concentrated markets employers may behave strategically in setting wages: employers appear to lower their wages when facing fewer competitors in the labor market following mergers.

Our paper is most similar to a research approach that examines how wages are generated in a model of bargaining (see, e.g., Jarosch et al. (2024) and Schubert et al. (2021)). In this framework, the employee/employer match generates rents, and a worker's wages will be a function of both the worker's opportunity wage and a fraction of the rents generated by the match. By contrast, if the labor force were perfectly competitive, any rents the firm earned would not be passed through to workers. A series of empirical papers have found evidence that workers capture a significant share of rent (between 0.02 and 0.29) consistent with the bargaining approach (Card et al., 2018).

Our paper also adds to (and draws heavily from) the literature on merger simulation, see, Whinston (2007) and Asker and Nocke (2021) for a general description of these techniques. Most merger simulation research has focused on forecasting the impact of mergers in the product markets where the merger takes place, e.g.,Werden and Froeb (1994), Nevo (2001). Implicitly, these papers have assumed that mergers in product markets do not have impacts on input markets. Our paper most closely relates to recent research that has extended merger simulation to allow downstream mergers to also impact behavior in upstream markets and vice versa (Sheu and Taragin, 2021).

[13] A notable exception being Berger et al. (2022) who model employers engaged in Cournot competition.

Berger et al. (2023) take a very different (and complementary) approach to simulate the effects of mergers on workers. They examine mergers between firms that each produce a single, undifferentiated product with heterogeneous production technologies who compete strategically for workers. Their model directly allows for the upward sloping labor supply curve common in many monopsony models.[14] By contrast, in our model we analyze how mergers between firms producing differentiated products in either overlapping or disjoint product and labor markets affect wages and product prices through a model of efficient bargaining. [15]

3 Model

The effect of horizontal mergers in the product market are well known. Absent efficiencies, most models predict that prices rise and market output falls. What is less understood is how horizontal mergers affect the employees of merging firms and workers at competing firms. Our research contribution is to examine the labor market effects of horizontal mergers by simultaneously modeling the effects of the merger on both the product and labor market.

We adopt the bargaining framework of Horn and Wolinsky (1988) that was originally developed to examine how a union and employer negotiate over wages. While unions only represent a fraction of U.S. private sector employment, unions can play a role in mergers involving industries scrutinized by antitrust authorities, including: supermarkets (Kroger's/Albertson's (2024), airlines (JetBlue/Spirit (2023), US Airways/American (2013), and publishing (Penguin Random House/Simon & Schuster(2022)).[16][17]

[14]Berger et al. (2023) also depart from a number of the standard assumptions made in implementing traditional merger simulation tools. In particular, Berger et al. (2023) use nested CES labor supply with decreasing returns to scale, where parameters are calibrated at the national level across all industries, while incorporating strategic interaction in labor demand in the form of Cournot competition.

[15]Specifically, in our paper employment in the markets affected by mergers is determined by the product market. For example, if post-merger output falls employment in the industry will fall. Displaced workers will then gain employment in the outside sector

[16]The BLS estimates that the private sector unionization rate was 6.1% in 2021.

[17]The FTC's complaint in Kroger's/Albertson's alleges that "The combined Kroger and Albertson's would

We follow Draganska et al. (2010) and Sheu and Taragin (2021) in relaxing two assumptions made by Horn and Wolinsky (1988). First, we allow for variation in the bargaining power parameter, which allows us to distinguish strong unions that are capable of extracting additional employer surplus from weak unions that are unable to increase wages beyond take-it-or-leave-it levels. Second, we allow for the workers' threat point, or opportunity wage, to be set endogenously. Doing so allows us to analyze how downstream mergers affect both wages and product prices in a vertical supply chain.

In addition, we extend Sheu and Taragin (2021) to accommodate certain features of employer/employee bargaining. First, we explicitly allow for employers that may or may not produce competing products in the same geographic region to be viable employment options for workers (through the the workers' threat point). Second, we examine how a merger affects negotiations by removing an independently operated employment option from the local labor market. Following the approach of Jarosch et al. (2024), post-merger we eliminate workers' ability to obtain employment at another outlet of the merged firm if workers and the firm fail to negotiate a wage. That is, in post-merger negotiations, all outlets now owned by the merged firm are removed from the threat point. Together, these two modifications allow us to examine how changes in the set of employment options available to workers resulting from mergers affect worker welfare.

In the following sections, we present product demand (Section 3.1), the Bertrand equilibrium for product prices (Section 3.2), and the bargaining game for wages, including worker and firm threat points (Section 3.3).

3.1 Product Demand

Our model is general and flexible to cover different labor and product market overlaps. However, for purposes of exposition and ease of notation, we outline the model assuming

have more leverage to impose sub-par terms on union grocery workers that slow improvements to wages, worsen benefits, and potentially degrade working conditions.".

there are i) multiple labor markets but only a single product market and ii) each product is manufactured in exactly one labor market. We do illustrate below different labor and product market sizes (i.e. different market elasticities.

We assume that product demand follows a standard logit demand framework. There is a finite set of products, $n \in N$. Each consumer chooses a single unit of one product, or instead chooses an outside option, which could be a product outside the product market, or not consuming at all. Product market size is denoted as $\mathcal{S}$. Consumer i receives utility

$$V_n^i = \delta_n - \alpha p_n + \epsilon_{in}$$

from choosing good $n \in \{N, 0\}$, where δ_n denotes the value of the good n to all consumers, p_n the price of good n, $-\alpha$ the dis-utility of spending money, and ϵ_{in} the idiosyncratic taste of consumer i for good n, which is not observed by the firm.

We assume that ϵ_{in} is distributed according to the Gumbel distribution. We also normalize utility from the outside option ($n = 0$) to be zero. Therefore, the consumer demand for product n is given by s_n, where

$$s_n = \frac{\exp(V_n)}{1 + \sum_{n \in N} \exp(V_n)}$$

is the share of consumers choosing product n.

3.2 Price Setting

We assume that product prices are set by firms in Bertrand equilibrium. Each firm may produce one or more products, such that $|J| \leq |N|$. Let Z_j denote the set of products produced by firm $j \in J$.

We assume a Leontief production function, meaning that each product is produced from

a single unit of labor and non-labor input, using constant marginal cost technology. Each unit of labor costs w_n, while each unit of non-labor input costs c_n. This assumption implies that labor and non-labor inputs are perfect complements, and each unit of product n costs $c_n + w_n$ to produce.[18]

Firm j maximizes prices over all the products that it owns, $h \in Z_j$, solving the following:

$$\max_{\{p_h\}_{h \in Z_j}} \sum_{h \in Z_j} \mathcal{S}(p_h - w_h - c_h) q_h. \tag{1}$$

Rearranging the firm's first order condition for product n yields the following expression for margin:

$$p_n - w_n - c_n = -\frac{1}{\alpha(1 - \sum_{h \in Z_j} s_h)} \tag{2}$$

The Bertrand equilibrium is the set of prices p_n for $n \in N$ such that Equation 2 is satisfied for all n.

3.3 Wage Setting Through Bargaining

Wages are set using the Nash-in-Nash bargaining concept of Horn and Wolinsky (1988). Below we outline the payoffs and threat points of firms and workers, and the bargaining solution.

3.3.1 Firm Payoff

For each product that is produced, workers collectively bargain for a single wage, w_n, to be paid per unit of output produced. If a firm reaches an agreement with the workers in labor

[18] While w_n will be allowed to adjust in equilibrium following the bargaining framework, for tractability we assume that other inputs are sold in a competitive market, meaning c_n will be held fixed.

market k producing product n, the firm is able to produce product n and receives profit:

$$\pi_n = \mathcal{S}(p_n^* - w_n^* - c_n)q_n$$

where w_n^* is the wage solving the bargaining game outlined below, and p_n^* solves the Bertrand game outlined above.

3.3.2 Firm Disagreement Payoff

The assumption we make about the firm disagreement payoff is one commonly used in the literature, see, e.g., Draganska et al. (2010) or Gowrisankaran et al. (2015). If a firm fails to reach an agreement with the workers, product n cannot be produced. The firm, however, continues to produce any other products that it owns, and in fact captures additional sales from consumers who substitute from the discontinued product n to other products owned by firm j.

The payoff to the multi-product firm failing to reach an agreement is therefore:

$$\sum_{h \in \{Z_j \setminus n\}} (p_h - w_h - c_h) \frac{s_h}{1 - s_n} s_n \mathcal{S}$$

Note that a single product firm will receive zero payoff following a failure to reach an agreement with workers.

3.3.3 Worker Payoff

Suppose there are L labor markets and for each labor market $m \in L$, let $\mathfrak{S}^{\mathfrak{m}}$ denote the size of the labor market and $N_m \subseteq N$ denote the set of products produced in labor market m. Assume that each product $n \in N$ is produced in exactly one labor market. In addition, let $\mathfrak{L}_m \subset N_m \cup \mathfrak{o}_m$ denote the set of employment opportunities available to workers in a

labor market, where $\mathfrak{o}_m$ is an outside option specific to labor market m whose wage $w_{\mathfrak{o}_m}$ is exogenously determined and could represent the payoff from not working at all, or working in a job outside the labor and product markets. For each $n \in N$, the $\mathfrak{s}_{\mathfrak{n}}^{\mathfrak{m}}$ workers who produce product n collectively bargain over the wage w_n. Under Leontief production technology, the number of workers who product n equals the number of units of n produced, meaning that the labor market share must be equal to the product market share up to the relative market sizes: $\mathfrak{s}_{\mathfrak{n}}^{\mathfrak{m}}\mathfrak{S}^{\mathfrak{m}} = s_n\mathcal{S}$.[19]

Workers care about both the wage paid and the output, their payoff from an agreement with the firm equal to $w_n\mathfrak{s}_{\mathfrak{n}}^{\mathfrak{m}}\mathfrak{S}^{\mathfrak{m}} = w_n s_n(\mathbf{p})\mathcal{S}$. Workers do not directly bargain over $s_n(\mathbf{p})$ but do take into account how a higher w_n will result in a lower $s_n(\mathbf{p})$ through increased product prices p_n.

3.3.4 Worker Disagreement Payoff

The workers' disagreement payoff takes a significantly different form than the firm's disagreement payoff. Workers are constrained to find employment in the labor market they live in. As a result, in the event employees and employer negotiations break down, the workers' alternative options are limited to employers located in the same geographic area they live in, whether that be in the same or different product market. In addition, like Jarosch et al. (2024), we assume that firms will not make multiple job offers to workers. For this reason, it is not possible for workers to get jobs producing a product owned by the same firm following a failure to reach an agreement in collective bargaining.

A failure of a firm and its workforce to reach an agreement has two effects that are relevant for determining the workers' disagreement payoff. First, consumers substitute away from discontinued product n to other products produced by rival firms. As a result, demand for substitute products increases. This, in turn, increases the demand for workers at those firms

[19]Note that this flexibility in the market sizes $\mathfrak{S}^{\mathfrak{m}}$ and $\mathcal{S}$ allows us to model different labor and product market elasticities that may occur in real world applications.

producing substitute products. Workers who had previously worked at the firms producing product $n \in Z_j$ can only consider working at other firms located in their labor market or the outside employment option. Since consumer demand follows the Gumbel distribution, diversion from product n to product l is given by $\frac{s_l}{1-s_n}$. Second, as noted above, following a merger, if workers fail to reach an agreement with the firm, they can only seek employment with non-merging firms. This assumption will tend to make workers worse off following a merger, since post-merger Z_j expands. The workers' threat point is as follows:

$$\sum_{l \in \{\mathfrak{L}_m \setminus Z_j\}} w_l \frac{s_l(\mathbf{p}) \frac{\mathcal{S}}{\mathfrak{S}^{\mathfrak{m}}}}{1 - s_n(\mathbf{p}) \frac{\mathcal{S}}{\mathfrak{S}^{\mathfrak{m}}}} s_n(\mathbf{p}) \mathcal{S}$$

The workers' threat point is increasing in the wages at other firms, and the attractiveness of substitute products to consumers. Under the Gumbel distribution this means that a worker producing a product with a small market share (less attractive product) has a better threat point than a worker working at a large firm (more attractive product), holding wages constant.

3.3.5 Bargaining Solution

Wages are assumed to be set in a Nash bargaining game. Worker surplus is given by the worker payoff from reaching an agreement minus the disagreement payoff, and likewise for firm surplus. The bargaining solution will maximize the product of worker and firm surplus, weighted by bargaining power, which is given by λ_m for each market $m \in M$. The bargaining problem is therefore:

$$\max_{w_n} \left(w_n s_n(\mathbf{p})\mathcal{S} - \sum_{l \in \{\mathfrak{L}_m \setminus Z_j\}} w_l \frac{s_l(\mathbf{p})\frac{\mathcal{S}}{\mathfrak{S}^{\mathfrak{m}}}}{1 - s_n(\mathbf{p})\frac{\mathcal{S}}{\mathfrak{S}^{\mathfrak{m}}}} s_n(\mathbf{p})\mathcal{S} \right)^{1-\lambda_m} \times \tag{3}$$
$$\left((p_n - w_n - c_n)s_n(\mathbf{p})\mathcal{S} - \sum_{h \in \{Z_j \setminus n\}} (p_h - w_h - c_h)\frac{s_h(\mathbf{p})}{1 - s_n(\mathbf{p})} s_n(\mathbf{p})\mathcal{S} \right)^{\lambda_m}$$

We make two assumptions for tractability. First, we assume that, for a given bilateral negotiation, all other negotiations are held fixed, commonly referred to as "Nash-in-Nash" and developed by Horn and Wolinsky (1988). Second, we assume that firms view downstream prices as fixed when bargaining over wages. Note that in equilibrium, product prices $\mathbf{p}$ will depend on negotiated wages, but this relationship is not explicitly modeled in the bargaining game due to tractability (see e.g. Draganska et al. (2010)). This means that product prices and wages are set simultaneously in equilibrium.Note that unlike Horn and Wolinsky (1988), which assumes worker disagreement payoffs are exogenously given, in our model, the disagreement payoffs are a function of wages that are also the outcome of simultaneous bargaining .

Taking the derivative with respect to to w_n and rearranging yields:

$$\lambda_m \left(w_n - \sum_{l \in \{\mathfrak{L}_m \setminus Z_j\}} w_l \frac{s_l(\mathbf{p})\frac{\mathcal{S}}{\mathfrak{S}^{\mathfrak{m}}}}{1 - s_n(\mathbf{p})\frac{\mathcal{S}}{\mathfrak{S}^{\mathfrak{m}}}} \right) = \tag{4}$$
$$(1 - \lambda_m) \left((p_n - w_n - c_n) - \sum_{h \in \{Z_j \setminus n\}} (p_h - w_h - c_h)\frac{s_h(\mathbf{p})}{1 - s_n(\mathbf{p})} \right)$$

A non-linear solver may be used to solve the system of $2|N|$ equations characterized by equations 2 and 4 for w_n^*, p_n^*. Post-merger equilibrium prices can be solved for by changing the ownership structure, or the set of products included in each set Z_j.

4 Model Implementation

In this section of the paper, we show how our model may be used to forecast the labor and product effects of mergers in different labor and product market configurations that frequently confront antitrust agencies. For example, markets where firms produce non-tradable goods, such as healthcare or retail services, where the geographic markets for labor and products may coincide. Alternatively, many mergers involve tradeable goods producers, such as meat packers or manufacturers, where the geographic market for final goods may be larger than the labor markets where the products are produced.

Because our model cannot be analytically solved, we cannot derive how the equilibrium predictions of the model change in response to changes in the model's primitives. For this reason, we use a simulation approach to examine the model's predictions. As we show, our model can predict the labor market effects of mergers using information commonly available to antitrust economists working on merger investigations: market shares, product prices and costs, and wages. In general, this type of detailed firm and worker level data is nonpublic and unavailable for research. We have, however, identified two public use data sets that contain sufficient information that can be used to illustrate how our model can be used to simulate merger effects for tradeable and non-tradeable goods. We use data from the U.S. hospital industry to simulate non-tradeable good mergers that either directly affect both the product and labor market or only the labor market. We then use data from the Census of Colombian Manufacturing to examine a subset of possible tradeable good mergers that affect the product market but do not change workers' local employment choices.

In the remainder of this section, we describe how we construct the geographic and product markets for the different market configurations examined in the simulations. Next, we describe how we use data from the U.S. hospital industry and Colombian manufacturing industries to calibrate the model. Finally, we present the findings from our simulations.

4.1 Market Configurations

The first step in simulating the price and wage effects of mergers is to specify the geographic and product markets for both the good being produced and the type of labor used in production. In our simulations, we focus on three configurations that illustrate the different mechanisms whereby mergers can affect negotiated wages in our model. The first corresponds to the non-tradable goods case when the geographic market corresponding to the product market and the labor market completely overlap (see Panel 1 of Figure 1). That is, the workers producing the product live and work in the same region where the product is consumed. This case likely corresponds to many non-tradable goods industries, such as the inpatient hospital market we examine, where the final good (health services) is produced and consumed in the same region. In this scenario, the merger of firms 1 and 2 will affect both the product market and the labor market. We define the product market as hospitals providing acute inpatient care, such as childbirth, major surgeries, or the treatment of serious illnesses. [20] In general, patients have strong preferences to receive hospital services relatively close to where they live, e.g., Gowrisankaran et al. (2015). For this reason, we define the geographic market for inpatient hospital services to be the Hospital Service Area (HSA) which is defined as the collection of zip codes whose residents receive most of their hospitalizations from the hospitals in that area.[21]

[20] Antitrust agencies often define a product market to be inpatient general acute care services provided by hospitals, see, for example the complaint from a recent FTC merger challenge (Novant and Community Health Systems), see, especially, page 4.

[21] See `https://www.dartmouthatlas.org/faq/`.

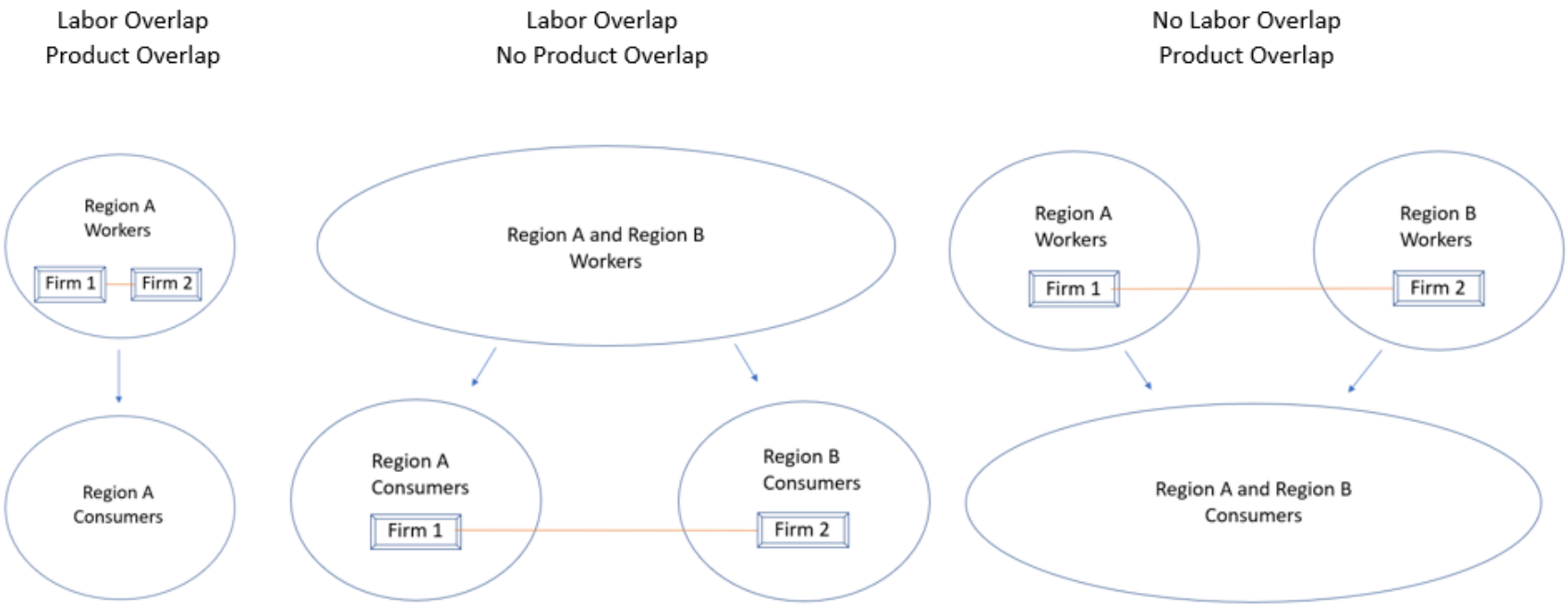

Figure 1 Product and labor market configurations.

We next specify the type of labor affected by the merger and the size of the geographic market for that type of labor. While hospitals directly employ many different types of employees, it is unlikely that all workers would be equally affected by mergers. In particular, workers with human capital specific to the hospital industry would likely benefit more from competition between potential hospital employers than unskilled workers (janitors) that could provide similar services in other industries. Prager and Schmitt (2021b)'s examination of the wage effects of hospital mergers found that in highly concentrated markets skilled workers, especially those with human capital specific to medical industries (nurses and pharmacists), fell most following mergers while unskilled workers with general human capital were unaffected. For this reason, we define the labor market affected by the merger to that for nurses and pharmacists.[22] In the first scenario, we define the geographic size of the labor market to be identical to that for the product market, the HSA, and only consider the mergers of hospitals located in the same HSA. This assumption implies that workers are willing to travel as far for employment as patients are willing to travel for inpatient hospital care.

The second non-tradable goods case we examine is mergers of firms that do not compete in the product market but do compete in the labor market (Panel 2 of Figure 1). In this case, the merger can affect the wages of workers, but only through changes in the labor market, as there is no reduction in product market competition because firms are selling to consumers in distinct geographic markets.[23] We again use data from the hospital industry to simulate mergers of this type. As in the first case, the product market is defined to be inpatient hospital services where the geographic market is defined as the HSA. We also assume that the labor market that is potentially affected by the merger is that for nurses and pharmacists. The distinction between the first and second case is that we now assume the

[22]While we would like to explore how mergers affect different types of healthcare workers, the narrowest hospital specific employment category in our data source corresponds to the nurse and pharmacist category

[23]Note that for illustrative purposes we assume firms do not compete at all in the product market, but the model could accommodate scenarios where there is some product market overlap but more labor market overlap.

geographic market for labor is larger. Specifically, we assume workers consider all hospitals within a Hospital Referral Region (HRR) as being potential employers. The HRR is an aggregate of contiguous HSAs and typically corresponds to a metropolitan area.[24] In this scenario, we consider mergers of hospitals in different HSAs (different product markets) that are located in the HRR (the same labor market).

The final case we examine are mergers in tradeable goods where there is no overlap in the labor market, but there is an overlap in the final goods market (Panel 3 of Figure 1). Here, we limit the merger simulations to those involving merging firms operating in the same industry but that hire labor in different regions and do not compete directly for workers.[25] In this case, the merger can affect the wages of workers, but only through changes in the product market (less output, but higher profits). This case most clearly corresponds to tradeable goods such as manufactured products. We analyze this case using data from the 1991 Census of Colombian Manufacturing.[26] This data set identifies the industry (as measured by an SIC code) of approximately 7,000 plants located in 27 different regions of Colombia. In simulating mergers for this scenario, we define the product market as the 4-digit SIC code assigned to a plant and assume that the geographic market for products is Colombia.[27] We define the labor market to be skilled workers in the industry the merger takes place in.[28] Further, we assume that workers do not consider employers outside of their region when negotiating wages. That is, the geographic market for labor is defined to be the

[24]HRRs correspond to the region that serves patient needing highly specialized care, such as major cardiovascular surgical procedures and neurosurgery, that can only be provided by large hospitals with specialized departments. Typically, patients requiring standard care will choose a hospital within their HSA and those needing specialized care will consider all hospitals within the HRR. The Dartmouth Atlas defines 3436 HSAs in the U.S. (most with a single hospital) and then aggregates those HSAs into 306 HRR corresponding to the larger regions that correspond to the geographic region for specialized care.

[25]Our model can also accommodate the case where firms hiring labor in the same labor market sell into a common tradeable goods market. However, to illustrate how mergers only affecting the product market can affect workers, we focus on the case of only product market overlap for tradeable goods producers.

[26]This data has previously been used in studying trade, e.g., Fernandes (2007), and estimating markups, e.g., Raval (2023).

[27]We exclude exports from the calibration.

[28]This assumption is consistent with Prager and Schmitt (2021b) who find that skilled workers are most likely to be adversely affected by mergers.

region the plant is located in. The mergers we consider are of plants in the same industry but different regions within Colombia.[29]

4.2 Parameter Calibration

Having specified the markets for products and labor, we now show how we can use observable information describing markets to construct the variables to calibrate the model's parameters. Our first task is to identify the demand parameters α and δ_j as a function of margins and shares, assuming the market is in the pre-merger equilibrium described by our model. To do so we exploit Equation 2, the employer's first order condition. With at least one employer's margin and market share, this equation allows us to recover the demand parameter reflecting customer sensitivity to price, α.[30] Given α, we can then recover equilibrium margins for all other firms in the market using observed market shares for each firm and each firm's first order conditions. Then, given observed cost information and model predicted margins, we infer product prices. Demand parameters δ_j reflecting the relative customer demand for each product are inverted from market shares, prices, and α. In turn, given equilibrium employer margins, we use the bargaining first order condition in Equation 4 above to infer λ. We allow the bargaining parameter λ to vary by product market based on the ratio of the firm's and the workers' gains from trade, where workers' gains from trade are defined by relative wages inside and outside the market.

[29]While we have attempted to construct reasonable representations of markets for labor and products, we have not conducted a formal market definition exercise to determine the markets for labor or products corresponding to each hypothetical merger like that described in the 2023 Merger Guidelines. `https://www.ftc.gov/system/files/ftc_gov/pdf/2023_merger_guidelines_final_12.18.2023.pdf`. In an actual merger investigation, economists working for the government and the merging parties would have access to detailed non-public data to more precisely determine the contours of the product and labor markets potentially affected by the merger.

[30]We take the margin of the largest firm for which margin is available.

4.3 Data Inputs

We obtain our inputs from two primary data sources. The first is the Centers for Medicare and Medicaid Services' (CMS) Healthcare Cost Report Information Center (HCRIS).[31] Under federal law, all hospitals that bill Medicare are required to provide HCRIS with annual reports including major types of costs, revenues, number of patient admissions, and numbers of different types of employees. Thus, this data source allows us to identify virtually all acute care inpatient hospitals in the U.S. The major data constraint we face is having sufficient information describing hospitals to calibrate the model as described above. In our application, this requires that we observe firm level market shares and wages for each significant hospital, and the margin of at least on hospital, in a specified geographic market. In our simulations, we focus on the set of hospitals observed in 2006 as in this year we have complete data for a large fraction of hospitals. We also use information from the American Hospital Association's annual survey to identify the owner of a hospital (e.g. if the hospital is in a system) and the HSA the hospital is located in.

Our second primary data source is the 1991 Census of Colombian Manufacturing provided by the Departamento Administrativo Nacional de Estadistica between 1981 and 1991. The data source contains plant level information including the number of employees of different types (e.g., unskilled, skilled, and managerial), total compensation paid to each type of worker, measures of fixed and variable costs, total domestic sales, total sales for exports. In addition, the data source identifies the primary industry the plant is in, and the region of Colombia that the plant is located in. Unfortunately, the data does not identify the owner of a plant. This means we cannot observe if multiple plants have a common owner. Consequently, we assume that pre-merger, each plant is a sole proprietorship.

Further details regarding how we constructed employee wages as well as firm-level margins

[31] We use a data set that was cleaned and used by Prager and Schmitt (2021b) and is available at `https://www.openicpsr.org/openicpsr/project/120834/version/V1/view`. For more information on data and code see Prager and Schmitt (2021a).

Table 1: Pre-Merger Summary Statistics for Simulated 2006 Health Service Area Mergers (n=855), Products (n=1044), Markets (n=325), Product and Labor Market Overlap

	50%	5%	25%	75%	95%
Calibration Inputs					
Margin (%)	58	25	47	68	78
Hospital Cost per Worker ($100k/year)	30	14	23	41	94
Number of Workers per Hospital	30	1.3	8.8	63	162
Hospital Wage ($100k/year)	0.65	0.51	0.59	0.71	0.81
Calibration Outputs					
Hospital Outside Wage ($100k/year)	0.39	0.32	0.36	0.41	0.46
Hospital Margin per Worker ($100k/year)	28	5.1	14	52	116
Hospital Price per Worker ($100k/year)	65	28	46	96	187
Market Price Sensitivity (α)	-0.069	-0.39	-0.14	-0.037	-0.014
Merger Conditions					
Market Bargaining Power (λ)	0.99	0.97	0.99	0.99	0.99
Merger HHI_L and HHI_P	4,371	2,093	2,917	5,716	8,821
Merger ΔHHI_L	798	131	284	2,379	4,781
Merger ΔHHI_P	798	131	284	2,379	4,781

and shares for both primary sources may be found in Appendix A.

4.4 Calibration Inputs and Outputs

Tables 1-3 contain descriptive statistics describing the calibration inputs and outputs used in our simulations. Table 1 describes the first scenario where we analyze hospital mergers that have both a product and geographic overlap. Our sample consists of 325 HSA markets with a total of 1044 hospitals and 855 simulated mergers.[32] We highlight a few important characteristics from the table. First, hospitals tend to have relatively high margins: in the median market margins are estimated to be 58%. Second, the mergers we simulate lead to large increases in market concentration in already concentrated markets. The median merger increases HHI_P (=HHI_L) by about 798 resulting in a post-merger HHI_P (HHI_L) of 4371. Third, our model predicts that firms have most of the bargaining power: λ is estimated

[32]We simulate all pairwise combinations of hospital mergers likely to have a meaningful impact on competition. Specifically, we only include simulated mergers with a post-merger HHI of at least 1500 and a HHI change of at least 100. See Appendix for further details on the set of mergers.

Table 2: Pre-Merger Summary Statistics for Simulated 2006 Hospital Referral Region Mergers (n=324), Products (n=526), Markets (n=62), No Product Market Overlap, Labor Market Overlap

	50%	5%	25%	75%	95%
Calibration Inputs					
Margin (%)	60	26	49	68	81
Hospital Cost per Worker ($100k/year)	30	14	22	40	92
Number of Workers per Hospital	26	1.2	8.1	59	178
Hospital Wage ($100k/year)	0.64	0.52	0.59	0.71	0.82
Calibration Outputs					
Hospital Outside Wage ($100k/year)	0.38	0.34	0.36	0.4	0.46
Hospital Margin per Worker ($100k/year)	25	5.1	13	48	100
Hospital Price per Worker ($100k/year)	61	27	46	90	179
Market Price Sensitivity (α)	-0.081	-0.4	-0.15	-0.039	-0.015
Merger Conditions					
Market Bargaining Power (λ)	0.99	0.98	0.99	0.99	0.99
Merger HHI_L	2,428	1,579	2,163	3,082	4,673
Merger ΔHHI_L	357	110	171	691	1,869
Merger ΔHHI_P	0	0	0	0	0

to be very close to 1. This low level of worker bargaining power, however, does not imply that workers do not gain from bargaining. Because the margin the typical hospital earns per nurse/pharmacist is large, roughly $2.8 million per nurse/pharmacist, capturing even a small amount of surplus can dramatically benefit nurses/pharmacists. Finally, while nurses and pharmacists are an important input into inpatient care, they account for a relatively low share of a hospital's marginal costs, roughly 2%.[33]

Table 2 describes the second scenario where we examine mergers that affect the labor market but not the product market. That is, where hospitals in the same HRR but in different HSAs merge. In this case, we simulate the impact of 324 mergers taking place in 62 HRRs. The calibration inputs and outputs in this scenario are very similar to those above because we are using data from the same industry. The primary difference is that the mergers have a much smaller impact on the labor market. Because HRRs have many more

[33]At the median hospital, a nurse/pharmacist is estimated to earn $65,000 a year while the hospital's other marginal costs per nurse/pharmacist are estimated to be about $3 million.

Table 3: Pre-Merger Summary Statistics for Simulated 1991 Colombia Manufacturing Mergers (n=423), Products (n=252), Markets (n=41), Product Market Overlap, No Labor Market Overlap

	50%	5%	25%	75%	95%
Calibration Inputs					
Margin (%)	26	7.5	18	36	49
Plant Cost per Worker ($100k/year)	0.67	0.14	0.37	1.3	4.2
Number of Workers per Plant	70	7	32	140	362
Plant Wage ($100k/year)	0.063	0.03	0.047	0.081	0.11
Calibration Outputs					
Plant Outside Wage ($100k/year)	0.029	0.006	0.02	0.035	0.043
Plant Margin per Worker ($100k/year)	0.26	0.077	0.14	0.53	0.99
Plant Price per Worker ($100k/year)	1.2	0.35	0.75	1.9	4.5
Market Price Sensitivity (α)	-5.1	-15	-8.1	-2.5	-1.2
Merger Conditions					
Market Bargaining Power (λ)	0.92	0.71	0.88	0.96	0.97
Merger HHI_P	1,955	1,559	1,708	2,629	3,794
Merger ΔHHI_L	0	0	0	0	0
Merger ΔHHI_P	334	115	196	582	1,402

hospitals in them than HSAs, both the level of market concentration and change in market concentration are much smaller for these hypothetical mergers. The median merger raises HHI_L by only 357 and the median post-merger HHI_L is only 2428.[34]

Table 3 describes the calibrated inputs and outputs from the Colombian manufacturing mergers which, because they are cross-region mergers, directly affect the product market but not the labor market. There are many differences between the manufacturing industries in the Colombian data and the U.S. hospital data. First, the manufacturing data consists of firms operating in many (53) different industries. While there is wide variation in the margins firms earn in the different industries, virtually all of them are considerably lower (median of 26%) than U.S. hospitals. Moreover, skilled workers appear to have more relative bargaining power in these industries than the U.S. hospital industry (median λ=.92).[35] Skilled labor also

[34]The reported concentration here refers only to the labor market and not the product market which is not directly affected by the merger.

[35]Note that we drop markets with $\lambda < .5$, affecting approximately 6% of our merger sample, due to issues with convergence of the model. At high levels of worker bargaining power, firms sometimes disappear from

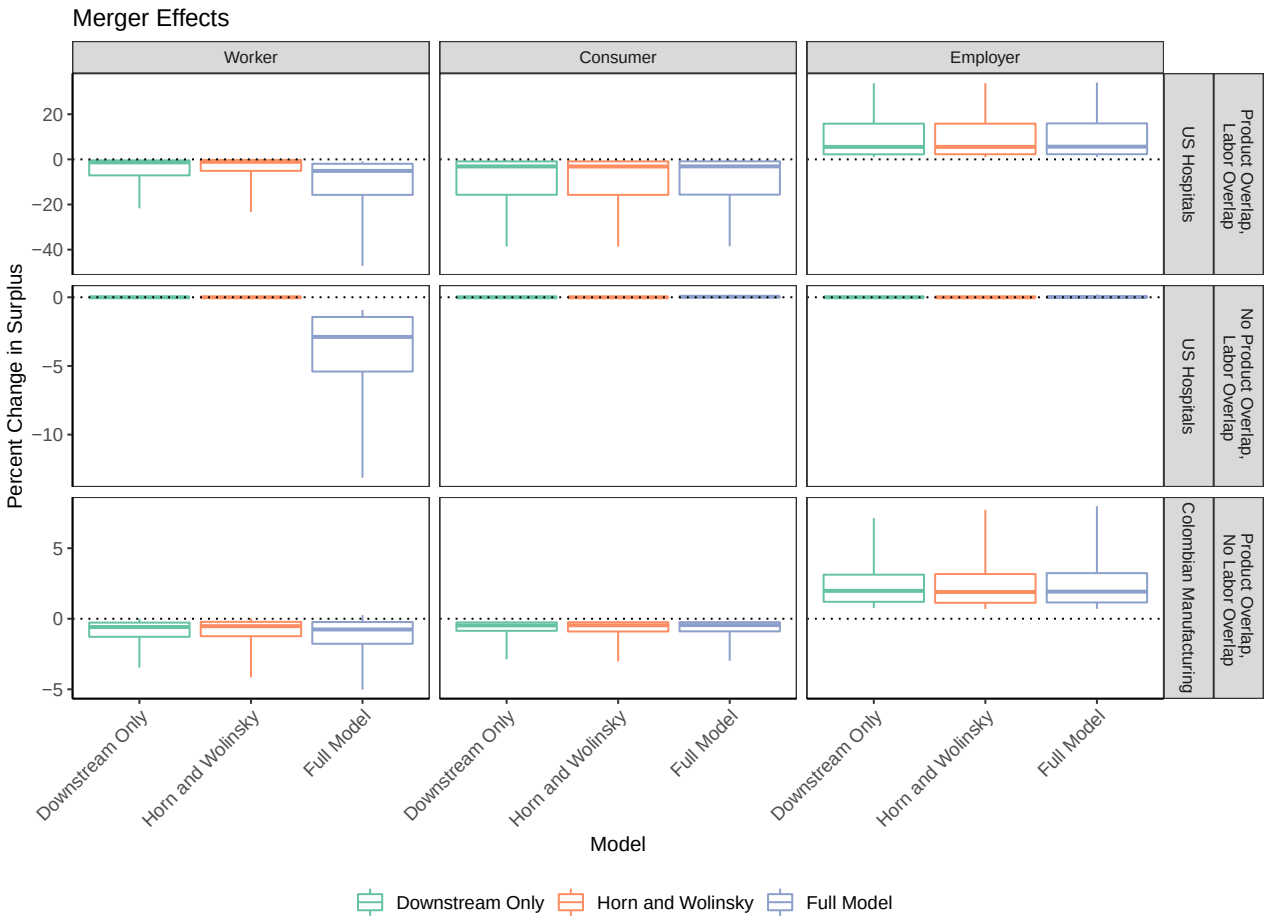

Figure 2 The figure displays worker, consumer, and employer surplus effects of the mergers in percentage terms, including the effect of changes to shares. Each box and whisker plot shows the 5th, 25th, 50th, 75th, and 95th percentiles of outcomes among the simulated mergers. We show results for three models: downstream only, bargaining with fixed worker threat point (Horn and Wolinsky) and the full bargaining model.

accounts for a considerably higher fraction of firm's marginal costs, roughly 10%. Finally, the mergers we simulate tend to take place in less concentrated product markets than in the U.S. hospital industry, with a median post-merger HHI_P of roughly 2000.[36]

4.5 Simulation Results

To illustrate how the different mechanisms in our model affect equilibrium outcomes following mergers, we simulate mergers corresponding to three different wage and price setting models. The first model assumes that wages are exogenously determined and that mergers only affect competition in the product market; that is, there is no bargaining over wages. We refer to this as the "downstream only" model that corresponds to the traditional Bertrand merger simulation model that is the workhorse of modern horizontal merger analysis, see, e.g., Werden and Froeb (1994). The next case we consider is a bargaining model where the threat point is exogenously determined as in Horn and Wolinsky (1988). In our implementation of Horn and Wolinsky (HW) we set the threat point for workers to be the average share-weighted wage in the local labor market (including the outside employment option) instead of zero.[37] Finally, we simulate mergers using our model where the wages of all firms in each labor market are determined by bargaining and where, post-merger, the workers' threat point no longer includes either merging party. We refer to this as the "Full Model."

The results of the merger simulations are shown in Figure 2 in a series of box and whisker plots. Each row of the figure corresponds to one of the three configurations of the product and labor markets for which we simulate mergers: (1) where the merger takes place in the same geographic market for labor and the final good market, (2) where the merger affects the local labor market but not the product market, and (3) where the merger only directly affects the product market. For each type of simulated merger, we show the distribution of welfare effects for worker, consumer, and employer welfare in the columns of the figure

the market (share goes to zero) as workers negotiate wages that are too high.

[36]Again, the reported HHI_P corresponds to the product market, which experiences a change in market structure under this market configuration, unlike the labor market.

[37]In HW the threat point wage offer to workers was set to zero (implicitly assuming no worker surplus should negotiations fail). We think setting the outside wage equal to the average wage in the labor market is a more realistic depiction of the outcome open to workers should negotiations fail. Moreover, we believe that having a similar pre-merger threat point for our implementation of the HW model and our full model makes them more easily comparable, by isolating the importance of having all wages of employers inside the market being endogenously determined (our model) in contrast to Horn and Wolinsky where negotiations take place between a single firm and its workforce.

where the median is shown by a solid line, the interquartile range is shown by the upper and lower bounds of the box, and the endpoints of the whiskers correspond to the 5th and 95th percentiles.[38]

We begin by describing the simulated effects of hospital mergers that directly affect the labor and the product market. The downstream only model is a good proxy for what an antitrust agency might predict if faced with making a decision on a merger based on the product market alone. Since wages are fixed, the only potential impact on workers in this model is through a reduction in output (and labor employed). In Figure 2, we see that the merger simulations corresponding to the downstream only model have very small effects on worker welfare. By contrast, we see that mergers substantially reduce consumer surplus and increase producer surplus due to standard product market recapture effects. The next simulation (HW) allows for bargaining between an employer and its workers, but assumes that the outside wage is fixed (exogenously determined). This means that the merger cannot affect the threat point of the workers either positively (through increased quantity produced at non-merging firms) or negatively (through decreased wages at non-merging firms). We see little difference in predicted worker welfare between the downstream only simulations and the HW simulations. Harm to workers is, on average, a bit lower in HW, however, in extreme cases the HW model predicts more harm than the downstream only model.[39] In moving to the full model described in section 2, we see notable differences in the labor market outcomes for workers. Workers are much more adversely affected by the merger when the merger is allowed to affect their threat point. Our model shows that if wages are determined by bargaining, mergers can have a substantial impact on workers by reducing their threat

[38] Change in consumer surplus is defined as $100 * \frac{\frac{log(\sum_j e^{\delta_j + \alpha p_j'})}{\alpha} - \frac{log(\sum_j e^{\delta_j + \alpha p_j})}{\alpha}}{\frac{log(\sum_j e^{\delta_j + \alpha p_j})}{\alpha}}$. Percent change in employer surplus is defined as $100 * \frac{\sum_j s_j' m_j' - \sum_j s_j m_j}{\sum_j s_j m_j}$ Percent change in worker surplus is defined as $100 * \frac{\sum_j s_j' w_j' - \sum_j s_j w_j}{\sum_j s_j w_j}$.

[39] When comparing the HW model to the downstream only model: 1) employer bargaining power increases 2) employer profits increase the total surplus in the bargaining game. The HW model therefore predicts higher or lower wages when wages are allowed to adjust post-merger.

point in negotiations with employers.

At first glance, it might seem surprising that the simulations do not show much change in either consumer or employer surplus despite the large change in worker surplus. There are two related reasons for this outcome, both specific to our examination of the hospital industry. First, the nurse and pharmacist wages, in aggregate, make up a very small share of total share of hospital costs, roughly 2%. As a result, the transfer from workers to the employer post-merger has a small incremental impact on hospital profits relative to the transfer from consumers to producers. Second, as shown in Table 1 in our calibrations, workers have extremely limited bargaining power. As a result, pre-merger most of the surplus from the gains from trade between workers and firms is accrued by firms. If we were examining an industry where workers had substantially more bargaining power and/or where the share of costs of negotiated wages were larger, our model would predict that some of the reduction in wages would be meaningfully passed-thru in the form of lower consumer prices and significantly passed through to producers in the form of increased employer profits. In the conclusion section, we describe a hypothetical industry where this is the case.

In the second row of Figure 2 we examine the changes in worker, consumer, and employer surplus resulting from hospital mergers that directly affect the labor market but not the product market. These are mergers of hospitals that do not compete in the product market (located in different HSAs) but do compete in the labor market for nurses and pharmacists (hiring workers from throughout the HRR). In this scenario, by construction, the downstream only and HW model predict that there should be no change in wages, and as a result no change in producer or consumer welfare. In the full model, however, we see that the reduction in an independent employment option for workers does reduce worker welfare, albeit by considerably less than the first case.[40] We find that in our simulations the median merger reduces worker welfare by about 3% and that 25% of mergers reduce worker welfare by at least 5%. Again, as was the case in the previous scenario, because nurse and pharmacists

[40]Recall HRR markets are by construction less concentrated.

wages make up such a small fraction of hospital costs, the reduction in worker wages is not large enough to significantly impact consumer or producer welfare.

Finally, we examine the third case where the merger directly affects the product market but not the labor market. In this scenario, we simulate the impact of mergers of Colombian manufacturing plants in the same industry (4 digit SIC code), but located in different regions of Colombia. In these simulations, we assume that firms are competing in the same national final goods market, but are hiring workers at plants located in different regions. As was the case in first scenario, we see small predicted reductions in worker welfare resulting from a reduction in labor demand from the merger. We also see that in the full model, where the firm's bargaining leverage changes, that firms are able to reduce wages (and worker's welfare) more than in either the HW or downstream only model. However, for the set of mergers we examine the effects are all fairly small: the median merger reduces worker welfare by less than 1% in all three of the models. This result is in part due to the distribution of mergers being less concentrated than in the previous cases, and in part due to the limited effect of product market overlap on the bargaining outcome. We will further disentangle these mechanisms below. As in the second case, because workers are estimated to have relatively low bargaining power, the predicted wage change is small, and total labor costs are, on average, only 13% of Colombian manufacturers' costs, meaning the pass through of reduced wages into either consumer or producer welfare is quite small.

The findings shown for producer and consumer surplus in Figure 2 are consistent with traditional models of merger simulation that focus on product market competition. As has been shown elsewhere, e.g. Nocke and Whinston (2022), absent efficiencies, mergers that result in significant increases in product market concentration (ΔHHI_P) reduce consumer surplus and increase employer surplus. However, to date, there is little model based evidence relating the economic significance of mergers as measured by the change in either product or labor market concentration (ΔHHI_P or ΔHHI_L) to changes in worker surplus. To provide some evidence on this relationship and how it varies across our three cases, we have plotted

the relationship between the ΔHHI_P or ΔHHI_L and the percentage change in worker surplus from our merger simulations for each of the three types of mergers we have studied using our full model. The results are shown in Figure 3. In the first panel, we plot results from hospital mergers that affect both the labor market and the product market. Because the two geographic markets coincide, the ΔHHI_P caused by the merger is equal to the ΔHHI_L in the labor market.[41] In the second panel, mergers only affect the labor market ($\Delta\text{HHI}_P = 0$) and we plot the ΔHHI_L and the percentage change in worker surplus. In the hospital mergers we examine, the ΔHHI_L takes place in a labor market defined to be an HRR.[42]. Finally, in panel 3 we examine mergers that only affect the product market ($\Delta\text{HHI}_L = 0$) and examine the relationship between ΔHHI_P and worker surplus.

In Figure 3, we see that for each type of merger there is a strong negative relationship between the change in market concentration and the change in worker surplus. For instance, a merger resulting in ΔHHI_L between 800 and 1000 is predicted to lower consumer welfare by 6-7% in the hospital markets, where there is labor market overlap, and about 3% in manufacturing markets with only a change in product market concentration. The slope is least steep where there is only a product market overlap (Colombian manufacturing) and steepest where both the merger affects both the product and labor market. However, for each type of merger, our model predicts that mergers resulting in very large changes in market structure will significantly reduce worker surplus. Overall, we think these results show that when wages are determined by bargaining as described here traditional competition metrics (ΔHHI_P or ΔHHI_L) can provide useful information to inform how mergers may affect workers.[43]

[41] In this case, the shares are equal to employment shares in the HSA in which the hospital is located.

[42] Recall that an HRR is a collection of contiguous HSAs that is meant to approximate a commuting area for hospital workers

[43] There are many differences between the hospital and Colombian manufacturing merger simulations that may affect the slope of the ΔHHI/Change in worker surplus relationship. In addition to the different mechanism changing the bargaining relationship (changes in product or labor market competition), market characteristics vary significantly as well. These market characteristics (e.g., margins, wages, relative bargaining power) will also change the ΔHHI/change in worker surplus relationship.

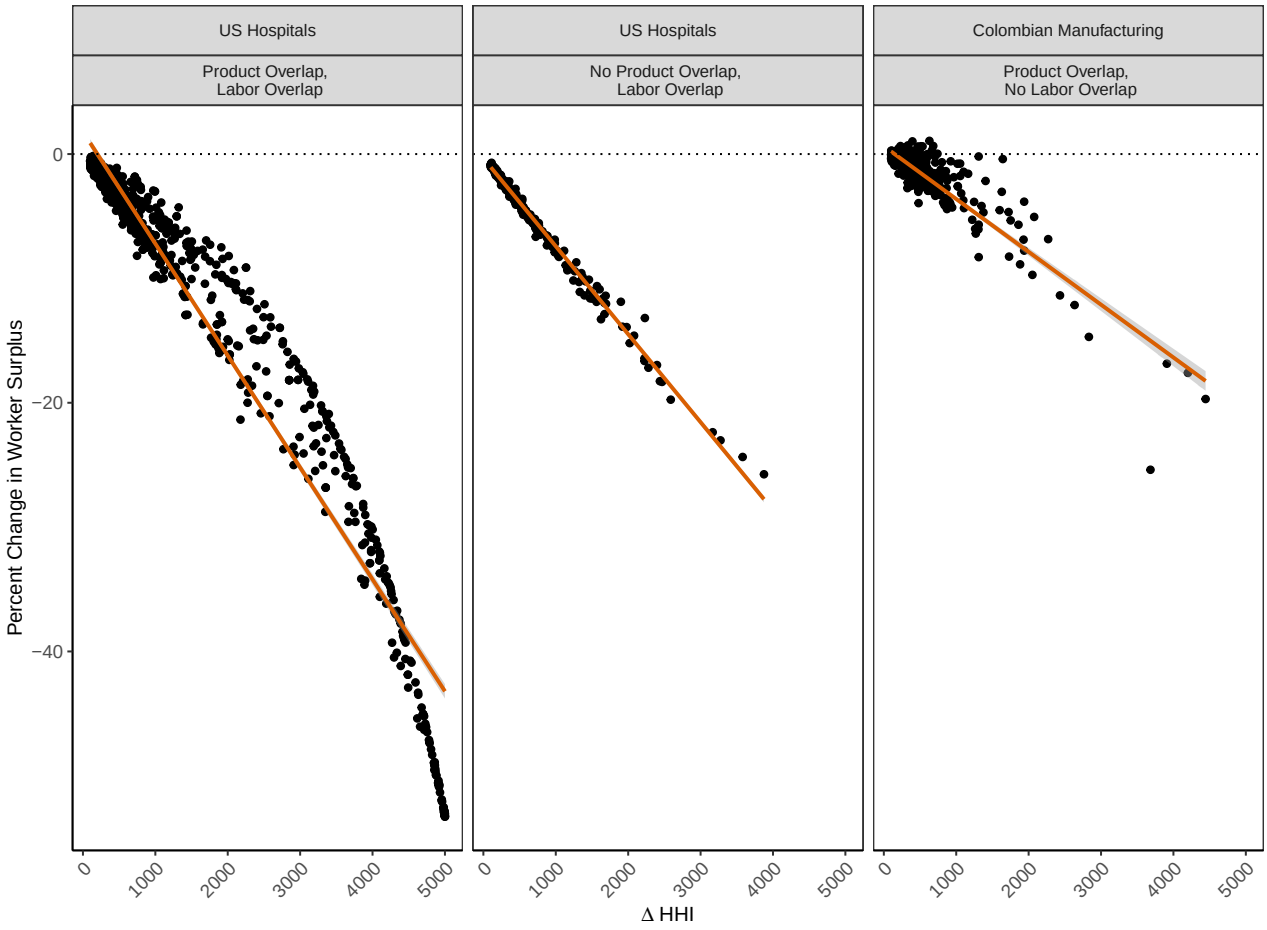

Figure 3 The figure displays worker surplus effects of the mergers in percentage terms, including the effect of changes to shares. Each dot represents one merger. All effects are plotted against ΔHHI, where ΔHHI in the first panel is ΔHHI_P which is equal to ΔHHI_L, in the second panel ΔHHI_L since $\Delta\text{HHI}_P = 0$, and the third panel ΔHHI_P since $\Delta\text{HHI}_L = 0$.

Having shown how mergers change surplus in our model, we now examine how those changes manifest themselves in terms of changes in market wages, employment (output), and consumer prices, which are other common measures of merger impact.[44] In some scenarios, our model predictions are ambiguous for workers, as wages can go up or down, depending on the bargaining mechanisms discussed below. Worker surplus, defined as the total wage bill, therefore may mask heterogeneity—while some workers will lose their jobs, wages may go up for those who remain in the labor market. In Figure 4 we begin by examining hospital mergers affecting both the product and the labor market that resulted in the largest reductions in worker surplus. In this case, a merger results in three changes that can harm workers: lower wages due to a reduction in worker leverage (loss of an employment option), lower wages due to an increase in firm leverage (the firm's able to make sales at another hospital in the event negotiations breakdown), and a reduction in employment resulting from increased hospital prices (recapture). Workers could benefit from the merger, however, if they were able to capture some of the increased employer profits caused by the reduction in product market competition. In the first row of Figure 4, we see that all simulated mergers result in a reduction in both worker wages and employment (reduced output), and that reduction increases as the impact on competition (ΔHHI_P or ΔHHI_L) increases. For hospital mergers that only affect the labor market but not the product market, the merger only affects workers by reducing their leverage. In our simulations, this manifests itself as a reduction in market wages with no change in employment (row 2 of Figure 4).[45] The third case, where there the merger increases concentration in the product market but not the labor market, is perhaps the most interesting. Here, mergers result in all the same impacts as the first case (row 1 of Figure 4), with the exception that there is no reduction in worker leverage, due to the lack of labor market overlap. The merger still harm workers by lowering output through a traditional unilateral effect and increasing the firm's leverage in wage negotiations, but the

[44] In our model, by assumption, output is proportional to employment.

[45] Because wages make up such a small share of a hospital's costs, the reduction in wages does not result in a significant reduction in consumer prices. As a result, there is no change in employment in this case.

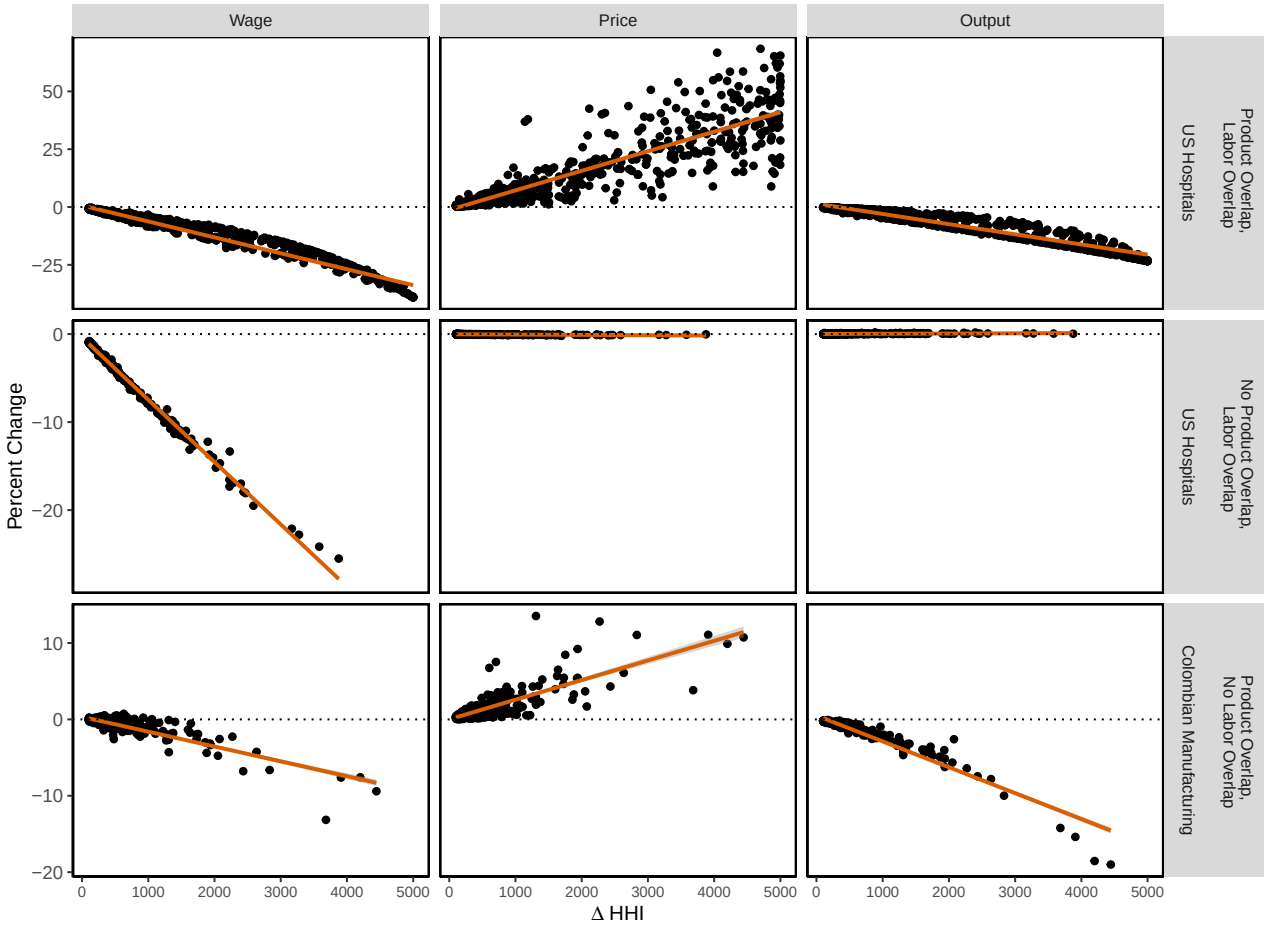

Figure 4 The figure displays wage, price, and output effects of the mergers in percentage terms, weighting by pre-merger shares. Each dot represents one merger. All effects are plotted against ΔHHI, where ΔHHI in the first row is ΔHHI_P which is equal to ΔHHI_L, in the second row ΔHHI_L since $\Delta\text{HHI}_P = 0$, and the third row ΔHHI_P since $\Delta\text{HHI}_L = 0$.

merger also results in a price increase that increases the rents to be split between workers and the firm that may increase wages. In the third row of Figure 4, we see that for mergers with relatively small increases in concentration ($\Delta\text{HHI}_P < 500$), the wage effects of mergers are very small and in some cases actually positive. This suggests that for small changes in ΔHHI_P the wage bargaining effects of the merger effectively offset each other. However, as mergers become more anticompetitive (ΔHHI_P >1000), simulated mergers almost always lower wages in addition to employment.

5 Screens

The results from the merger simulations show that if a bargaining model like ours describes wage setting, then mergers that affect the relative bargaining position of workers and their employers can have large impacts on worker welfare. As a result, merger simulation generated using conventional merger simulations focusing only on downstream competition may dramatically underestimate the impact of consummated mergers on worker welfare. However, while downstream only merger simulations may fail to accurately measure wage effects, it is possible that these merger simulation tools still can play an important role in identifying mergers that harm workers. In this section of the paper, we test the efficacy of the most commonly used merger simulation screen (the downstream only model) in identifying mergers that harm workers in the three market configurations we have studied.

The results of this analysis are shown in Table 4. The first row of the table evaluates the efficacy of screens where the geographic market for labor and products are the same (HSA). In our simulations, we find that 78% of mergers that were not flagged as being harmful to consumers using a downstream only model were predicted to reduce would worker welfare by at least 1% using the full model.[46] However, this same screen would only miss 2% of mergers that would reduce worker welfare by more than 5%. We also identify the fraction of all simulated mergers that would harm workers that would be identified by the traditional downstream only screen, and find that 77% of mergers that would reduce worker surplus by 1% and essentially all of mergers that would reduce worker surplus by 5% would be flagged as anti-competitive. Collectively, we take this as suggestive evidence that when the product and labor markets completely overlap, as is often the case for non-tradeable goods, that product market screens likely identify the mergers most harmful to workers.

Similarly, we find that product market screens are very effective in identifying mergers that harm workers where there is only a direct overlap in the product market, as is common

[46] In our screen, we flag all mergers that are predicted to lower consumer surplus by at least 1% as anticompetitive.

Table 4: Fraction of mergers that harm workers missed and caught, using a downstream only model and a 1%, 5% enforcement threshold, by market configuration

Setting	Type of Merger	Mergers Missed		Mergers Caught	
		$> 1\%$	$> 5\%$	$> 1\%$	$> 5\%$
Hospitals	Product Overlap, Labor Overlap	0.78	0.02	0.77	0.99
Hospitals	No Product Overlap, Labor Overlap	0.90	0.27	0.00	0.00
Manufact.	Product Overlap, No Labor Overlap	0.28	0.00	0.45	1.00

Note:
'Harmful Mergers Missed' denotes the fraction of simulations where the full model predicts that a merger harms workers by either at least 1% or 5%, conditional on a downstream only model predicting no more than 1% consumer harm. 'Harmful Mergers Caught' denotes the fraction of simulations where the partial model predicts that a merger yields more than 1% consumer harm, conditional on the full model predicting that a merger harms workers by either at least 1% or 5%.

in tradeable goods markets. Finally, if there is no product market overlap, by construction, a downstream only merger screen would never identify a merger as harmful to workers. Hence, if there are mergers that involve firms that are important employers for a well defined type of labor but not competitors in the product market, then antitrust economists will be forced to use information about substitution patterns in the labor market rather than the product market to forecast the labor effects of mergers. We think the case we have examined here, a broader labor market than product market for hospital services, is a plausible instance where this could occur. Another potential example, might be merger of non-competing retailers who use similar employees for certain kinds of tasks. It is in these instances that antitrust economists must focus very carefully on the scope of the labor market to determine the likelihood of harm to workers as product market screens cannot provide helpful information.

6 Conclusion

We model the interaction between product and labor markets using a two-level supply chain where employers and workers negotiate over wages in a Nash-in-Nash game upstream, and

firms produce differentiated products and engage in Bertrand price competition downstream. In our modeling approach, there are four mechanisms associated with mergers that can change worker welfare: the leverage of workers or employers in wage negotiations, labor demanded by employers, and the rents to be shared. In our simulations, we have focused on different configurations of the product and labor markets to highlight when and how these different effects impact worker welfare. For example, when mergers affect only the product market, e.g., involve manufacturing plants producing tradeable goods located in different local labor markets, mergers increase manufacturer's leverage in negotiations (harming workers), and increase the total rents for workers and the firm to share in negotiations (potentially benefiting workers). In our simulations, we found that these types of mergers had little effect on worker wages when the ΔHHI_P associated with the merger was less than 1000, but resulted in meaningful reductions in wages when the change in market concentration was larger. By contrast, mergers that only affect the labor market only reduce worker leverage in bargaining. In our simulations, we found a strong negative relationship between the ΔHHI_L and wages for these types of mergers. We view this finding as illustrating how the loss of an independent employment option in a labor market can reduce workers' wages.

One implication of our model is that mergers can reduce wages and that this reduction will be partially passed through to consumers in the form of lower prices and to employers in the form of higher profits. This effect will result in larger increases in producer surplus and smaller decreases in consumer surplus than a downstream only merger simulation. In our discussion of the simulation results, however, we noted that the change in consumer, and producer welfare were very similar in the 'downstream only' model and in our full model. This is not a general finding, but is, instead, a result of characteristics specific to the hospital and manufacturing industries we have studied. For example, in the U.S. hospital industry, the total size of the costs we model as being subject to negotiation is very small, roughly 2% of a hospital's marginal costs. As a result, the transfer of surplus from workers to either consumers or producers as the result of the merger is very small relative to the transfer

from consumers to producers resulting from the effect of the merger on the product market. However, in extreme cases, where the share of labor costs subject to negotiation are very large and where unions are very strong, our model predicts that horizontal downstream mergers can actually increase consumer surplus.[47] Ultimately, the degree to which worker harms are passed thru to the benefit of consumers will depend on characteristics specific to a given industry.

While we believe that the modeling approach we have developed can be used to simulate the consumer and worker welfare effects of mergers using the information typically available in merger investigations, we acknowledge our simulations are subject to a number of caveats due data limitations. Our simulation results are based on publicly available data on the U.S. hospital and Colombian manufacturing industries. We have had to make plausible assumptions about the scope of the markets for labor and products observed in these data sets that we cannot verify. As a result, the simulations results should be views as illustrative rather than precise estimates. In an actual merger investigation, practitioners may be able to relax these assumptions and improve the quality of our estimates by using superior non-public data on firm margins as well as worker and consumer substitution patterns.

[47] For example, in pure simulations (not calibrated to any specific industry), we have simulated hypothetical mergers where the union is assumed to capture 30% of surplus (λ=0.7) and where the labor share of costs is very high (94%), and found market configurations where horizontal mergers increase consumer and producer surplus and lower worker surplus.

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A Data Appendix

A.1 Market Shares

A.1.1 U.S. Hospitals

We define inside labor shares according to the relative employment of nurses and pharmacists across firms as reported in HCRIS.[48] In the case where there the geographic market for labor and products are the same, this will be relative employment in the HSA market. When we examine mergers that affect the labor market but not the product market, the labor share is defined as the share of employment at a hospital (or system) within the broader region (HRR).[49] Next, we assume that the nurses and pharmacists outside option share is fixed across all markets and use the national BLS occupation and employment statistics data to compute an outside share of 52%.[50] The overall labor shares will therefore be the inside labor shares multiplied by one minus the outside share $(1 - .52)$.

We assume a ratio of one worker to one unit of output, meaning that inside product shares are also defined as the relative employment of nurses and pharmacists across firms. In both configuration 1 and 2, the geographic market for products is the HSA, and product shares are calculated using hospitals located in the HSA. We set the outside share for the product market to be 10% to reflect inelastic demand for hospital services. Therefore overall product market shares are defined as the inside product share multiplied by one minus the outside share $(1 - .10)$.

When we are analyzing mergers where both the geographic market for labor and inpatient

[48]Note that we use the data from Prager and Schmitt (2021b) which converts hours to full-time equivalents assuming 40 hour weeks and 52 weeks a year. This often results in fractional FTEs. See Prager and Schmitt (2021a)

[49]Note that we define HRR as the superset of HSAs used in our first scenario. This means that our HRR mergers involve the same set of hospitals in scenarios 1 and 2, allowing for more comparability.

[50]Specifically, we take the number of nurses and pharmacists, defined as SOC codes 29-1051, 29-1141, 29-1171, and 29-2061, employed outside the hospital industry, defined as NAICS code 622000, in the BLS occupation and employment statistics data

medical services is the HSA, the inside market shares for labor and the product market are identical: the proportion of nurses employed by each hospital (or hospital system) in the HSA. When we analyze mergers where the merger affects that labor market but not the product market, the inside labor and product market shares differ.

A.1.2 Colombian Manufacturing

We assume there is a national product market for the final good, and that labor is specialized within each industry and supplied to factories from workers within the region where the factory is located. As with hospitals, we assume that output is proportional to employment. For this reason, we measure shares in the product market as the fraction of skilled employment at each plant within each product market (defined by the 4-digit SIC code) for all of Columbia.[51] We assume that imports make up the outside option for the product market and are around 21% following Ocampo (1990). We measure the share of labor in a market as the fraction of skilled labor at each plant in a given industry (4-digit SIC code) within the Department, the narrowest geographic region reported in the data source, corresponding to 31 regions of Colombia. We set the worker's outside share to 52% to allow consistent comparison of worker welfare to the hospital data.

A.2 Margins

A.2.1 U.S. Hospitals

We assume that all variable inputs other than nurse and pharmacist wages (which are determined endogenously in our model) are purchased at constant margin cost. We calculate the margin of downstream firms using commercial price, costs, and discharges from HCRIS as cleaned by Prager and Schmitt (2021b), and case-mix index from CMS following Dafny

[51] Unfortunately, the data does not identify if there is a parent company that owns a plant, or if multiple plants have a common owner. In constructing market shares and simulating mergers, we assume that all plants are independently owned and operated prior to the simulated mergers.

(2009) and Garmon (2017). Margins predicted to be > 1 or $< .01$ are marked as missing. We convert the percent margin of the acquiring firm into a level margin using information on operating costs and wages from HCRIS. Note that in converting the percent margins following Dafny (2009) and Garmon (2017) calculations to level margins at the worker year level, we remove the costs associated with nurse and pharmacy wages from the hospital's marginal costs because those wages are endogenously determined in our model. In calibrating α, we use the margin of the largest firm in the HSA for which margin is available. From there we obtain the margins of all other firms in the market from the downstream first order conditions.

A.2.2 Colombian Manufacturing

These data report variable costs that include industrial expenditures such as parts and fuel, raw materials, wage bill and worker benefits (excluding skilled workers), and total energy consumed.[52] Other expenditures such as rent and royalties we consider to be fixed. We assume that all costs are allocated between domestic and export production according to the share of exports, so, for example, the domestic wage bill for a firm that exports 10% of its sales will be 90% of the total wage bill.

We take the most recent year of data available which is 1991. We drop all industries that are non-specific, e.g. include "miscellaneous" in the title. We also drop synthetic textiles since the margins of the largest firm is too small for calibration. We drop plants that have 100% of sales as exports. We also drop plants with extremely small shares ($< 3\%$), or no skilled workers, to avoid outliers. We drop plants with margins less than 1%, which occurs for 10% of the plants. We drop textiles, aircraft, and sporting goods industries because the margins of their largest firms are too low for the model to rationalize.

[52] We convert dollar values from Colombian pesos to US dollars using the average conversion rate of 633:1 for 1991 from FRED `https://fred.stlouisfed.org/series/COLCCUSMA02STM`.

A.3 Wages

A.3.1 U.S. Hospitals

To calibrate our model, we need to observe wages within the market where wages are endogenously determined and also specify the outside wage. Measuring the wages of workers within the affected industry is straightforward. Using the cleaning code of Prager and Schmitt (2021b), we pull wages and employment of nurses and pharmacists from HCRIS for the hospital merger simulations. We define a hospital's wage as the ratio of total wages paid for nurses and pharmacists assuming each full-time-equivalent works 40 hours a week in a calendar year divided by the number of full-time-equivalent nurses and pharmacists employed by the hospital.

Measuring the wage of the outside option for workers is more involved. Here we need to forecast the wage a worker would earn if they were forced to work outside the industry being studied. We use a different approach to forecast this outside wage to match the likely institutional characteristics of the nurse and pharmacist market and that of industrial workers. We assume that a worker who had to leave the hospital setting would work in a different sector but would continue to work as a nurse or pharmacist. However, by being forced to change sectors, the displaced nurse/pharmacist would likely face some wage penalty when moving to the new industry. That is, the worker would not enter the new industry at that industry's mean wage, but at some fraction reflecting some displacement effect in the years immediately following separation. To construct this measure, we first use the BLS OES to estimate (at a national level) the relative wage of nurses and pharmacists working in hospitals relative to those working in all other sectors which is 0.93. We then apply the displacement wage scarring estimates Lachowska et al. (2020) to the worker's out-of-market outside option. Specifically, we assume that having to find employment outside of the hospital market will lead to a displacement wage penalty of 40%, but our results are

robust to penalties of 30% to 50%.[53] We then multiply this fraction by the mean nurse and pharmacist wage in hospitals operating in the HSA.

A.3.2 Colombian Manufacturing

For each Colombian manufacturing plant, we take the total wage bill for skilled workers and divide by the total number of skilled workers to get the average yearly earnings of a skilled worker. We assume that skilled workers forced to leave an industry (4-digit SIC code) would seek employment in a similar industry (a plant in the same 2-digit SIC code but different 4-digit SIC code).[54] We do not have an estimate of wage scaring effects for Colombian workers from this time period. Instead, we use a measure of displacement that would result in a period of unemployment when finding new employment. Eslava et al. (2010) find that Colombian workers experience a period of unemployment of, on average, 3.8 months following a plant closure. Using this information, we estimate the outside wage as the mean wage in the plants in the outside option reduced by 32% to reflect the expected time spent searching for new employment.

B Simulated Mergers

B.1 U.S. Hospitals

We simulate all possible mergers between active, short-term, critical access, or children's hospitals where we observe sufficient data and where mergers are possible [55] within the local

[53] Earnings in another sector may also have a different utility value by revealed preference.

[54] The 2-digit SIC labor market allows workers to consider jobs that are similar, but not identical to their current job, and avoids scenarios where there may only be one plant within a 4-digit SIC in a given region. For example, this means that a worker at a plant that makes "fertilizers and pesticides" may threaten to switch to plant that makes "paint varnish and lacquer" since both are chemicals industries, assuming these plants are in the same region. Wages are share-weighted.

[55] Our universe of hospitals consists of all hospitals appearing in the HCRIS data in 2006 that are active, short-term, critical access, or children's hospitals.

geographic market (Health Service Area) in 2006, resulting in a sample of 1392 potential mergers.[56] Our primary sample restriction is only including HSAs with multiple independently owned hospitals so that mergers are possible. This restriction results in a sample of 2114 hospitals located in 541 HSAs.

In order to calibrate our model and simulate mergers, we require that each hospital in an HSA report a market share and a wage data for nurses and pharmacists. Unfortunately, some data is often missing for at least some hospitals (especially very small hospitals) in HSAs with many hospitals. Because very small hospitals are unlikely to be important in price setting, we simply ignore hospitals in the merger simulations that are very small (accounting for less than 3% of patient discharges in an HSA) if those hospitals are missing on the data inputs critical to model calibration and merger simulation. If this data is missing for hospitals with greater than a 3% market share, we drop the HSA (and all of its hospitals) from the merger simulation exercise.

We simulate all possible mergers that take place between systems and single hospitals[57] operating in the same HSA, therefore we keep only HSAs in which there are multiple hospital systems operating. HSA information is mapped to hospitals in HCRIS by zip code using information from the American Hospital Association Annual Survey and the CMS provider of service files.[58] When system information is missing, we assume hospitals are independent.

For within HSA mergers (scenario 1), we require that mergers increase HHI in the HSA, meaning that the acquiring system must have more nurse and pharmacist FTEs than the system of the acquired hospital. This restriction, plus requiring HCRIS data on critical inputs, reduces our final sample is to 1044 hospitals in 325 HSAs. For mergers within the

[56] We choose 2006 because it is the year that allows us to easily estimate hospital margins for each hospital system following the methodology developed by Dafny (2009) and Garmon (2017).

[57] Simulating systems acquiring single hospitals rather than systems acquiring systems allows for more potential mergers.

[58] CMS provider of service data from Adam Sacarny, and AHA Annual Survey data. We also obtain system identifiers from AHA and CMS data to establish pre-merger ownership structure in each market. When system is missing we impute that the hospital as independent. HSAs are obtained from Dartmouth's HSA crosswalk file.

HRR but across HSAs (scenario 2), we additionally impose the restriction that the merger must increase HHI in the HRR, meaning that the acquiring system has more nurses and pharmacists in the HRR than the acquired hospital's system. Furthermore, to avoid changes in the HHI within the HSA of the acquired hospital, we impose that the acquired hospital must be the only hospital in its system in the HSA, and that the acquiring system must not already be present in the HSA of the acquired system. These restrictions reduce the sample to 526 hospitals in 62 HRRs.

B.2 Colombian Manufacturing

Our goal for the tradable goods configuration is to simulate mergers with product market overlap but no labor market overlap. We achieve this by only simulating mergers between plants that have the same 4-digit SIC industry in Colombia, but operate in different geographic regions and therefore in employ workers in separate labor markets.[59] Therefore our main sample restriction is to keep only industries that have plants in multiple regions in order to simulate cross-region mergers. We then simulate all possible mergers between plants within four digit SIC industry and across region.

[59] Although the case in which tradable goods firms operate in the same labor market and sell into the same product market is of interest, for the purposes of illustrating our model, this case is similar to our first configuration but where concentration may not be exactly the same in the labor and product markets.