Barcelona School of Economics

Master's Degree in Specialized Economic Analysis
Specialization in Competition, Regulation and Markets

"The structural presumption in horizontal merger review: evidence from Monte Carlo experiments"

Davide Bernardini & Matt Wohlleben

Supervised by Fabian Gaessler

28 May 2024

ABSTRACT IN ENGLISH (100 words)**:**

US antitrust agencies lowered the threshold of concentration required for the presumption of anticompetitive effects ("the structural presumption") in 2023. We provide evidence using Monte Carlo experiments that the new presumption flags many more mergers and reflects an agency preference to decrease the Type II error rate at the expense of generating many more Type I errors. We also show that the agencies could improve the accuracy of the presumption without increasing leniency by relying only on changes in concentration. This is true across common settings of competition and demand structures, though the optimal level of the presumption varies. Then, we show that the structural presumption is an effective way to screen for mergers under uncertainty in parameters, but current concentration measures are inadequate to screen for coordinated effects.

ABSTRACT IN CATALAN/ SPANISH (100 words)

Las agencias de competencia estadounidenses redujeron el umbral de concentración requerido para identificar presuntos efectos anticompetitivos ("la presunción estructural") en 2023. Proporcionamos evidencia, mediante experimentos de Monte Carlo, de que la nueva presunción identifica muchas más fusiones y refleja una preferencia de las agencias por disminuir la proporción de errores Tipo II, a costa de generar muchos más errores Tipo I. También demostramos que las agencias podrían mejorar la precisión de sus presunciones sin necesidad de ser más laxas, basándose únicamente en los cambios en los niveles de concentración. Esto es válido para diversos entornos competitivos y estructuras de demanda, aunque el nivel óptimo de la presunción varía. Además, mostramos que la presunción estructural es una forma eficaz de detectar fusiones bajo incertidumbre en parámetros, pero las medidas de concentración utilizadas actualmente son inadecuadas para detectar efectos coordinados.

KEYWORDS IN ENGLISH (3)**:** Mergers, Monte Carlo experiments, concentration screens

KEYWORDS IN CATALAN/ SPANISH (3)**:** Fusiones, experimentos de Monte Carlo, detectas de concentración

The structural presumption in horizontal merger review: evidence from Monte Carlo experiments

Davide Bernardini Matt Wohlleben

June 28, 2024

Abstract

US antitrust agencies lowered the threshold of concentration required for the presumption of anticompetitive effects ("the structural presumption") in 2023. We provide evidence using Monte Carlo experiments that the new presumption flags many more mergers and reflects an agency preference to decrease the Type II error rate at the expense of generating many more Type I errors. We also show that the agencies could improve the accuracy of the presumption without increasing leniency by relying only on changes in concentration. This is true across common settings of competition and demand structures, though the optimal level of the presumption varies. Then, we show that the structural presumption is an effective way to screen for mergers under uncertainty in parameters, but current concentration measures are inadequate to screen for coordinated effects.[1]

[1]Submitted in partial fulfillment of the requirements for the master's in Competition, Regulation, and Markets at the Barcelona School of Economics. We thank Fabian Gaessler, Nicholas Hill, Massimo Motta, and Frank Verboven for helpful discussions. Our work was implemented in part using the *antitrust* R package from Charles Taragin, Michael Sandfort, and Shlok Goyal. Despite helpful contributions from others, all errors are the responsibility of the authors.

1 Introduction

The Department of Justice (DOJ) and Federal Trade Commission (FTC), collectively responsible for antitrust enforcement in the United States, occasionally revise the US Merger Guidelines to reflect the latest in agency practice and provide guidance and clarity to antitrust practitioners, courts, and the business community. The most recent such update, released in December 2023, indicated a general shift to tighter antitrust enforcement and more active intervention. Among other changes relative to the previously released 2010 Guidelines, the antitrust agencies switched to a stronger "structural presumption" of assumed anticompetitiveness.

Since the 1982 Merger Guidelines, the agencies have evaluated concentration with a first-screen based on the Herfindahl-Hirschman Index (HHI).[2] The structural presumption is a rebuttable indicator of whether a merger may substantially lessen competition. While it has long been a feature of US antitrust law, little work has been done on the optimal level of concentration that merits application of the presumption. Assistant Attorney General Baxter, speaking on the 1982 thresholds from which the 2023 thresholds are derived, said the following: "the lines themselves are arbitrary, and reflect the fact that we were born with ten fingers and have gotten used to a base ten system" (Baxter, 1982)[5].

It is well understood that market structure cannot be taken as the sole determinant of the level of competition (Demsetz, 1973[13]; Miller et al., 2022[20]), but the structural presumption has an important role for its ability to allow resource-constrained agencies to screen mergers without large data requirements, its ability to deal with the uncertainty inherent to merger review, and its predictive power in determining the likelihood that a merger will be allowed.[3] Additionally, legal precedent makes it important for agencies to establish the structural presumption when challenging a merger even if more advanced modelling is possible.

The 2023 Guidelines state that "the Agencies consider the [new] HHI thresholds to better reflect both the law and the risks of competitive harm suggested by market structure." To our knowledge, no work has been published on the marginal change in merger screening efficacy from this update. The purpose of this study is to evaluate this claim that the new thresholds more effectively screen for harmful mergers. To test the new thresholds, we present evidence from Monte Carlo experiments of mergers in randomly generated markets. We show that the new presumptions flag many more mergers, greatly increasing the Type I error rate while modestly decreasing the Type II error rate. This change implies a decrease in the threshold of merger harm that the agencies are willing to tolerate. The exact effect of the change in HHI thresholds depends on the setting of competition and demand system we assume. In particular, we show that consumer harm is particularly unlikely at low levels of concentration in second score auctions while being somewhat more likely in the Bertrand and Cournot settings. Consumer harm at a given level of concentration also increases as the convexity of the underlying demand system increases. We extend our results by

[2] The HHI is calculated as the sum of squares of each firm's share. It decreases with the number of firms in a market and the degree of symmetry between them.

[3] See Coate (2005)[9]. HHI levels and changes are among the strongest predictors of the FTC suing to block a merger.

evaluating whether an alternative screening mechanism could be as effective at screening harmful mergers without blocking neutral or positive mergers and show that a structural presumption based on changes in concentration alone outperforms the 2010 and 2023 Guidelines. Then, we show that HHI thresholds are especially effective at screening mergers when inputs for more advanced techniques like merger simulation are difficult to observe. Finally, we evaluate coordinated effects by considering how HHIs relate to the change in likelihood of coordination post-merger and show that measures of symmetry between firms are better at evaluating the likelihood of coordination.

2 Background

When evaluating horizontal mergers, the potential mechanisms of price changes are usually separated into unilateral and coordinated effects. Unilateral effects refer to the change in own-firm incentives stemming from the merger that encourage firms to increase prices. Coordinated effects refer to the increased ability of firms to reach coordinated outcomes in price post-merger, even absent an explicit collusive agreement. In the 1982 and 1984 Merger Guidelines, the level of concentration specified for further scrutiny was motivated by the potential for coordinated effects. With the 1992 Guidelines, the agencies began to motivate the concentration screens for their potential to also identify unilateral effects from mergers, albeit with the same presumptions as in previous versions.[4] The presumptions from the 1992, 2010, and 2023 Guidelines are shown in Table 1. The presumption is based on both the post-merger level of concentration in the market and the change in concentration caused by the merger.[5] The 2023 presumption is largely a reversion to the 1992 Guidelines, with the additional screen of mergers with combined market shares >30% and with a Δ HHI of 100 or more.

Table 1: Presumptively illegal mergers by Guideline

	1992 Guidelines	**2010 Guidelines**	**2023 Guidelines**
Post-merger HHI	1,800+	2,500+	1,800+
ΔHHI	100+	200+	100+
Combined market share	N/A	N/A	30%+ and a ΔHHI of 100+

Note: Structural presumptions by version of FTC/DOJ Merger Guideline. The structural presumption of the 2023 Guidelines is largely a reversion to those from the 1992 Guidelines, with the addition of a screen based on combined market share.

Two of the principal drafters of the 2023 Guidelines wrote that "the structural presumption has as strong an economic pedigree today as ever" (Athey and Lawrence, 2024)[3]. Indeed, a growing body of evidence has linked the degree of consumer harm stemming from unilateral effects to the

[4]Each version describes the presumptions in a slightly different way, and prior to the 2023 Guidelines the agencies also defined "moderately" concentrated markets of moderate potential concern. In practice, few of these mergers were challenged.

[5]Of course, mergers may impact the output decisions of firms and post-merger quantities may therefore be difficult to forecast. In practice, HHIs in merger review are naively computed using shares in the pre-merger equilibrium.

level of concentration. For instance, Nocke and Whinston (2022)[25] construct a theoretical model for evaluating mergers based on HHI in both the Bertrand and Cournot settings. The authors then use simulations of local mergers in the beer market to show positive and significant price effects for mergers that fall below the 2010 Guideline thresholds under Bertrand competition. The authors find that the change in HHI is a more helpful predictor of price effects than the post-merger level. In the working paper Affeldt et al. (2021)[1], the authors extend the Nocke and Whinston framework to attempt to determine the average Compensating Marginal Cost Reductions (CMCR) needed to overcome the anti-competitive effects of mergers notified to the European Commission (EC). Using a near-census of EC decisions over a thirty year period, the authors find that large cost reductions are needed to overcome anti-competitive pricing pressure from many of the approved mergers.

Given the difficulties associated with analyzing consummated mergers to draw policy conclusions,[6] a segment of this literature has abstracted from real-world data and has compared the performance of screening measures on market data generated through Monte Carlo experiments. For instance, Miller et al. (2017)[21] simulate a dataset composed of a large number of markets in which firms compete à la Bertrand and the underlying demand system is either logit, linear or almost ideal. They evaluate the HHI thresholds under each demand system and find that even mergers in moderately concentrated markets frequently produce substantial price increases. They also show that results from merger simulation can be highly dependent on the correct choice of demand system. Loudermilk and Taragin (2019)[27] simulate market data to test two screening rules and compare the results to the 2010 Guideline thresholds. They find that the screen depends on the type of competition of the market, suggesting that different screening levels should be applied for different competitive settings. Each of these papers and our own research use merger simulation to determine the "true" effects of mergers. Merger simulation uses market data and a model of the nature of competition to recover costs and elasticities in the status quo and model counterfactuals. The validity of predicted price effects depends on the accuracy of the the assumptions used.

The evidence from academic work of the link between the HHI and the price effects of a merger is significantly weaker for coordinated effects. In fact, the expected risk of coordination under some settings can *decrease* with HHI.[7] Nocke and Whinston (2022)[25] offer a guess that agency practice of relying on both post-merger levels and changes in HHIs, rather than changes alone, could be motivated by screening for coordinated effects. But given the relative primacy of empirical evaluation of coordinated effects and the industry-specific features that foster tacit collusion, such a link has not been formally shown.[8]

We contribute to this literature in several respects using a Monte Carlo experiment methodology calibrated to real-world mergers and following parameters commonly used in academic re-

[6] See Werden (2015)[29] for issues associated with merger retrospective studies, including econometric challenges and selection problems.

[7] For example, Fabra and Motta (2018)[15] write that the level of symmetry with a given number of firms in the market improves the ability of firms to coordinate but decreases the HHI. See also Loertscher and Marx (2021)[19]: "the HHI is not a reliable indicator of coordinated effects, except inversely so for some efficient procurement markets."

[8] This lack of evidence does not suggest that coordinated effects are of only secondary importance. Gilbert and Greene (2015)[17] document that 60% of merger complaints from the DOJ and FTC allege coordinated effects.

search. First, we provide further evidence on the relevance of the structural presumption to detection of merger price effects in the Bertrand setting of differentiated product price competition with logit demand. Second, we show the relevance of the presumption changes when we change our assumptions on the structure of demand and the nature of competition. In particular, we also consider the same mergers in the Bertrand setting with the almost ideal demand system. Then, we consider the same mergers in the Cournot setting where firms compete by choosing production quantities. We consider this Cournot game under two demand systems: linear and log-linear, which provide upper and lower bounds for estimated merger effects. As a final setting, we consider the case where firms compete via second score auction and face logit demand. We choose these models on the basis that they are commonly used in the antitrust review process,[9] and they provide insight into how our view of the structural presumption changes when we have additional information on the shape of demand and setting of competition. Finally, we evaluate the ability of concentration screens to detect coordinated effects in the Bertrand setting with logit demand.

3 Data and methodology

We generate market data to create a synthetic representation of the universe of potential mergers agencies might face. The distributions of our drawn parameters are informed by the existing literature. The details of the data generation process are as follows:

1. Begin with four firms, each producing a single product within a market. Generate quantities independently for each firm from a log-normal distribution with mean equal to one.[10] Normalize the price of each product to one.[11]

2. Randomly select two firms to merge.

3. Draw additional parameters:

   (a) Draw the margin of the first firm from a uniform distribution between 0.25 and 0.75 as in Miller and Sheu (2020)[22].

   (b) Draw the market elasticity from a uniform distribution between 0 and 2.5.[12]

   (c) Draw merger-specific cost efficiencies for the merged entity from a uniform distribution between 0% and 5%.[13]

[9]See Loudermilk and Taragin (2019)[27] for examples in recently litigated mergers.

[10]The standard deviation of the distribution is calibrated according to the distribution of mergers notified to the European Commission between 1998 and 2018 from Affeldt et al. (2021).

[11]This follows the approach from Miller et al. (2016)[24] and helps to both minimize differences between our demand models and improve interpretability of results without loss of generality.

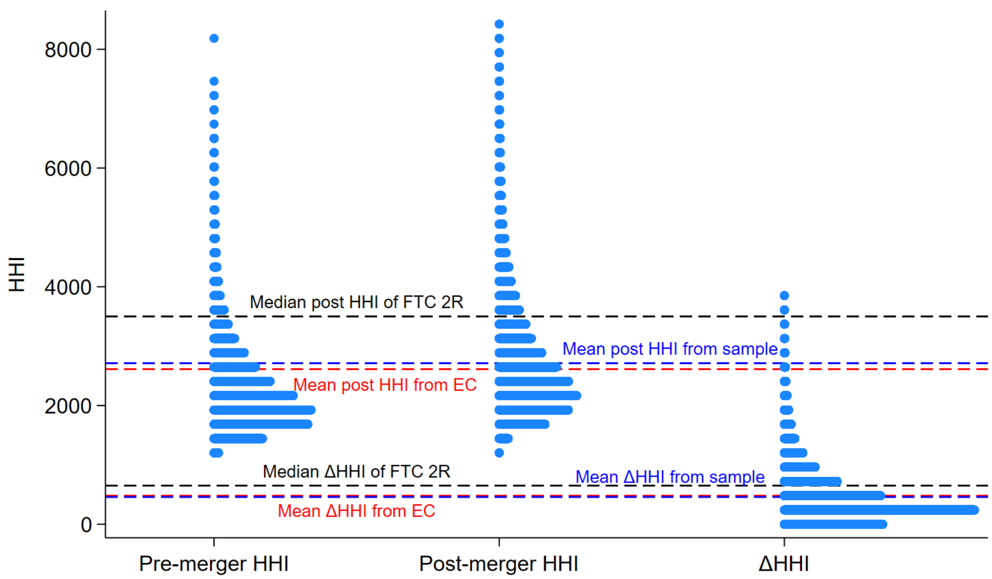
[12]These values are selected based on a review of the relevant literature. Loudermilk and Taragin (2019)[27] use market elasticities between (roughly) 0 and 5. Nocke and Whinston (2022)[25] refer to the range from 1 to 2.5 as "common levels of market elasticity."

[13]An alternative from other papers is to test for merger effects at multiple values of efficiency inside this range (see

4. Repeat the process, including for markets with five, six, seven, eight, and nine firms, until we have 30,000 mergers in as many markets.

The resulting distribution of market concentration is shown in Figure 1. The mean values of post-merger HHI and ΔHHI, shown in blue, closely approximate the mean values from the census of mergers notified to the European Commission from 1998-2018, shown in red.[14] Similar information is not available for the US, though we include (in black) the median values of mergers receiving Second Requests from the FTC from 1996-2011. Second Requests are issued in cases where the agencies have competition concerns for proposed mergers, which likely occur in more concentrated markets than the universe of all mergers that we seek to replicate here.

Figure 1: Distribution of HHIs from random draws



Note: Median post and ΔHHIs for FTC Second Requests calculated from January 2013 Horizontal Merger Investigation Data reported for 1996-2011. HHIs are reported in ranges: we use the midpoint of these ranges to calculate the median of the sample. European Commission merger information is derived from summary statistics in Affeldt el al. (2021) for mergers reported for 1998-2018. Average merged firm shares are used to calculate ΔHHIs.

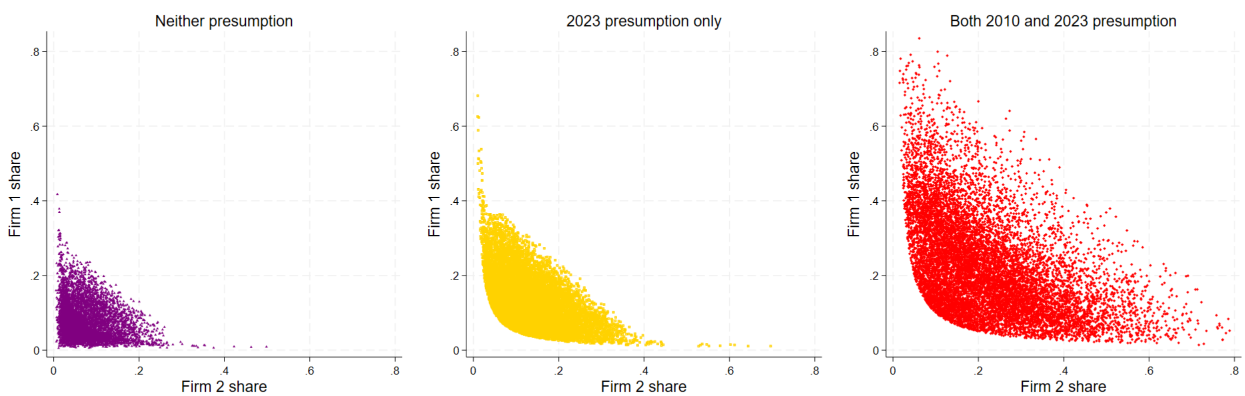
From these random draws we determine whether a given merger would be screened by the structural presumption in neither the 2023 nor 2010 Guidelines, the 2023 Guidelines but not the 2010 Guidelines, or both the 2023 and 2010 Guidelines (there are no mergers that are flagged by the 2010 Guidelines but not the 2023 Guidelines). The resulting presumptions are summarized in Figure 2, which plots as unique dots each merger as expressed by the shares of the merging parties. Mergers meeting neither presumption (in purple) unsurprisingly have lower average shares than

Nocke and Whinston, 2022[25]). We include it as a drawn parameter because it is unobserved to the antitrust agency and therefore a source for uncertainty in the merger review process. Using a single efficiency for all mergers might overstate the predictive ability of the structural presumption. This range is consistent with recent empirical estimates of merger efficiencies (see Demirer and Karaduman (2022)[12] and Ashenfelter et al. (2015)[2]).

[14] EC merger information is derived from summary statistics in Affeldt et al. (2021).

those meeting only the 2023 presumption (in gold) and especially those meeting both presumptions (in red). There is also significant dispersion in firm shares and significant overlap between the three presumption categories, with a merger at a given point in the party shares space able to fall into multiple presumption categories depending on the concentration of outside firms (and therefore the post-merger HHI). The median and standard deviation of key parameters under each presumption are summarized in Table 2. While the indicators of concentration unsurprisingly differ widely between mergers falling under different presumptions, other key drawn parameters (market elasticities, cost efficiencies, and the first firm's margin) remain relatively constant across the presumption groups.

Figure 2: Structural presumption by merged party shares



Note: Shares of merged firms by the presumption triggered in our sample of simulated markets.

Once we have generated market data, we apply the parameters in each setting of competition and demand function to recover cost margins for the remaining firms according to the assumptions of the model. We then implement the Hypothetical Monopolist Test (HMT) in each demand model to find and eliminate markets whose drawn parameters imply a hypothetical monopolist would not have an incentive to increase price by at least 5% in the market. This allows us to rule out markets whose combinations of randomly drawn parameters are outside the bounds of reasonable expectation.[15]

We choose demand systems for each competition setting that have been used in recently litigated mergers, provide tractable results, and provide rough upper and lower bounds of price effects based on the curvature of the demand curve.[16] In the Bertrand setting we first solve with

[15]We also drop a small share of markets where the merger simulation fails to converge because the combination of drawn parameters implies a share of the outside good very close to 1. This occurs in roughly 1% of our markets, typically where we assign a very high margin to a very small firm. In the Bertrand logit setting we preserve roughly 75% of the original mergers in our data set after making these exclusions.

[16]The choice of demand function depends on the assumptions we make on competition. For example, while linear

Table 2: Descriptive statistics of Monte Carlo experiments

	Neither presumption	2023 only	Both presumptions
Acquired firm share	0.04	0.08	0.12
	(0.02)	(0.04)	(0.06)
Acquiring firm share	0.10	0.17	0.30
	(0.05)	(0.07)	(0.12)
Δ HHI	79.50	255.53	709.93
	(79.41)	(164.28)	(526.77)
Post-merger HHI	1,881.61	2,206.44	3,205.81
	(755.72)	(448.79)	(884.94)
Market elasticity	-1.23	-1.24	-1.23
	(0.72)	(0.72)	(0.72)
Cost efficiency	-0.02	-0.03	-0.03
	(0.01)	(0.01)	(0.01)
First firm's margin	0.50	0.50	0.50
	(0.14)	(0.14)	(0.15)
Observations	6651	11772	11577

Table presents median and st. dev. values in drawn Monte Carlo experiments.

logit demand, which assumes diversion between alternatives that is proportional to share. We choose logit demand for our main results because it is, in the words of Miller et al. (2017)[21], the "workhorse model of the discrete choice literature." We then extend our results with the proportionally calibrated almost ideal demand system (Epstein and Rubinfeld, 2002)[14]. To ensure consistency across demand systems and tractable substitution patterns, we apply the own-price elasticity of the first firm recovered from the logit system to the almost ideal setting.[17] Almost ideal demand is estimated using expenditure shares while logit demand is estimated using quantity shares, but these quantities are identical given our normalization of prices to one. By applying the proportionally calibrated assumption to the almost ideal demand function, we make an additional assumption on the nature of substitution between products that is less flexible but ensures consistency with logit demand, which also assumes substitution in proportion to share. This also removes the need to draw additional information that would otherwise be needed to identify the parameters in the almost ideal setting but not the logit setting. In both Bertrand demand systems, we assume marginal costs to be constant.

In the Cournot setting the only inputs required are shares and the market elasticity. Since we assume the existence of a single homogenous product, margins for each firm at the equilibrium can then be computed as the share of the firm divided by the elasticity. For the same reason,

and log-linear are tractable in the homogenous goods Cournot game, they can provide results incompatible with consumer choice theory in the differentiated products Bertrand game (Loudermilk and Taragin, 2019)[27].

[17]This approach is similar to Miller et al. (2017)[21].

elasticities recovered from the Bertrand case are not relevant. These new margins differ from those supplied in the Bertrand simulations, but are needed to fit the assumptions of the Cournot game with a homogenous product. The same identifying parameters are needed for both linear and log-linear demand. We assume firms face linearly increasing marginal costs across both demand systems.

Lastly, in the second score auction setting, we assume products to be both horizontally and vertically differentiated.[18] Without loss of generality, a buyer-specific idiosyncratic shock to utility (i.e. "horizontal" differentiation parameter) is drawn from a Gumbel distribution with mean 0 and variance 1. In this setting, all the parameters of the model are then calibrated with just a single margin and market shares. We choose second score auctions because they have been employed in merger litigations beyond pure auctions, typically in bargaining settings where firms can re-negotiate in successive rounds and in reaction to rivals' actions. In second score auctions, the transaction price between the buyer and the chosen seller is determined by the bid of the second-best option. Miller (2014)[23] shows that firms in such settings have an incentive to bid at marginal cost. Banternghansa, Garibotti, and Zetenyi (2023)[4] show that the effect of mergers in such auctions depend on the competitiveness of rivals pre-merger. Post-merger, the combined entity has an incentive to only offer the product with a higher margin for the seller. This results in consumer harm when the merging firms are #1 and #2, but may generate consumer benefit in other situations. Given the presence of efficiencies, the merger lowers prices when one of the merged firms is the runner-up either pre-merger or post-merger by reducing the transaction price that the outside firm winner receives.[19].

To compute coordinated effects, we follow the approach described in Davis and Garces (2009)[10] where the relevant values to consider incentives from coordination are obtained from the unilateral effects output from the Bertrand game with logit demand. In particular, we consider the canonical model of collusion with infinitely repeated interaction formalized by Friedman (1971)[16]. Firms choose in each period whether to continue on the collusive path or deviate. By deviating firms can earn higher profits in the present followed by lower profits in the future after other firms have responded. We assume that firms begin by coordinating in the first period and continue coordinating as long as all firms have done so in all previous periods. Once one firm deviates, all firms set prices at the competitive level. Equation 1 formalizes this idea for each firm.

$$\forall i : \frac{\pi_i^c}{(1-\delta_i)} > \pi_i^d + \frac{\delta_i \pi_i^p}{(1-\delta_i)} \tag{1}$$

π_i^c denotes coordinated profits where we assume each firm prices its product to maximize the joint maximization problem as if the market participants were a single monopolist. π_i^d denotes deviation profits which are given by the optimal deviation price given that all other products continue to be priced at the monopoly level. π_i^p denotes punishment profits, which are the profits obtained from

[18] The model is mostly based on Brannman and Froeb (2000)[8] and Miller (2014)[23].

[19] Given that the bids vary not only in price but also in characteristics, the price effect that we present may fail to capture all changes to consumer utility as a result of the merger

competition with no coordination. δ_i denotes the discount value that firms use to evaluate future profits, which is not a quantity that is known.

These terms can be re-arranged to find the minimum necessary discount factor needed for each firm to profitably coordinate, δ_i^*.

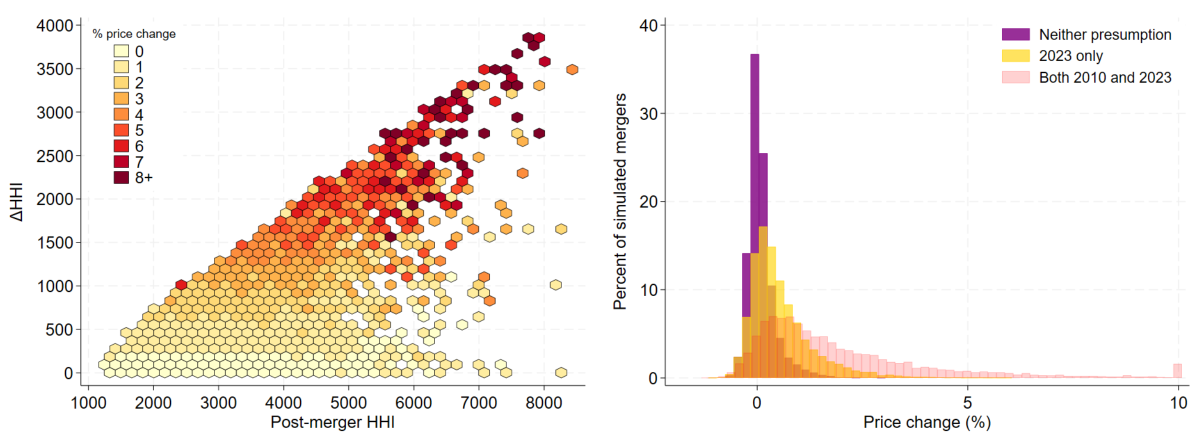
$$\forall i : \delta_i^* \geq \frac{\pi_i^d - \pi_i^c}{\pi_i^d - \pi_i^p}$$

The critical discount factor for each market, δ^*, is the largest such value among the firms in the market (i.e. it is the critical discount value of the firm with the weakest incentive to coordinate). Absent efficiencies, a merger affects the above expression by increasing punishment profits (competitive profits increase post-merger) and increasing deviation profits for the merging firms (the optimal deviation will be affected as a merged deviator now must take into account the effect on its other deviating product) but leaving unchanged the deviation profits for outside firms. The perfect coordination equilibrium is not affected by the merger, but the merged firm now receives coordination profits for both of its products. With efficiencies, coordination profits further increase for the merging firms and the effect on coordination profits, as well as punishment and deviation profits, depends on the relative size of the cost efficiency and gross pricing pressure. Taken together, these changes in profits counter-intuitively predict that mergers will generally increase the critical discount factor and therefore decrease the incentive to coordinate.

4 Results

4.1 Unilateral effects

Figure 3: Average price change by concentration level, Bertrand logit



Note: The graph on the left shows the price effect of simulated mergers at different levels of concentration. Where more than one merger is included in a hexagon, the average price effect is calculated. Mergers with negative price effects are included in the 0 price effect category. No mergers are included in our sample in regions without hexagons.
The graph on the right shows the distribution of price effects for simulated mergers by the structural presumption triggered. The area under the curve of each presumption curve equals one. For visualization, price effects are capped at 10%.

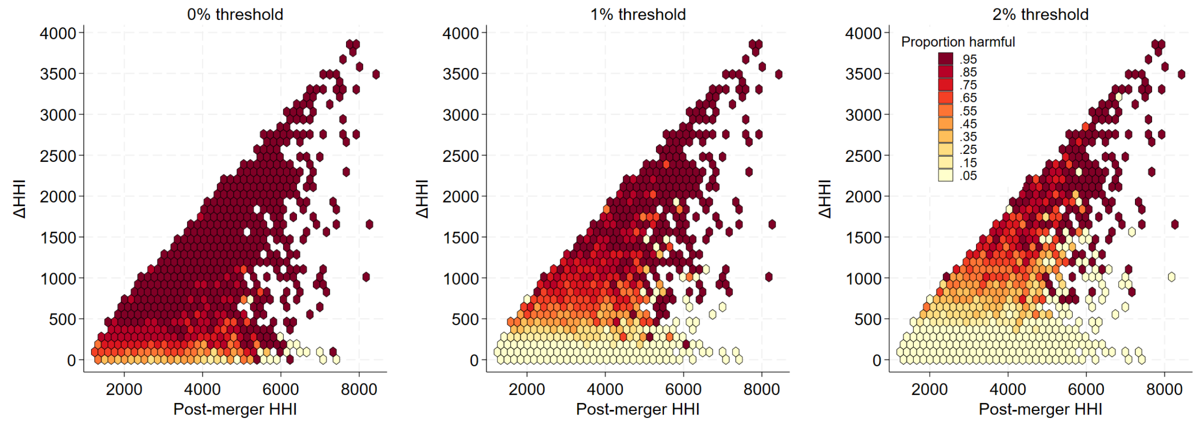
Figure 3 summarizes the results from our Monte Carlo experiments under Bertrand competition and with logit demand. On the left we show the average market price effect at various levels of concentration. Mergers with small (and in some cases negative) price effects are shaded in tan while mergers with large price effects are shaded in dark red. We observe that the risk of large price effects increases as concentration increases, but there are remarkably few mergers with large positive price effects when changes in HHI are small, even if post-merger levels are high.[20] Since these are average values at given levels of concentration, they obscure significant variation in price effects driven by elasticities and efficiencies, especially at middling levels of concentration where we have many observations. In the figure on the right, we transform these concentration levels to show the distribution of price effects by presumption. For each presumption the area in the histogram sums to one. The price effects for mergers with low concentration that exceed the presumptions in neither Guideline (shaded in purple) are tightly centered around 0, with a significant number of mergers having net negative price effects. By contrast the price effects for mergers that meet the presumption in both Guidelines (shaded in red) are widely dispersed and on average positive, though there are a small fraction of mergers even in highly concentrated markets with negative price effects.[21] Mergers captured by the 2023 Guidelines but not the 2010 Guidelines, with ΔHHI values between 100 and 200 and post-merger HHI values between 1800 and 2500, are shaded in gold and have on average small but positive (1-2%) price effects.

From these results, we can identify the change in merger screening efficiency from the 2023 Guidelines. The optimal presumption depends on the agencies' target level of allowable price increase and their relative weighting of Type I and Type II errors. This is a normative question for which we have no empirical answer, but we assume that the agencies seek to block mergers with large price effects while not blocking pro-competitive mergers. To operationalize this notion, we define a Type I error as a merger that triggers the structural presumption but has negative price effects (i.e. it lowers the market price) and a Type II error as a merger that does not trigger the structural presumption but increases market price by at least 2%. This notion is visualized in Figure 4, which shows the percentage of mergers at each level of concentration that have at least a 0%, 1%, and 2% price effect. As is apparent from the figure, the frequency of anti-competitive mergers depends on the threshold of harm chosen. The Agencies are budget constrained in the number of cases they can investigate, and a recent study suggests that the agencies prefer to intervene when expected price effect are between 3.7 and 5.6% (Bhattacharya et al., 2023)[6]. Our lower threshold of 2% reflects that agencies may wish to screen a merger for further review even if they are unlikely to challenge it in court. We also provide results with a threshold of 1% in Appendix A. Given this definition of enforcement error, we can determine the relative tolerance for the agencies in committing Type I and Type II errors. The Type I error rate is the percentage of all pro-competitive mergers that are flagged by the presumption, while the Type II error rate is the percentage of all anti-competitive mergers that are not flagged. Loudermilk and Taragin (2019)[27] refer to the ratio of Type I errors

[20] Note that large changes in HHI are not possible for mergers with low values of post-merger HHI, and the top left section of the figure is blank for this reason.

[21] Price changes in this figure are capped at 10% for visualization purposes.

Figure 4: Percent of mergers with consumer harm by harm threshold



Note: Mergers in the Bertrand, logit setting are categorized as harmful or benign depending on whether the average market-wide price effect exceeds the critical threshold specified: {0%, 1%, 2%}. Only mergers with efficiencies that at least offset the upward pricing pressure are benign with a critical threshold of 0%. Due to budget constraints, antitrust agencies are unlikely to block mergers with small price effects and may prefer a structural presumption that allows them to effectively screen for mergers with large price effects at the expense of allowing mergers with de minimis effects. The hexagons are shaded based on the proportion of mergers that are harmful in each neighborhood of concentration.

divided by Type II errors as the "enforcement ratio." As noted by Miller et al. (2017)[21], it is probably preferable for the enforcement ratio to be greater than one, as the agencies can clear a false positive merger following further investigation but may not be able to investigate a false negative merger after clearing it. In other words, there are asymmetric costs between the two classes of errors. In Table 3 we show the error rates and implied enforcement ratios from the 2010 Guidelines, 2023 Guidelines, and several counterfactual structural presumptions that rely on the change in HHI alone. In the Bertrand-logit results, we show that the presumption of the 2010 Guidelines was about 5 times more likely to commit Type I than Type II errors, which implies that the agencies preferred an enforcement ratio of close to 5. By contrast, the 2023 presumption is much more likely to flag pro-competitive mergers, with the effect of roughly doubling the overall error rate. The new presumptions also doubles the share of total mergers in our sample that are flagged, from 38% to 78%. The change to the new presumption can be interpreted as a shift to a much stronger preference for detecting anti-competitive mergers at the expense of blocking pro-competitive mergers, and the implied enforcement ratio increases to *1558*.[22] We re-weight the errors by this value to express an alternative overall error term that incorporates this implied preference in the second to last column. Re-weighting by the enforcement error allows us to evaluate alternative presumptions based on the agencies' own implied policy preference, which is attractive because it does not require us to take a stance of the normative question of weighting the two error types. In the subsequent three rows, we show that counterfactual presumptions could improve the overall accuracy of the presumption and also improve the Type II error rate. In fact, setting the presumption at ΔHHI values of 150 or 250 reduces the Type I error rate and results in no Type II errors. This results in an enforcement ratio-weighted error close to zero. Setting the presumption where ΔHHI is 350 results in a further

[22]That is, the presumption is 1558 times more likely to commit a Type I error than Type II error.

reduction in Type I errors, though at the cost of an increase in the Type II error rate, which increases the enforcement ratio-weighted error.[23] These results indicate that the agencies show a strong preference for avoiding Type II errors at the expense of generating many Type I errors. But the agencies could improve their accuracy in predicting both Type I and Type II errors by switching to a structural presumption that relies on the change in concentration alone.

Table 3: Error rates by presumption, 2% threshold of harm

	Type I error (%)	Type II error (%)	Overall error (%)	Implied enforcement ratio	Overall error, 2023 ratio (%)	% of mergers flagged
Bertrand, logit demand						
2010 Guidelines	14.45	2.71	5.15	5.33	2.15	38.5
2023 Guidelines	53.05	.03	11.05	1558	.03	77.72
ΔHHI>150	44.89	0	9.33	Inf	0	74.83
ΔHHI>250	24.21	0	5.03	Inf	0	58.23
ΔHHI>350	14.11	.28	3.15	50.7	.22	45.36

Error rates are listed for mergers in the Bertrand setting with logit demand in % terms for structural presumptions from the 2010 and 2023 Guidelines and from hypothetical alternatives that rely on Δ HHI alone. The Type I error rate is the number of mergers with negative price effects flagged by the presumption divided by the total number of mergers with negative price effects. The Type II error rate is the number of mergers with price effects above 2% not flagged by the presumption divided by the number of mergers with price effects above 2%. The overall error rate is the number of mergers with either error divided by the total count of mergers. The implied enforcement ratio is the Type I error rate divided by the Type II error rate. Infinite enforcement ratios indicate presumptions with no Type II errors. Overall error, 2023 ratio is the overall error rate when Type I and Type II errors are weighted by the enforcement ratio from the 2023 Guidelines.

In Table 4 we replicate these error rate calculations for additional competition settings. There is a wider dispersion and higher average price effect when we apply almost ideal demand (the first set of rows), and as a result we find overall higher Type I and especially Type II error rates.[24] This is unsurprising, as the greater convexity of almost ideal demand implies that firms face demand with elasticities that increase more gradually as prices increase and are therefore able to profitably increase prices further than in the logit case. It is easier to rationalize the 2023 change in presumption under almost ideal demand, as the 2010 Guidelines implied an enforcement ratio below 1.[25] While we analyze only logit and almost ideal demand in the Bertrand setting, we can generalize the results to other demand systems with similar second derivatives. When we weight our results for Bertrand, almost ideal demand by the enforcement ratio implied from the 2023 Guidelines of 32.3, we find that a structural presumption based on a ΔHHI value of 150 commits fewer errors than both the 2010 and 2023 Guidelines and presumptions based on higher values of ΔHHI, suggesting that the optimal presumption is lower when we consider almost ideal demand to best represent the market.

[23]In Appendix A we repeat this exercise but define Type II errors as mergers that don't meet the presumption and increase market prices by at least 1% (instead of 2%). The results are broadly consistent, with ΔHHI presumptions outperforming the 2010 and 2023 Guidelines. The overall error rates from the 2010 and 2023 Guidelines, though, are roughly equal with this definition.

[24]We also include figures for each competition setting in Appendix A.2.

[25]That is, the 2010 Guidelines featured a Type II error rate that was higher than the Type I error rate.

In both models shown of Bertrand competition with differentiated products, outsider firms respond to an increase in price from the merged entity by increasing their own prices due to the decreased intensity of competition. In contrast, in the Cournot setting with homogenous products firm quantities act as strategic substitutes. The increase in price associated with an upwards pricing pressure is partially offset by outsiders increasing their own production in response to decreased production from the merged entity. Similarly, an efficiency gain that offsets the upwards pricing pressure for the merged entity is less likely to result in substantial price decreases under Cournot, as rivals respond by cutting their own production. We present results from two demand functions under Cournot: linear and log-linear, the latter being more convex and therefore predicting larger price effects. Both demand models display an increase in the enforcement ratio implied by the Guidelines from less than one in 2010 to 15 or greater in 2023. In both cases, the 2023 Guidelines generate a lower overall error rate than the 2010 Guidelines, and in both cases the frequency of Type I and Type II errors can be improved by switching to a presumption of anticompetitiveness for ΔHHI values above 150. In merger review, Cournot models are often used when firms compete in sales of a homogenous product and when the existence of fixed costs or extended production timelines imply that capacity constraints are relevant to competition.

As noted in the methodology section, the price effects of a merger in the second score auction setting depends on the relative position of the merging firms. Mergers in markets where a merged firm product wins and an outsider is in second have no impact on price. In markets where neither party is in the first or second position, mergers have no impact on price unless the efficiencies are sufficiently large to move the merged firm to first or second position, in which case there is a negative impact on price. Due to the presence of (small) efficiencies, in markets where one party is in the second position and outsider is in the first position mergers also have a negative impact on price. Finally, mergers in markets where the merged firms are in the first and second position pre-merger are likely to be anticompetitive, as the merged entity has an incentive to not bid the offering with a lower margin, and the price will now be set by the outside firm with the third most attractive option. The risk of this occurring increases with the shares of the merged firm, so ΔHHI is still an meaningful predictor of merger effects. But the relative frequency of anticompetitive effects is much lower here, and the concerning mergers tend to occur at higher levels of changes in concentration. In this setting, the 2023 Guidelines greatly increase the Type I error rate. Type II errors are unlikely to occur at any of the presumptions considered, and our results suggest that a presumption at a ΔHHI value of 350 is the most effective among those listed.

In practice, antitrust agencies are unlikely to consider different structural presumptions for different settings of competition. But these results may be helpful in interpreting the likelihood of harm once HHIs are calculated: harm is more likely the more convex demand is, harm is larger at a given level of HHI when costs are increasing, and second score auctions are unlikely to be harmful in cases where the change in concentration does not far exceed the 2023 structural presumption.

Table 4: Error rates by presumption for other competition settings, 2% threshold of harm

	Type I error (%)	Type II error (%)	Overall error (%)	Implied enforcement ratio	Overall error, 2023 ratio (%)	% of mergers flagged
Bertrand, almost ideal						
2010 Guidelines	14.37	15.26	15.08	.941	11.8	38.49
2023 Guidelines	52.96	1.64	12.21	32.3	1.59	77.72
ΔHHI>150	44.82	1.12	10.12	40.1	1.13	74.83
ΔHHI>250	24.23	4.34	8.44	5.58	3.49	58.23
ΔHHI>350	14.11	8.98	10.04	1.57	7	45.36
Cournot, linear						
2010 Guidelines	5.19	8.08	7.95	.641	7.44	37.55
2023 Guidelines	29.63	1.06	2.41	27.9	1.01	77.64
ΔHHI>150	16.95	.3	1.09	56.2	.300	75.18
ΔHHI>250	4.2	1.81	1.92	2.32	1.66	58.17
ΔHHI>350	.66	4.12	3.96	.159	3.79	45.26
Cournot, log-linear						
2010 Guidelines	5.16	11.9	11.58	.433	10.6	37.48
2023 Guidelines	29.46	1.95	3.25	15.1	1.83	77.6
ΔHHI>150	16.86	1.49	2.22	11.3	1.37	75.13
ΔHHI>250	4.17	4.42	4.41	.944	3.96	58.1
ΔHHI>350	.65	7.64	7.31	.085	6.82	45.2
Second score auction, logit						
2010 Guidelines	25.76	.37	14.93	68.9	.	38.54
2023 Guidelines	68.57	0	39.32	Inf	.	77.67
ΔHHI>150	63.02	0	36.13	Inf	.	74.55
ΔHHI>250	42.12	0	24.15	Inf	.	57.9
ΔHHI>350	28.21	0	16.17	Inf	.	45.04

Error rates are listed for mergers in other settings in % terms for structural presumptions from the 2010 and 2023 Guidelines and from hypothetical alternatives that rely on Δ HHI alone. The Type I error rate is the number of mergers with negative price effects flagged by the presumption divided by the total number of mergers with negative price effects. The Type II error rate is the number of mergers with price effects above 2% not flagged by the presumption divided by the number of mergers with price effects above 2%. The overall error rate is the number of mergers with either error divided by the total count of mergers. The implied enforcement ratio is the Type I error rate divided by the Type II error rate. Infinite enforcement ratios indicate presumptions with no Type II errors. Overall error, 2023 ratio is the overall error rate when Type I and Type II errors are weighted by the enforcement ratio from the 2023 Guidelines. The % of mergers flagged varies in each setting, as a different set of mergers pass the HMT and do not experience convergence issues in each setting.

4.2 Performance of merger simulation with mismeasured parameters

The results from the previous section show the performance of the structural presumption when we have merger simulation output to tell us the "true" price effects of the merger. The reader may finish the section on unilateral effects with doubts about the use of any structural presumption when merger simulation in feasible. In practice, merger simulation requires making assumptions about the nature of competition and the input parameters used are often subject to measurement error and debate. The actual performance of merger simulation in predicting price effects is an area of active research.[26] In Table 5, we present the prediction accuracy of merger simulation under Bertrand competition with logit demand when we add a degree of mismeasurement to three input parameters: cost efficiencies of the merging parties, margins of the first firm, and market elasticities.[27] In the first three sections of the table we show how our prediction error changes when we increase the measurement error from 0% (the baseline scenario where we predict effects perfectly) to 10%, 25%, and 50% for each of these three parameters separately, leaving the other parameters untouched. In the fourth and final section of Table 5, we show the error rate from merger simulation if we apply the measurement to all three parameters simultaneously. We then present the resulting Type I and Type II errors, the overall error rate, and the error rate weighted by the implied enforcement ratio from the 2023 Guidelines as introduced in Table 3.[28]

Our results show that a moderate amount of mismeasurement still leads to fairly accurate classification of merger effects. In particular, the overall error rate is lower than any of the presumption rules listed in Table 3 when the mismeasurement in the parameters is 10%, and the weighted error rate is within the same range. The mismeasurement becomes more important when it is increased to 25% and especially to 50%, and when the measurement occurs simultaneously for each of three parameters. In particular, while the unweighted overall error continues to outperform the 2010 and 2023 Guidelines, it underperforms the ΔHHI-based presumptions, and the weighted overall error of the mismeasured simulations also underperforms the 2023 Guidelines. This analysis points to the relative attractiveness of the structural presumptions in cases where there is considerable uncertainty over the key parameters used as inputs to more sophisticated predictors of post-merger price.[29]

[26]See for example Peters (2006)[26], Weinberg and Hosken (2013)[28], and Björnerstedt and Verboven (2016)[7].

[27]We choose these parameters because they seem prone to mismeasurement. We could also assume mismeasured shares (which would also affect HHIs) or prices, but these parameters seem less prone to large measurement errors.

[28]We implement these mismeasurements by randomly determining whether each merger will have a positive or negative measurement error, then scaling the parameter by 10, 25, or 50% of its original value. Mergers are then classified using the mismeasured merger simulation results by whether the predicted price effects are positive or negative, and compared to the "true" effects using the 0% and 2% cutoffs for Type I and Type II errors from Table 3. Large mismeasurements can create non-convergence in our simulations, so we keep only merger simulations that converge across all levels of mismeasurement. This creates a data set that contains 90% of the simulations in our baseline Bertrand, logit results. Note that the reported error rates from the structural presumptions reported in Table 5 differ slightly from those in Table 3 for this reason.

[29]This analysis also does not consider error related to the usage of the wrong demand system. For this, see Miller et al. (2017)[21]. On the other hand, our assumption in the previous section that diversion is proportional to share may overestimate the predictive power of structural presumptions. Mergers may also harm consumers when the firms

Table 5: Error rates for merger simulation with mismeasured parameters

	2023 Guidelines	Δ HHI >250	10% error	25% error	50% error
Cost Efficiency					
Type I error rate (%)	53.49	24.27	6.28	15.29	29.75
Type II error rate (%)	.08	0	0	.15	.15
Overall error rate (%)	12.15	5.51	1.43	3.49	6.77
2023 Guidelines weighted error rate (%)	.03	0	0	.03	.03
Margin					
Type I error rate (%)	53.49	24.27	5.8	12.17	12.26
Type II error rate (%)	.08	0	0	.5	1.37
Overall error rate (%)	12.15	5.51	1.32	2.83	2.97
2023 Guidelines weighted error rate (%)	.03	0	0	.07	.19
Market Elasticity					
Type I error rate (%)	53.49	24.27	9.15	19.45	26.74
Type II error rate (%)	.08	0	0	.5	2.75
Overall error rate (%)	12.15	5.51	2.08	4.48	6.45
2023 Guidelines weighted error rate (%)	.03	0	0	.07	.39
Efficiency, Margin, and Elasticity					
Type I error rate (%)	53.49	24.27	10.69	21.73	29.05
Type II error rate (%)	.08	0	.11	1.33	3.24
Overall error rate (%)	12.15	5.51	2.44	5.11	7.04
2023 Guidelines weighted error rate (%)	.03	0	.02	.19	.45

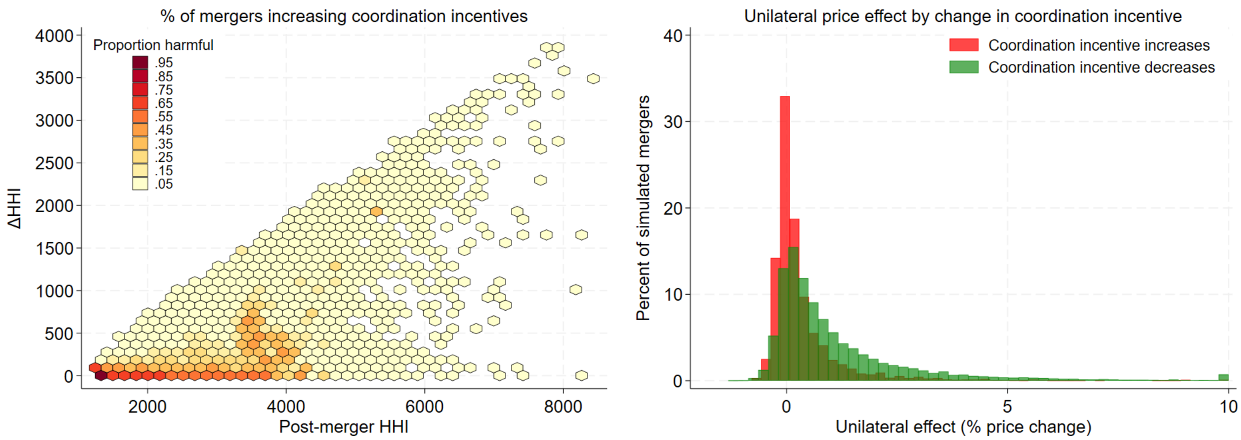
Error rates are listed in % terms for (1) simulations with no mismeasurement based on the structural presumption from the 2023 Guidelines and a hypothetical presumption relying on Δ HHI alone and (2) based on assigning a 10%, 25%, and 50% mismeaurement. Mismeasurements are assigned to only cost efficiencies in the first set of rows, only margins in the second, only market elasticities in the third, and to all three variables in the final set of rows. The results show that a sizable mismeasurement in even one parameter, with perfect information in all others, can lead to errors as large as the structural presumption. Errors for the structural presumption differ slightly from previous results as only markets that converge under all mismeasurement contexts are included in the sample. The weighted error rate is found by weighting Type I and II errors by the enforcement ratio of Type I to II errors from the Bertrand logit results.

4.3 Coordinated effects

To evaluate coordinated effects we categorize each merger based on whether it increases or decreases the critical delta value needed to sustain coordination. We don't capture price effects as in unilateral effects but instead measure the change in the incentive to coordinate. Figure 5 shows the proportion of mergers that are harmful at each level of concentration. As shown in the methodology section, mergers generally decrease incentives to coordinate for outsiders and increase the incentives to coordinate for insiders. This means that a merger is most likely to enhance coordinated effects when it is between small firms with difficult to satisfy critical discount factors pre-merger. While this will decrease the incentive of outsiders to coordinate, the overall risk of coordination increases

are important innovators, or if one firm is expected to expand. These effects are captured by neither concentration screens nor the type of merger simulation conducted here.

Figure 5: Coordinated effects by concentration level

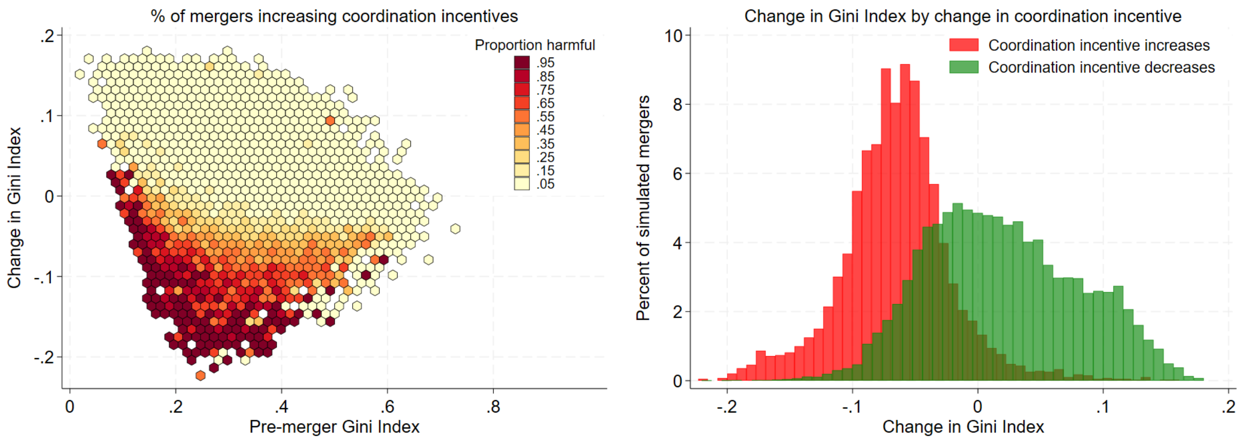


Note: The graph on the left shows the percentage of simulated mergers enhancing incentives to coordinate at different levels of concentration. No mergers are included in our sample in regions without hexagons.
The graph on the right shows the distribution of price effects under unilateral effects by whether the merger increases or decreases coordination incentives. Unilateral price effects are larger on average for mergers that decrease these incentives. The area under the curve of each presumption curve equals one. For visualization, price effects are capped at 10%.

post-merger if the outsiders had sufficiently large incentives pre-merger. The counterintuitive result, as shown in the right graph in Figure 5, is that the concern for coordinated effects is greatest when the concern for unilateral effects is small. This result connects to the notion of "maverickness" often discussed in merger review. A single firm, usually with a small share, can compete particularly aggressively and thereby increases the intensity of competition in the market. Our results indicate that the elimination of a small firm is a cause for concern of anticompetitive effects, but only when the acquiring firm is also small. When a large firm acquires the maverick, the merger enhances asymmetries between firms and decreases the likelihood of coordination.

Given these results, it is unsurprising that the HHI is a poor indicator of coordination. A better indicator would increase, rather than decrease, the concern for harm with the degree of symmetry between firm market shares. One such indicator is the Gini Index, which is most commonly used to express inequality in income distributions. It is calculated as the integral of the difference between a line of equality between quantities and the distribution actually observed in the data and is then normalized from 0 (total equality between quantities) to 1 (total inequality). We can also calculate the ΔGini, which is the difference between the post-merger and pre-merger values of the Index. In Figure 6 we show that, while the Gini Index itself is not a strong predictor of coordinated effects, the ΔGini is. In particular, few mergers with an increase in the Gini Index generate increases in incentives to coordinate and most mergers with a decrease in the Index generate decreases. This suggests that an improved structural presumption could separately test for unilateral and coordinated effects using different measurements derived only from firms' shares. In Table 6 we compare the efficacy of a presumption based on the change in symmetry alongside error rates from the 2010 and 2023 Guidelines. All ΔGini Index thresholds considered in the table

Figure 6: Percent of mergers with consumer harm by harm threshold



Note: The graph on the left shows the percentage of simulated mergers enhancing incentives to coordinate at different levels of firm share inequality. No mergers are included in our sample in regions without hexagons. Mergers that decrease inequality are more likely to enhance coordination. The level of pre-merger inequality doesn't seem to be an important predictor of coordinated effects.
The graph on the right shows the change in Gini Index by whether a merger increases or decreases coordination incentives. The area under the curve of each presumption curve equals one.

outperform both the 2010 and 2023 Guidelines. For instance, the Type I error rate is 44% in the 2010 Guidelines and 85% in the 2023 Guidelines but only 9-39% when using one of the ΔGini presumptions shown. The Type II error rate is 80% in the 2010 Guidelines and 48% in the 2023 Guidelines but only 6-33% among the ΔGini presumptions shown. The optimal level of allowable change in the Index depend on the preferred enforcement ratio, with thresholds at more negative values of ΔGini implying lower values of the enforcement ratio (more Type II errors with fewer Type I errors).[30]

Our results are generated from a specific model with strong assumptions on the nature of coordination. Still, the result that mergers tend to decrease incentives to coordinate in the Bertrand game with differentiated products should hold across various demand functions.[31] Further, Davis and Huse (2010)[11] show that this general result also holds when multi-market contact, the existence of a competitive fringe, and antitrust penalties are incorporated into the model. Other changes to the assumptions of the model may produce different results. If we assume that the coordination prices are not set to maximize joint profits but instead to equalize all firms' incentive compatibility constraints (implying that firms who find coordination the most profitable yield some profits to firms who find it less profitable), the effect of more mergers may be to enhance incentives to coordinate. This alternative assumption seems less reasonable when thinking of tacit coordination, as it would require firms to exchange information on their profitability of coordination without

[30] Calculating the Gini Index may be difficult when there is a fringe of small firms as it can be highly sensitive to the number of firms that are included. But the change in Gini Index should be less impacted.

[31] Results may differ in auction settings or Cournot with a homogenous products, as the number of offered products/sellers changes post-merger.

Table 6: Error rates by presumption, coordinated effects

	Type I error (%)	Type II error (%)	Overall error (%)	Implied enforcement ratio	Overall error, 2023 ratio (%)	% of mergers flagged
Bertrand, logit demand						
2010 Guidelines	44.21	80.25	44.29	.550	19.93	38.5
2023 Guidelines	84.94	48.11	66.42	1.76	26.36	77.72
Δ Gini Index <0	38.89	5.79	27.55	6.71	10.25	50.63
Δ Gini Index <–0.025	22.89	13.2	17.94	1.73	7.13	36.49
Δ Gini Index <–0.05	9.25	32.59	12.05	.284	5.95	21.83

Error rates are listed for mergers in the Bertrand logit setting in % terms for structural presumptions from the 2010 and 2023 Guidelines and from hypothetical alternatives that rely on Δ Gini Index alone. The Type I error rate is the number of mergers with decreased coordination incentives flagged by the presumption divided by the total number of mergers with decreased coordination incentives. The Type II error rate is the number of mergers with increased coordination incentives not flagged by the presumption divided by the number of mergers with increased coordination incentives. The overall error rate is the number of mergers with either error divided by the total count of mergers. The implied enforcement ratio is the Type I error rate divided by the Type II error rate. Overall error, 2023 ratio is the overall error rate when Type I and Type II errors are weighted by the enforcement ratio from the 2023 Guidelines.

explicit discussion.

This analysis captures only the change in incentive to coordinate post-merger. Also important to consider is whether the merger causes any change in the ability of firms to tacitly agree on a focal price post-merger. All things equal, it appears easier to find a focal price when there are fewer firms in the market. On the other hand, cost efficiencies may change the joint profit maximizing coordination price post-merger and this change may diminish firms' ability to find a new focal coordination price. This creates ambiguity as to the impact of mergers on the ability to coordinate. There does not seem to be any reason to believe this change in ability is related to the level or change in HHI. The likelihood of coordination also depends on other factors like frequency of interaction, ability to detect defection, and entry barriers, though these seem less likely to be affected by a merger. The reader should observe that these Monte Carlo experiments provide informative results to the degree that the assumed model is correct. Future research on how firms tacitly agree on coordinated prices and split profits would further inform this exercise.

5 Conclusion

In his 1950 paper proposing the HHI, Orris Herfindahl noted that "the economist will perform an important service if he can develop a more adequate account of the relationships between measures of concentration and market behavior."[18] We contribute to this inquiry by evaluating the effect of the change in the structural presumption in the 2023 Guidelines. Our results suggest that, under logit demand, the 2023 Guidelines are extremely intolerant of allowing anticompetitive mergers to escape scrutiny. This intolerance is at the expense of flagging many pro-competitive mergers. The new presumptions seem more defensible if we instead consider more convex demand systems to be a better representation of reality. Under any setting, a presumption based on changes in concentration alone (in particular, in the range of ΔHHI between 150 and 250) outperforms the 2023 presumption.

Further, a presumption based on concentration alone can outperform even merger simulation when there is considerable mismeasurement in one or more parameters. This suggests that concentration analysis, while simplistic in describing dynamics of the market, can be a powerful initial screen in antitrust agency decision-making. Conversely, under one common model of collusion the risk of coordination does not increase with concentration. The merged firm's incentive to coordinate tends to strengthen, while the incentives for other firms tends to weaken. As a result, mergers tend to pose coordination risks when the symmetry in market shares increases. Antitrust agencies can improve their ability to detect coordinated effects by using an alternative screen that reflects this pattern.

In the decades since the introduction of the structural presumption, advances in academic research have created the potential to more accurately predict merger effects. Still, legal precedent and practical considerations have continued to support the use of concentration-based presumptions. Given the relevance of presumptions for merger review, it is important for researchers to study the issue and suggest better alternatives where possible. Our work is one such attempt to aid practitioners.

References

[1] P. Affeldt, T. Duso, K. Gugler, and J. Piechucka. "Assessing EU Merger Control through Compensating Efficiencies". *DIW Berlin Discussion Paper* 1979 (Nov. 2021).

[2] O. Ashenfelter, D. Hosken, and M. Weinberg. "Efficiencies Brewed: Pricing and Consolidation in the US Beer Industry". *RAND Journal of Economics* 46.2 (2015).

[3] C. Athey and S. Lawrence. "The 2023 Merger Guidelines: Lessons in the Importance of Incipiency, Modern Economics, and Monopsony". *Competition Policy International Antitrust Chronicle* (2024). Forthcoming.

[4] C. Banternghansa, M. E. Garibotti, and K. Zetenyi. "Efficiencies in the Second-Score Auction Model". *Concurrences* 2-2023 (2023).

[5] W. F. Baxter. "Justice Department Perspective". *Antitrust Law Journal* 51 (1982), pp. 287–287.

[6] V. Bhattacharya, G. Illanes, and D. Stillerman. "Merger Effects and Antitrust Enforcement: Evidence from US Consumer Packaged Goods". Working Paper Series 31123 (Apr. 2023).

[7] J. Björnerstedt and F. Verboven. "Merger Simulation with Nested Logit Demand: Application to the Swedish Analgesics Market". *Economica* 83.330 (2016).

[8] L. Brannman and L. M. Froeb. "Mergers, Cartels, Set-Asides, and Bidding Preferences in Asymmetric Oral Auctions". *The Review of Economics and Statistics* 82.2 (2000), pp. 283–290.

[9] M. B. Coate. "Empirical Analysis of Merger Enforcement Under the 1992 Merger Guidelines". *Review of Industrial Organization* 27.3 (2005), pp. 279–301.

[10] P. Davis and E. Garces. *Quantitative Techniques for Competition and Antitrust Analysis*. Princeton University Press, 2009.

[11] P. Davis and C. Huse. *Estimating the 'coordinated effects' of mergers*. Working Paper. UK Competition Commission, 2010.

[12] M. Demirer and Ö. Karaduman. "Do Mergers and Acquisitions Improve Efficiency: Evidence from Power Plants" (Oct. 2022).

[13] H. Demsetz. "Industry Structure, Market Rivalry, and Public Policy". *Journal of Law and Economics* 16.1 (1973), pp. 1–9.

[14] R. J. Epstein and D. L. Rubinfeld. "Merger Simulation: A Simplified Approach with New Applications". *Industrial Organization* 0201002 (2002).

[15] N. Fabra and M. Motta. "Assessing Coordinated Effects in Merger Cases". *Handbook of Game Theory and Industrial Organization, Volume II*. 2018. Chap. 5, pp. 91–122.

[16] J. Friedman. "A Non-cooperative Equilibrium for Supergames". *Review of Economic Studies* 38.1 (1971).

[17] R. Gilbert and H. Greene. "Merging Innovation into Antitrust Agency Enforcement of the Clayton Act". *George Washington Law Review* 863.6 (Nov. 2015).

[18] O. C. Herfindahl. "Concentration in the Steel Industry". Ph.D. dissertation. Columbia University, 1997.

[19] S. Loertscher and L. M. Marx. "Coordinated Effects in Merger Review". *The Journal of Law and Economics* 64.4 (Nov. 2021).

[20] N. Miller, S. T. Berry, F. M. Scott Morton, J. B. Baker, T. F. Bresnahan, M. Gaynor, R. Gilbert, G. A. Hay, G. Z. Jin, B. H. Kobayashi, F. Lafontaine, J. A. Levinsohn, L. M. Marx, J. W. Mayo, A. Nevo, A. Pakes, N. L. Rose, D. L. Rubinfeld, S. C. Salop, M. Schwartz, K. Seim, C. Shapiro, H. A. Shelanski, D. S. Sibley, and A. Sweeting. "On the Misuse of Regressions of Price on the HHI in Merger Review". 3974267 (Nov. 2021).

[21] N. Miller, M. Remer, C. Ryan, and G. Sheu. "Upward Pricing Pressure as a Predictor of Merger Price Effects". *International Journal of Industrial Organization* 52 (2017).

[22] N. Miller and G. Sheu. "Quantitative Methods for Evaluating the Unilateral Effects of Mergers". *Georgetown McDonough School of Business Research Paper* 3635245 (Dec. 2020).

[23] N. H. Miller. "Modeling the Effects of Mergers in Procurement". *International Journal of Industrial Organization* 37 (2014), pp. 201–208.

[24] N. H. Miller, M. Remer, C. Ryan, and G. Sheu. "Pass-Through and the Prediction of Merger Price Effects". *Journal of Industrial Economics* 64.4 (2016), pp. 683–709.

[25] V. Nocke and M. D. Whinston. "Concentration Thresholds for Horizontal Mergers". *American Economic Review* 112.6 (June 2022), pp. 1915–48.

[26] C. Peters. "Evaluating the Performance of Merger Simulation: Evidence from the U.S. Airline Industry". *The Journal of Law Economics* 49.2 (2006), pp. 627–649.

[27] C. Taragin and M. Loudermilk. *Using Measures of Competitive Harm for Optimal Screening of Horizontal Mergers.* Oct. 2019.

[28] M.C. Weinberg and D.S. Hosken. "Evidence on the Accuracy of Merger Simulations". *Review of Economics and Statistics* 95.5 (2013).

[29] G. J. Werden. "Inconvenient Truths on Merger Retrospective Studies" (Jan. 2015).

Appendices

A Additional figures from the analysis of unilateral effects

A.1 Alternative Bertrand logit error table

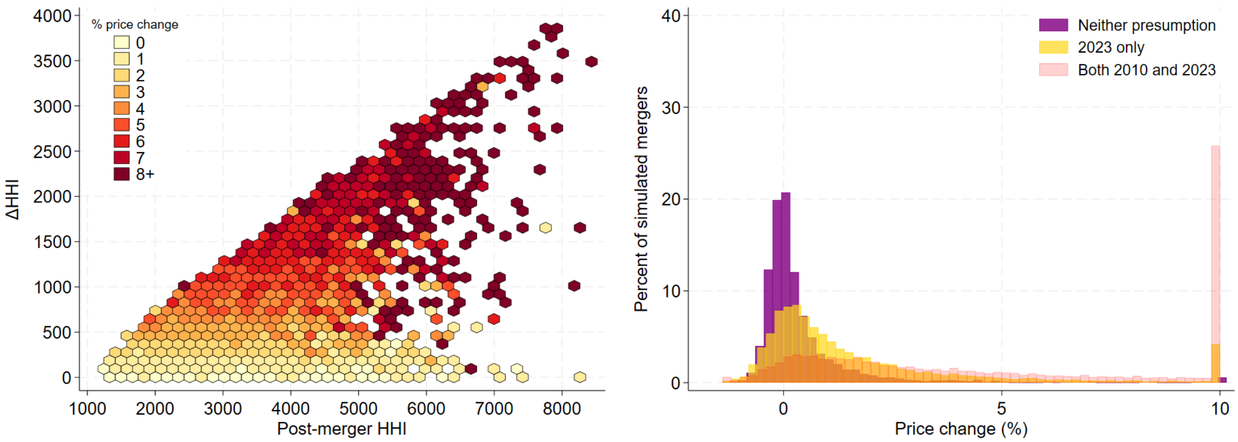
Table 7: Error rates by presumption, 1% threshold of harm

	Type I error (%)	Type II error (%)	Overall error (%)	Implied enforcement ratio	Overall error, 2023 ratio (%)	% of mergers flagged
Bertrand, logit demand						
2010 Guidelines	14.45	10.39	11.23	1.39	8.16	38.5
2023 Guidelines	53.05	.72	11.59	73.6	.71	77.72
ΔHHI>150	44.89	.02	9.34	1978	.14	74.83
ΔHHI>250	24.21	1.17	5.95	20.7	.98	58.23
ΔHHI>350	14.11	4.34	6.37	3.25	3.43	45.36

Error rates are listed for mergers in the Bertrand setting with logit demand in % terms for structural presumptions from the 2010 and 2023 Guidelines and from hypothetical alternatives that rely on Δ HHI alone. The Type I error rate is the number of mergers with negative price effects flagged by the presumption divided by the total number of mergers with negative price effects. The Type II error rate is the number of mergers with price effects above 1% not flagged by the presumption divided by the number of mergers with price effects above 1%. The overall error rate is the number of mergers with either error divided by the total count of mergers. The implied enforcement ratio is the Type I error rate divided by the Type II error rate. Infinite enforcement ratios indicate presumptions with no Type II errors. Overall error, 2023 ratio is the overall error rate when Type I and Type II errors are weighted by the enforcement ratio from the 2023 Guidelines.

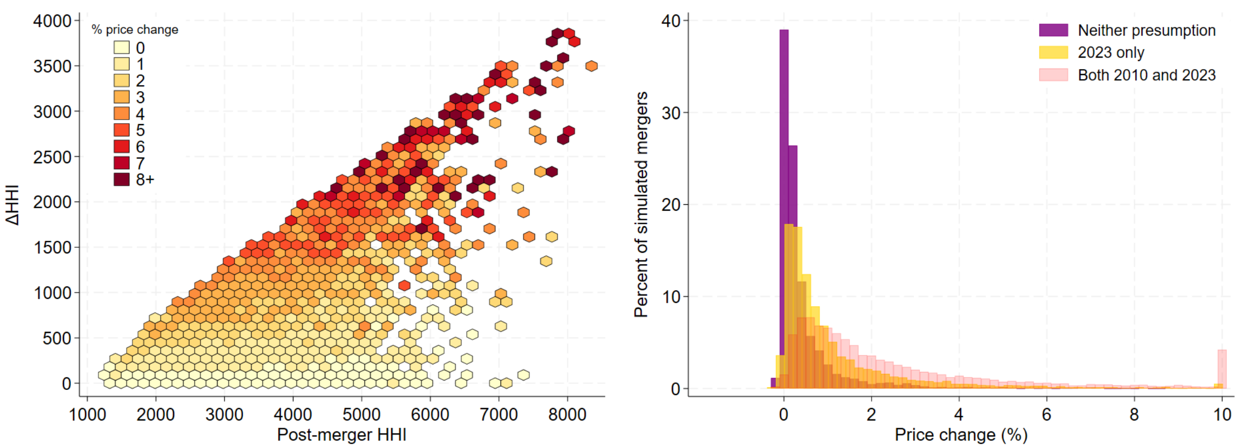
A.2 Distribution of price effects from other competition settings

Figure 7: Average price change by concentration level, Bertrand almost ideal demand



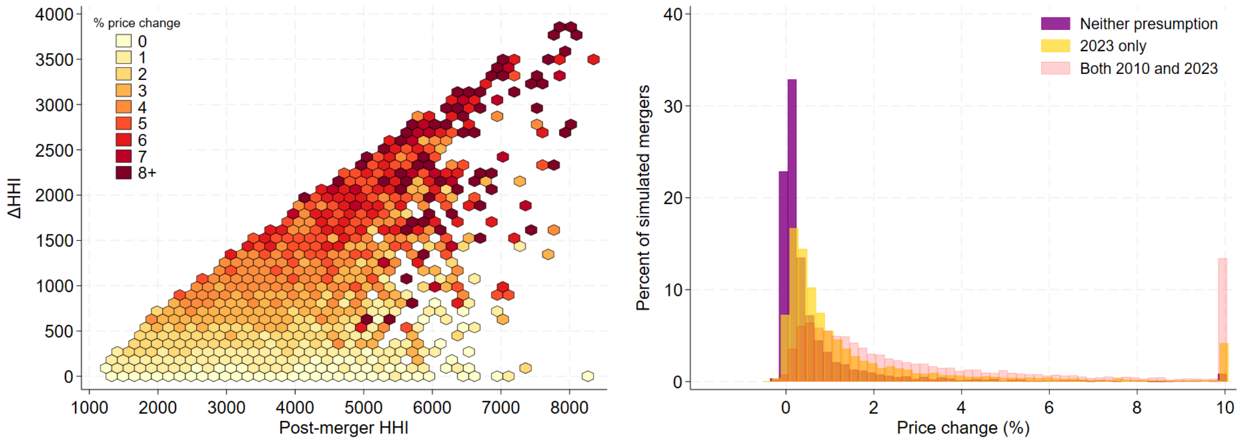
Note: The graph on the left shows the price effect of simulated mergers at different levels of concentration. Where more than one merger is included in a hexagon, the average price effect is calculated. Mergers with negative price effects are included in the 0 price effect category. No mergers are included in our sample in regions without hexagons.
The graph on the right shows the distribution of price effects for simulated mergers by the structural presumption triggered. The area under the curve of each presumption curve equals one. For visualization, price effects are capped at 10%.

Figure 8: Average price change by concentration level, Cournot linear demand



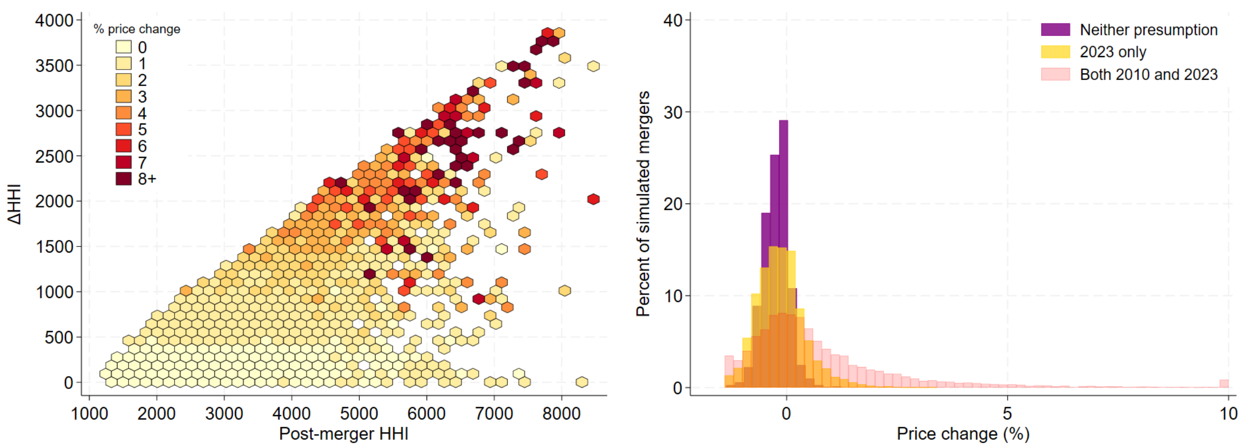
Note: The graph on the left shows the price effect of simulated mergers at different levels of concentration. Where more than one merger is included in a hexagon, the average price effect is calculated. Mergers with negative price effects are included in the 0 price effect category. No mergers are included in our sample in regions without hexagons.
The graph on the right shows the distribution of price effects for simulated mergers by the structural presumption triggered. The area under the curve of each presumption curve equals one. For visualization, price effects are capped at 10%.

Figure 9: Average price change by concentration level, Cournot log-linear demand



Note: The graph on the left shows the price effect of simulated mergers at different levels of concentration. Where more than one merger is included in a hexagon, the average price effect is calculated. Mergers with negative price effects are included in the 0 price effect category. No mergers are included in our sample in regions without hexagons.
The graph on the right shows the distribution of price effects for simulated mergers by the structural presumption triggered. The area under the curve of each presumption curve equals one. For visualization, price effects are capped at 10%.

Figure 10: Average price change by concentration level, second score auction logit demand



Note: The graph on the left shows the price effect of simulated mergers at different levels of concentration. Where more than one merger is included in a hexagon, the average price effect is calculated. Mergers with negative price effects are included in the 0 price effect category. No mergers are included in our sample in regions without hexagons.
The graph on the right shows the distribution of price effects for simulated mergers by the structural presumption triggered. The area under the curve of each presumption curve equals one. For visualization, price effects are capped at 10% and negative price effects are capped at -1.5%.