Merger Control in Retail Markets with National Pricing

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Abstract

We theoretically examine the impact of retail chains' pricing policies on the efficiency of structural remedies in retail merger control. Under local pricing, divestiture of stores can fully remedy retail mergers in our model. However, if chains implement national (uniform) pricing, these remedies become less effective and potentially counterproductive. Moreover, remedies under national pricing may perform even worse if chains also compete locally on nonprice factors like quality and service. This suggests that competition authorities should block a larger share of the mergers under national pricing, instead of conditionally approving them subject to structural remedies, simply because the available remedies are less effective than those with local pricing.

1. Introduction

Merger control lies at the heart of competition policy worldwide. In resolving merger cases, the acceptance of structural remedies has become an important policy tool (Motta, Polo, and Vasconcelos 2007). Structural remedies are measures proposed by (and involving a structural change on the part of) the merging parties that may be accepted by a competition authority. Such remedies will typically involve divestment of assets.[1]

An important area where structural remedies are particularly relevant is retail merger cases. According to the UK Competition and Markets Authority (CMA

We thank two reviewers for valuable comments. We are grateful to José L. Moraga for valuable discussion. We also thank participants at the 2022 annual Bergen Center for Competition Law and Economics conference on competition policy. This project has received financial support from the Price Regulation Fund administered by the Norwegian Competition Authority. Odd Rune Straume also acknowledges funding from the Portuguese Foundation for Science and Technology (project UIDB/03182/2020).

[1] Structural remedies are distinguished from behavioral remedies, the latter typically intended to regulate the future behavior of a party involved in a merger. The remedy can take various forms, for instance, price regulations.

[*Journal of Law and Economics*, vol. 68 (February 2025)]
 0022-2186/2025/6801-0005$10.00

2017), retail mergers account for a significant number of cases presented before it. By their nature, retail markets facilitate the use of structural remedies, and such remedies will involve divestitures of local retail outlets. The 2008 merger between Co-operative Group Limited (Co-op) and Somerfield Limited in the grocery market may serve as an illustrative example (for a detailed discussion, see Section 6). Co-op, the UK's largest cooperative, with 2,228 food retail outlets, proposed to the Office of Fair Trading (OFT) to acquire the entire share capital of Somerfield, a food retailer that had 877 retail outlets. In this case the OFT raised competition concerns in a number of local markets throughout the UK. In 2008, it announced a decision (OFT 2008) to seek divestment remedies, and later the same year it cleared the merger by accepting an offer from Co-op to sell more than 120 supermarkets in markets in which the OFT had raised concerns about competition.

Another feature of many retail markets is that chains often adopt national (uniform) prices, which means that the chains set identical prices across distant local markets.[2] The alternative to national pricing (or regional/zone pricing) is local pricing, in which the chains set their prices according to competition and demand conditions for each individual store (in each local market). A recent study by DellaVigna and Gentzkow (2019) finds that most US food, drugstore, and mass-merchandise chains charge national or regional prices, even though there is large variation in demographics and competition across the different regional and local markets. Similar evidence from the United States is presented by Hitsch, Hortaçsu, and Lin (2021) and Adams and Williams (2019). In Europe, Dobson and Waterson (2005) report (although without presenting any data) that UK electrical goods retailers predominately use national prices, while some groups in the UK supermarket sector price uniformly and others price locally. Merker (2021) documents that Norwegian grocery retail chains adopt national prices. Moreover, in an ex post evaluation of a merger in the French supermarket industry, Allain et al. (2017) present evidence that, although chains raised their prices after the merger, the price adjustments were not correlated with any changes in local concentration levels. They also show that this can be explained by national pricing. In addition to the evidence presented in the economic literature, national pricing has also been documented in several merger investigations conducted by the UK and European competition authorities (see Section 6).

Under national pricing, merger policy appears to be guided by a simple and admittedly intuitive logic. National prices are determined by local characteristics of all markets in which a retail chain is active. If a merger reduces competition in a local market, this will tend to increase the national price, and the appropriate

[2] There is a literature seeking to rationalize the use of national pricing in retail markets; see, for example, Dobson and Waterson (2005) and Gabrielsen, Johansen, and Straume (2023). Also, somewhat related to this, there is a wider literature on oligopolistic third-degree price discrimination or differential pricing that evaluates the effects of uniform versus differential pricing; see, for example, Chen, Li, and Schwartz (2021); Adachi (2023); and Dertwinkel-Kalt and Wey (2023). Unlike this literature, we focus instead on the effects of mergers and merger remedies in the context of local (differential) versus national (uniform) pricing.

measure is to remedy the merger in the local market. The intuitive idea is that such a measure will bring down the national price to the premerger level. As we show in the present paper, this logic is fundamentally wrong. Unlike when prices are set locally in each market, changes in ownership structure create externalities across markets with national pricing. With local pricing, structural remedies affect pricing only in the specific market in which the remedy is adopted. However, with national pricing, the change in store ownership structure, brought about by structural remedies applied to a particular local market, induces price changes in not only that market but also other markets. This key mechanism is central to the analysis presented here.

The aim of our analysis is to investigate the effects on consumer welfare of a structurally remedied merger in a retail market. We perform our analysis under both local and national pricing and also when the local competition entails nonprice dimensions, for example, local quality or service. We present a model with spatial differentiation in which four retail chains compete in two local markets and two chains propose a merger. The two markets vary in terms of market size, competition intensity, and diversion ratios (competitive overlap) between the merger candidates. In this setting we investigate how structural remedies, specifically, divestitures of local retail outlets, perform in terms of repairing the competitive harm to consumers created by the merger.

We show that when pricing is local, remedies perform perfectly in the sense that consumer welfare can be restored to the premerger level. However, when prices are set nationally, which in our model entails that each chain sets the same price for its product sold in both markets, structural remedies do not work that well, and they can even be detrimental compared with the unremedied merger. Moreover, and unlike remedied mergers under local pricing, under national pricing remedies will produce winners and losers. In each market, remedies will leave some consumers better off and others worse off compared with the premerger equilibrium, and we show that the latter effect will always dominate the former at the aggregate level. Under national pricing, it is generally not possible to find effective remedies.

Competition authorities appear inattentive to the externalities created by remedies under national pricing. Moreover, even if authorities sometimes recognize that national pricing might be an issue, they often argue that local remedies may still be useful. This was the case in the Co-op–Somerfield merger. Co-op argued that its local pricing was not based on local competition. The OFT (2008) countered this in two ways. First, it argued that even though the pricing policy was national, there was no conclusive evidence that local deviations from such a policy might not occur. Second, the OFT argued that pricing is only one of a number of ways competitive harm could occur, including a deterioration of local nonprice factors such as quality, range, and service. On this basis, the OFT considered local divestitures to be the appropriate remedy even though Co-op claimed that prices were decided nationally.

To investigate this argument, we extend our model with national pricing by allowing stores to compete locally on quality also. We show that the logic presented above by the OFT is flawed; local nonprice (quality) competition does not necessarily improve the effectiveness of structural remedies under national pricing. On the contrary, we show that such remedies may even perform worse with local quality competition than without it.

Our analysis has important implications for merger policy. The main implication is that the pricing policy of the parties, specifically, whether they adopt national or local pricing policies, will have a crucial bearing on the effectiveness of structural remedies in retail markets. While it is true that pricing policy is often discussed in retail merger cases, it is also true that competition authorities tend to accept remedies as if the pricing policy is local. When pricing policy de facto is national, our analysis shows that this approach may lead to clearance of remedied mergers that will involve a loss in consumers' surplus, and sometimes even to the degree that the remedy makes matters worse; that is, consumers may end up losing compared with the situation under an unremedied merger. This suggests that competition authorities should block a larger share of the mergers under national pricing instead of conditionally approving them subject to structural remedies.[3]

The theoretical literature on merger remedies is scarce, and most contributions analyze Cournot markets in which all parts of the industry are equal. The focus in this literature is on whether the availability of merger remedies is welfare enhancing. One of the first papers to address this question is Vergé (2010), which shows that a merger without synergies is highly unlikely to benefit consumers, even if it is subjected to appropriate structural remedies. The issues studied in the literature also include whether competition authorities will request too many remedies, referred to as overfixing (Vasconcelos 2010; Farrell 2003); information problems related to competitive harm (Cosnita-Langlais and Sørgard 2018); the implications of having the parties propose remedies (Dertwinkel-Kalt and Wey 2016a); and when the parties have private information on the competitive harm and can signal (Dertwinkel-Kalt and Wey 2016b). These approaches are very different from ours as we study retail mergers and remedies in highly diversified local markets with a focus on the pricing policy of the parties. Cabral (2003) studies the effects of a merger in a spatially differentiated oligopoly. His focus is on how cost efficiencies and remedies will be affected by free entry after the merger and how this affects consumers' welfare compared with when entry is exogenous. While our model also is a spatially differentiated oligopoly, our setup and focus are very different. We have two local markets with four active retail chains, and our main ingredient is the potential pricing externalities between markets caused by structural remedies in one market.

A main takeaway of our analysis is that under national pricing, even remedied mergers will likely lead to concentration and anticompetitive effects, and we show that this may still hold when other nonprice dimensions of competition, for example, quality and service, are decided locally. In that sense our paper also

[3] Throughout the paper, when we refer to mergers, we have in mind mergers that exceed a screening threshold for further scrutiny.

relates to the ongoing academic discussion about the documented increase in market concentration in both the United States (De Loecker, Eeckhout, and Unger 2020; Shapiro 2019) and Europe (Koltay, Lorincz, and Valetti 2022) and the role merger policy plays in that development. Many authors argue that merger policy has been too lax on both sides of the Atlantic. In his book, Kwoka (2015) examines empirical studies of the effect of US mergers and finds that most mergers result in competitive harm not only due to higher prices but also with respect to various nonprice outcomes. Kwoka also finds that accepted remedies in these mergers are generally inefficient in restraining price increases. Affeldt et al. (2021) express concerns about the European Commission's merger enforcement being too lax. Part of this discussion is related to screens used to clear mergers below certain concentration levels. This practice has been criticized by Kwoka (2017) and also by Nocke and Whinston (2022).

The rest of the paper is organized as follows. In Section 2 we present our model. Section 3 contains the analysis of our benchmark case in which all four retail chains set local prices in both markets. In Section 4 we present our main analysis in which we assume that the retail chains use national prices. We compare the outcome in this case with our benchmark case with local pricing and present our main results. At the end of the section we discuss the robustness of our main results and also present some formal robustness checks. Section 5 extends our main analysis by introducing store-specific quality provision (local quality competition). In Section 6 we interpret and discuss our results in relation to a range of retail merger cases handled by competition authorities in different jurisdictions. Section 7 concludes.

2. Model

Consider four national retail chains, indexed $i = 1, 2, 3, 4$, that compete in two local markets, indexed $j =$ A, B. Each chain has one store in each market, where the stores are equidistantly located on a circle with circumference equal to 1. In each market, consumers are uniformly distributed on the circle, and each consumer demands 1 unit of the good from the most preferred retailer. The total mass of consumers in market j is given by m^j.

The utility of a consumer in market j who is located at x^j and buys the good from the store of chain i, located at z_i^j, is given by

$$U^j(x, z_i) = v - p_i^j - t^j \mid x^j - z_i^j \mid, \tag{1}$$

where $p_i^j > 0$ is the price charged by chain i in market j, and $t^j > 0$ is a transport cost parameter that captures the degree of horizontal product differentiation, and therefore inversely measures the intensity of competition, in market j. The utility parameter $v > 0$ is assumed to be sufficiently large such that both markets are always fully covered in equilibrium.[4] For space-saving purposes, in the subse-

[4] The assumption of covered markets implies that price changes represent a welfare-neutral transfer of surplus between firms and consumers. This feature is not critical for our analysis because, like most national competition authorities, we focus on consumer welfare, which is always decreasing in prices.

quent analysis we use the following notational shorthand: $\alpha := m^A t^B$, $\beta := m^B t^A$, $\tau := t^A t^B$.

Our aim is to evaluate the effects of mergers and structural merger remedies (local divestitures) under two different assumptions about the chains' pricing policies. First, under the assumption of local pricing, we allow each chain to set different prices in the two markets; that is, we allow $p_i^j \neq p_i^{-j}$ for any i. Second, under the assumption of national (uniform) pricing, each chain is required to set the same price in the two markets; that is, $p_i^j = p_i^{-j} = p_i$ for all i.[5]

In the model we take chain 1 and chain 2 as the merger candidates. We assume that the markets that the two chains are active in differ along three dimensions: the intensity of competition, inversely measured by $t^A \neq t^B$; the size of the markets, measured by $m^A \neq m^B$; and the diversion ratio between the merger candidates. The latter asymmetry is introduced by assuming that the order of store locations differs across the two markets. In market A, the order of locations is {1, 2, 3, 4}, whereas in market B, the order of locations is {1, 3, 2, 4}. Since competition is localized, this implies that the diversion ratio between the stores of the merger candidates (chains 1 and 2) is $\frac{1}{2}$ in market A and 0 in market B. That is, the merger candidates compete directly with each other in market A but only indirectly in market B. The two markets are shown in Figure 1, where the stores of the merger candidates are underlined.

Under the assumption that all consumers make utility-maximizing decisions, the demand facing store i in market j is given by

$$q_i^j = m^j\left(\frac{1}{4} - \frac{2p_i^j - p_{i+1}^j - p_{i-1}^j}{2t^j}\right), \tag{2}$$

where $i-1$ and $i+1$ refer to the stores located immediately to the left and right, respectively, of store i. To understand the intuition behind some of the subsequently derived results, the following property of equation (2) is useful.

Lemma 1. With the price elasticity of demand for store i in market j defined as

$$\varepsilon_i^j := -\frac{\partial q_i^j}{\partial p_i^j}\frac{p_i^j}{q_i^j}, \tag{3}$$

it follows that

$$\frac{\partial^2 \varepsilon_i^j}{\partial (t^j)^2} = \frac{p_i^j}{8}\left(\frac{t^j q_i^j}{m^j}\right)^{-3} > 0. \tag{4}$$

We focus only on the anticompetitive effects of a merger, that is, the effects of price coordination between the merging chains. For simplicity, we therefore as-

[5] In a model with two local markets there are only two possible pricing strategies: local or national. Notice, however, that our setup also covers the intermediate case of regional pricing, in which chains set a uniform price across two or more markets but price locally in others. If we extend our model with at least one market in which the chains set local (or regional) prices, this would have no effect on the optimal choices of regional prices applying to market A and market B.

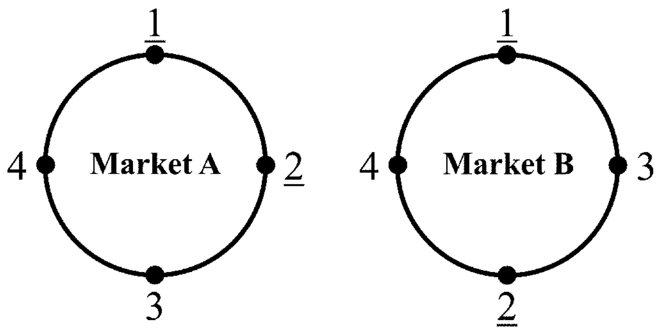

Figure 1. Competition and merging retail chains (underlined)

sume that there are no variable costs of production, which implies that the profits of store i in market j are given by

$$\pi_i^j = p_i^j q_i^j. \tag{5}$$

Although we do not explicitly model production costs, we assume that a merger entails (unmodeled) fixed-cost synergies that always make a merger profitable, with and without remedies. Since such synergies do not affect the chains' pricing incentives, consumer welfare is also unaffected.

Throughout the analysis we treat the chains' pricing policy (local or national) as exogenously given, possibly influenced by factors outside the model. Moreover, we assume that the firms' pricing policy does not change after the merger. This is justified first and foremost by the empirical observation that in many industries the firms adopt uniform prices. Various explanations for national pricing have been proposed and discussed in the literature. Some of these explanations are completely orthogonal to the incentives analyzed in our model and may therefore serve as justification for treating the pricing policies as exogenously given in our analysis. DellaVigna and Gentzkow (2019), for example, argue that the two most likely explanations for uniform pricing are managerial inertia and brand image concerns.

Other papers in the literature point out that retail chains may opt for uniform national pricing for strategic reasons, to dampen the rivalry between stores locally along one dimension or more of competition. Dobson and Waterson (2005) show how this can occur in a model with pure price competition, while Gabrielsen, Johansen, and Straume (2023) demonstrate how this incentive may be further strengthened if the firms also engage in local quality competition. Endogenizing national pricing in this way is beyond the scope of our analysis.[6] However, we have verified that subgame-perfect Nash equilibria in which all four chains choose uniform pricing (both before the merger and after a remedied merger) ex-

[6] Fully endogenizing national pricing in our current model is complicated. The equilibria are difficult to characterize, both because of the number of players and the asymmetries among them in the postmerger game and because of all the deviations that need to be checked as a consequence.

ist for at least some parameter values in our model when the chains set prices and local qualities (see Appendix D for a numerical example).

3. Local Pricing

As a benchmark for comparison, consider the case in which each chain sets local prices in a noncooperative game. It is straightforward to derive the Nash equilibrium prices, which are given by

$$p_i^j = \frac{t^j}{4}. \tag{6}$$

Since the chains are symmetrically located within each market, each chain sets the same price in each market, but prices are lower in the market with a higher intensity of competition. Consumers' surplus in market j is then given by

$$\mathrm{CS}^j = m^j\left(v - \frac{5}{16}t^j\right). \tag{7}$$

3.1. Merger

Suppose that chain 1 and chain 2 merge, which allows them to coordinate the prices set for stores 1 and 2 in each of the two markets. Such a price coordination has an effect on prices only in market A, where the merger participants directly compete. In the postmerger equilibrium, the prices set by the insiders (chains 1 and 2) and the outsiders (chains 3 and 4) in this market are given by, respectively,

$$p_1^{\mathrm{A}} = p_2^{\mathrm{A}} = \frac{5}{12}t^{\mathrm{A}} \tag{8}$$

and

$$p_3^{\mathrm{A}} = p_4^{\mathrm{A}} = \frac{1}{3}t^{\mathrm{A}}. \tag{9}$$

The merger participants use their increased market power to set higher prices, which in turn induces a price increase (though by a smaller amount) for the outsiders as well, because of strategic complementarity. Thus, a merger leads to a price increase for all stores in market A. The merger therefore creates two different types of distortions that contribute to a reduction in consumers' surplus. In addition to the price increase, which obviously affects consumers negatively, the postmerger equilibrium is asymmetric, which implies an increase in aggregate transportation costs. Postmerger consumers' surplus in market A is given by

$$\mathrm{CS}^{\mathrm{A}} = m^{\mathrm{A}}\left(v - \frac{205}{288}t^{\mathrm{A}}\right), \tag{10}$$

which is lower than the premerger surplus. In market B, however, the merger has no effect on prices.

3.2. *Merger Remedies*

The negative effect of the merger on consumer welfare in market A can in principle be countervailed by a structural remedy that eliminates the price-coordination effect of the merger. Such a remedy must necessarily imply a change of ownership for one of the two neighboring stores of the merging chains in market A. In our setting, there are two different types of ownership transfer that can eliminate the price-coordination effect, which we define as follows.

Remedy 1. The merged chain sells one of its stores in market A to a competing chain, such that the diversion ratio between the two stores of the acquiring chain in market A is 0. This can be achieved either by chain 3 buying store 1 or by chain 4 buying store 2.

Remedy 2. The merged chain sells one of its stores in market A to a new entrant, if such a potential buyer exists.

Under local pricing, it is straightforward to see that either remedy would completely restore the premerger equilibrium in terms of prices. This establishes our first main result.[7]

Proposition 1. Under local pricing, the anticompetitive effect of a merger can be fully rectified by a structural remedy.

4. National Pricing

Suppose instead that the retail chains practice national pricing, such that the same price applies to all stores within a chain. For each chain, the optimally chosen price p_i must satisfy the following condition:[8]

$$\left(\frac{q_i^A}{q_i^A + q_i^B}\right)\varepsilon_i^A(p_i, t^A) + \left(\frac{q_i^B}{q_i^A + q_i^B}\right)\varepsilon_i^B(p_i, t^B) = 1, \tag{11}$$

where $\varepsilon_i^j(p_i, t^j)$ is the price elasticity of demand for chain i in market j. Under local pricing, prices are set such that the own-price elasticity of demand is equal to 1 in each market, which in turn implies that the optimal local price is lower in the market with more intense competition (inversely measured by t^j). Under national pricing, in contrast, the optimal uniform price is set such that the weighted average price elasticity of demand across the two markets is equal to 1, where the weights are given by the chain's relative sales in each market. It follows directly that store prices for chain i will be different under national and local pricing as long as the own-price elasticity of demand differs across the two markets. If $\varepsilon_i^A > (<)\ \varepsilon_i^B$ for $p_i^A = p_i^B$, the optimal national price for chain i is higher (lower) than the optimal local price in market A and lower (higher) than the optimal

[7] The proof is trivial and thus is omitted.

[8] See Appendix A for more details about how this condition is derived. We implicitly assume that the differences between the two markets are sufficiently small, so that we can rule out the possibility of setting the locally optimal price in the most profitable market and stop serving the other market.

local price in market B. Whether the national price is closer to the optimal local price in market A or in market B depends on the weights attached to the two elasticities in equation (11). If a larger share of the chain's total sales occurs in market j, the national price will be closer to the optimal local price in this market.

Using equation (2), the symmetric Nash equilibrium under national pricing is given by

$$p_i = \frac{(m^A + m^B)\tau}{4(\alpha + \beta)}. \tag{12}$$

By comparing equations (6) and (12) it is easy to verify that $p_i^A < p_i < p_i^B$ if $t^A < t^B$ (which implies $\varepsilon_i^A > \varepsilon_i^B$ for $p_i^A = p_i^B$) and that $p_i^B < p_i < p_i^A$ if $t^A > t^B$ (which implies $\varepsilon_i^A < \varepsilon_i^B$ for $p_i^A = p_i^B$). Notice also that, in contrast to the case of local pricing, the national prices are affected by relative market sizes as long as the intensity of competition is different in the two markets. If $t^A < t^B$, the equilibrium national price is decreasing (increasing) in m^A (m^B), because of a higher weight given to the market with more (less) price-elastic demand. The opposite holds of course for $t^A > t^B$. If $t^A = t^B$, equilibrium prices are equal under local and national price setting.

Consumers' surplus in market j is given by

$$\mathrm{CS}^j = m^j \frac{16v(m^j t^{-j} + m^{-j} t^j) - t(5m^j t^{-j} + 4m^{-j} t^{-j} + m^{-j} t^j)}{16(m^j t^{-j} + m^{-j} t^j)}, \tag{13}$$

where $-j$ indicates the market other than j.

4.1. Merger

With national pricing, a merger between chain 1 and chain 2 affects prices in both markets, even if the merging chains are competitors in only one market. In the postmerger equilibrium, the prices set by insiders and outsiders, respectively, are given by[9]

$$p_1 = p_2 = \frac{(2\alpha + 3\beta)(m^A + m^B)\tau}{(5\alpha + 6\beta)(\alpha + 2\beta)} \tag{14}$$

and

$$p_3 = p_4 = \frac{3(m^A + m^B)\tau}{2(5\alpha + 6\beta)}. \tag{15}$$

A comparison of equations (8) and (9) with equations (14) and (15) shows that the price effects of a merger are qualitatively similar under local and national

[9] Notice that the stores of chains 3 and 4 are symmetrically located vis-à-vis the stores of the merged chain in both markets (see Figure 1), which implies that these chains will set the same price in the postmerger equilibrium.

pricing. In both cases, all prices increase, and the price increase is larger for the merged chain. The main difference is that, under national pricing, these price effects occur in both markets. In other words, national price setting creates an externality whereby the anticompetitive effect of price coordination in one local market spills over to markets in which the merger participants do not compete. However, although the merger has anticompetitive effects in both markets, the relative price increase is smaller under national price setting.[10] This is entirely intuitive, since the price-coordination externality caused by national pricing represents a profit loss to the coordinating chains. Similar to the case of local pricing, consumers are also negatively affected by a merger because of higher aggregate transportation costs caused by the postmerger asymmetry in prices.

4.2. Merger Remedies

As before, the price-coordination effect of the merger is eliminated if one store in the merged chains in market A is sold either to a competing chain (remedy 1) or to an independent buyer (remedy 2). If selling to a competing chain, the equilibrium outcome is identical whether chain 1's store is sold to chain 3 or chain 2's store is sold to chain 4. We therefore consider the latter ownership transfer. The postmerger store ownership structure with each of the two remedies is shown in Figure 2.

4.2.1. Remedy 1

If the store of chain 2 in market A is transferred to chain 4, each store (in both markets) has stores from competing chains as neighbors, which effectively removes the price-coordination effect of the merger. However, the ownership structure has changed compared with the premerger situation, as in Figure 2. One of the nonmerging chains (chain 4) now has two stores in market A, whereas one merger participant (chain 2) has a store only in market B. Under local pricing, such a reallocation of store ownership would have no effect on equilibrium price setting, as evidenced by proposition 1, which implies that the anticompetitive effect of the merger would be completely eliminated by the remedy. Under national pricing, however, this reallocation of store ownership has nontrivial effects on equilibrium price setting for all the chains in the market, as we show below.

[10] The interested reader can easily verify this by comparing equilibrium prices before and after the merger in each of the two price-setting regimes.

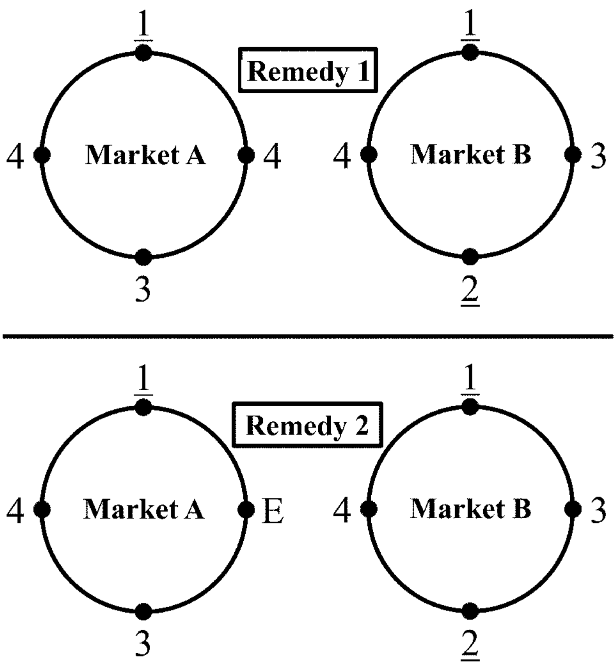

Figure 2. Merger remedies with stores retained by merging parties (underlined)

If we allow all chains to reoptimize their prices after the merger and the implementation of remedy 1, the Nash equilibrium prices are given by

$$p_1 = \frac{\{\alpha[2\alpha(48m^A + 43m^B) + \beta(163m^A + 148m^B)] + 4\beta^2(13m^A + 12m^B)\}\tau}{4[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}, \tag{16}$$

$$p_2 = \frac{\{48[m^A\alpha^2(t^A + t^B) + \beta^3] + m^A\beta[3\alpha(27t^A + 56t^B) + 4\beta(7t^A + 43t^B)]\}t^B}{4[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}, \tag{17}$$

$$p_3 = \frac{\{\alpha[2\alpha(48m^A + 49m^B) + \beta(151m^A + 156m^B)] + 4\beta^2(11m^A + 12m^B)\}\tau}{4[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}, \tag{18}$$

$$p_4 = \frac{\{\alpha[4\alpha(24m^A + 19m^B) + \beta(173m^A + 132m^B)] + 4\beta^2(17m^A + 12m^B)\}\tau}{4[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}. \tag{19}$$

If we compare these prices with the price in the symmetric premerger equilibrium, we can characterize the price responses as in proposition 2 (for proofs of all propositions, see Appendix A).

Proposition 2: Remedy 1 under National Pricing. Suppose that a merger between chain 1 and chain 2 is remedied by a transfer of store ownership in market A from chain 2 to chain 4. After the ownership transfer, if $t^A < (>)\ t^B$, this remedied merger leads to a price increase (decrease) for the stores owned by chain 2 and chain 3, whereas prices go down (up) for the stores owned by chain 1 and chain 4, all relative to the premerger situation.

Notice first that a remedied merger leads to price increases for some stores and price reductions for others. Thus, and in contrast to the case of local pricing, there are both winners and losers among consumers. These price changes are caused by the remedy, which produces two different first-order price responses. First, chain 2 is left with only one store (in market B) after the remedy is implemented, which implies that it effectively practices local pricing after the merger. This leads to a price increase (decrease) if the intensity of competition is lower (higher) in market B than in market A. Second, the remedy also causes chain 4 to have more stores in market A than in market B, which implies that chain 4 will place a larger weight on demand conditions in market A when setting its national price. This leads to a higher (lower) price if the intensity of competition is lower (higher) in market A than in market B. Thus, the price responses of chain 2 and chain 4 always go in opposite directions.

In addition, there are (second-order) price responses from chain 1 and chain 3 due to strategic interaction. Three of the four stores that are neighbors to chain 1's stores are owned by chain 4. Because of strategic complementarity, the price response of chain 1 will therefore follow that of chain 4. Chain 3, in contrast, has the stores of both chain 4 and chain 2 as neighbors. Notice, however, that the magnitude of the price response is always larger for store 2 than for store 4. The reason is simply that the remedy implies that chain 2 sets prices according to conditions only in market B, whereas the pricing incentives for chain 4 are more modestly affected. For this reason, the price response of chain 3 will always follow that of store 2.

4.2.2. Remedy 2

Suppose instead that the store of chain 2 in market A is sold to a new entrant, denoted E (see Figure 2). As for the case of remedy 1, the price-coordination effect of the merger is eliminated. However, such a remedied merger implies, once more, that the store ownership structure is affected in a way that turns out to have significant effects on prices and consumer welfare under national pricing. Similar to remedy 1, chain 2 now operates only in market B, but in addition, remedy 2 also implies that the number of store owners increases from four to five, with the new entrant operating only in market A.

If we allow all chains to reoptimize their prices after the merger and the implementation of remedy 2, the Nash equilibrium prices are given by

$$p_1 = \frac{[(48m^A + 43m^B)\alpha^2 + (53m^A + 48m^B)\beta^2 + (94m^B + 104m^A)\alpha\beta]\tau}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \tag{20}$$

$$p_2 = \frac{[48\beta^3 + 24\alpha^3 + 99\alpha^2\beta + 124\alpha\beta^2 + (23\beta^2 + 24\alpha^2 + 48\alpha\beta)m^A t^A]t^B}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \tag{21}$$

$$p_3 = \frac{[(48m^A + 49m^B)\alpha^2 + (49m^A + 48m^B)\beta^2 + 98(m^A + m^B)\alpha\beta]\tau}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \tag{22}$$

$$p_4 = \frac{[(48m^A + 53m^B)\alpha^2 + (43m^A + 48m^B)\beta^2 + (104m^B + 94m^A)\alpha\beta]\tau}{12[16(\alpha^2+\beta^2)+33\alpha\beta]}, \tag{23}$$

$$p_E = \frac{[48\alpha^3 + 24\beta^3 + 99\alpha\beta^2 + 124\alpha^2\beta + (23\alpha^2 + 24\beta^2 + 48\alpha\beta)m^B t^B]t^A}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}. \tag{24}$$

The price responses of this remedied merger can then be characterized as in proposition 3.

Proposition 3: Remedy 2 under National Pricing. Suppose that a merger between chain 1 and chain 2 is remedied by a transfer of store ownership in market A from chain 2 to a new entrant. After the ownership transfer, if $t^A < (>)\ t^B$, this remedied merger leads to a price increase (decrease) for the store owned by chain 2 and the stores owned by chain 4, whereas prices go down (up) for the stores owned by chain 1 and for the store acquired by the new entrant, all relative to the premerger situation. The price effect for the stores owned by chain 3 is a priori indeterminate.

Once more, prices go up in some stores and down in others, which implies that a merger with remedy 2 has both winners and losers among consumers. The first-order price effects of such a remedied merger now occur for the remaining store of chain 2 and for the store of the new entrant. These two stores are located in different markets, and prices are set according to only local market conditions. The response for the remaining store of chain 2 is similar under both types of remedies and leads to a price increase (decrease) if this store is located in the market with lower (higher) competition intensity. Since the store of the new entrant is located in the other market, the price response for it always goes in the opposite direction.

The price responses for the remaining stores are second-order effects resulting from strategic complementarity. The directions of the price responses for chain 1 and chain 4 are unambiguous. Since chain 1 is a neighbor to the new entrant in market A but not to chain 2 in market B, its price response follows that of the new entrant. Conversely, since chain 4 is a neighbor to chain 2 in market B but not to the new entrant in market A, its price response follows that of chain 2. Finally, since chain 3 is a neighbor to the new entrant in market A and also to chain 2 in market B, the price response depends on the relative size and competition intensity across the two markets. More specifically, the remedied merger leads to a higher price for the stores of chain 3 if $t^A > t^B$ and $m^A/m^B < t^A/t^B$ or if $t^A < t^B$ and $m^A/m^B > t^A/t^B$. Otherwise, the national price set by chain 3 goes down.

4.2.3. Effects of a Remedied Merger on Consumer Welfare

Since a remedied merger under national pricing always leads to price increases for some stores and price reductions for others, regardless of which remedy is applied, the effect on aggregate consumer welfare is not immediately obvious. Could the gains of some consumers possibly outweigh the losses of the other consumers? Proposition 4 gives a negative answer to this question.

Proposition 4. Under national pricing, a remedied merger leads to a higher average price and lower consumers' surplus relative to the premerger situation, for all $t^A \neq t^B$, regardless of whether remedy 1 or remedy 2 is applied.

Despite the mixed price responses of the different stores, and despite the direction of these price responses varying according to the relative degree of competition in the two markets, the average price always goes up as a result of the remedied merger. This means that, regardless of which chains increase their prices after the merger, the price increases always outweigh the price reductions. Furthermore, a remedied merger leads to an asymmetric equilibrium outcome with unequal market shares across the stores in each market. This leads in turn to an increase in aggregate transportation costs. Combined with a higher average price, the overall effect is an unambiguous reduction in consumers' surplus. This result holds for both types of merger remedy.

A key factor behind this result is that the magnitude of the price responses to a remedied merger is generally smaller when the price response is negative than when it is positive. This follows from lemma 1, which says that the price elasticity of demand is convex in the intensity of competition (inversely measured by t^j).[11] The implication of this demand property is that the market with more intense

[11] The convexity highlighted by lemma 1 is not particular to the Salop (or Hotelling) model. It is easily shown that an equivalent property holds for all linear demand systems for horizontally differentiated products.

competition is relatively more important for the optimal choice of a national price, all else being equal. This implies in turn that if a chain goes from owning one store in each market to owning only one store in one market, the chain's price response to such an ownership change is smaller in absolute value if the remaining store is located in the market with more intense competition. Thus, although merger remedies (of both types) imply a change of ownership structure that leads to price responses in both directions, the demand property highlighted in lemma 1 means that positive price responses tend to dominate, which leads to an increase in the average price paid by consumers.

These results are obviously based on a model with a particular market structure, and the nature of our research question is such that it cannot be addressed in a theoretical framework that encompasses all possible market structures. Nevertheless, some general insights emerge. To fully restore the (national) pricing incentives to their premerger state, the divestiture package would have to ensure that the number and structure of independent national price units (INPUs) remain the same. An INPU may be defined as a chain or a unit (brand) under a larger umbrella chain that is not strategically connected to any other unit that belongs to the same umbrella. For example, under remedy 1, chain 1 and chain 2 each form their own INPU, since they are not strategically connected (even though they belong under the same umbrella after the acquisition). However, under remedy 1, even though the number of INPUs remains the same after the merger, the structure of the INPUs has changed: One INPU is active in market B only (chain 2), and one INPU has three outlets (chain 4)—which is different from the situation before the merger (when there were four INPUs with one store in each of the two markets). In practice it is probably very difficult or impossible to ensure that both the number and the structure of INPUs remain the same after a merger. However, in Appendix B we use our model framework to present an example that demonstrates how it may still happen in theory.

4.2.4. Remedy 1 versus Remedy 2

Under local pricing, the two alternative remedies are completely equivalent in the sense that they produce exactly the same market outcome. In both cases, the price-coordination effect in market A is eliminated, and the competitive harm of the merger is therefore fully remedied. This is not the case under national pricing. Not only are both remedies imperfect, as shown by proposition 4, but they also produce different market outcomes. One of the remedies is consistently superior.

Proposition 5. Under national pricing, a merger with remedy 1 yields a lower average price and a higher consumers' surplus than a merger with remedy 2.

In other words, under national pricing a merger is better remedied by letting the merged chains sell a store in market A to a competing chain than to a new entrant. This is arguably a surprising result, since it implies that consumers are better off with a lower number of independent competitors, given that the merger takes place.

To see the intuition behind this result, notice that the key difference between remedy 1 and remedy 2 is that the number of chains operating in both markets is lower with the latter remedy, and this has implications for price setting under national pricing. Suppose first that the degree of competition is higher in market A, so that prices are generally lower in this market than in market B. Under remedy 1, where store 2 in market A is sold to chain 4, the higher competitive pressure in market A spills over to market B because chain 4 places a heavier weight on market A (where it owns two of three stores after remedy 1 is applied) in its national price setting. A similar spillover effect does not occur with remedy 2 because the new entrant does not operate in market B, which implies that the average price is lower under remedy 1 than under remedy 2. Suppose instead that the degree of competition is lower in market A. Under remedy 2, a new entrant would thus set a relatively high price because it sets prices only in this market. In contrast, under remedy 1, chain 4 also owns a store in market B (where competition is tougher), which contributes to dampening the price increase in market A. The result is once more that the average price is lower under remedy 1 than under remedy 2.

Since our analysis is conducted within the context of a particular market structure, the result in proposition 5 obviously cannot be extended to a general policy recommendation that the optimal merger remedy in markets with national pricing always implies a transfer of store ownership to existing chains rather than to new entrants. Nevertheless, this result illustrates that the pattern of cross-market ownership is crucially important in determining the optimal merger remedy and that policies that consider only local market conditions can result in suboptimal outcomes when different markets are connected through national pricing.

4.2.5. Counterproductive Merger Remedies

We have established that structural remedies to eliminate the effect of price coordination are less effective in our model when the chains set national rather than local prices. Could such remedies also be counterproductive, in the sense that the remedy might do more harm than the merger? Perhaps surprisingly, the answer is yes.

Proposition 6. For a sufficiently high degree of asymmetry between the markets in terms of competition intensity, and if the market in which the merger participants do not directly compete is sufficiently large, there exists a parameter set for which remedy 2 is counterproductive under national pricing, which leads to a higher average price and a lower consumers' surplus relative to the unremedied merger.

It is possible to identify a counterproductive effect of remedy 2 in which one store in the merged chain is sold to a new entrant. As we show in the proof of proposition 6 (see Appendix A), this might occur in a scenario in which market B is sufficiently large, and the degree of competition in this market is sufficiently strong, relative to market A.[12] Without any remedy, a merger will lead to higher prices because of a price-coordination effect between the merger participants in market A; this price-coordination effect spills over to market B because of national pricing. However, this effect is relatively modest if market B is large and has a high degree of competition. In this case, the merged chain will place a heavy weight on market B (because of its size) when setting the national price, and the higher degree of competition in this market will therefore constrain the price increase as a result of the merger. In such a situation, if remedy 2 is implemented, the price-coordination effect is removed by the introduction of a new player in market A. However, the new entrant is not constrained in its price setting by store ownership in another market with stronger competition. The entrant will therefore set a relatively high price, and, as proved by proposition 6, there exists a parameter set for which the entrant's incentive for setting a high price outweighs the price-coordination effect of an unremedied merger, which implies that the remedy in itself leads to a higher average price and a lower consumers' surplus. In other words, the cure is worse than the disease.

4.2.6. A Numerical Example

To get a sense of the potential impact on consumers of the (remedied) merger, Table 1 presents a numerical example of the percentage increase in consumers' total expenditures, in total and for each market separately, which account for both the price and the travel costs. More specifically, the total expenditure in market j, denoted P^j, is defined as

$$P^j := \sum_{i=1}^{N=4}\left[q_i^j p_i + m^{\mathrm{A}} t^j \left(\int_0^{x_{i+1}^*} x dx + \int_0^{x_{i-1}^*} x dx\right)\right], \tag{25}$$

where x_{i+1}^* and x_{i-1}^* represent the distances from store i to the indifferent consumers on the right- and left-hand sides, respectively. The consumers' premerger equilibrium expenditure is denoted P_{N}^j, whereas the postmerger expenditure is given by P_{M}^j without remedies and by P_1^j and P_2^j with remedy 1 and remedy 2, respectively. We may then write the percentage increase in the consumers' total expenditures in market j for case $S \in \{\mathrm{M}, 1, 2\}$ (relative to the premerger situation) as

$$\mathrm{PP}_S^j := 100\left(\frac{P_S^j}{P_{\mathrm{N}}^j} - 1\right). \tag{26}$$

Similarly, we can write the overall effect of case S as

$$\mathrm{PP}_S^T := 100\left(\frac{\sum_j P_S^j}{\sum_j P_{\mathrm{N}}^j} - 1\right). \tag{27}$$

[12] Note that, unlike our other main results, the result in proposition 6 that remedy 2 is sometimes counterproductive requires the two markets to be sufficiently asymmetric. This implies that equilibrium existence is no longer guaranteed. In the proof of proposition 6 in Appendix A we show that the result holds for a subset of the parameter values (for which equilibria exist).

Table 1
Percentage Increase in Consumers' Expenditures after a Merger

	Unremedied			Remedy 1			Remedy 2		
t^A	PP_M^A	PP_M^B	PP_M^T	PP_1^A	PP_1^B	PP_1^T	PP_2^A	PP_2^B	PP_2^T
2.25	4.23	4.44	4.39	.60	−.18	.03	2.00	−.58	.09
2.50	3.21	3.58	3.48	1.10	−.29	.09	4.24	−1.06	.38
2.75	2.33	2.82	2.68	1.49	−.36	.17	6.87	−1.47	.92
3.00	1.59	2.13	1.97	1.76	−.41	.26	9.93	−1.83	1.81
3.25	.98	1.52	1.33	1.85	−.43	.35	13.83	−2.14	3.33
3.50	.49	.96	.77	1.71	−.43	.42	18.97	−2.41	6.11

Note. The other parameter values are $m^A = .5$, $m^B = 1.5$, and $t^B = 4 - t^A$.

In the numerical example in Table 1, the market in which the merging chains are direct competitors (market A) is the smaller market ($m^A < m^B$) and has a lower intensity of competition ($t^A > t^B$). In a wider discussion of our main results in Section 6 we argue that this particular case seems to fit many real-world retail merger cases. It is also worth noting that $t^A > t^B$ is a sufficient condition for a remedied merger to be profitable for the participants even in the absence of fixed-cost synergies (see Section 4.3.1), which further increases the relevance of this case.

Table 1 has several consistent patterns. Remedy 1 works consistently better than remedy 2, but neither remedy can fully repair the harm caused by the merger. Moreover, the remedies are less effective the more asymmetric the markets are in terms of competition intensity. If the markets are sufficiently asymmetric, remedy 2 becomes counterproductive in the sense that consumers' total expenditures postmerger would be lower without the remedy. These patterns are all in line with the more general results shown by propositions 2–6. Furthermore, the example in Table 1 is also characterized by another consistent pattern that does not follow directly from our previously derived results, namely, that each remedy leads, quite paradoxically, to only a modest price reduction (and sometimes even a price increase) in market A, while inducing prices below the premerger level in market B. In other words, to the extent that a remedy manages to reduce the competitive harm of a merger, it does so by inducing price reductions in the market other than the one where the harm of the merger originates, while the harm in the latter market is sometimes even reinforced.

Overall, the numerical example in Table 1 illustrates a key underlying message from the results in propositions 2–6, namely, that the basic intuition about optimal merger control that applies under local pricing might fail, and sometimes spectacularly so, in markets characterized by national pricing.

4.3. Robustness of the Main Results

In this section we discuss the robustness of our main results with respect to some of our model assumptions. The main results can be summarized as follows: Compared with the premerger situation, a remedied merger always causes a price increase for some stores and a price reduction for other stores; compared with the premerger situation, a remedied merger causes an increase in the average (paid) price and thus a reduction in consumers' surplus; when comparing remedies, remedy 1 always causes a lower average price (and higher consumers' surplus) than remedy 2; remedy 2 is sometimes counterproductive, in the sense that it can lead to a higher average price (and lower consumers' surplus) than the unremedied merger.

In the following sections we present a discussion of some of our critical assumptions and give an intuitive summary of the formal robustness checks that we have done, with all technical details relegated to Appendix C. The discussion focuses on questions related to the endogenization of the parties' merger decision, postmerger store rebranding, and alternative market structures (in that order). As a final robustness check, we also present an extension that introduces local nonprice (quality) competition (see Section 5).

4.3.1. Endogenization of the Firms' Decision to Merge

Although we have not explicitly modeled production costs in our main analysis, we still had to assume the existence of some (unmodeled) fixed-cost synergies that make sure that the merger is always jointly profitable for the merging parties, even after implementing merger remedies. What would be the implication if such fixed-cost synergies do not exist or are not sufficiently large, such that the two chains have to decide whether to merge on the basis of strategic merger effects alone?

First, under national pricing the unremedied merger is always profitable for the merging parties. The unremedied merger gives the merged entity increased market power in market A, which the chains may exploit by raising their national prices. For the remedied mergers, the effects are not so clear. The relevant alternative to a remedied merger is the premerger equilibrium. However, as demonstrated above, a remedied merger under national pricing will increase prices for only some stores while reducing them for others. Thus, the remedied merger is not assured to be (weakly) profitable for the merging parties. More specifically, in Appendix C we show that a remedied merger is jointly profitable for the merging parties (and the buyer) if and only if the price goes up at the divested store. This happens whenever competition is weaker in the market in which the merging parties are direct competitors (market A), as demonstrated by propositions 2 and 3. This also gives some justification to our choice of numerical examples in Table 1, which focuses on cases in which $t_A > t_B$.

4.3.2. Postmerger Store Rebranding

In our main analysis we assume that the stores of the merging chains keep their brand identity after the merger. In other words, the merged entity becomes a multibrand chain with two types of stores (the ones previously belonging to independent chains 1 and 2). The crucial implication of this assumption is that the merged entity sets different national prices (p_1 and p_2) for different brands of stores. Let us now relax this assumption and instead assume that the stores of the merging chains are rebranded to a single brand after the merger, with the implication that the merged entity sets the same national price for all of its stores.[13]

Notice first that, since the merging chains' stores are symmetrically located toward each other in each market, the equilibrium price is the same for both store brands before and after a merger in the absence of remedies. Thus, our alternative assumption of store rebranding has no implications for the price effects of an unremedied merger. However, this conclusion no longer holds in the presence of merger remedies.

Consider first a merger with remedy 1 in which one store in the merging chain in market A is sold to chain 4. Such a merger yields first-order price effects for the stores of the merged entity and the stores of chain 4. The merged entity now has two stores in market B and only one in market A. If the same national price applies to all three stores, the optimal price will to a larger extent reflect market conditions in market B. Consequently, the merger will lead to a higher (lower) price for these stores if competition is less (more) intense in market B than in market A. Chain 4, in contrast, has two stores in market A and only one in market B after the remedied merger, and the price response of this chain will therefore be the exact opposite (in qualitative terms). For the remaining chain 3, the (second-order) price response is considerably less clear-cut, since the chain now competes directly with two stores owned by chain 4 in market A and two stores owned by the merged chain in market B. Chain 3 therefore faces opposite price changes from its direct competitors in the two markets, and the direction of chain 3's price response is therefore generally indeterminate.

Consider next a merger with remedy 2 in which one store in the merging chain in market A is sold to a new entrant. Such a merger yields a first-order price effect for the merging chains' stores that is equivalent to the case of remedy 1, and it also yields a first-order price effect for the store acquired by the new entrant that is similar to the effect on the pricing of chain 4 under remedy 1. Thus, the price change for the merging chains' stores and the price change for the new entrant's store always go in opposite directions. Notice also that the latter price change is larger in magnitude than the former, since the optimal price of the new entrant's store depends on market conditions only in market A after the merger. For the remaining two chains, the price effects also go in opposite directions. Chain 3 has stores that are neighbors to the store of the new entrant (in market A) and to the stores of the merged entity (in market B), but the price response of chain 3 will always go in the same direction as the price effect of the new entrant's store, simply because this price effect is stronger. Chain 4, however, does not own a store

[13] In retail industries acquisitions sometimes involve the takeover of physical property (that is, store locations) only, meaning that the acquiring chain does not obtain the rights to the brand name of the target company. In these cases the acquired stores naturally will have to be rebranded after the merger. In other cases, the acquiring company obtains both the physical properties and the rights to the brand name and can choose whether to rebrand the new stores.

that is a neighbor to the new entrant, and 75 percent of its neighboring stores are owned by the merged entity. The price response of chain 4 will therefore go in the same direction as the price change for these stores.

These results show that a key feature of our main analysis remains under the alternative assumption of postmerger store rebranding, namely, that a remedied merger (of both types) always leads to price increases for some stores and price reductions for others. Furthermore, it can be shown (see Appendix C) that our remaining main results are also qualitatively similar: Remedy 1 yields a lower average price than remedy 2, but the average price is higher in the postmerger equilibrium under both types of remedies, and remedy 2 might yield a higher average price than the unremedied merger. Thus, our analysis shows that, regardless of whether we allow for postmerger store rebranding, merger remedies are less effective when retail chains set national prices and might even (in the case of remedy 2) be counterproductive.

4.3.3. Alternative Market Structures

Our analysis is conducted within the context of a particular market and ownership structure. As previously mentioned, since the set of potential market structures and ownership configurations is infinitely large, an analysis that encompasses all possibilities is infeasible. Nevertheless, in this section we consider two alternative assumptions regarding the distribution of chain stores across different markets and the total number of chains.

No Indirect Competition between the Merging Parties. In our main model we assume that all chain stores are present in all (both) markets but with a different order of store locations, which implies that the merger candidates are direct competitors in one market and indirect competitors in the other. An alternative assumption is that both merger candidates have stores and are direct competitors in some markets, but in other markets only one merger candidate has a store. That is, in each market the merger candidates are either direct competitors or do not compete at all.

A simple way to illustrate this case is to assume that there are three markets, A, B, and C, each characterized by a Salop circle with circumference equal to 1, equidistantly located stores, and a uniform distribution of consumers. Suppose that market A is identical to the main model in all respects. In contrast, there are only two stores in each of the two other markets. Suppose that chain 1 and chain 3 each have a store in market B, whereas chain 2 and chain 4 each have a store in market C. For simplicity, we assume that market B and market C are identical in terms of size and competition intensity (but generally different from market A).

In this alternative version of the model, the premerger game is still symmetric, since each of the chains is present in market A and also owns a store in one of two other markets that are identical in all respects apart from the identity of the store owners. In the case of an unremedied merger, the postmerger Nash equilibrium is also qualitatively similar to the main analysis. A merger leads to a price increase for all chains (with a larger price increase for the merging chains), and these price increases occur in all markets because of national pricing. The alternative model produces qualitatively different results only under a remedied merger.

Consider first a merger with remedy 1. Such a merger has first-order price effects for the stores of chain 2 and chain 4 and second-order price effects for the remaining stores. Because of the remedy, chain 2 is left with only one store, in market C, and will therefore reduce (increase) the price if the intensity of competition is stronger (weaker) in market C than in market A. The price effect for the stores of chain 4, in contrast, always go in the opposite direction, since this chain now has more stores in market A than in market C. As for the remaining stores, both chain 1 and chain 3 will respond in the same direction as their new direct competitor in market A, namely, chain 4.

Consider next a merger with remedy 2. Such a remedied merger has a first-order effect for the remaining store of chain 2 that is similar to the case of remedy 1 and a first-order effect for the store of the new entrant that is similar to the effect on the stores of chain 4 under remedy 2. Thus, as before, the two first-order price effects always go in opposite directions. As for the remaining second-order effects, the price response of both chain 1 and chain 3 will go in the same direction as the first-order price effect of their new direct competitor in market A, namely, the new entrant. In contrast, chain 4's price response will go in the same direction as the first-order price effect of chain 2, which is a direct competitor in market C.

Once more, a remedied merger leads to price increases for some stores and price reductions for others. It can also be shown (see Appendix C) that the average postmerger price is higher under remedy 2 than under remedy 1, that both of these average prices are higher than the premerger average price, and that the average price under remedy 2 might be higher than the average postmerger price for an unremedied merger. Thus, all our main results are qualitatively robust to the alternative market structure analyzed in this section.

Symmetric Chains of $n \geq 4$. To facilitate the analysis, we have used a model with four chains. Suppose instead that there are n chains with stores in both markets but that the order of stores differs across the two markets. Because of the numerous potential asymmetries of the postmerger game (with price effects being different for all configurations of store locations), a formal analysis is not feasible. Nevertheless, we can use existing results from the literature on price competition in Salop markets to offer some general insights about how our main results might be affected by the number of competing chains.

Notice first that the intensity of competition in each market depends both on the transportation cost parameter t and on the distance between neighboring stores. In a model with equidistantly located stores, an increase in the number of stores is therefore equivalent to a reduction in t, which implies a stronger intensity of competition, all else being equal. However, the intensity of competition in itself is not important for the results we derive. What matters instead is the difference in competition intensity between the two markets, which would not be qualitatively affected by an increase in the number of stores in each market from four to n.

As before, consider a merger between chain 1 and chain 2, which are assumed to have neighboring stores in market A but not in market B. That the merger candidates are direct competitors in market A but not in market B is a key assumption in our main analysis, and the importance of this assumption would not change in a model with n chains. In a Salop model characterized by localized competition, stores are either direct competitors or not, regardless of the number of stores in the market. Thus, under local pricing the anticompetitive effect of a merger would be fully rectified by a remedy involving transfer of store ownership, either to a chain that is not a direct competitor in market A (remedy 1) or to a new entrant (remedy 2). With n chains, the only difference would be that there is a larger number of candidates to be a buyer of a store in the merging chains under remedy 1.

Under national pricing, an unremedied merger would lead to a price increase for all stores in both markets also with n chains. The only difference would be that the magnitude of the price increase for each chain would depend on the distance to the merging firms' stores. In a single n-firm Salop market, a merger between two neighboring firms would yield heterogeneous price increases for the outside firms that are larger (smaller) for firms located closer to (farther away from) the merging firms (see, for example, Levy and Reitzes 1992; Brito 2003). In our context, with national pricing across two different markets, the equilibrium postmerger price for each chain would be a weighted average of the optimal local prices, which in each market depends on the intensity of competition and the distance to the nearest of the merging chains' stores, where the weights are given by relative demand from the two markets, as in equation (11), and therefore depend on the distribution of stores across the two markets.

With national pricing, both remedy 1 and remedy 2 imply a change in store ownership structure that yields first-order price effects in opposite directions. Under each remedy, the buyer of a store in the merged chains in market A, whether a competitor or a new entrant, would have relatively more stores in this market and would therefore increase (reduce) its national price if the intensity of competition is lower (higher) in market A than in market B. In contrast, the merging chains would be left with relatively more stores in market B, which would lead to a price effect in the opposite direction. The direction of these first-order effects would not depend on the number of competing chains. A larger number of chains would only reduce the magnitude of these first-order effects' contribution to the average price, because of a lower market share for the merging chains. As for the second-order price effects, both the magnitude and the direction of these price responses would depend on whether stores are direct competitors to the stores subject to first-order price effects. Consequently, the set of second-order price responses would be harder to characterize in an n-chain model, because of potential differences in store locations across the two markets. Nevertheless, the overall picture remains the same. Any remedied merger would yield price increases at some stores and price reductions at others, regardless of the number of competing chains. Furthermore, given the result in lemma 1, which obviously survives in an n-chain model, the magnitudes of the price increases are likely to dominate the magnitudes of the price reductions. Thus, we conjecture that a remedied merger would (at least in most cases) also lead to an increase in average prices in an equivalent model with n chains.

5. Local Quality Competition

In this section we extend our main analysis by introducing a second dimension of competition, namely, store-specific quality (or service) provision. As highlighted in Section 6, in many retail merger cases the competition authorities seem to believe that local divestiture is an appropriate remedy despite the retail chains' use of national pricing. Moreover, this view seems to be based in part on the authorities' concerns for local nonprice competition, such as competition on quality and service. Our main aim in this section is therefore to investigate whether the presence of local quality competition creates a rationale for using local divestiture as a merger remedy under national pricing. The short answer: It also does not. While quality competition at the local level may improve the efficiency of structural remedies in certain situations, it also makes it worse in others. Thus, it is still impossible to offer a strong recommendation for the use of such remedies, as long as the firms are pricing nationally.

Suppose that consumers not only care about the price and transportation cost when choosing which store to buy from but also value the quality offered by the stores. We incorporate quality by extending the utility function along the lines of Gabrielsen, Johansen, and Straume (2023), so that the utility of a consumer in market j who is located at x^j and buys the good from the store of chain i, located at z_i^j, is given by

$$U^j(x, z_i) = v + bs_i^j - p_i - t^j \mid x^j - z_i^j \mid, \tag{28}$$

where s_i^j is the quality offered by chain i in market j. The parameter $b > 0$ measures the marginal willingness to pay for quality and therefore also measures how strongly the chains compete on quality relative to prices, all else being equal.

As in Gabrielsen, Johansen, and Straume (2023), we assume that quality is observable but nonverifiable, which implies that it is impossible for the chains to commit to a national quality standard. By its nature, quality competition is local. Thus, we assume that the chains set national prices and local qualities.[14] With utility-maximizing choices by each consumer, the demand for chain i's store in market j is given by

$$q_i^j = m^j\left[\frac{1}{4} + \frac{b(2s_i^j - s_{i+1}^j - s_{i-1}^j) - (2p_i - p_{i+1} - p_{i-1})}{2t^j}\right]. \tag{29}$$

We assume that the cost of quality provision for store i in market j is equal to

$$C(s_i^j) = \frac{k}{2}(s_i^j)^2, \tag{30}$$

[14] Hence j is absent from the price variable in equation (28).

where $k > 0$. Thus, higher quality implies a higher fixed (output-independent) cost.[15] The profits of store i in market j are then given by

$$\pi_i^j = p_i q_i^j - \frac{k}{2}(s_i^j)^2. \tag{31}$$

We consider a game in which prices and qualities are determined simultaneously. With competition on both price and quality, the strategic interaction between the chains is multidimensional. Here we will briefly summarize the nature of this strategic interaction, which is nontrivial. We refer the interested reader to Gabrielsen, Johansen, and Straume (2023) for a more detailed analysis.

Prices are strategic complements in the absence of quality competition, and this is obviously also true if we keep the quality levels fixed. This is called gross strategic complementarity. The stores' qualities, in contrast, are strategically independent under our assumption of output-independent quality costs. Moreover, price and quality are what we call complementary strategies for each store and chain: A higher price makes it more profitable for the store to attract consumers by offering higher quality, and higher quality increases demand and therefore makes it less price elastic, which in turn increases the chain's profit-maximizing price, all else being equal.

However, the nature of the strategic interaction along the quality dimension changes once we take into account that a quality change by a rival chain leads to quality and price responses. A quality increase by one store will induce a price reduction by the rival store, which in turn gives the rival store an incentive to reduce the quality provision. This implies that a quality increase by chain i will be met by quality reductions by the rival chain j, when we take into account the optimal price response by chain j. Thus, qualities are net strategic substitutes, which is a key feature of the (two-dimensional) competition between the chains. Lemma 2 proves useful when explaining the intuition for some of our results below.

Lemma 2. For each of a chain's stores, the optimal local quality level is proportional to the chain's national price:

$$s_i^j = s_r^j(p_i) := \frac{bm^j}{kt^j} p_i.$$

The implication of lemma 2 is that each chain's price and quality levels change not only in the same direction but also in the same proportion. Thus, a 10 percent increase in the national price translates into a 10 percent increase in the local quality level.

[15] Gabrielsen, Johansen, and Straume (2023) also allow for the possibility that quality increases the marginal cost of supplying the good, specifically assuming $C(s_i^j) = cs_i^j q_i^j + \frac{k}{2}(s_i^j)^2$, where $c > 0$. Here we assume $c = 0$ to keep the analysis tractable.

5.1. *Premerger Equilibrium*

In the premerger equilibrium, the symmetry between the chains makes for simple equilibrium expressions, even while introducing quality competition. The national equilibrium price set by chain *i* is still given by equation (12), while the equilibrium quality chosen by chain *i* in market *j* is given by

$$s_i^j = m^j \frac{b(m^A + m^B)t^{-j}}{4k(\alpha + \beta)}. \tag{32}$$

Because the cost of quality provision is output independent, the chains' equilibrium prices are unaffected by the introduction of quality competition. In the premerger game, quality competition is therefore a pure benefit to consumers.

5.2. *Merger*

The asymmetric postmerger Nash equilibria (with or without remedies) are given by a set of prices and qualities whose explicit expressions are highly involved and thus not presentable.[16] Our results are therefore best demonstrated by giving some numerical examples, which we discuss in Section 5.2.1.

5.2.1. Competitive Effects of a Merger

Consider once more a merger between chain 1 and chain 2. In addition to the standard price effect of the merger, quality competition brings about three additional (direct) effects for the consumers, two beneficial and one harmful.

i) The merging parties will coordinate and thus reduce their quality levels to save costs in market A, where they are adjacent rivals. This effect is clearly negative for the consumers in this market.

ii) However, because own quality and price are complementary strategies, the quality reduction in market A will dampen the standard price increase following the merger. In the extreme, this effect may even be strong enough to cause a price reduction for the merging parties.[17] With national pricing, this effect is clearly positive for the consumers in both markets.

iii) Finally, because of the national price increase, and again because price and quality are complementary strategies, the merging chains will also increase their quality levels in market B, where they are not adjacent rivals. This effect is clearly positive for the consumers in this market.

Interestingly, it turns out that effects ii and iii may sometimes dominate and thus cause the effect of the merger to be less harmful to consumers with quality

[16] The equilibrium solutions were computed in Mathematica, and further details are available on request.

[17] Brekke, Siciliani, and Straume (2017) show how this may happen in a model without national pricing. See also Johnson and Rhodes (2021), who similarly demonstrate how the prices of some products may decrease after the merger if firms are allowed to reposition their product lines (the range of qualities offered).

competition. In turn, this may also influence how effective the remedies are at preventing harm to the consumers, which we discuss below.

5.2.2. Remedies

As before, the competitive harm of the merger may potentially be remedied by store ownership transfer in market A (either remedy 1 or remedy 2), which eliminates the price-coordination effect of the merger. In the absence of quality competition, proposition 4 indicates that such remedies are not able to eliminate the adverse effect of the merger on consumers when the chains practice national pricing, and remedy 2 might even be counterproductive and reinforce the adverse effects of the merger. We want to explore whether this problem is reduced or aggravated in the presence of quality competition.

To get a sense of how quality competition may affect the outcome, we conduct numerical simulations for a set of cases similar to the numerical example in Table 1, in which market A is the smaller market with relatively weaker competition. More specifically, we let $m^{A} = .3$ and $m^{B} = 1.7$, and we let t^{A} and t^{B} be inversely related, such that $t^{B} = 4 - t^{A}$, and focus on the case in which competition is stronger in market B ($t^{A} > 2$). We also set $b = 1$ and $k = 2$. To measure the impact on consumers, we expand equation (25) to account for store quality and thus calculate consumers' quality-adjusted total expenditures in each market, which account for both the price and travel costs (but adjusted for the consumers' willingness to pay for the quality). More specifically, the quality-adjusted total expenditure in market j is now defined as

$$P^{j} := \sum_{i=1}^{N=4}\left[q_i^{j}(p_i - bs_i^{j}) + m^{A}t^{j}\left(\int_0^{x_{i+1}^{*}} x dx + \int_0^{x_{i-1}^{*}} x dx\right)\right], \tag{33}$$

where x_{i+1}^{*} and x_{i-1}^{*} are defined as in equation (25). The percentage increases in consumers' market-specific and total expenditures are then given by equations (26) and (27), respectively, but where P_S^{j} is given by equation (33) instead of equation (25).

In Figure 3 we plot the percentage increase in the consumers' quality-adjusted expenditures (relative to the premerger situation) in each market. For the chosen parameter set, both PP_1^{A} and PP_2^{A} are strictly positive. In other words, the two remedies never manage to fully neutralize the competitive harm in market A (except for the special case of $t^{A} = t^{B}$). Moreover, if the degree of competition is sufficiently weak in market A relative to market B, both remedies cause even more harm than the unremedied merger in either market or both.

Figure 3 shows only the market-specific welfare effects. The overall effects, as given by equation (27), are plotted in Figure 4. Again, neither remedy manages to fully neutralize the harmful effect of the merger, and the remedies may also make the situation worse for consumers overall. That both remedies may turn out to be counterproductive is different from the situation without quality competition, in which a counterproductive effect was identified only for remedy 2.

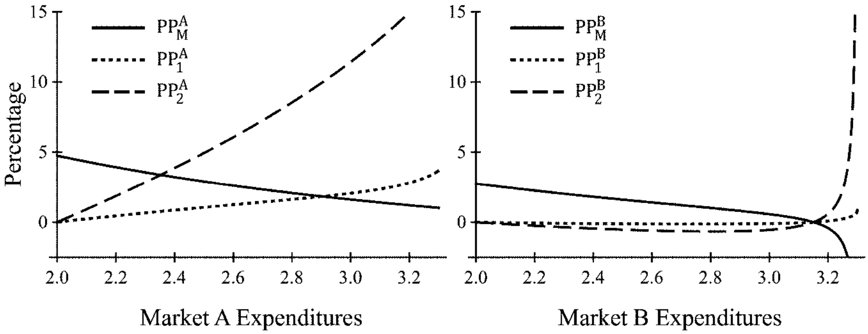

Figure 3. Percentage changes in consumers' quality-adjusted expenditures

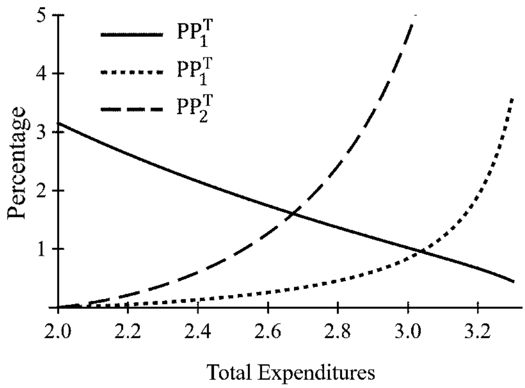

Figure 4. Total percentage changes in consumers' quality-adjusted expenditures in both markets

Finally, we may ask how the introduction of quality competition affects the efficiency of the remedies, which we measure by calculating the share of the consumers' loss that is remedied overall (in both markets). We define the efficiency E_r of remedy $r \in \{1, 2\}$ as

$$E_r := 100\left[1 - \frac{\sum_j (P_r^j - P_N^j)}{\sum_j (P_M^j - P_N^j)}\right]. \tag{34}$$

Figure 5*A* plots the efficiency of remedy 1, E_1, with and without quality competition, where the latter case is recovered by setting $b = 0$. In the former case, we plot E_1 for $b = .5$ and $b = 1$. Figure 5*B* compares the efficiency of remedy 2 in the same way. Both remedies become less efficient as the intensity of quality competition increases. Thus, we can conclude that the introduction of quality competition does not necessarily improve the performance of local structural remedies, and it may sometimes make it worse.

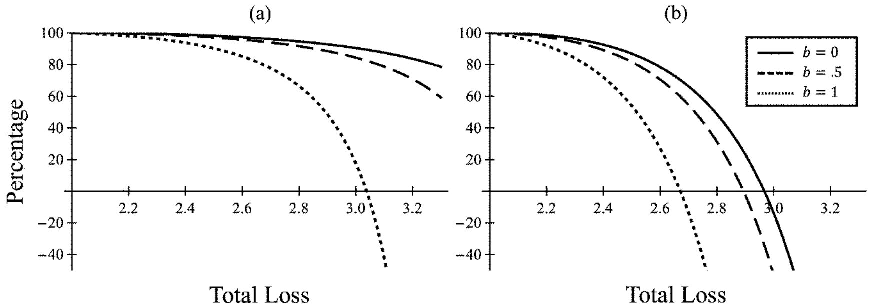

Figure 5. Efficiency of remedies: *A*, remedy 1; *B*, remedy 2

To explain the intuition behind these results, we will use remedy 1 as our case in point. In our numerical example, the impact of quality competition is twofold: The harmful effect of the unremedied merger is reduced (see Section 5.2.1), and the harmful effect of the remedied merger is increased. Put together, this implies that the remedied merger performs worse relative to the unremedied merger after quality competition is introduced.

Since market A is the smaller market with weaker competition, the changes in store ownership brought about by remedy 1 (see Figure 2) create (i) an incentive for chain 4 to increase its national price (since it now owns a second store in the market with weak competition) and (ii) an incentive for chain 2 to reduce the price at its remaining location in market B (where competition is tougher), all else being equal. These incentives are the same with and without quality competition.[18] However, because own quality and price are complementary strategies, quality competition produces two additional effects: Chain 4 will want to increase the quality levels at its three locations, and chain 2 will have an incentive to reduce its quality level at its remaining location in market B. These two additional effects also create second-order feedback effects in the sense that they reinforce the price responses given by incentives i and ii.

The overall impact of the additional effects created by quality competition is a priori unclear, since they benefit some consumers and harm others. In market B, the postmerger responses always go in opposite directions for chains 2 and 4, and thus they tend to cancel each other, both with and without quality competition, which therefore has relatively little impact on the effect of the remedied merger in market B. In market A, in contrast, quality competition produces an inflated national price response from chain 4. This can potentially be countered only by a comparable increase in chain 4's quality levels. However, because the quality levels are already relatively low in market A, which is the smaller and less com-

[18] Without quality competition, effect ii always dominates effect i, as implied by proposition 4.

petitive market, and because price and quality increase by the same rate (compare lemma 2), the quality increases in this market are of relatively little value to consumers (compared with the national price increase). Thus, the consumers in market A are left significantly worse off when quality competition is introduced. In sum, this explains how the remedied merger performs worse under quality competition in our example: On average, the consumers in market B are relatively weakly impacted, because the chains' responses go in opposite directions, whereas the consumers in market A are left with chain 4's inflated national price response without any comparable increase in local quality.

It is important to stress that these results are based on a numerical example and do not demonstrate general results within our model framework.[19] However, we believe that the example is relevant (as highlighted in Section 6), and we also believe it demonstrates an important insight: Even if the competition between retail firms involves rivalry along important local dimensions (in addition to the national price dimension), this does not necessarily mean that local divestitures perform better as merger remedies. In fact, they may perform even worse.

6. Discussion and Policy Implications

Our results demonstrate that when local divestitures of stores are used as remedies in retail mergers, unintended consequences may arise at both the local and national levels if the retail chains adopt national (uniform) prices. In fact, in our model local divestitures may turn out to be counterproductive, in the sense that the unremedied merger sometimes results in smaller overall harm to consumers than the remedied merger. The root of the problem is that all local acquisitions and divestitures, in addition to changing the incentives at the local level, will change the structure of the different chains, as this affects both the number of stores owned by the chains and their local presence in different markets—that is, the changes affect the number and structure of INPUs. And this in turn affects the chains' incentives at the national level in ambiguous ways.

This insight is important, as currently (or at least historically) competition authorities do consider and sometimes accept local divestitures as remedies in markets in which national pricing occurs, such as the grocery market and other retail markets.

One early example from the UK is the OFT's investigation of the merger between the grocery retail chains Co-op and Somerfield in 2008. The transaction meant that Co-op would take over about 900 Somerfield stores located in a large number of local markets. In 94 of the affected local markets the OFT (2008, para. 26) identified concerns that the stores of the merging parties were sufficiently close local competitors that the elimination of competition between them would cause a "substantial lessening of competition" at the local level (OFT

[19] If the smaller market is also the more competitive one, the results may move in the opposite direction, and the remedied merger may perform better with quality competition.

2008, para. 26).[20] The OFT was of the opinion that these merger-specific concerns would be resolved by means of divestments in the relevant local areas, and in the end it also decided to accept the offer from Co-op to divest more than 120 supermarkets. It is worth noting that questions were raised during the investigation about the extent to which the prices were locally or centrally decided. Co-op argued that its pricing policies meant that local pricing was not based on local competition, because it allocated all stores to one of several national price bands, based on the format of the store. The reply of the OFT was twofold. First, it argued (OFT 2008, para. 45) that it had not seen conclusive evidence that there was no prospect of "local price flexing" in any form.[21] Second, it replied that "pricing is only one of a number of ways in which competitive harm might occur, such as a deterioration of non-price factors such as quality, range and service."

In a similar case the Norwegian Competition Authority (NCA) in 2015 investigated the merger between the grocery retail chains Coop and ICA Norge. At the time Coop owned about 800 grocery stores across Norway, with an overall market share of about 23 percent; ICA owned about 550 stores and had a market share of about 10 percent. The case was important, in particular because the Norwegian grocery retail industry was already very concentrated at the time.[22] During the investigation the NCA identified 90 local areas in which competition would be substantially harmed by the merger (Coop Norge Handel AS–ICA Norge AS, konkurranseloven § 16, jf. § 20, inngrep mot foretakssammenslutning, vilkår, Vedtak V2015-24 [Coop Norge Handel AS–ICA Norge AS, Norwegian Competition Act sec. 16, cf. sec. 20, Intervention against Merger, Conditions, Decision No. V2015-24], [April 3, 2015])). As in the Co-op and Somerfield case, there were discussions during the investigation to what extent the prices were locally determined. The two chains imposed national maximum prices, which implied a high degree of uniformity across local markets. However, the NCA also noted that local market conditions naturally would affect the chains' national prices, and thus the merger might cause the national prices to increase. Moreover, the NCA argued that the use of new technologies, such as electronic shelf labels, over time would make it easier for the chains to adjust prices locally. In the end the NCA did not conclude whether prices would be raised nationally, locally, or both—instead it simply noted that prices would likely increase. Moreover, like the OFT in the Co-op–Somerfield merger, it argued that the chains might exploit market

[20] The OFT also identified concerns in an additional 32 local areas where Somerfield and Co-op did not face each other directly but competition was primarily between Somerfield and another regional co-operative that was a member of the CRTG buying group (of which Co-op was itself a member). This brought the total number of problematic markets to 126.

[21] Local price flexing here refers to the decision of a retailer to raise the price level in a particular area to exploit local market power.

[22] In 2013 the four largest grocery chains in Norway had a joint market share of around 96 percent (Coop Norge Handel AS–ICA Norge AS, konkurranseloven sec. 16, jf. sec. 20, inngrep mot foretakssammenslutning, vilkår, Vedtak V2015-24 [Coop Norge Handel AS–ICA Norge AS, Norwegian Competition Act sec. 16, cf. sec. 20, Intervention against Merger, Conditions, Decision No. V2015-24], [April 3, 2015])).

power locally by adjusting nonprice parameters such as quality and service. The NCA therefore concluded that divestitures would be necessary in the 90 local areas in which it had identified a lessening of competition. In the end the merger was conditionally accepted after Coop offered to divest 93 stores.

Another example from the UK, but from a different industry, is the acquisition of Sainsbury's pharmacy business by Celesio's LloydsPharmacy in 2016. LloydsPharmacy operated around 1,540 pharmacies at the time, and the acquisition meant that it would take over all of Sainsbury's 281 pharmacies (most of them operating out of Sainsbury's grocery stores). During the investigation the CMA (2016) identified a substantial lessening of competition in a small number of local areas, only 12 in total. What makes the case interesting, however, is that the merging parties and the CMA all agreed that the non-price-regulated medicines (so-called pharmacy-only medicines and general sales list medicines) were priced at nationally set levels and that postmerger local price flexing was unlikely to occur. Still, the CMA was concerned that the pharmacies would have an incentive to reduce quality, range, or service at the local level after the merger, and in particular in the 12 areas in which it had identified lower competition. In the end the CMA concluded that one local divestiture in each of the 12 relevant markets, which the parties had offered, would be an effective and proportionate remedy.

In the United States the Federal Trade Commission (FTC) has investigated several mergers between large retail chains in the last few years, such as Office Depot and OfficeMax (FTC 2013), Albertsons and Safeway (*Cerberus Institutional Partners,* FTC File No. 141 0108 [July 2015]), Dollar Tree and Family Dollar (*Dollar Tree, Inc.,* FTC File No. 141 0107 [September 2015]), Walgreens and Rite Aid (FTC 2017), and 7-Eleven and Sunoco (*Seven and i Holdings Co.,* FTC File No. 171 0126 [March 2018]). Some mergers were cleared after the parties agreed to divest stores, as in the Albertsons-Safeway grocery merger and the Dollar Tree–Family Dollar variety store merger. The FTC required Albertsons and Safeway to sell 168 stores, after finding that the merger would likely be anticompetitive in 130 local markets, while Dollar Tree and Family Dollar had to sell 330 stores, after the agency concluded that consumers would be harmed in many local markets spanning a total of 35 states (*Cerberus Institutional Partners*; *Dollar Tree*). We may also note the recently proposed $24.6 billion grocery merger between Kroger and Albertsons. According to Reuters, the companies announced that, in order to avoid a challenge from the FTC, they would be prepared to divest more than 400 grocery stores before the deal's close. This case is interesting not just because of its size, but also because the companies had previously suggested that if they could not find suitable buyers, they planned to divest stores by spinning them off as a stand-alone unit to its shareholders. The new unit would then effectively serve as a new entrant into the US grocery retail market. In light of previous cases reviewed by the FTC, some commentators suggested that their plan to divest the stores in overlapping areas could be enough to clear the merger (see Venugopal, Bartz, and Summerville 2022; Summerville and Sen 2022; Bartz 2023). However, in February 2024 the FTC filed a lawsuit to block the merger, and the deal was eventually terminated in December 2024. These US examples are particularly relevant, given that DellaVigna and Gentzkow (2019) thoroughly document how grocery retail chains in the United States charge prices that are essentially uniform across their stores, despite wide variation in local market conditions, with similar evidence presented for pharmacies and mass-merchandise chains.

In our view there are two important takeaways from these examples that are relevant for our discussion: Competition agencies seem to believe that local divestitures are often an appropriate merger remedy, even if store prices are not fully decided locally, and this belief is in part based on the authorities' concerns for local nonprice competition, such as competition on quality, range, and service. As we have demonstrated, this logic is flawed. In our model, if the prices are set nationally, local divestitures will in many cases be less effective in remedying the harm from mergers. Moreover, the introduction of local quality competition does not necessarily improve the effectiveness of local divestitures. On the contrary, local nonprice competition will sometimes cause local divestitures to perform even worse. Finally, with national pricing we find that a local divestiture may turn counterproductive for the consumers located in the specific market that the remedy seeks to benefit, and it may also turn counterproductive for consumers on aggregate (across markets), in the sense that the total consumer surplus would have been higher under the unremedied merger.

The intuition for our results is derived from the following two mechanisms: National pricing creates pricing externalities between different local markets, and the structure of a chain (the number of shops controlled by the chain and their locations) will affect its national price level. As a consequence of the pricing externalities, a postmerger divestiture in market A will have uncertain consequences for the price levels in market B, and vice versa. Moreover, a local divestiture in market A may, because of the specific chain structure of the buyer, have the unintended consequence of causing even more harm in market A, compared with the unremedied merger.

In our model framework, a remedy can be counterproductive (not just less effective) if the following two conditions are met: The market in which the parties are direct competitors (market A) is sufficiently small relative to the market in which they are not direct competitors (market B), and the degree of competition in the market in which they are competitors is already sufficiently weak relative to the degree of competition in the other market. The parameters m^A and m^B in our model may be interpreted as the sizes of two different local markets. However, another potential interpretation is that the parameters simply reflect numbers of markets of different types (but of equal size): m^A would then reflect the number of markets in which the stores of the merging parties are direct competitors, and m^B would be the number of markets in which the parties are not direct competitors. Yet another interpretation is that the parameters reflect both the number of markets and their size.[23] Under this interpretation, the case in which the ratio m^A/m^B is sufficiently small seems to fit many real-life merger cases. In many proposed retail mergers, having a relatively modest number of local markets raises concerns (at least compared with the total number of affected markets), and in many cases these are mostly small local markets, with small populations and a small number of stores.

When it comes to policy implications, our analysis suggests the need for caution when reviewing structural remedies in retail markets in which national pricing occurs. The main insight of our paper is that competition authorities may need to stop a larger share of mergers under national pricing, instead of approving them subject to structural remedies, simply because the available remedies in these cases are less effective and sometimes even counterproductive. This applies in particular to situations in which there are large (demand-side) asymmetries across local markets, because the difference between national and local pricing is then more pronounced.

Another general insight of our analysis is that, unlike the situation with local pricing, the effectiveness of local divestitures depend crucially on the store ownership structure of the buyer when firms engage in national pricing. However, it is difficult to identify in general which remedy is more effective because of the options, whether it involves selling to a small or large chain, to a new entrant or an incumbent, and so on. In a structurally richer model, the set of potential candidates for the most effective remedy might be very large, and the most effective one—at least when it comes to maximizing total consumer surplus across all markets—might even involve divestitures in other local markets than the ones from which the competitive harm of the merger originates. This makes merger control in industries with uniform pricing very challenging in practice, and it is very difficult to make specific recommendations beyond a general call for stricter enforcement.

In addition to these findings, the insights presented here are important because a divestiture, like any other merger, is costly both for the seller and for the buyer. And it is costly for the competition authorities, who need to review the effects of each proposed divestiture. In many cases it may be difficult to find a buyer, especially one who will be cleared by the competition authorities, and in other cases several buyers are needed to finalize a divestment plan. Structural remedies should therefore be used only if it is reasonably certain that they will have the intended effects and benefit consumers.

[23] Note that this interpretation does not work as well with local quality competition, because of the presence of local quality costs.

7. Concluding Remarks

A key tool for merger control in retail markets is the application of structural remedies, which imply a divestiture of assets in local markets in which the merger is considered to cause competitive harm. In this paper we show that the effectiveness of such remedies depends crucially on firms' pricing policy—whether prices are set locally or nationally. Under local pricing, any competitive harm of a merger can, at least in principle, be fully rectified by appropriate structural remedies. This is not the case when retail chains use national (or regional) pricing. Not only may structural remedies then be less effective, but they may even be counterproductive, in the sense that the competitive harm of a remedied merger is larger than the competitive harm of an unremedied one. These conclusions generally hold in our model even if competition is multidimensional and there is a significant element of local competition along other dimensions than price, such as quality or service.

Our results are derived from a stylized model that depicts a particular market and industry structure. This is a necessity, since the set of possible market structures, above all in terms of store ownership structure across different local markets, is infinitely large. Whereas all the details of our results are unlikely to survive under any possible market structure, our model is nevertheless structurally rich enough to illustrate and identify some very general mechanisms and insights. The use of structural remedies for merger control in retail markets relies on the underlying logic that the competitive harm of a merger can be remedied in those local markets that are the source of this harm (that is, in the local markets in which the merger leads to less competition). However, this logic does not work in retail markets in which chains set prices nationally. The reason is that the optimally chosen national price is a weighted average of the optimally set local prices, which in turn means that national price setting is affected by store ownership structure across local markets. This implies that any change in store ownership structure, which necessarily follows from any structural remedy, will have price effects not only in the local market in which the remedy is implemented but in other markets as well. When structural remedies lead to such cross-market externalities, the remedies may not only be less effective but may even be counterproductive. This suggests that competition authorities should block a larger share of the mergers under national pricing, instead of conditionally approving them subject to structural remedies, simply because the available remedies are then less efficient than in the case with local pricing.

Appendix A

Proofs

Proof of Lemma 1

The price elasticity of demand for store i in market j is given by

$$\varepsilon_i^j := -\frac{\partial q_i^j}{\partial p_i^j}\frac{p_i^j}{q_i^j}. \tag{A1}$$

Using equation (2), this elasticity is

$$\begin{aligned}\varepsilon_i^j &= -\left(-\frac{m^j}{t^j}\right)\frac{p_i^j}{m^j\{(1/4)-[(2p_i^j - p_{i+1}^j - p_{i-1}^j)/2t^j]\}} \\ &= \frac{p_i^j}{(t^j/4)-[(2p_i^j - p_{i+1}^j - p_{i-1}^j)/2)]} \\ &= \frac{4p_i^j}{t^j - 4p_i^j + 2p_{i+1}^j + 2p_{i-1}^j}.\end{aligned} \tag{A2}$$

The first- and second-order derivatives of ε_i^j with respect to t^j are given by

$$\frac{\partial \varepsilon_i^j}{\partial t^j} = \frac{-4p_i^j}{(t^j - 4p_i^j + 2p_{i+1}^j + 2p_{i-1}^j)^2} \tag{A3}$$

and

$$\begin{aligned}\frac{\partial^2 \varepsilon_i^j}{\partial (t^j)^2} &= \frac{-(-4p_i^j)2(t^j - 4p_i^j + 2p_{i+1}^j + 2p_{i-1}^j)}{(t^j - 4p_i^j + 2p_{i+1}^j + 2p_{i-1}^j)^4} \\ &= \frac{8p_i^j}{(t^j - 4p_i^j + 2p_{i+1}^j + 2p_{i-1}^j)^3}.\end{aligned} \tag{A4}$$

From equation (2) it follows that

$$t^j - 4p_i^j + 2p_{i+1}^j + 2p_{i-1}^j = \frac{4t^j q_i^j}{m^j}, \tag{A5}$$

which we can insert in the denominator of equation (A4) to obtain

$$\frac{\partial^2 \varepsilon_i^j}{\partial (t^j)^2} = \frac{8p_i^j}{(4t^j q_i^j/m^j)^3} = \frac{p_i^j}{8}\left(\frac{t^j q_i^j}{m^j}\right)^{-3} > 0. \tag{A6}$$

Proof of Proposition 2

Define Δp_i as the difference between the equilibrium post- and premerger prices of chain i. A comparison of equations (16)–(19) and (12) then yields

$$\Delta p_1 = \frac{\alpha\beta(t^A - t^B)[5\alpha(2\alpha + 3\beta) + 4\beta^2]}{4(\alpha + \beta)[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}, \tag{A7}$$

$$\Delta p_2 = -\frac{\alpha(t^A - t^B)(4\alpha + 5\beta)[3\alpha(4\alpha + 5\beta) + 4\beta^2]}{4(\alpha + \beta)[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}, \tag{A8}$$

$$\Delta p_3 = -\frac{\alpha\beta(t^A - t^B)[\beta(2\alpha + 5\beta) + 4\beta^2]}{4(\alpha + \beta)[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}, \tag{A9}$$

$$\Delta p_4 = \frac{\alpha\beta(t^A - t^B)(5\alpha + 4\beta)(4\alpha + 5\beta)}{4(\alpha + \beta)[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]}. \tag{A10}$$

It is easily confirmed that $\Delta p_1 > (<)\ 0$, $\Delta p_2 < (>)\ 0$, $\Delta p_3 < (>)\ 0$, and $\Delta p_4 > (<)\ 0$ if $t^A > (<)\ t^B$.

Proof of Proposition 3

Once more, define Δp_i as the difference between the equilibrium post- and premerger prices of chain i. In addition, define Δp_E as the difference between the postmerger price of the new entrant and the premerger price set by the previous owner of the store. A comparison of equations (20)–(24) and equation (12) then yields

$$\Delta p_1 = -\Delta p_4 = \frac{5\alpha\beta(t^A - t^B)}{12[16(\alpha^2 + \beta^2) + 33\alpha\beta]}, \tag{A11}$$

$$\Delta p_2 = -\frac{\beta(t^A - t^B)(24\alpha^2 + 25\beta^2 + 51\alpha\beta)}{12(\alpha + \beta)[16(\alpha^2 + \beta^2) + 33\alpha\beta]}, \tag{A12}$$

$$\Delta p_3 = -\frac{\alpha\beta(t^A - t^B)(\alpha - \beta)}{12(\alpha + \beta)[16(\alpha^2 + \beta^2) + 33\alpha\beta]}, \tag{A13}$$

$$\Delta p_E = \frac{\beta(t^A - t^B)(25\alpha^2 + 24\beta^2 + 51\alpha\beta)}{12(\alpha + \beta)[16(\alpha^2 + \beta^2) + 33\alpha\beta]}. \tag{A14}$$

It is easily confirmed that $\Delta p_1 > (<)\ 0$, $\Delta p_2 < (>)\ 0$, $\Delta p_4 < (>)\ 0$, and $\Delta p_E > (<)\ 0$ if $t^A > (<)\ 0$, whereas $\Delta p_3 > 0$ if $t^A > t^B$ and $\alpha < \beta$, which implies $m^A/m^B < t^A/t^B$, or if $t^A < t^B$ and $\alpha > \beta$, which implies $m^A/m^B > t^A/t^B$; otherwise, $\Delta p_3 < 0$.

Proof of Proposition 4

The average paid retail price is

$$\overline{p} := \frac{\sum_j \sum_i p_i q_i^j}{m^A + m^B}. \tag{A15}$$

Define $\Delta\overline{p}_r$ as the difference between the post- and premerger average prices, where the latter is given by equation (12), under remedy r. Using the equilibrium price expressions derived in Section 4, the average price differences under remedy 1 and remedy 2, respectively, are given by

$$\Delta\overline{p}_1 = \frac{\begin{gathered}[(85\alpha + 13\beta)16\beta^4 + (288\alpha + 1{,}265\beta)2\alpha^4 \\ + (4{,}280\alpha + 3{,}477\beta)(\alpha\beta)^2]m^B t^B [m^A(t^A - t^B)]^2\end{gathered}}{4(m^A + m^B)(\alpha + \beta)[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]^2} \tag{A16}$$

and

$$\Delta\overline{p}_2 = \frac{[144(\alpha^4 + \beta^4) + 988(\alpha\beta)^2 + 637\alpha\beta(\alpha^2 + \beta^2)]m^A m^B (t^A - t^B)^2}{36(m^A + m^B)(\alpha + \beta)[\alpha\beta(249\alpha + 200\beta) + 48(2\alpha^3 + \beta^3)]^2}. \tag{A17}$$

Evidently, $\Delta\overline{p}_1 > 0$ and $\Delta\overline{p}_2 > 0$ for all $t^A \neq t^B$. Furthermore, since the premerger equilibrium is symmetric and the postmerger equilibrium is asymmetric, aggregate transportation costs always increase as a result of a merger (regardless of whether remedy 1 or 2 is implemented). A higher average price combined with higher aggregate transportation costs must necessarily imply a reduction in the total consumers' surplus.

Proof of Proposition 5

Consider first a merger with remedy 1. The Nash equilibrium prices are given by equations (16)–(19). The corresponding store demand in each market is found by substituting these prices into equation (2), and the corresponding average price is given by

$$\overline{p}_1 := \frac{p_1(q_1^A + q_1^B) + p_2 q_2^B + p_3(q_3^A + q_3^B) + p_4(q_2^A + q_4^A + q_4^B)}{m^A + m^B}, \tag{A18}$$

where q_2^A is the postmerger equilibrium demand for the store owned by chain 2 before the merger and owned by chain 4 after the (remedied) merger. The equilibrium consumers' surplus in market A is given by

$$\begin{aligned} CS_1^A = m^A \Bigg\{ & \int_0^{x_{1,2}^A} (v - p_1 - t^A y)dy + \int_{x_{1,2}^A}^{1/4} \left[v - p_4 - t^A \left(\frac{1}{4} - y \right) \right] dy \\ & + \int_{1/4}^{x_{2,3}^A} \left[v - p_4 - t^A \left(y - \frac{1}{4} \right) \right] dy + \int_{x_{2,3}^A}^{1/2} \left[v - p_3 - t^A \left(\frac{1}{2} - y \right) \right] dy \\ & + \int_{1/2}^{x_{3,4}^A} \left[v - p_3 - t^A \left(y - \frac{1}{2} \right) \right] dy + \int_{x_{3,4}^A}^{3/4} \left[v - p_4 - t^A \left(\frac{3}{4} - y \right) \right] dy \\ & + \int_{3/4}^{x_{4,1}^A} \left[v - p_4 - t^A \left(y - \frac{3}{4} \right) \right] dy + \int_{x_{4,1}^A}^{1} [v - p_1 - t^A (1 - y)] dy \Bigg\}, \end{aligned} \tag{A19}$$

where

$$x_{1,2}^A = \frac{1}{8} - \left(\frac{p_1 - p_4}{2t^A} \right) \tag{A20}$$

is the location of the consumer who is indifferent between store 1 and store 2 (now owned by chain 4),

$$x_{2,3}^A = \frac{3}{8} - \left(\frac{p_4 - p_3}{2t^A} \right) \tag{A21}$$

is the location of the consumer who is indifferent between store 2 (now owned by chain 4) and store 3,

$$x_{3,4}^A = \frac{5}{8} - \left(\frac{p_3 - p_4}{2t^A} \right) \tag{A22}$$

is the location of the consumer who is indifferent between store 3 and store 4, and

$$x_{4,1}^A = \frac{7}{8} - \left(\frac{p_1 - p_4}{2t^A} \right) \tag{A23}$$

is the location of the consumer who is indifferent between store 4 and store 1. Similarly, the equilibrium consumers' surplus in market B is

$$\begin{aligned} CS_1^B = m^B \Bigg\{ & \int_0^{x_{1,3}^B} (v - p_1 - t^B y)dy + \int_{x_{1,3}^B}^{1/4} \left[v - p_3 - t^B \left(\frac{1}{4} - y \right) \right] dy \\ & + \int_{1/4}^{x_{3,2}^B} \left[v - p_3 - t^B \left(y - \frac{1}{4} \right) \right] dy + \int_{x_{3,2}^B}^{1/2} \left[v - p_2 - t^B \left(\frac{1}{2} - y \right) \right] dy \\ & + \int_{1/2}^{x_{2,4}^B} \left[v - p_2 - t^B \left(y - \frac{1}{2} \right) \right] dy + \int_{x_{2,4}^B}^{3/4} \left[v - p_4 - t^B \left(\frac{3}{4} - y \right) \right] dy \\ & + \int_{3/4}^{x_{4,1}^B} \left[v - p_4 - t^B \left(y - \frac{3}{4} \right) \right] dy + \int_{x_{4,1}^B}^{1} [v - p_1 - t^B (1 - y)] dy \Bigg\}, \end{aligned} \tag{A24}$$

where

$$x_{1,3}^{\mathrm{B}} = \frac{1}{8} - \left(\frac{p_1 - p_3}{2t^{\mathrm{B}}}\right) \tag{A25}$$

is the location of the consumer who is indifferent between store 1 and store 3,

$$x_{3,2}^{\mathrm{B}} = \frac{3}{8} - \left(\frac{p_3 - p_2}{2t^{\mathrm{B}}}\right) \tag{A26}$$

is the location of the consumer who is indifferent between store 3 and store 2,

$$x_{2,4}^{\mathrm{B}} = \frac{5}{8} - \left(\frac{p_2 - p_4}{2t^{\mathrm{B}}}\right) \tag{A27}$$

is the location of the consumer who is indifferent between store 2 and store 4, and

$$x_{4,1}^{\mathrm{B}} = \frac{7}{8} - \left(\frac{p_1 - p_4}{2t^{\mathrm{B}}}\right) \tag{A28}$$

is the location of the consumer who is indifferent between store 4 and store 1.

Consider next a merger with remedy 2, which implies that the Nash equilibrium prices are given by equations (20)–(24). The corresponding store demand in each market is found by substituting these prices into equation (2), and the corresponding average price is given by

$$\overline{p}_2 := \frac{p_1(q_1^{\mathrm{A}} + q_1^{\mathrm{B}}) + p_2 q_2^{\mathrm{B}} + p_3(q_3^{\mathrm{A}} + q_3^{\mathrm{B}}) + p_4(q_4^{\mathrm{A}} + q_4^{\mathrm{B}}) + p_{\mathrm{E}} q_{\mathrm{E}}^{\mathrm{A}}}{m^{\mathrm{A}} + m^{\mathrm{B}}}, \tag{A29}$$

where $q_{\mathrm{E}}^{\mathrm{A}}$ is the postmerger equilibrium demand for the store owned by chain 2 before the merger and owned by the new entrant E after the (remedied) merger. The equilibrium consumers' surplus in market A, denoted $\mathrm{CS}_2^{\mathrm{A}}$, is given by the same expression as in equation (A19) for $\mathrm{CS}_1^{\mathrm{A}}$ with the exception that p_4 is replaced by p_{E} in the second and third terms of equation (A19) and in the corresponding indifferent consumer locations in equations (A20) and (A21). In contrast, the equilibrium consumers' surplus in market B, denoted $\mathrm{CS}_2^{\mathrm{B}}$, is identical to the expression in equation (A24) for $\mathrm{CS}_1^{\mathrm{B}}$ (but obviously evaluated at a different set of equilibrium prices).

A comparison of average prices under the two remedies yields

$$\overline{p}_1 - \overline{p}_2 = -\frac{m^{\mathrm{A}} m^{\mathrm{B}} \beta (t^{\mathrm{A}} - t^{\mathrm{B}})^2 (3\alpha + 2\beta)(5\alpha + 6\beta)\Phi}{36(m^{\mathrm{A}} + m^{\mathrm{B}})(\alpha + \beta)[16(\alpha^2 + \beta^2) + 33\alpha\beta]^2 \Theta^2}, \tag{A30}$$

where

$$\begin{aligned} \Phi := {} & 27{,}648\beta^7 + 936{,}064\alpha^2\beta^5 + 1{,}597{,}461\alpha^5\beta^2 + 96{,}768\alpha^7 \\ & + 248{,}256\alpha\beta^6 + 606{,}768\alpha^6\beta + 2{,}284{,}216\alpha^4\beta^3 + 1{,}912{,}204\alpha^3\beta^4 \end{aligned} \tag{A31}$$

and

$$\Theta := 96\alpha^3 + 48\beta^3 + 200\alpha\beta^2 + 249\alpha^2\beta. \tag{A32}$$

A similar comparison of total consumers' surplus, where we define

$$\Delta CS_{1,2} := CS_1^A + CS_1^B - CS_2^A - CS_2^B, \tag{A33}$$

yields

$$\Delta CS_{1,2} = \frac{m^A m^B \beta (t^A - t^B)^2 (5\alpha + 6\beta)(3\alpha + 2\beta)\Psi}{72(\alpha + \beta)[16(\alpha^2 + \beta^2) + 33\alpha\beta]^2 \Theta^2}, \tag{A34}$$

where

$$\begin{aligned} \Psi := {} & 5{,}182{,}516\alpha^3\beta^4 + 82{,}944\beta^7 + 2{,}626{,}240\alpha^2\beta^5 + 235{,}008\alpha^7 \\ & + 721{,}728\alpha\beta^6 + 1{,}508{,}496\alpha^6\beta + 5{,}996{,}944\alpha^4\beta^3 + 4{,}075{,}359\alpha^5\beta^2. \end{aligned} \tag{A35}$$

It is easily confirmed that a merger with remedy 1 yields a strictly higher average price and a strictly lower consumers' surplus than a merger with remedy 2, as long as the degree of competition intensity differs between the two markets ($t^A \neq t^B$).

Proof of Proposition 6

After an unremedied merger, the Nash equilibrium prices are given by equations (14) and (15). Since $p_1 = p_2$ and $p_3 = p_4$, the consumers' surplus in market A can be defined as

$$\begin{aligned} CS_m^A = 2m^A \Bigg\{ & \int_0^{1/8} (v - p_1 - t^A y)dy + \int_{1/4}^{\hat{x}_{2,3}^A} \left[v - p_2 - t^A \left(y - \frac{1}{4} \right) \right] dy \\ & + \int_{1/2}^{5/8} \left[v - p_3 - t^A \left(y - \frac{1}{2} \right) \right] dy \\ & + \int_{3/4}^{x_{4,1}^A} \left[v - p_4 - t^A \left(y - \frac{3}{4} \right) \right] dy, \end{aligned} \tag{A36}$$

where

$$\hat{x}_{2,3}^A = \frac{3}{8} - \left(\frac{p_2 - p_3}{2t^A} \right) \tag{A37}$$

is the location of the consumer who is indifferent between store 2 and store 3 in market A and where $x_{4,1}^A$ is given by equation (A23). Similarly, by using the symmetry properties of the equilibrium, the consumers' surplus in market B can be defined as

$$CS_m^B = 4m^B \left\{ \int_0^{x_{1,3}^B} (v - p_1 - t^B y)dy + \int_{x_{1,3}^B}^{1/4} \left[v - p_3 - t^B \left(\frac{1}{4} - y \right) \right] dy \right\}, \tag{A38}$$

where $x_{1,3}^{B}$ is given by equation (A25). Similarly, using the equilibrium prices given by equations (14)–(15), the average price in the unremedied postmerger equilibrium, denoted $\overline{p}_m$, is given by

$$\overline{p}_m = \frac{(17\alpha^2 + 36\beta^2 + 51\alpha\beta)(m^A + m^B)\tau}{2(\alpha + 2\beta)(5\alpha + 6\beta)^2}. \tag{A39}$$

The equilibrium average price and consumers' surplus if remedy 2 is implemented alongside the merger were derived in the proof of proposition 5.

Define $\Delta\overline{p}_{2,m} := \overline{p}_2 - \overline{p}_m$ as the effect of remedy 2 on the average price. This effect is given by

$$\Delta\overline{p}_{2,m} = \frac{(\kappa m^B - \eta\tau)m^A}{36(m^A + m^B)(\alpha + \beta)(\alpha + 2\beta)(5\alpha + 6\beta)^2[16(\alpha^2 + \beta^2) + 33\alpha\beta]^2}, \tag{A40}$$

where

$$\begin{aligned}\kappa := {}& (3{,}600\alpha + 11{,}029\beta)\alpha^6(t^B)^2 \\ & + (10{,}368\beta^2 + 14{,}4876\alpha^2 + 68{,}328\alpha\beta)\beta^5(t^A)^2\end{aligned} \tag{A41}$$

and

$$\begin{aligned}\eta := {}& 20{,}736m^A\alpha^7 + 20{,}736m^B\beta^7 + 48{,}672m^B\alpha^7 + 31{,}104(m^B)^2\beta^6t^B \\ & + 340{,}854\alpha^2\beta^4(m^B)^2t^B + 834{,}648\alpha^2\beta^5m^B + 354{,}410\alpha^6\beta m^B \\ & + 1{,}601{,}728\alpha^3\beta^4m^B - 42{,}686\alpha^2\beta^5m^A + 183{,}912\alpha^4\beta^2t^B(m^B)^2 \\ & + 1{,}731{,}174\alpha^4\beta^3m^B + 292{,}857\alpha^3\beta^4m^A + 1{,}070{,}982\alpha^5\beta^2m^B \\ & + 514{,}008\alpha^4\beta^3m^A + 386{,}492\alpha^5\beta^2m^A + 219{,}600\alpha\beta^6m^B \\ & + 141{,}840\alpha^6\beta m^A + 162{,}648\alpha\beta^5(m^B)^2t^B + 28{,}206\alpha^5\beta(m^B)^2t^B \\ & + 357{,}580\alpha^3\beta^3(m^B)^2t^B.\end{aligned} \tag{A42}$$

Similarly, define

$$\Delta CS_{2,m} := CS_2^A + CS_2^B - CS_m^A - CS_m^B \tag{A43}$$

as the effect of remedy 2 on total consumers' surplus. This effect is given by

$$\Delta CS_{2,m} = -\frac{(\gamma m^B - \mu\tau)m^A}{72(\alpha + \beta)(\alpha + 2\beta)(5\alpha + 6\beta)^2[16(\alpha^2 + \beta^2) + 33\alpha\beta]^2}, \tag{A44}$$

where

$$\begin{aligned}\gamma := {}& 10{,}800\alpha^7(t^B)^2 + 31{,}104\beta^7(t^A)^2 + 459{,}228\alpha^2\beta^5(t^A)^2 \\ & + 40{,}029\alpha^5\beta^2(t^B)^2 + 200{,}952\alpha\beta^6(t^A)^2 + 50{,}119\alpha^6\beta(t^B)^2\end{aligned} \tag{A45}$$

and

$$\begin{aligned}\mu := {} & 493{,}231(\alpha\beta)^3(m^{\mathrm{B}})^2t^{\mathrm{B}} + 62{,}208\beta^7m^{\mathrm{B}} + 109{,}152\alpha^7m^{\mathrm{B}} \\ & + 51{,}840\beta^6(m^{\mathrm{B}})^2t^{\mathrm{B}} + 43{,}776\alpha^7m^{\mathrm{A}} + 2{,}012{,}856\alpha^2\beta^5m^{\mathrm{B}} \\ & + 3{,}718{,}756\alpha^3\beta^4m^{\mathrm{B}} - 328{,}910\alpha^2\beta^5m^{\mathrm{A}} + 179{,}958\alpha^4\beta^2(m^{\mathrm{B}})^2t^{\mathrm{B}} \\ & + 3{,}933{,}732\alpha^4\beta^3m^{\mathrm{B}} + 385{,}743\alpha^3\beta^4m^{\mathrm{A}} + 2{,}406{,}288\alpha^5\beta^2m^{\mathrm{B}} \\ & + 943{,}680\alpha^4\beta^3m^{\mathrm{A}} + 766{,}532\alpha^5\beta^2m^{\mathrm{A}} + 567{,}792\alpha\beta^6m^{\mathrm{B}} \\ & + 291{,}888\alpha^6\beta m^{\mathrm{A}} + 263{,}304\alpha\beta^5(m^{\mathrm{B}})^2t^{\mathrm{B}} + 793{,}166\alpha^6\beta m^{\mathrm{B}} \\ & + 524{,}040\alpha^2\beta^4(m^{\mathrm{B}})^2t^{\mathrm{B}}.\end{aligned} \tag{A46}$$

The sign of $\Delta\overline{p}_{2,m}$ is determined by the sign of $(\kappa m^{\mathrm{B}} - \eta\tau)$, whereas the sign of $\Delta\mathrm{CS}_{2,m}$ is determined by the sign of $(\gamma m^{\mathrm{B}} - \mu\tau)$. It is straightforward to verify that $\lim_{m^{\mathrm{B}}\to 0}\Delta\overline{p}_{2,m} < 0$, $\lim_{m^{\mathrm{B}}\to 0}\Delta\mathrm{CS}_{2,m} > 0$, $\lim_{t^{\mathrm{A}}\to 0}\Delta\overline{p}_{2,m} > 0$, $\lim_{t^{\mathrm{A}}\to 0}\Delta\mathrm{CS}_{2,m} < 0$, $\lim_{t^{\mathrm{B}}\to 0}\Delta\overline{p}_{2,m} > 0$, $\lim_{t^{\mathrm{B}}\to 0}\Delta\mathrm{CS}_{2,m} < 0$, $\lim_{t^{\mathrm{B}}\to t^{\mathrm{A}}}\Delta\overline{p}_{2,m} < 0$, and $\lim_{t^{\mathrm{B}}\to t^{\mathrm{A}}}\Delta\mathrm{CS}_{2,m} > 0$. Thus, $\Delta\overline{p}_{2,m} > 0$ and $\Delta\mathrm{CS}_{2,m} < 0$ only if markets are asymmetric, with a sufficiently high degree of competition in one of them, and market B is sufficiently large.

However, since $\Delta\overline{p}_{2,m} > 0$ and $\Delta\mathrm{CS}_{2,m} < 0$ requires a sufficient degree of market asymmetry, it remains to show that the national pricing equilibrium exists for this particular set of parameters. Equilibrium existence requires that none of the chains has any incentive to unilaterally deviate from the candidate equilibrium and choose a price that implies no demand for one store or more in the chain in one market. The absence of such deviation incentives must hold in three different equilibria: the premerger equilibrium, the postmerger equilibrium without remedies, and the postmerger equilibrium with remedy 2. In the following analysis we consider deviation incentives in each of the equilibria in turn.

i) In the premerger Nash equilibrium the profit chain i is

$$\pi_i = \frac{(m^{\mathrm{A}} + m^{\mathrm{B}})^2\tau}{16(\alpha+\beta)}. \tag{A47}$$

Since the equilibrium is symmetric, the incentives for unilateral deviation are the same for every chain. If chain i unilaterally deviates by withdrawing from market A, the optimal deviation price solves

$$\max_{p_i}\hat{\pi}_i^{\mathrm{B}} = p_iq_i^{\mathrm{B}} \tag{A48}$$

and is given by

$$\hat{p}_i^{\mathrm{B}} = \frac{(\alpha + 2\beta + m^{\mathrm{A}}t^{\mathrm{A}})t^{\mathrm{B}}}{8(\alpha+\beta)}, \tag{A49}$$

which yields a deviation profit of

$$\hat{\pi}_i^{\mathrm{B}} = \frac{(\alpha + 2\beta + m^{\mathrm{A}}t^{\mathrm{A}})^2m^{\mathrm{B}}t^{\mathrm{B}}}{64(\alpha+\beta)^2}. \tag{A50}$$

Alternatively, if this chain deviates by withdrawing from market B, the optimal deviation price solves

$$\max_{p_i} \hat{\pi}_i^{A} = p_i q_i^{A} \tag{A51}$$

and is given by

$$\hat{p}_i^{A} = \frac{(2\alpha + \beta)t^{A} + \beta t^{B}}{8\alpha + 8\beta}, \tag{A52}$$

which yields a deviation profit of

$$\hat{\pi}_i^{A} = \frac{(2\alpha + \beta + m^{B}t^{B})^2 m^{A} t^{A}}{64(\alpha + \beta)^2}. \tag{A53}$$

ii) In the postmerger equilibrium without remedies, the profits in the Nash equilibrium are

$$\pi_1 = \pi_2 = \frac{(2\alpha + 3\beta)^2 (m^{A} + m^{B})^2 \tau}{2(\alpha + 2\beta)(5\alpha + 6\beta)^2} \tag{A54}$$

and

$$\pi_3 = \pi_4 = \frac{9\tau (m^{A} + m^{B})^2 (\alpha + \beta)}{4(5\alpha + 6\beta)^2}. \tag{A55}$$

There are three types of potentially profitable deviations in the equilibrium. The merger participants (chains 1 and 2) can withdraw one store from one market, or they can withdraw both stores from one market. Furthermore, one of the remaining chains (3 or 4) can withdraw its store from one market. Consider first the case in which the merged chains withdraw both stores from market A. In this case, the optimal deviation prices solve

$$\max_{p_1, p_2} \hat{\pi}_1^{B} + \hat{\pi}_2^{B} = p_1 q_1^{B} + p_2 q_2^{B} \tag{A56}$$

and are given by

$$\hat{p}_1^{B} = \hat{p}_2^{B} = \frac{6\alpha t^{A} + (5\alpha + 12\beta)t^{B}}{40\alpha + 48\beta}, \tag{A57}$$

which yields a deviation profit of

$$\hat{\pi}_1^{B} = \hat{\pi}_2^{B} = \frac{(5\alpha + 12\beta + 6m^{A}t^{A})^2 m^{B} t^{B}}{64(5\alpha + 6\beta)^2}. \tag{A58}$$

Alternatively, if the merged chains withdraw both stores from market B, the optimal deviation prices solve

$$\max_{p_1, p_2} \hat{\pi}_1^{A} + \hat{\pi}_2^{A} = p_1 q_1^{A} + p_2 q_2^{A} \tag{A59}$$

and are given by

$$\hat{p}_1^{A} = \hat{p}_2^{A} = \frac{6\beta t^{A} + (8m^{A} + 3m^{B})\tau}{20\alpha + 24\beta}, \tag{A60}$$

which yields a deviation profit of

$$\hat{\pi}_1^{A} = \hat{\pi}_2^{A} = \frac{(8\alpha + 6\beta + 3m^{B}t^{B})^2 m^{A}t^{A}}{32(5\alpha + 6\beta)^2}. \tag{A61}$$

Another possible deviation for the merged chains is to withdraw only one store from one market. Because of symmetry, the incentive to withdraw only store 1 from one market is the same as the incentive to withdraw only store 2 from one market. Suppose that store 2 is withdrawn from market A. This implies that the remaining store 1 in market A faces a new demand given by

$$\hat{q}_1^{A} = m^{A}\left[\frac{3}{8} + \left(\frac{p_3 + p_4 - 2p_1}{2t^{A}}\right)\right]. \tag{A62}$$

The optimal deviation prices then solve

$$\max_{p_1, p_2} \hat{\pi}_1 + \hat{\pi}_2^{B} = p_1(\hat{q}_1^{A} + q_1^{B}) + p_2 q_2^{B} \tag{A63}$$

and are given by

$$\hat{p}_1 = \frac{(27\alpha + 30\beta)m^{A} + (22\alpha + 24\beta)m^{B}}{16(\alpha + \beta)(5\alpha + 6\beta)}\tau \tag{A64}$$

and

$$\hat{p}_2^{B} = \frac{5\alpha + 12\beta + 6m^{A}t^{A}}{8(5\alpha + 6\beta)}t^{B}, \tag{A65}$$

which yield deviation profits of

$$\hat{\pi}_1 = \frac{[(27\alpha + 30\beta)m^{A} + (22\alpha + 24\beta)m^{B}]^2}{256(\alpha + \beta)(5\alpha + 6\beta)^2}\tau \tag{A66}$$

and

$$\hat{\pi}_2^{B} = \frac{(5\alpha + 12\beta + 6m^{A}t^{A})^2}{64(5\alpha + 6\beta)^2}m^{B}t^{B}. \tag{A67}$$

If the merger participants instead withdraw store 2 from market B, this does not affect the demand functions for the remaining stores of the two chains (since store 1 and store 2 do not compete directly with each other in market B). The optimal deviation prices in this case solve

$$\max_{p_1, p_2} \hat{\pi}_1 + \hat{\pi}_2^{A} = p_1(q_1^{A} + q_1^{B}) + p_2 q_2^{A} \tag{A68}$$

and are given by

$$\hat{p}_1 = \frac{(24\alpha + 30\beta)m^{A} + (19\alpha + 24\beta)m^{B}}{4(3\alpha + 4\beta)(5\alpha + 6\beta)}\tau \tag{A69}$$

and

$$\hat{p}_2^{\mathrm{A}} = \frac{12\alpha^2 + 6\beta^2 + 20\alpha\beta + (7\alpha + 9\beta)m^{\mathrm{B}}t^{\mathrm{B}}}{2(3\alpha + 4\beta)(5\alpha + 6\beta)}t^{\mathrm{A}}, \tag{A70}$$

which yield deviation profits of

$$\hat{\pi}_1 = \frac{\tau(m^{\mathrm{A}} + m^{\mathrm{B}})(2\alpha + 3\beta)[(24\alpha + 30\beta)m^{\mathrm{A}} + (19\alpha + 24\beta)m^{\mathrm{B}}]}{8(3\alpha + 4\beta)(5\alpha + 6\beta)^2} \tag{A71}$$

and

$$\hat{\pi}_2^{\mathrm{A}} = \frac{m^{\mathrm{A}}t^{\mathrm{A}}(8\alpha + 6\beta + 3m^{\mathrm{B}}t^{\mathrm{B}})[12\alpha^2 + 6\beta^2 + 20\alpha\beta + (7\alpha + 9\beta)m^{\mathrm{B}}t^{\mathrm{B}}]}{16(3\alpha + 4\beta)(5\alpha + 6\beta)^2}. \tag{A72}$$

Finally, consider the incentives for one of the nonmerged chains to withdraw its store from one market. Because of symmetry, these incentives are the same for chain 3 and chain 4. Suppose that chain 3 withdraws its store from market A. In this case, the optimal deviation price solves

$$\max_{p_3} \hat{\pi}_3^{\mathrm{B}} = p_3 q_3^{\mathrm{B}} \tag{A73}$$

and is given by

$$\hat{p}_3^{\mathrm{B}} = \frac{5\alpha^2 + 24\beta^2 + 24\alpha\beta + (8\alpha + 12\beta)m^{\mathrm{A}}t^{\mathrm{A}}}{8(\alpha + 2\beta)(5\alpha + 6\beta)}t^{\mathrm{B}}, \tag{A74}$$

which yields a deviation profit of

$$\hat{\pi}_3^{\mathrm{B}} = \frac{[5\alpha^2 + 24\beta^2 + 24\alpha\beta + (8\alpha + 12\beta)m^{\mathrm{A}}t^{\mathrm{A}}]^2}{64(\alpha + 2\beta)^2(5\alpha + 6\beta)^2}m^{\mathrm{B}}t^{\mathrm{B}}. \tag{A75}$$

Suppose instead that chain 3 withdraws its store from market B. In this case, the optimal deviation price solves

$$\max_{p_3} \hat{\pi}_3^{\mathrm{A}} = p_3 q_3^{\mathrm{A}} \tag{A76}$$

and is given by

$$\hat{p}_3^{\mathrm{A}} = \frac{[12\alpha^2 + 12\beta^2 + 28\alpha\beta + (7\alpha + 12\beta)m^{\mathrm{B}}t^{\mathrm{B}}]}{8(\alpha + 2\beta)(5\alpha + 6\beta)}t^{\mathrm{A}}, \tag{A77}$$

which yields a deviation profit of

$$\hat{\pi}_3^{\mathrm{A}} = \frac{[12\alpha^2 + 12\beta^2 + 28\alpha\beta + (7\alpha + 12\beta)m^{\mathrm{B}}t^{\mathrm{B}}]^2}{64(\alpha + 2\beta)^2(5\alpha + 6\beta)^2}m^{\mathrm{A}}t^{\mathrm{A}}. \tag{A78}$$

iii) If the merger is implemented with remedy 2, there are three chains with stores in both markets that could therefore potentially benefit from a unilateral deviation: chain 1 (a merger participant), chain 3, and chain 4. In the candidate Nash equilibrium, the profits of these three chains are

$$\pi_1 = \frac{[(48\alpha^2 + 53\beta^2 + 104\alpha\beta)m^{\mathrm{A}}(43\alpha^2 + 48\beta^2 + 94\alpha\beta)m^{\mathrm{B}}]^2\tau}{144(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]^2}, \quad \text{(A79)}$$

$$\pi_3 = \frac{[(48\alpha^2 + 49\beta^2 + 98\alpha\beta)m^{\mathrm{A}} + (49\alpha^2 + 48\beta^2 + 98\alpha\beta)m^{\mathrm{B}}]^2\tau}{144(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]^2}, \quad \text{(A80)}$$

and

$$\pi_4 = \frac{[(48\alpha^2 + 43\beta^2 + 94\alpha\beta)m^{\mathrm{A}} + (53\alpha^2 + 48\beta^2 + 104\alpha\beta)m^{\mathrm{B}}]^2\tau}{144(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]^2}. \quad \text{(A81)}$$

If the merged chain withdraws store 1 from market A, the optimal deviation price solves

$$\max_{p_1} \hat{\pi}_1^{\mathrm{B}} = p_1 q_1^{\mathrm{B}} \quad \text{(A82)}$$

and is given by

$$\hat{p}_1^{\mathrm{B}} = \frac{\begin{array}{c}[24\alpha^3 + 48\beta^3 + 124\alpha\beta^2 + 99\alpha^2\beta \\ + (24\alpha^2 + 23\beta^2 + 48\beta m^{\mathrm{A}}t^{\mathrm{A}})m^{\mathrm{A}}t^{\mathrm{A}}]t^{\mathrm{B}}\end{array}}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \quad \text{(A83)}$$

which yields a deviation profit of

$$\hat{\pi}_1^{\mathrm{B}} = \frac{\begin{array}{c}[24\alpha^3 + 48\beta^3 + 124\alpha\beta^2 + 99\alpha^2\beta \\ + (24\alpha^2 + 23\beta^2 + 48\beta m^{\mathrm{A}}t^{\mathrm{A}})m^{\mathrm{A}}t^{\mathrm{A}}]^2 m^{\mathrm{B}}t^{\mathrm{B}}\end{array}}{144(\alpha+\beta)^2[16(\alpha^2+\beta^2)+33\alpha\beta]^2}. \quad \text{(A84)}$$

Alternatively, if this chain withdraws store 1 from market B, the optimal deviation price solves

$$\max_{p_1} \hat{\pi}_1^{\mathrm{A}} = p_1 q_1^{\mathrm{A}} \quad \text{(A85)}$$

and is given by

$$\hat{p}_1^{\mathrm{A}} = \frac{\begin{array}{c}[48\alpha^3 + 30\beta^3 + 109\alpha\beta^2 + 128\alpha^2\beta \\ + (19\alpha^2 + 18\beta^2 + 38\alpha\beta)m^{\mathrm{B}}t^{\mathrm{B}}]t^{\mathrm{A}}\end{array}}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \quad \text{(A86)}$$

which yields a deviation profit of

$$\hat{\pi}_1^{\mathrm{A}} = \frac{\begin{array}{c}[48\alpha^3 + 30\beta^3 + 109\alpha\beta^2 + 128\alpha^2\beta \\ + (19\alpha^2 + 18\beta^2 + 38\alpha\beta)m^{\mathrm{B}}t^{\mathrm{B}}]^2 m^{\mathrm{A}}t^{\mathrm{A}}\end{array}}{144(\alpha+\beta)^2[16(\alpha^2+\beta^2)+33\alpha\beta]^2}. \quad \text{(A87)}$$

If chain 3 withdraws from market A, the optimal deviation price solves

$$\max_{p_3} \hat{\pi}_3^{\mathrm{B}} = p_3 q_3^{\mathrm{B}} \tag{A88}$$

and is given by

$$\hat{p}_3^{\mathrm{B}} = \frac{[30\alpha^3 + 48\beta^3 + 128\alpha\beta^2 + 109\alpha^2\beta + (18\alpha^2 + 19\beta^2 + 38\alpha\beta)m^{\mathrm{A}}t^{\mathrm{A}}]t^{\mathrm{B}}}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \tag{A89}$$

which yields a deviation profit of

$$\hat{\pi}_3^{\mathrm{B}} = \frac{[30\alpha^3 + 48\beta^3 + 128\alpha\beta^2 + 109\alpha^2\beta + (18\alpha^2 + 19\beta^2 + 38\alpha\beta)m^{\mathrm{A}}t^{\mathrm{A}}]^2 m^{\mathrm{B}}t^{\mathrm{B}}}{144(\alpha+\beta)^2[16(\alpha^2+\beta^2)+33\alpha\beta]^2}. \tag{A90}$$

If instead chain 3 withdraws from market B, the optimal deviation price solves

$$\max_{p_3} \hat{\pi}_3^{\mathrm{A}} = p_3 q_3^{\mathrm{A}} \tag{A91}$$

and is given by

$$\hat{p}_3^{\mathrm{A}} = \frac{[48\alpha^3 + 30\beta^3 + 109\alpha\beta^2 + 128\alpha^2\beta + (19\alpha^2 + 18\beta^2 + 38\alpha\beta)m^{\mathrm{B}}t^{\mathrm{B}}]t^{\mathrm{A}}}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \tag{A92}$$

which yields a deviation profit of

$$\hat{\pi}_3^{\mathrm{A}} = \frac{[48\alpha^3 + 30\beta^3 + 109\alpha\beta^2 + 128\alpha^2\beta + (19\alpha^2 + 18\beta^2 + 38\alpha\beta)m^{\mathrm{B}}t^{\mathrm{B}}]m^{\mathrm{A}}t^{\mathrm{A}}}{144(\alpha+\beta)^2[16(\alpha^2+\beta^2)+33\alpha\beta]^2}. \tag{A93}$$

Finally, if chain 4 withdraws from market A, the optimal deviation price solves

$$\max_{p_4} \hat{\pi}_4^{\mathrm{B}} = p_4 q_4^{\mathrm{B}} \tag{A94}$$

and is given by

$$\hat{p}_4^{\mathrm{B}} = \frac{[30\alpha^3 + 48\beta^3 + 128\alpha\beta^2 + 109\alpha^2\beta + (18\alpha^2 + 19\beta^2 + 38\alpha\beta)m^{\mathrm{A}}t^{\mathrm{A}}]t^{\mathrm{B}}}{12(\alpha+\beta)[16(\alpha^2+\beta^2)+33\alpha\beta]}, \tag{A95}$$

which yields a deviation profit of

$$\hat{\pi}_4^{\mathrm{B}} = \frac{[30\alpha^3 + 48\beta^3 + 128\alpha\beta^2 + 109\alpha^2\beta + (18\alpha^2 + 19\beta^2 + 38\alpha\beta)m^{\mathrm{A}}t^{\mathrm{A}}]m^{\mathrm{B}}t^{\mathrm{B}}}{144(\alpha+\beta)^2[16(\alpha^2+\beta^2)+33\alpha\beta]^2}. \tag{A96}$$

If the chain instead withdraws from market B, the optimal deviation price solves

$$\max_{p_4} \hat{\pi}_4^{\mathrm{A}} = p_4 q_4^{\mathrm{A}} \tag{A97}$$

and is given by

$$\hat{p}_4^{\mathrm{A}} = \frac{[48\alpha^3 + 24\beta^3 + 99\alpha\beta^2 + 124\alpha^2\beta + (23\alpha^2 + 24\beta^2 + 48\alpha\beta)m^{\mathrm{B}}t^{\mathrm{B}}]t^{\mathrm{A}}}{12(\alpha+\beta)[16(\alpha^2+\beta^2) + 33\alpha\beta]}, \tag{A98}$$

which yields a deviation profit of

$$\hat{\pi}_4^{\mathrm{A}} = \frac{[48\alpha^3 + 24\beta^3 + 99\alpha\beta^2 + 124\alpha^2\beta + (23\alpha^2 + 24\beta^2 + 48\alpha\beta)m^{\mathrm{B}}t^{\mathrm{B}}]^2 m^{\mathrm{A}}t^{\mathrm{A}}}{144(\alpha+\beta)^2[16(\alpha^2+\beta^2) + 33\alpha\beta]^2}. \tag{A99}$$

Consider the set of parameter values defined by the absence of profitable deviations in all cases considered above. Proposition 6 is valid if the intersection of this set and the parameter set defined by $\Delta\overline{p}_{2,m} > 0$ and $\mathrm{CS}_{2,m} < 0$ is nonempty. A single example suffices to show that this is indeed the case. Let $m^{\mathrm{A}} = .5$, $m^{\mathrm{B}} = 1.5$, $t^{\mathrm{A}} = 3.5$, and $t^{\mathrm{B}} = .5$, which implies that market A is considerably smaller and with a lower degree of competition than market B. For this particular example, it is easily confirmed that all three Nash equilibria considered above exist (that is, there are no profitable deviations for any chain in any of the three candidate equilibria). Furthermore, this particular example yields $\Delta\overline{p}_{2,m} \approx .008$ and $\Delta\mathrm{CS}_{2,m} \approx -.025$.

Proof of Lemma 2

After substituting the demand function in equation (29) into the profit expression in equation (31) and maximizing with respect to s_i^j, the first-order condition for the optimal quality level at store i in market j is given by

$$\frac{\partial \pi_i^j}{\partial s_i^j} = p_i m^j \frac{b}{t^j} - k s_i^j = 0, \tag{A100}$$

which solved for s_i^j yields

$$s_i^j = \frac{bm^j}{kt^j} p_i. \tag{A101}$$

Supplementary Calculations for the Premerger Equilibrium under National Pricing

Under national pricing, chain i chooses p_i to maximize

$$\pi_i = p_i(q_i^{\mathrm{A}} + q_i^{\mathrm{B}}). \tag{A102}$$

The first-order condition for a profit-maximizing price is given by

$$\frac{\partial \pi_i}{\partial p_i} = q_i^{A} + q_i^{B} + p_i\left(\frac{\partial q_i^{A}}{\partial p_i} + \frac{\partial q_i^{B}}{\partial p_i}\right) = 0 \tag{A103}$$

or

$$-p_i\left(\frac{\partial q_i^{A}}{\partial p_i} + \frac{\partial q_i^{B}}{\partial p_i}\right) = q_i^{A} + q_i^{B} \tag{A104}$$

or

$$-\frac{\partial q_i^{A}}{\partial p_i}\frac{p_i}{q_i^{A}}q_i^{A} - \frac{\partial q_i^{B}}{\partial p_i}\frac{p_i}{q_i^{B}}q_i^{B} = q_i^{A} + q_i^{B}, \tag{A105}$$

which can be written

$$\varepsilon_i^{A} q_i^{A} + \varepsilon_i^{B} q_i^{B} = q_i^{A} + q_i^{B}, \tag{A106}$$

where ε_i^j is the price elasticity of demand for store i in market j, as defined in lemma 1. The first-order condition on the form given by equation (11) in Section 4 is obtained by dividing both sides of equation (A106) by $q_i^{A} + q_i^{B}$. The national price in the symmetric premerger equilibrium, given by equation (12), is then easily found by using the expression for q_i^j given by equation (2), from which we can derive

$$\varepsilon_i^j = \frac{m^j}{t^j}\frac{p_i}{q_i^j}, \tag{A107}$$

and then setting $p_{i+1}^j = p_{i-1}^j = p_i^j = p_i$ and solving equation (11) for p_i.

Appendix B

An Illustrative Example

Imagine that we have two markets, A and B, like before. Different from our baseline model, we now assume that there are five retail chains, indexed 1–5, of which only chains 1–3 are active in both markets. The remaining chains, chain 4 and chain 5, are active in market A and market B, respectively. Like in our baseline model, there are thus four stores in each market (but with a different chain structure), and in each market the stores are assumed to be equidistantly located around a Salop circle: Clockwise are the stores of chains 1, 2, 3, and 4 in market A and the stores of chains 1, 3, 2, and 5 in market B. The industry structure is shown in Figure B1.

Consider again the acquisition of chain 2 by chain 1. This merger will give the merged entity increased market power in market A, where the stores of chains 1 and 2 are direct competitors before the acquisition, just like in our baseline model. However, unlike in our baseline model, the harm from the merger can now be fully remedied (under some specific conditions that we mention below) by a divestiture in market A: By requiring the merged entity to divest chain 2's store in market A to chain 5, we are effectively letting chain 2 and chain 5 switch

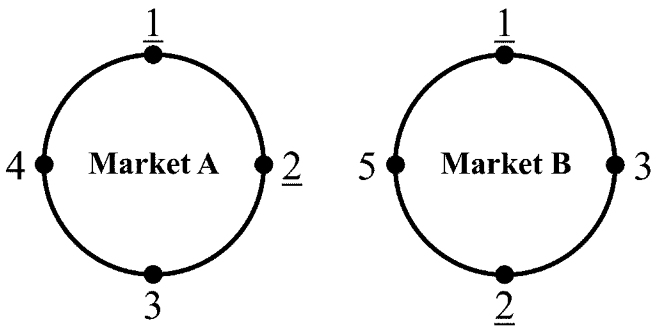

Figure B1. Unchanged independent national price units after merging retail chains (underlined)

roles; after the merger, chain 2 (now controlled by chain 1) is operating a single store in market B (just like chain 5 did before the merger), while chain 5 is operating two stores, one in each market (just like chain 2 did before the merger). With this remedy, both the number and the structure of INPUs, as previously defined, remain the same after the merger, and the distribution of retail prices in each market (and thus the average price) will therefore remain the same.[24]

A couple of conditions need to be met for this remedy to work as described. The store must be divested to chain 5 specifically; if the store is sold to chain 4 instead, or to a new entrant, then the structure of the remaining INPUs will have changed, and thus the national pricing incentives will be affected as well. After the remedied merger, the pricing incentives are restored only if chain 2 operates as its own unit (with its own price level) under chain 1's umbrella. If chain 2's store in market B is rebranded as a store of chain 1, then the number (and structure) of the remaining INPUs will have changed—which again will affect the national pricing incentives.

Appendix C

Technical Details for Section 4.3

C1. Profitability of Remedied Mergers under National Pricing

The relevant alternative to a remedied merger is the premerger equilibrium. In this symmetric equilibrium, each store in market j generates a profit of

$$\pi_i^j = p_i \frac{m^j}{4}, \tag{C1}$$

[24] Because chain 2 and chain 5 switch roles after the merger, the acquisition still has distributional consequences. However, aggregate consumers' surplus will remain the same.

which, when using equation (12), is given by

$$\pi_i^j = \frac{(m^A + m^B)m^j\tau}{16(\alpha+\beta)}, \tag{C2}$$

which implies that each chain earns a total profit of

$$\pi_i = \frac{(m^A + m^B)^2\tau}{16(\alpha+\beta)}. \tag{C3}$$

A merger with remedy 1 implies that store 2 in market A is sold to chain 4. Such a merger is profitable if there exists a selling price for store 2 that gives both the merging chains (chain 1 and chain 2) and the buyer of store 2 (chain 4) a profit that is at least as high as the equilibrium profits in the premerger game. A necessary and sufficient condition for such a price to exist is that the sum of the postmerger profits (after the ownership transfer of store 2 in market A) for all six stores owned by chains 1, 2, and 4 is at least as high as in the premerger equilibrium. The relevant postmerger profits are therefore

$$p_1(q_1^A + q_1^B) + p_2q_2^B + p_4(q_2^A + q_4^A + q_4^B). \tag{C4}$$

Using the equilibrium prices given by equations (16)–(19), these profits are higher than three times the profits given by expression (C4) if

$$\frac{\begin{aligned}\alpha m^B(t^A - t^B)[&384m^A\alpha^5(7t^A - 6t^B) + 12m^A\alpha^4\beta(1{,}006t^A - 811t^B)\\ &+ 8m^A\alpha\beta^4(935t^A - 152t^B)\\ &+ m^A\alpha^2\beta^3(18{,}051t^A - 9{,}809t^B)\\ &+ 2m^A\alpha^3\beta^2(10{,}579t^A - 7{,}572t^B)\\ &+ 16\beta^5(79\alpha + 24\beta + 75m^At^A)]\end{aligned}}{16(\alpha+\beta)(96\alpha^3 + 48\beta^3 + 200\alpha\beta^2 + 249\alpha^2\beta)^2} > 0, \tag{C5}$$

which is true if $t^A > t^B$.

A merger with remedy 2 implies that store 2 in market A is sold to a new entrant. In this case, the remedied merger will be profitable if the four stores initially owned by the merging chains generate a higher combined profit after the remedied merger than before it. Thus, the relevant postmerger profits are given by

$$p_1(q_1^A + q_1^B) + p_2q_2^B + p_Eq_E^A. \tag{C6}$$

Using equations (20)–(24), these profits are higher than two times the profits given by expression (C6) if

$$\frac{\begin{aligned}m^Am^B(t^A - t^B)[&288\alpha^3(2t^A - t^B) + 96\beta^3(3t^A - t^B)\\ &+ \alpha\beta^2(1{,}165t^A - 481t^B) + \alpha^2\beta(1{,}471t^A - 685t^B)]\end{aligned}}{72(16\alpha^2 + 16\beta^2 + 33\alpha\beta)^2} > 0, \tag{C7}$$

which again is true if $t^A > t^B$.

C2. *Rebranding of Stores after the Merger*

Suppose that, after the merger, the merged chains rebrand their stores such that all stores are of the same brand, which implies that the same (national) price applies to all of the merged chains' stores. In terms of the notation used in the main analysis, this implies that the merged chains set prices for their stores such that $p_1 = p_2$. Because of symmetry, such rebranding has no effect on the post-merger equilibrium prices when the merger is unremedied. Only in a remedied merger are the equilibrium prices affected by rebranding.

C3. *Merger with Remedy 1*

In the case of remedy 1, the postmerger equilibrium is now given by

$$p_1(= p_2) = \frac{[\alpha^2(12m^A + 17m^A) + 2\beta^2(5m^A + 6m^B) + \alpha\beta(27m^A + 34m^B)]\tau}{16(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)}, \quad \text{(C8)}$$

$$p_3 = \frac{[\alpha^2(12m^A + 11m^B) + \beta^2(11m^A + 12m^B) + 33\alpha\beta(m^A + m^B)]\tau}{16(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)}, \quad \text{(C9)}$$

$$p_4 = \frac{[2\alpha^2(6m^A + 5m^B) + \beta^2(17m^A + 12m^B) + \alpha\beta(34m^A + 27m^B)]\tau}{16(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)}. \quad \text{(C10)}$$

Comparing these prices with the premerger prices, given by equation (12), we derive the following price responses to the merger:

$$\Delta p_1(= \Delta p_2) = -\frac{\alpha\beta(t^A - t^B)(5\alpha + 2\beta)}{16(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)}, \quad \text{(C11)}$$

$$\Delta p_3 = \frac{\alpha\beta(t^A - t^B)(\alpha - \beta)}{16(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)}, \quad \text{(C12)}$$

$$\Delta p_4 = \frac{\alpha\beta(t^A - t^B)(2\alpha + 5\beta)}{16(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)}. \quad \text{(C13)}$$

It is straightforward to see that $\Delta p_1 > (<)\ 0$ if $t^A < (>)\ t^B$ whereas $\Delta p_4 < (>)\ 0$ if $t^A < (>)\ t^B$. Thus, for the stores of the merged chains and the stores of chain 4, the price responses always go in the opposite direction (apart from the knife-edge case of $t^A = t^B$). In contrast, the sign of Δp_3 is more indeterminate. More specifically, $\Delta p_3 > 0$ if $t^A > t^B$ and $m^A/m^B > t^A/t^B$ or if $t^A < t^B$ and $m^A/m^B < t^A/t^B$. Otherwise, $\Delta p_3 > 0$.

By substituting the prices in equations (C11)–(C13) into the demand functions, given by equation (2), we can derive the average postmerger price. By comparing this price with the average price before the merger, given by equation (12), we find the average price response to the remedied merger (with remedy 1), which is given by

$$\Delta\overline{p}_1 = \frac{m^A m^B \alpha\beta(t^A - t^B)^2(34\alpha^2 + 34\alpha^2 + 79\alpha\beta)}{256(m^A + m^B)(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)^2} > 0. \qquad \text{(C14)}$$

Since the Nash equilibrium is symmetric before the merger and asymmetric after the merger, which implies that aggregate transportation costs increase after the merger, an increase in the average price unambiguously leads to a reduction in total consumers' surplus.

C4. Merger with Remedy 2

In case of remedy 2, the postmerger equilibrium prices are given by

$$p_1(= p_2) = \frac{[4\alpha^2(12m^A + 17m^B) + 4\beta^2(19m^A + 24m^B) + \alpha\beta(132m^A + 173m^B)]\tau}{4[48\beta^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}, \qquad \text{(C15)}$$

$$p_3 = \frac{[4\alpha^2(12m^A + 11m^B) + 2\beta t^2(49m^A + 48m^B) + \alpha\beta(156m^A + 151m^B)]\tau}{4[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}, \qquad \text{(C16)}$$

$$p_4 = \frac{[4\alpha^2(12m^A + 13m^B) + 2\beta^2(43m^A + 48m^B) + \alpha\beta(148m^A + 163m^B)]\tau}{4[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}, \qquad \text{(C17)}$$

$$p_E = \frac{[4\alpha^2 t^B(12m^A + 7m^B) + 48\beta^2 m^B(t^A + t^B) + \alpha\beta(172\alpha + 168\beta + 81m^B t^B)]t^A}{4[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}. \qquad \text{(C18)}$$

The price effects of the merger are now given by

$$\Delta p_1(= \Delta p_2) = -\frac{\alpha\beta(t^A - t^B)(4\alpha + 5\beta)(5\alpha + 4\beta)}{4(\alpha+\beta)[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}, \qquad \text{(C19)}$$

$$\Delta p_3 = \frac{\alpha\beta(t^A - t^B)(4\alpha^2 + 2\beta^2 + 5\alpha\beta)}{4(\alpha+\beta)[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}, \qquad \text{(C20)}$$

$$\Delta p_4 = -\frac{\alpha\beta(t^A - t^B)(4\alpha^2 + 10\beta^2 + 15\alpha\beta)}{4(\alpha+\beta)[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}, \qquad \text{(C21)}$$

$$\Delta p_E = \frac{\beta(t^A - t^B)(5\alpha + 4\beta)(4\alpha^2 + 12\beta^2 + 15\alpha\beta)}{4(\alpha+\beta)[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]}, \qquad \text{(C22)}$$

where Δp_E is defined as the difference between the postmerger price of the new entrant's store in market A and the premerger price of the same store (which before the merger belonged to chain 2). It is straightforward to verify that Δp_1 and Δp_4 are positive (negative), whereas Δp_3 and Δp_E are negative (positive) if $t^A < (>)\ t^B$.

This yields the following average price response to the remedied merger (with remedy 2):

$$\Delta\overline{p}_2 = \frac{m^A m^B \beta (t^A - t^B)^2 \theta}{4(m^A + m^B)(\alpha+\beta)[48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta)]^2} > 0, \quad \text{(C23)}$$

where

$$\theta := 208\alpha^5 + 576\beta^5 + \alpha\beta[1{,}360\alpha^3 + 2{,}530\beta^3 + \alpha\beta(3{,}477\alpha + 4{,}280\beta)]. \quad \text{(C24)}$$

Furthermore, if we compare the average price response of a merger depending on which remedy is used, we find that

$$\Delta\overline{p}_2 - \Delta\overline{p}_1 = \frac{m^A m^B \beta (t^A - t^B)^2 (4\alpha + 3\beta)(3\alpha + 8\beta)\xi}{256(m^A + m^B)(\alpha+\beta)(3\alpha^2 + 3\beta^2 + 8\alpha\beta)^2 \varpi^2} > 0, \quad \text{(C25)}$$

where

$$\begin{aligned} \xi := {} & 3{,}456\alpha^7 + 13{,}824\beta^7 \\ & + \alpha\beta\{37{,}152\alpha^5 + 97{,}776\beta^5 \\ & \quad + \alpha\beta[158{,}184\alpha^3 + 280{,}502\beta^3 \\ & \quad\quad + \alpha\beta(345{,}394\alpha + 417{,}505\beta)]\} \end{aligned} \quad \text{(C26)}$$

and

$$\varpi := 48\alpha^3 + 96\beta^3 + \alpha\beta(200\alpha + 249\beta). \quad \text{(C27)}$$

Thus, a remedied merger yields a higher average price if remedy 2 is used instead of remedy 1.

It can also be shown that remedy 2 might be counterproductive in the sense that $\overline{p}_2$ is higher than the average price in the unremedied postmerger equilibrium. Using the same numerical example as in the proof of proposition 6, namely, $m^A = .5$, $m^B = 1.5$, $t^A = 3.5$, and $t^B = .5$, the difference in equilibrium average prices with and without remedy 2 is given by

$$\overline{p}_2 - \overline{p}_m \approx .007, \quad \text{(C28)}$$

where $\overline{p}_m$ is given by equation (A32). By following the same procedure as in the proof of proposition 6, it can be shown that all relevant Nash equilibria (premerger and postmerger with and without remedy 2) also exist for this parameter configuration for the case of postmerger rebranding (which implies $p_1 = p_2$).

C5. Alternative Market Structure

Suppose that there are three different geographical markets A, B, and C. Before the merger, all four chains have one store each in market A, which is therefore identical to the main model (and with the same store order). However, only chain 1 and chain 3 have stores (one each and equidistantly located) in market

B, whereas only chain 2 and chain 4 have stores (one each and equidistantly located) in market C. We assume that all three markets are characterized by a Salop circle with circumference equal to 1, but the markets differ in terms of the number of stores, market size, and competition intensity. For simplicity, suppose that the market conditions in markets B and C are identical, with market size $m^B = m^C = \tilde{m}$ and competition intensity $t^B = t^C = \tilde{t}$. We correspondingly redefine the parameters α, β, and τ as $\alpha := m^A\tilde{t}$, $\beta := \tilde{m}t^A$, and $\tau := t^A\tilde{t}$. With these assumptions, the demand facing store i in market A is given by equation (2) as before, whereas the demand facing store i in either of the two other markets is given by

$$q_i = \tilde{m}\left[\frac{1}{2} - \left(\frac{p_i - p_j}{\tilde{t}}\right)\right], \tag{C29}$$

where p^j is the price of the single competing store. Notice that since the distance between the stores is twice as large in markets B and C as in market A (because of more stores in the latter market), the competition intensity is equal in all three markets if $\tilde{t} = 2t^A$. Otherwise, if $\tilde{t} > (<)\ 2t^A$, the intensity of competition is higher (lower) in market A than in the two other markets.

C6. Premerger Equilibrium

The premerger game is symmetric, and the Nash equilibrium price set by chain i is given by

$$p_i = \frac{(m^A + 2\tilde{m})\tau}{4(\alpha + \beta)},\ i = 1,\ 2,\ 3,\ 4. \tag{C30}$$

C7. Unremedied Merger

In the postmerger equilibrium without any remedy, the prices are given by

$$p_1 = p_2 = \frac{(m^A + 2\tilde{m})(2\alpha + 3\beta)\tau}{(\alpha + 2\beta)(5\alpha + 6\beta)} \tag{C31}$$

and

$$p_3 = p_4 = \frac{3(m^A + 2\tilde{m})\tau}{2(5\alpha + 6\beta)}. \tag{C32}$$

By substituting these price expressions into the demand functions, we can calculate the average price after an unremedied merger, which is given by

$$\overline{p}_m = \frac{(17\alpha^2 + 36\beta^2 + 51\alpha\beta)(m^A + 2\tilde{m})\tau}{2(\alpha + 2\beta)(5\alpha + 6\beta)^2}. \tag{C33}$$

C8. Merger with Remedy 1

In the case of remedy 1, the postmerger equilibrium is given by

$$p_1 = p_3 = \frac{[3m^A(4\alpha+\beta)+2\tilde{m}(11\alpha+3\beta)]\tau}{4(12\alpha^2+3\beta^2+14\alpha\beta)}, \tag{C34}$$

$$p_2 = \frac{[6\alpha^2+3\beta^2+m^At^A(3\alpha+\beta)+12\alpha\beta]\tilde{t}}{2(12\alpha^2+3\beta^2+14\alpha\beta)}, \tag{C35}$$

$$p_4 = \frac{[2\alpha(3m^A+5\tilde{m})+\beta(2m^A+3\tilde{m})]\tau}{2(12\alpha^2+3\beta^2+14\alpha\beta)}. \tag{C36}$$

Notice that the stores of chain 1 and chain 3 have the same price. This is caused by the symmetry of the ownership configuration after the remedied merger in which both chains have the stores of chain 4 as neighbors in market A and are the only chains with stores (symmetrically located) in market B.

The price effects of this merger (compared with the premerger equilibrium) are given by

$$\Delta p_1 = \Delta p_3 = \frac{\alpha^2\beta(t^A-2\tilde{t})}{4(\alpha+\beta)(12\alpha^2+3\beta^2+14\alpha\beta)}, \tag{C37}$$

$$\Delta p_2 = -\frac{\alpha(t^A-2\tilde{t})(6\alpha^2+\beta^2+6\alpha\beta)}{4(\alpha+\beta)(12\alpha^2+3\beta^2+14\alpha\beta)}, \tag{C38}$$

$$\Delta p_4 = \frac{\alpha\beta(t^A-2\tilde{t})(2\alpha+\beta)}{4(\alpha+\beta)(12\alpha^2+3\beta^2+14\alpha\beta)}. \tag{C39}$$

It is straightforward to verify that Δp_1, Δp_3, and Δp_4 are positive (negative), whereas Δp_2 is negative (positive) if $t^A > (<) 2\tilde{t}$. The effect of the remedied merger on the average price is given by

$$\Delta\overline{p}_1 = \frac{m^A\tilde{m}\alpha(t^A-2\tilde{t})^2[18\alpha^3+\beta^3+\alpha\beta(23\alpha+8\beta)]}{8(m^A+2\tilde{m})(\alpha+\beta)(12\alpha^2+3\beta^2+14\alpha\beta)^2} > 0. \tag{C40}$$

C9. Merger with Remedy 2

In the case of remedy 2, the postmerger equilibrium prices are given by

$$p_1 = p_3 = \frac{[4\tilde{m}(11\alpha+6\beta)+3m^A(8\alpha+5\beta)]\tau}{4(24\alpha^2+12\beta^2+37\alpha\beta)}, \tag{C41}$$

$$p_2 = \frac{[12(\alpha^2+\beta^2)+2m^At^A(3\alpha+\beta)+33\alpha\beta]\tilde{t}}{2(24\alpha^2+12\beta^2+37\alpha\beta)}, \tag{C42}$$

$$p_4 = \frac{[\tilde{m}(29\alpha + 12\beta) + 4m^{A}(3\alpha + \beta)]\tau}{2(24\alpha^2 + 12\beta^2 + 37\alpha\beta)}, \tag{C43}$$

$$p_{E} = \frac{[12\alpha^2 + 3\beta^2 + \tilde{m}\tilde{t}(11\alpha + 6\beta) + 13\alpha\beta]t^{A}}{2(24\alpha^2 + 12\beta^2 + 37\alpha\beta)}. \tag{C44}$$

Once more, the prices are identical across chain 1 stores and chain 3 stores, because of the symmetry of the postmerger store ownership configuration.

The price effects of this remedied merger are given by

$$\Delta p_1 = \Delta p_3 = \frac{\alpha\beta(t^{A} - 2\tilde{t})(2\alpha + 3\beta)}{4(\alpha + \beta)(24\alpha^2 + 12\beta^2 + 37\alpha\beta)}, \tag{C45}$$

$$\Delta p_2 = -\frac{\alpha(t^{A} - 2\tilde{t})(12\alpha^2 + 8\beta^2 + 21\alpha\beta)}{4(\alpha + \beta)(24\alpha^2 + 12\beta^2 + 37\alpha\beta)}, \tag{C46}$$

$$\Delta p_4 = -\frac{\alpha\beta(t^{A} - 2\tilde{t})(5\alpha + 4\beta)}{4(\alpha + \beta)(24\alpha^2 + 12\beta^2 + 37\alpha\beta)}, \tag{C47}$$

$$\Delta p_{E} = \frac{\beta(t^{A} - 2\tilde{t})(13\alpha^2 + 6\beta^2 + 20\alpha\beta)}{4(\alpha + \beta)(24\alpha^2 + 12\beta^2 + 37\alpha\beta)}, \tag{C48}$$

where, as before, Δp_{E} is defined as the difference between the store price of the new entrant and the price of the same store when it was previously owned by chain 2. It is evident that Δp_1, Δp_3, and Δp_{E} are positive (negative), whereas Δp_2 and Δp_4 are negative (positive) if $t^{A} > (<)\, 2\tilde{t}$.

The effect of this remedied merger on the average price is given by

$$\Delta\overline{p}_2 = \frac{m^{A}\tilde{m}(t^{A} - 2\tilde{t})^2(72\alpha^4 + 18\beta^4 + 344\alpha^2\beta^2 + 151\alpha\beta^3 + 281\alpha^3\beta)}{8(m + 2n)(\alpha + \beta)(24\alpha^2 + 12\beta^2 + 37\alpha\beta)^2} > 0. \tag{C49}$$

Furthermore, if we compare the effect of the two remedied mergers on the average price,

$$\Delta\overline{p}_2 - \Delta\overline{p}_1 = \frac{3m^{A}\tilde{m}\beta(t^{A} - 2\tilde{t})^2(3\alpha + \beta)\zeta}{8(m^{A} + 2\tilde{m})(12\alpha^2 + 3\beta^2 + 14\alpha\beta)^2(24\alpha^2 + 12\beta^2 + 37\alpha\beta)^2} > 0, \tag{C50}$$

where

$$\zeta := 2{,}160\alpha^5 + 54\beta^5 + 3{,}254\alpha^2\beta^3 + 6{,}765\alpha^3\beta^2 + 693\alpha\beta^4 + 6{,}318\alpha^4\beta. \tag{C51}$$

Finally, it can be shown that remedy 2 might be counterproductive in the sense that it might lead to a higher average price than an unremedied merger. Consider a numerical example in which $m^{A} = .5$, $\tilde{m} = 1.5$, $t^{A} = 3.5$, and $\tilde{t} = .5$. For this numerical example, the difference in postmerger average prices with and without remedy 2 is given by

$$\overline{p}_2 - \overline{p}_m \approx .0006. \tag{C52}$$

By following the same procedure as in the proof of proposition 6, it can be shown that all relevant Nash equilibria (premerger and postmerger with and without remedy 2) exist for this parameter configuration.

Appendix D

A Numerical Example

This appendix presents a numerical example that illustrates that national pricing may be part of a subgame-perfect Nash equilibrium both before a merger and after a remedied merger in a two-stage game in which the chains first commit to a pricing policy (local or national) before competing by setting prices and local qualities. In this example we restrict attention to remedy 1.

The chains' demand functions in each market are given by equation (29). In the example we assume that $m^B = 2 - m^A$, $t^B = 4 - t^A$, $k = 1.8$, and $b = 2$. The hatched areas in Figure D1 show some ranges for the parameters m^A $(2 - m^A)$ and t^A $(4 - t^A)$ in which national pricing exists as an equilibrium strategy for all four chains, which implies that it is not profitable for any chain to unilaterally deviate to local pricing—neither before nor after the merger under remedy 1. Notice that, in the areas in which national pricing is part of a subgame-perfect Nash equilibrium, the degree of price (and quality) competition is more fierce in the larger market, that is, in the market in which the transport cost (t^j) is lower and the number of consumers (m^j) is higher. This corresponds (qualitatively) to the examples we have chosen to focus on elsewhere in the paper, in which competition is always assumed to be stronger in the larger market.

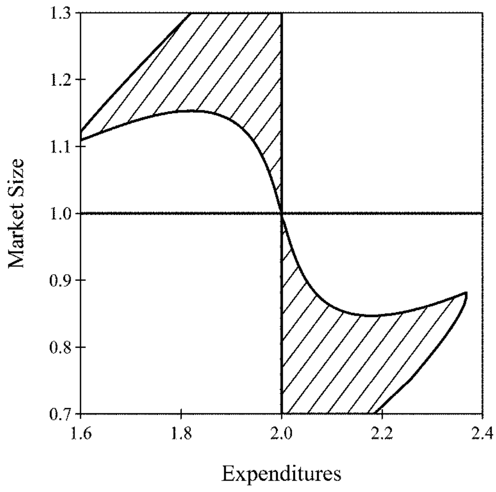

Figure D1. National pricing under remedy 1

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