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Abstract

We study the incentives of national retail chains to adopt national (uniform) prices across local markets that differ in size and competition intensity. In addition to price, the chains may also compete along a quality dimension, and quality is always set locally. We show that absent quality competition, the chains will never use national pricing. However, if quality competition is sufficiently strong there exist equilibria where at least one of the chains adopts national pricing. We also identify cases in which national pricing benefits (harms) all consumers, even in markets where such a pricing strategy leads to higher (lower) prices.

Keywords: National pricing, local pricing, retail chains, price and quality competition.

JEL Classification: L11, L13, L21

1 Introduction

National pricing occurs when a firm, say a chain-store, adopts a uniform consumer price across all its stores, even though the stores are facing different local market conditions. The pricing may be truly national in the sense that all stores have the same price, but it may also be that groups of stores charge the same price at a regional (sub-national) level. The alternative to national or regional pricing is that each local store has a unique price based on the local demand characteristics.

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Whether chain-store groups adopt national or local prices varies from sector to sector and sometimes also within a sector. A recent study by DellaVigna and Gentzkow (2019) finds that most U.S. 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. Dobson and Waterson (2005) report that UK electrical goods retailers predominately use national prices, US office supply superstores adopt local prices, and in the UK supermarket sector some groups price uniformly and others price locally.[1] This variation in incidence of national prices suggests that a strategy of strictly local pricing may not always be optimal.

When analyzing retail markets, competition authorities will often assume, either implicitly or explicitly, that businesses react optimally to local market conditions. However, given the incidence of national and regional pricing, as indicated by the data, this will in many cases be a wrong assumption. It is therefore important that we understand (i) how and when firms choose to adopt national pricing strategies, (ii) what national pricing means for the competition between the firms, and (iii) what are the consequences for the consumers locally and for welfare more generally.

An important characteristic of most retail markets is that competition is multidimensional. Retailers clearly compete for consumers by setting prices, but consumers' choice of retail outlet for their purchases also depends on a set of other characteristics. Consumers may care about store location, opening hours and a wide range of in-store activities performed by each local retailer, ranging from display and restocking of products in the shelves to friendliness towards customers. It seems reasonable to expect that the nature of such non-price competition has an impact on the optimal pricing strategies.

The key issues analyzed in this paper are why chain-stores sometimes use national prices and sometimes pure local prices, and what are the determinants for the choice of pricing strategy. We formalize a model of spatial competition with two retail chains with chain-stores in two local markets. Although each local market is a duopoly, the two markets may differ in terms of market size and competition intensity. In each market each store offers a good at a price and with a set of other characteristics dubbed as "quality". Thus, quality is meant to encompass all other characteristics important for consumer demand than the price of the good. The provision of quality is costly and observable, but *non-verifiable*, since important dimensions of quality are hard to measure. This implies that it is not possible for a chain to commit to a national quality standard and quality is therefore decided locally by each store. We also allow for the possibility that the costs of quality provision may or may not be fully internalized by the chain. Prices, on the other hand, may be determined by each chain either locally or nationally, the latter meaning that prices will be equal in both local markets. In this model we investigate whether it can be an equilibrium that one or both

[1] For more evidence of national pricing, see also Hitsch et al. (2017).

retail chains adopt a national pricing strategy, under what circumstances national pricing will arise, and the welfare implications thereof.

The literature on national pricing is rather limited. At some level it is related to the extensive literature on third-degree price discrimination[2], but while the focus in this literature is how firms may exploit differences in demand conditions, the focus in the national pricing literature is in some sense the opposite: How can it be rational not to price discriminate according to differences in market conditions? The prevailing theories mostly center around a dampening-of-competition story (Dobson and Waterson, 2005; Guo and Zhang, 2015). When committing to a national price a firm deviates from the local profit-maximizing price in all markets. The benefit is that the price and the profit are increased in markets with more competition, but the downside is that prices and profits are reduced in markets where the firm enjoys more market power. Hence the profitability of national prices depends on the composition of market characteristics the firm is faced with. The relatively less important monopoly markets are for the total revenues of the firm, the more likely it is that a firm will choose a national pricing strategy.[3]

DellaVigna and Gentzkow (2019) suggest a series of alternative explanations for national pricing (none of them formalized). They argue that the two most plausible explanations, backed up by discussions and interviews with chain managers, consultants, and industry analysts, are (i) managerial inertia (various behavioral factors that prevent the firms from implementing optimal pricing policies), and (ii) brand image concerns (the idea being that different prices at different stores may lead to negative reactions from consumers, which ultimately may lead to reduced demand in the long run).

There has also been some attempts at estimating welfare consequences of national pricing. Adams and Williams (2019) quantify the welfare effects of national (zone) pricing with data from the US retail home-improvement industry. They conclude that national pricing softens competition in markets where firms compete, but it shields consumers from higher prices in rural markets. Overall, they conclude that national prices result in higher consumer surplus than local pricing.

The paper closest to ours is Dobson and Waterson (2005) (DW henceforth). These authors analyze a model with a single upstream chain that serves a number of local markets. Each local market is either a large market that supports local competition or smaller markets where the chain enjoys a monopoly position. Specifically, they assume that in the large markets the chain-store faces competition from a single local independent retailer. Market

[2]Seminal contributions on the effects of third-degree price discrimination in imperfectly competitive markets include Holmes (1989), Corts (1998) and Armstrong and Vickers (2001).

[3]Li et al. (2018) empirically analyze the profitability of national versus local chain-store pricing using data from the US digital camera industry. They conclude that the optimal pricing policy depends on the profile of the chains, with national pricing being more profitable for two of the three main chains in the industry analyzed.

demand is derived from a representative consumer model. In this model they show that the chain-store would sometimes prefer to use national prices. There are two countervailing effects. On one side national prices tend to soften competition in the larger duopoly markets, but on the other side national prices reduce profits in the monopoly markets. This trade-off may favour national prices if the monopoly markets are not too large (or not to many) compared to the competitive markets. DW also show that national prices have an ambiguous effect on social welfare and consumers' surplus.

Our approach differs from DW in several respects. First, while DW have one chain and one independent retailer that can only be active in the larger markets, we have two chains that are active in all markets. Moreover, whereas DW assume competition only in the larger markets, we allow competition in all markets and we allow competition intensity to be independent of market size. Another difference is our demand model where we use a spatial model with fixed total demand. And most importantly, our model allows for multidimensional competition, i.e., competition both on price and quality, which is the key to understand incentives for national pricing.[4]

Our key results are the following. First, absent competition along the quality dimension, we find that national prices will never arise as an equilibrium outcome in our model.[5] This result holds regardless of the differences in size and competition intensity across the two markets. This shows that the results in DW are not general and are sensitive to specific formulations about demand and market characteristics. However, when firms compete with both price and quality, equilibria with national pricing by either one or both chains will arise provided that competition along the quality dimension is sufficiently strong. Thus, we identify the presence of local quality competition as being potentially a key driver of national pricing strategies.

The effects of national pricing on consumers' surplus and total welfare are non-trivial. A switch form local to national pricing will induce opposite price and quality effects in the two markets, and a typical outcome will be that consumers in one market benefit at the expense of a loss for the consumers in the other. This is the typical effects we also get in models where there is no quality competition, and we must weigh the benefits against the loss. However, in our model it is also possible that *all* consumers gain from national pricing. This may happen when the two markets are sufficiently asymmetric. In this case, both price and quality may decrease in one market and increase in the other in such a way that the effect of the price drop dominates the quality drop in the first market, and the quality

[4] In the literature on third-degree price discrimination there are some papers that incorporate a quality dimension, but typically either in a monopoly framework (e.g., Ikeda and Toshimitsu, 2010) or with exogenous quality differences between firms (e.g., Galera et al., 2017). None of these papers analyze how the presence of local quality competition affects the incentives for national versus local pricing in retail markets.

[5] This result has some parallels to Thisse and Vives (1988) who find that price discrimination is the unique equilibrium in a setting of spatially continuous demand, where two competing firms choose between uniform and location-specific prices.

increase dominates the price increase in the second market. As a consequence, consumers in both markets may benefit from national prices. Conversely, we also identify cases in which the opposite occurs, that consumers in both markets are harmed by a switch from local to national pricing. These are results that can only arise with multidimensional competition.

The total welfare effects of national pricing are also ambiguous. In our model with fixed total demand, welfare does not depend directly on prices but only indirectly through provided quality. Our most clear-cut result is that total welfare is maximized when both chains practice local pricing and all quality costs are internalized by the chains, implying that national pricing by one or both chains always implies a welfare loss compared to the case of local pricing. When seen in conjunction with the aforementioned effects of national pricing on consumers' surplus, showing that national pricing tends to benefit some and sometimes all consumers, this welfare result implies that the firms are often caught in a "prisoners' dilemma" when choosing between a local or national pricing strategy.

The remainder of the paper is organized in the following way. In the next section we describe our basic model. In Sections 3 and 4 we analyze price and quality competition between the chains under different assumptions about the pricing strategies (local versus national). In Section 3 we derive the Nash equilibrium outcome when both chains practice local pricing, whereas in Section 4 we derive the equilibrium prices and qualities when either one or both chains practice national pricing. The pricing strategies are endogenized in Section 5, where we characterize the subgame perfect Nash equilibria of a game where each chain initially commits to either a local or a national pricing strategy. Finally, in Section 6 we explore the implications of national pricing for consumers and total welfare, and Section 7 concludes.

2 Model

Consider two national retail chains, indexed by $i = 1, 2$, that compete in two local markets, indexed by $j = A, B$. Each local market is a duopoly where the retail store of Chain 1 (2) is located at the left (right) endpoint of the unit line $Z^j = [0, 1]$. The store of Chain i in Market j offers a good with quality s_i^j at price p_i^j. Consumers are uniformly distributed along Z^j and each consumer demands one unit of the good from the most preferred retailer. The utility of a consumer located at $x \in Z^j$ is given by

$$U^j(x) = \begin{cases} v + bs_i^j - p_i^j - t^j x & if \quad i = 1 \\ v + bs_i^j - p_i^j - t^j (1 - x) & if \quad i = 2 \end{cases}, \tag{1}$$

where $b > 0$ is the marginal willingness to pay for quality and $t^j > 0$ is a transportation cost parameter that captures the degree of horizontal product differentiation, and therefore inversely captures 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.

The two markets differ along two dimensions; competition intensity and market size. Differences along the former dimension are captured by $t^A \neq t^B$, whereas differences along the latter dimension are captured by assuming that the total mass of consumers in Market A (B) is given by m^A (m^B), where $m^A \neq m^B$. Thus, we allow for the possibility that the intensity of competition is stronger in either the larger or the smaller market.

Under the assumption that all consumers make utility-maximizing decisions, the demand facing Chain 1 in Market j is given by

$$q_1^j = m^j \left(\frac{1}{2} - \frac{p_1^j - p_2^j}{2t^j} + b \frac{s_1^j - s_2^j}{2t^j} \right). \tag{2}$$

The demand facing Chain 2 in Market j is then given by $q_2^j = m^j - q_1^j$. Note that t^j is a measure of "general" competition intensity between the stores in Market j where differences in both price and quality matter. On the other hand, for any given t^j, the parameter b scales up and down the importance of differences in quality relative to differences in price for consumers' choice. When we in the following discuss effects of more or less competition, this will refer to what we above dubbed as general competition intensity. In contrast, when we discuss stronger or weaker quality competition, this will refer to changes in the parameter b.

We assume that quality is observable but non-verifiable, since important dimensions of quality are hard to measure. This implies that it is not possible for a chain to commit to a national quality standard that applies to the stores in both markets. Thus, we assume that quality is decided at each store to maximize local payoff, which might include both monetary and non-monetary (effort) costs of quality provision. These costs are assumed to be identical for all stores and given by the following cost function:

$$C\left(s_i^j\right) = c s_i^j q_i^j + \frac{k}{2} \left(s_i^j\right)^2, \tag{3}$$

where $k > 0$ and $c \in [0, b)$. Under these assumptions, higher quality provision implies a fixed (i.e., output independent) cost and might also increase the marginal cost of supplying the good (if $c > 0$).[6] Furthermore, for a given supply of the good, it is increasingly costly to increase the level of quality. With the underlying assumption of constant marginal costs of supplying the good (for a given quality level), we set all other quality-independent costs equal to zero, without further loss of generality. The payoff of Store i in Market j is then

[6] The assumption $c < b$ is needed to ensure equilibrium existence with an interior solution.

given by

$$\pi_i^j = \left(p_i^j - cs_i^j\right) q_i^j - \frac{k}{2}\left(s_i^j\right)^2. \tag{4}$$

Whereas qualities are set to maximize local (store) payoff, prices are set to maximize chain profits, which are given by

$$\Pi_i = \sum_j \left(\pi_i^j + (1-\alpha) C\left(s_i^j\right)\right). \tag{5}$$

Here $\alpha \in [0,1]$ represents the share of the local stores' total quality costs that are internalized by the chain (i) when it decides whether or not to set a uniform national price, and (ii) at the moment it decides its price level(s). The parameter α may for example represent contract frictions that can arise if the chain is using a franchise model and contracts are incomplete. Thus, $\alpha = 1$ represents situations in which there are no contract frictions between the chain and its local stores, such as for example when the local stores are fully owned by the chain.

We assume that the players are engaged in a non-cooperative game in which prices and qualities in each market are set simultaneously, where prices are set to maximize chain profits and qualities are set to maximize store payoffs. Although differences in local market conditions imply that, *all else equal*, the profits of Chain i are maximized by setting different prices in each market, we assume that each retail chain is able to commit to a *national pricing* strategy, for example through national advertising campaigns, with a uniform price that applies to both markets, if this is unilaterally profitable.[7]

3 Local pricing

Let us first consider the benchmark case of local pricing, where all decisions are market-specific (and thus store-specific). Before deriving the Nash equilibrium, it is highly instructive to spend some time detailing the nature of the strategic interaction between the players.

3.1 Strategic price and quality interactions

Under local pricing, all the main insights on the nature of the two-dimensional strategic interaction between retail chains are obtained by focussing on one local market only. From the first-order conditions of the profit-maximization problems, we obtain the following best-

[7]Keep in mind that a uniform price (or quality) is generally not a "local best response" in either of the two markets. A Nash equilibrium with national pricing therefore requires some kind of commitment. A national advertising campaign can be a credible commitment device as long as the advertised information is verifiable, which is certainly the case for prices, but arguably not for quality. In Section 5.3 we explore if and how our main results would change if the chains were also able to commit to a national quality standard.

response functions for Chain 1 in Market j:

$$p_1^j\left(p_2^j, s_1^j, s_2^j\right) = \frac{1}{2}\left(t^j + p_2^j + (b + \alpha c)\, s_1^j - b s_2^j\right), \tag{6}$$

$$s_1^j\left(p_1^j, p_2^j, s_2^j\right) = \frac{(b + c)\, p_1^j - c p_2^j + b c s_2^j - c t^j}{2\left(b c m^j + k t^j\right)} m^j. \tag{7}$$

Due to symmetry, the best-response functions for Chain 2 are obviously completely equivalent.

As expected, prices are strategic complements. A higher price by Chain 2 leads to a demand increase, and therefore less price-elastic demand, for Chain 1, which optimally responds by increasing the price. Qualities are also strategic complements, but only if $c > 0$. A quality increase by Chain 2 leads to a demand reduction for Chain 1. If $c > 0$, this demand reduction reduces the marginal cost of quality provision, and Chain 1 will therefore optimally respond by choosing a higher level of quality. Otherwise, if $c = 0$, qualities are strategically independent.

While own price is a strategic complement to the rival's price, it is a strategic substitute to the rival's quality (i.e., $\partial p_1^j / \partial s_2^j < 0$). Increased quality provision by Chain 2 reduces the demand, and therefore reduces the price-elasticity of demand, for Chain 1. The optimal response by the latter chain is therefore to reduce the price. Conversely, own quality is a strategic substitute to the rival's price, but only if $c > 0$. A higher price by Chain 2 leads to increased demand for Chain 1. If $c > 0$, this demand increase leads to a higher marginal cost of quality provision, resulting in a lower optimal quality level by Chain 1.

Finally, notice that own price and own quality are what we can dub *complementary strategies* (i.e., $\partial p_1^j / \partial s_1^j > 0$ and $\partial s_1^j / \partial p_1^j > 0$). All else equal, a higher price increases the price-cost margin, which makes it more profitable to increase quality in order to attract more customers. Conversely, an increase in quality leads to higher demand and therefore makes demand less price-elastic, implying that the profit-maximizing price also increases. The latter effect is reinforced if a quality increase also leads to higher marginal production costs for the chain (which requires $c > 0$ and $\alpha > 0$).

All the above strategic interactions are derived holding *everything else constant*, including other decisions made by the same player. For example, the optimal price response is derived keeping the quality decision of the same player constant, and *vice versa*. However, these best responses are potentially different when we take into account that each player optimizes along two different dimensions: price and quality. By internalizing the strategic relationship between price and quality for each player, we derive a new set of best-response functions that allow us to determine what we dub *net* strategic complementarity or substitutability.

These best-response functions, where each player's best response is solely a function of the rival player's decisions, are given by

$$p_1^j\left(p_2^j, s_2^j\right) = \frac{\left(2kt^j + c\left(b - \alpha c\right)m^j\right)\left(t^j + p_2^j - bs_2^j\right)}{4kt^j - m^j\left(\left(b-c\right)^2 - \left(1-\alpha\right)c\left(b+c\right)\right)}, \tag{8}$$

$$s_1^j\left(p_2^j, s_2^j\right) = \frac{m^j\left(b-c\right)\left(t^j + p_2^j - bs_2^j\right)}{4kt^j - m^j\left(\left(b-c\right)^2 - \left(1-\alpha\right)c\left(b+c\right)\right)}. \tag{9}$$

Whereas the strategic complementarity between prices remain, we see that this is not the case for qualities. Keeping the price of Chain 1 constant, a quality increase by Chain 2 is optimally met by a quality increase by Chain 1 (if $c > 0$). However, a quality increase by Chain 2 also gives Chain 1 an incentive to reduce the price, as explained above. Since price and quality are complementary strategies, Chain 1 will optimally respond to Chain 2's quality increase by reducing both price and quality. This is a dominating effect, making qualities *net strategic substitutes.* We also see from (9) that own quality is a net strategic complement to the rival's price. Strategic complementarity in prices, combined with the fact that own price and own quality are complementary strategies, imply that Chain 1 optimally responds to a price increase (by Chain 2) by increasing both price and quality.

The above derived strategic interactions are useful in order to characterize what is a key mechanism determining many of the subsequently derived results in this paper. How does a unilateral price change affect the rival's optimal quality choice when we internalize all strategic interactions? The answer to this question is found by simultaneously solving $p_2^j\left(p_1^j, s_1^j, s_2^j\right)$, $s_1^j\left(p_1^j, p_2^j, s_2^j\right)$ and $s_2^j\left(p_1^j, p_2^j, s_1^j\right)$ to obtain s_2^j as a function of p_1^j only, given by

$$s_2^j\left(p_1^j\right) = \frac{\left(\left(2kt^j - m^j b\left(b-c\right)\right)p_1^j + \left(2kt^j + 3m^j bc\right)t^j\right)m^j\left(b-c\right)}{2kt^j\left(4kt^j - m^j b^2\right) + 2m^j ckt^j\left(6b - \alpha\left(b+c\right)\right) + cb\left(b\left(4c-b\right) - \alpha c\left(2b+c\right)\right)\left(m^j\right)^2}, \tag{10}$$

from which we derive

$$\frac{\partial s_2^j\left(p_1^j\right)}{\partial p_1^j} > (<)\, 0 \text{ if } 2kt^j > (<)\, m^j b\left(b-c\right). \tag{11}$$

Notice that b measures the relative intensity of competition along the quality dimension, which allows us to reach the following conclusion:

Lemma 1 *In a given market, a unilateral price increase by one chain leads to a higher (lower) quality provision by the rival chain if the intensity of quality competition is sufficiently weak (strong) relative to the intensity of price competition.*

The sign of (11) is determined by two main effects that pull in opposite directions:

1. Keeping the quality of Chain 1 constant, a price increase by Chain 1 leads to a price increase by Chain 2 (because prices are strategic complements), which in turn leads to

a quality increase by Chain 2 (because own price and own quality are complementary strategies). In other words, this is the effect of own quality being a net strategic substitute to the rival's price.

2. However, since price and quality are complementary strategies, a price increase by Chain 1 will be accompanied by a quality increase by the same chain. Since qualities are net strategic substitutes, this leads to a quality reduction by Chain 2.

The relative strength of these two effects depends on the intensity of quality competition, which crucially determines the magnitude of the second effect, which depends on the net strategic substitutability of qualities. The stronger the chains compete along the quality dimension, the larger is Chain 2's loss of demand when Chain 1 increases the quality. Consequently, the larger are the price and quality reductions by Chain 2. Thus, when b is sufficiently high, the second effect dominates, which means that each chain can induce a quality reduction at the other chain by increasing the price. Otherwise, if b is sufficiently low, a unilateral price increase will instead trigger a quality increase by the rival chain.

3.2 Nash equilibrium

The symmetric Nash equilibrium is given by[8]

$$p_{LL}^{j} = t^{j} + \frac{\alpha c \left(b-c\right) t^{j} m^{j}}{2kt^{j} + \left(1-\alpha\right) bcm^{j}}, \tag{12}$$

$$s_{LL}^{j} = \frac{\left(b-c\right) t^{j} m^{j}}{2kt^{j} + \left(1-\alpha\right) bcm^{j}}. \tag{13}$$

A comparison of equilibrium prices and qualities across the two markets reveals that

$$\begin{aligned} p_{LL}^{A} &> (<)\, p_{LL}^{B} \text{ if} \\ t^{A} - t^{B} &> (<)\, \frac{2\alpha ckt^{A}t^{B}\left(b-c\right)\left(m^{B}-m^{A}\right)}{4k^{2}t^{A}t^{B} + \left(1-\alpha\right) cb\left(2k\left(m^{A}t^{B}+m^{B}t^{A}\right) + c\left(b-\alpha c\right) m^{A}m^{B}\right)}, \end{aligned} \tag{14}$$

and

$$s_{LL}^{A} > (<)\, s_{LL}^{B} \text{ if } m^{A} - m^{B} > (<)\, \frac{\left(1-\alpha\right) cb\left(t^{B}-t^{A}\right) m^{A}m^{B}}{2kt^{A}t^{B}}. \tag{15}$$

The main features of the Nash equilibrium with local pricing by both chains can therefore be stated as follows:

[8] We use subscript LL to denote equilibrium values of the variables in the case where both chains adopt a local pricing strategy.

Proposition 1 *Suppose that both retail chains set local prices. (i) If $c = 0$ or $\alpha = 0$, the equilibrium price is higher in the market with less competition. If $c > 0$ and $\alpha > 0$, the price might be higher in the market with more competition if this market is sufficiently large relative to the market with less competition. (ii) If $\alpha = 1$ or $c = 0$, quality is higher in the larger market. If $c > 0$ and $\alpha < 1$, quality might be lower in the larger market if the degree of competition is stronger in this market.*

Proposition 1, whose proof follows from a straightforward inspection of (14) and (15), reveals that the relationship between competition intensity and equilibrium prices is not straightforward when competition takes place along two different dimensions. In the absence of quality competition, equilibrium prices are uniquely determined by the intensity of competition (inversely measured by t^j). This is a standard feature of spatial competition models with fixed total demand, where a unilateral price reduction has a pure business stealing effect. This result survives the introduction of quality competition as long as quality does not affect the chain's marginal production costs (i.e., $c = 0$ or $\alpha = 0$). However, for $c > 0$ and $\alpha > 0$, equilibrium prices also depend positively on market size. The reason is that incentives for quality provision are stronger in a larger market, all else equal. If $c > 0$ (and $\alpha > 0$), higher quality provision increases the marginal cost of supplying the good, which in turns increases the profit-maximizing price. If this effect is sufficiently strong, equilibrium prices are higher in the market with a lower degree of competition, if this market is sufficiently larger than the other market.

Whereas the optimal price setting always depends (at least in part) on the degree of competition, this is not necessarily the case for the choice of optimal quality provision. There are two counteracting effects of competition intensity on quality choices. On the one hand, stronger competition makes demand more quality-elastic, which gives each store an incentive to increase quality. On the other hand, stronger competition also makes demand more price-elastic. This gives each chain an incentive to reduce the price, which in turn reduces the marginal gain of quality provision (recall that price and quality are complementary strategies). If $\alpha = 1$, such that prices and qualities are chosen to maximize the same objective function, the two above mentioned effects exactly cancel each other, implying that equilibrium quality provision is unaffected by the degree of competition.[9] In this case, equilibrium quality is always higher in the larger market.

However, this is not necessarily the case if $\alpha < 1$, implying that some of the quality costs are not internalized by the chain. If $\alpha < 1$ and $c > 0$, more competition leads to *lower* quality provision. This is explained by a subtle feedback effect. The former of the two above explained effects (i.e., the increase in quality provision as a result of more quality-elastic

[9] This is a well known result from the spatial competition literature (e.g., Ma and Burgess, 1993, and Gravelle, 1999). Brekke et al. (2010) have shown that this does not generally hold in the presence of income effects (which implies that price changes affect the marginal utility of consumers).

demand) is amplified by a feedback effect related to quality and price being complementary strategies. Higher quality yields an incentive to increase the price, which in turn yields an incentive for a further quality increase. The incentive to increase the price in response to a quality increase is partly related to an increase in marginal production costs (if $c > 0$). However, a lower value of α reduces the marginal cost increase for the chain, which in turn reduces the magnitude of this feedback effect, as can be directly seen from (6), and therefore reduces the former of the two above described effects of competition on quality provision. Thus, if $\alpha < 1$ and $c > 0$, the latter effect dominates the former, implying a *negative* relationship between competition intensity and equilibrium quality provision. Consequently, equilibrium quality might be lower in the larger market if the degree of competition is sufficiently strong in this market.

4 National pricing

In this section we analyze if and how the previously derived results (under local pricing) change if either one or both chains adopt a national pricing strategy.

4.1 National pricing by one chain

Suppose that Chain 1 sets a national price, denoted p_1, whereas Chain 2 practices local pricing and sets p_2^A and p_2^B. As before, qualities are set to maximize (local) store payoff. In this case, the best-response function for the pricing decision of Chain 1 is given by

$$p_1 = \frac{m^A t^B \left(p_2^A + t^A + b\left(s_1^A - s_2^A\right) + c\alpha s_1^A\right) + m^B t^A \left(p_2^B + t^B + b\left(s_1^B - s_2^B\right) + c\alpha s_1^B\right)}{2\left(m^A t^B + m^B t^A\right)}. \quad (16)$$

Naturally, the optimal national price set by Chain 1 depends on all decisions (prices and qualities) made by both players in both markets. Nevertheless, the strategic relationships are qualitatively similar to the ones analyzed in great detail in the previous section, under local pricing by both chains, in the sense that the optimal national price depends positively on the rival's prices and on own qualities, but it depends negatively on the rival's qualities. All other best-response functions are identical to the ones under local pricing, and it can also be shown that the previously derived results on net strategic substitutability or complementarity carry over to the case of asymmetric pricing strategies.

The asymmetric Nash equilibrium, where one chain practices national pricing whereas the other chain practices local pricing, is given by a set of prices and qualities whose explicit expressions are highly involved and thus not presentable.[10] We can nevertheless gain some insights into the main mechanisms at play by considering the special case of $c = 0$, which

[10] The equilibrium solution was computed in Mathematica and further details are available upon request.

implies that the value of α only affects chain profits and does not affect equilibrium prices and qualities. We also impose the parameter restriction $b^2 < \max\left\{3kt^A/m^A, 3kt^B/m^B\right\}$, which is a sufficient condition for equilibrium existence. In this case, the Nash equilibrium is given by[11]

$$p_{NL} = \left[\begin{array}{c} \left(m^A + m^B\right)\left(m^A m^B b^4 + 12k^2 t^A t^B\right) \\ -b^2 k \left(3m^A m^B \left(t^A + t^B\right) + 4\left(\left(m^A\right)^2 t^B + \left(m^B\right)^2 t^A\right)\right) \end{array} \right] \frac{t^A t^B}{\Theta}, \tag{17}$$

$$p^j_{LN} = \left[\begin{array}{c} 4m^j k \left(t^{-j}\right)^2 \left(3kt^j - m^j b^2\right) + b^4 m^{-j} m^j \left(m^j + m^{-j}\right) t^{-j} \\ + m^{-j} k \left(t^j + t^{-j}\right)\left(6kt^j t^{-j} - b^2\left(2m^{-j} t^j + 3m^j t^{-j}\right)\right) \end{array} \right] \frac{t^j}{\Theta}, \tag{18}$$

$$s^j_{NL} = \frac{m^j b}{2kt^j} p_{NL}, \tag{19}$$

$$s^j_{LN} = \frac{m^j b}{2kt^j} p^j_{LN}, \tag{20}$$

where

$$\Theta := m^B t^A \left(4kt^A - m^A b^2\right)\left(3kt^B - m^B b^2\right) + m^A t^B \left(3kt^A - m^A b^2\right)\left(4kt^B - m^B b^2\right) > 0, \tag{21}$$

and where $-j$ refers to the other market than Market j.

In order to see how prices and qualities in each market are affected by the adoption of a national pricing strategy by Chain 1, we define $\underline{\theta} := \min\left\{t^A/m^A, t^B/m^B\right\}$ and $\overline{\theta} := \max\left\{t^A/m^A, t^B/m^B\right\}$. This allows us to define three different regimes, depending on the intensity of quality competition. In all three regimes, national price setting leads to higher (lower) price and quality by Chain 1 in the market with more (less) competition, but the strategic response from Chain 2 differs across the three regimes:[12]

Regime 1 If $b^2 < 2k\underline{\theta}$, Chain 2 responds by increasing (reducing) price and quality in the market with more (less) competition.

Regime 2 If $2k\underline{\theta} < b^2 < 2k\overline{\theta}$, Chain 2 responds by either reducing or increasing price and quality in both markets.

Regime 3 If $b^2 > 2k\overline{\theta}$, Chain 2 responds by increasing (reducing) both price and quality in the market with less (more) competition.

By committing to national price setting, Chain 1 can affect competition along two dimensions; price and quality. In the absence of quality competition, the strategic gain of

[11] We use subscript NL to denote equilibrium values of the chain practicing national pricing and subscript LN to denote equilibrium values of the competing chain (practicing local pricing).

[12] These regimes are defined by equilibrium price and quality differences when comparing the case of local pricing by both chains with the asymmetric case of national pricing by one of the chains. See the Appendix for details.

national price setting is that the optimal national price is higher than the optimal price in the most competitive market under local price setting, which dampens competition in this market because of strategic complementarity. However, this strategic gain comes at a cost, which is the loss in profits due to the national price being suboptimally low in the market with less competition.

When the chains also compete along a second dimension, namely quality, the strategic gains and costs of national price setting are affected in non-trivial ways. A key factor is the direction of the rival's equilibrium quality response to the price changes introduced by national price setting. This strategic response is characterized by Lemma 1. If the intensity of quality competition (as measured by b) is sufficiently low, the rival chain responds to a price increase (reduction) by providing higher (lower) quality. In Regime 1, this is the nature of the strategic response in both markets. National price setting consequently implies that quality competition is reinforced (dampened) in the market with more (less) competition. Thus, the strategic gain of national price setting that is related to quality competition occurs in the market with *less* competition, whereas the cost occurs in the other market. In other words, quality competition reduces both the gain and the cost of national price setting, compared to the case where the chains are only engaged in price competition.

However, a sufficiently high intensity of quality competition changes the direction of this strategic response. In Regime 2, the sign of $\partial s_2(p_1)/\partial p_1$ is different in the two markets, which implies that the direction of Chain 2's strategic response is reversed in one of the markets, compared with Regime 1. Consequently, Chain 2 will respond to national pricing by either reducing or increasing price and quality in both markets. A sufficient condition for a price and quality reduction by Chain 2 in both markets is that the competition intensity is higher in the larger market. Finally, in Regime 3, $\partial s_2(p_1)/\partial p_1 < 0$ in both markets, which implies that the strategic response of Chain 2 is completely reversed, compared with Regime 1.

The above analysis shows that, depending on the regime, the price and quality responses by Chain 2 either dampen or reinforce the effects of national price setting (by only Chain 1) on the price difference and quality difference between the two chains in each market. In Regime 1, the price and quality differences are dampened by the strategic response of Chain 2, whereas these differences are reinforced in Regime 3. However, in the asymmetric Nash equilibrium, regardless of the direction of the strategic responses, the price and the quality of Chain 1 are higher (lower) than the price and quality of Chain 2 in the market with more (less) competition.

4.2 National pricing by both chains

Suppose now that both chains adopt a national price setting strategy, implying that Chain 1 chooses $\left(p_1, s_1^A, s_1^B\right)$ and Chain 2 chooses $\left(p_2, s_2^A, s_2^B\right)$. The symmetric Nash equilibrium is given by[13]

$$p_{NN} = \left[\begin{array}{c} 4k^2t^At^B\left(m^A+m^B\right)+2bckm^Am^B\left(t^A+t^B\right) \\ +c\left(b-\alpha c\right)\left(2k\left(t^A\left(m^B\right)^2+t^B\left(m^A\right)^2\right)+cbm^Am^B\left(m^A+m^B\right)\right) \end{array} \right] \frac{t^At^B}{\Phi}, \quad (22)$$

$$s_{NN}^j = \frac{\left(bp_{NN}-ct^j\right)m^j}{2kt^j+bcm^j}, \quad (23)$$

where

$$\begin{aligned} \Phi \ : \ &= 4kt\tau\left(k\left(t^Am^B+t^Bm^A\right)+bcm^Am^B\right) \\ &+\left(1-\alpha\right)cb\left(2k\left(\left(t^A\right)^2\left(m^B\right)^2+\left(t^B\right)^2\left(m^A\right)^2\right)+bc\left(t^Am^B+t^Bm^A\right)m^Am^B\right) > 0 \quad (24) \end{aligned}$$

Comparing the equilibrium prices and qualities under local and national pricing, i.e., comparing (12)-(13) with (22)-(23), we can express the price and quality differences as follows:

$$p_{NN}-p_{LL}^j = \left(2kt^j+m^jbc\right)\left(2kt^{-j}+\left(1-\alpha\right)bcm^{-j}\right)\left(p_{LL}^{-j}-p_{LL}^j\right)\frac{m^{-j}t^j}{\Phi}, \quad (25)$$

$$s_{NN}^j - s_{LL}^j = \frac{m^jb}{2kt^j+m^jbc}\left(p_{NN}-p_{LL}^j\right). \quad (26)$$

From these expressions, the following conclusions are immediate:

Proposition 2 *If both chains switch from local to national price setting, this leads to a price reduction (increase) in the market with the highest (lowest) price. In each market, quality and price changes go in the same direction.*

5 National versus local pricing

In this section we endogenize each chain's pricing strategy by considering an extended game that are played in two stages. In the first stage, each chain decides whether to commit to a national pricing strategy or to set local prices. In the second stage, prices and qualities are decided as in the previous sections. Using backwards induction, there are three possible pure-strategy subgame-perfect Nash equilibria (SPNE):

1. Local pricing by both chains, which is an SPNE if $\Pi_{LL} \geq \Pi_{NL}$.

[13] In line with previous notation, we use subscript NN to denote equilibrium values in the case where both chains adopt a national pricing strategy.

2. National pricing by both chains, which is an SPNE if $\Pi_{NN} \geq \Pi_{LN}$.
3. Local pricing by one chain and national pricing by the other chain, which is an SPNE if $\Pi_{NL} \geq \Pi_{LL}$ and $\Pi_{LN} \geq \Pi_{NN}$.

5.1 Pure price competition

As a benchmark for comparison, consider first the special case in which there is no quality competition and the two chains compete purely in prices. This case is captured by $b = 0$, which also implies $c = 0$. Setting $b = c = 0$ and comparing equilibrium profits across the different pricing regimes, it is easily verified that

$$\Pi_{LL} - \Pi_{NL} = \frac{m^A m^B \left(t^A - t^B\right)^2}{2\left(m^A t^B + m^B t^A\right)} > 0 \tag{27}$$

and

$$\Pi_{LN} - \Pi_{NN} = \frac{m^A m^B \left(t^A - t^B\right)^2}{8\left(m^A t^B + m^B t^A\right)} > 0. \tag{28}$$

Thus:

Proposition 3 *In the absence of quality competition, local pricing by both chains is the unique subgame-perfect Nash equilibrium.*

In other words, the results of Dobson and Waterson (2005) do not carry over to our spatial framework with fixed total demand. Regardless of the differences in size and competition intensity across the two markets, the profit gain obtained by relaxing competition in the more competitive market (through national price setting) is always outweighed by the profit loss suffered by a suboptimally low price in the less competitive market.[14]

5.2 Price and quality competition

Consider now the more general case in which the two chains compete along two different dimensions; price and quality. Due to analytical intractability, we resort to numerical simulations, illustrated by graphical plots, in order to identify the subgame perfect Nash equilibria.

[14] There are several differences between our model framework and the one used by Dobson and Waterson (2005). For example, whereas they use a Bowley-type demand system based on a representative consumer, our analysis is conducted within a spatial competition framework with fixed total demand. The latter assumption, which implies that competition takes the form of pure business-stealing, tends to reinforce the profit gain (loss) of relaxed (intensified) price competition. In other words, both the gains and losses from a national price setting strategy tend to be larger when total demand is fixed.

5.2.1 "Weak" quality competition with full cost internalization

As a benchmark case, we consider parameter configurations that correspond to Regime 1 in Section 4.1, in which the quality competition is sufficiently weak relative to the degree of price competition. This regime is characterized by a positive relationship, within a given market, between the price of one chain and the quality offered by the competing chain (cf. Lemma 1). We also assume that all costs of quality provision are fully internalized by the chain (i.e., $\alpha = 1$). In Figures 1a–1d, we show the equilibrium configurations in (t^A, m^A)-space for $b = 1.5$ and $k = 0.85$, and for different values of the cost parameter c (successively increasing in each figure). In each figure we set $t^B = 4 - t^A$ and $m^B = 2 - m^A$, implying that we measure *relative* competition intensity and market size along the horizontal and vertical axes, respectively. By design, each figure is thus symmetric around the point $(t^A, m^A) = (2, 1)$. In the North-East and South-West quadrants (defined according to the symmetry point), competition is less intense in the larger market. In the remaining space (the North-West and South-East quadrants), competition is more intense in the larger market. In each figure, the red (orange) areas depict the parameter space in which the unique SPNE has national pricing by both chains (one chain). In the remaining (white) areas, the unique SPNE has local pricing by both chains.

Consider first Figure 1a, in which the level of quality provision does not affect marginal production costs ($c = 0$). Here we see that, in contrast to the case of no quality competition, national pricing by one or both chains appears as an equilibrium outcome, and the scope for national pricing in equilibrium is larger if the difference in market size is relatively high while the difference in competition intensity is relatively low. Notice, however, that an SPNE with national pricing occurs within the chosen parameter range only *if competition is more intense in the smaller market.*

We can explain this result by considering the incentives for a unilateral switch from local to national pricing, as in Section 4.1. Recall that such a switch implies a price and quality increase (reduction) in the market with more (less) intense competition. Recall also that the competing chain strategically responds in the same manner (in Regime 1). Thus, a unilateral switch to national pricing relaxes price competition but intensifies quality competition in one market, and intensifies price competition but relaxes quality competition in the other market. Put differently, the presence of quality competition reduces both the gains and costs of national price setting.

From Proposition 3 we know that national pricing is not unilaterally profitable in the absence of quality competition. Thus, for national pricing to be unilaterally profitable in the presence of quality competition, the gains from relaxed quality competition in one market must be sufficiently higher than the losses from intensified quality competition in the other market. This depends in turn on whether these gains occur in the larger or smaller market.

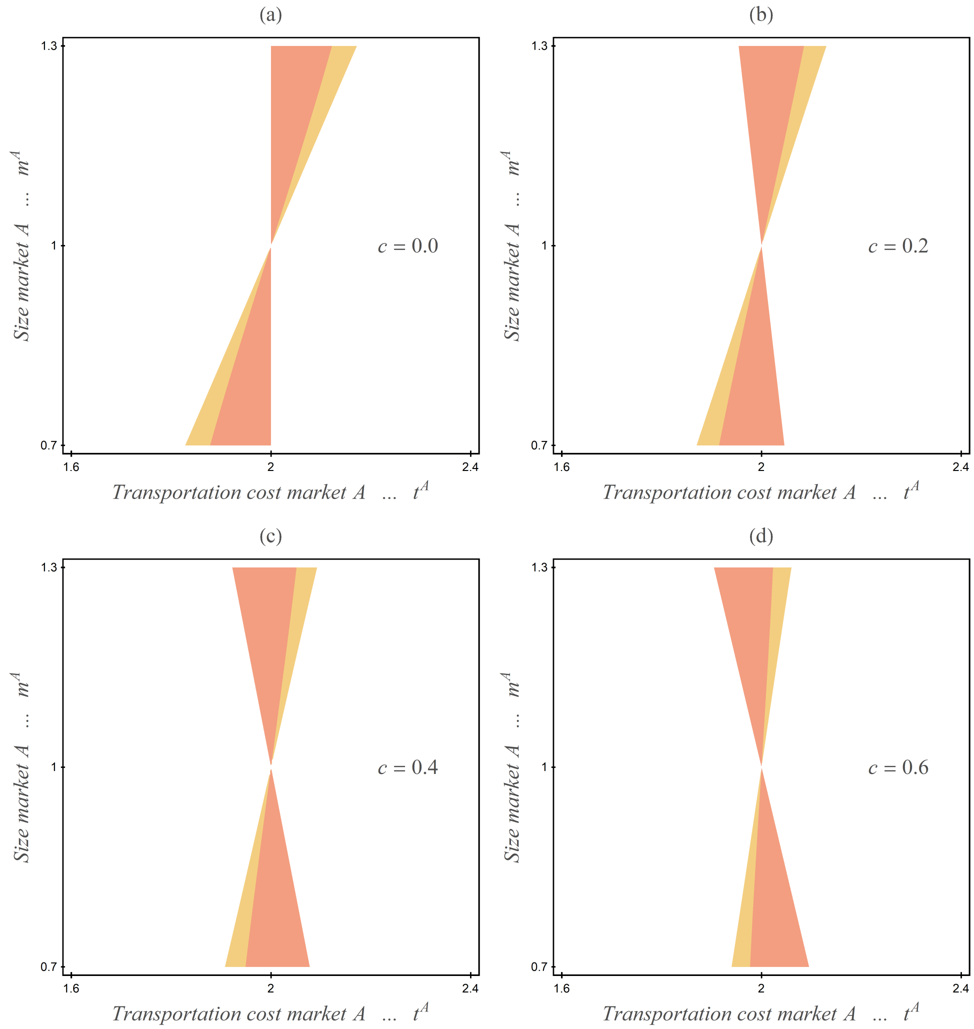

Figure 1. Equilibrium pricing strategies under "weak" quality competition and full cost internalization. The red (orange) area has national pricing by both chains (one chain).

Because of quality cost convexity, the profit gain from a marginal relaxation of quality competition is larger the higher the equilibrium quality level is to begin with. And *vice versa*, the profit loss from a marginal intensification of quality competition is lower the smaller the equilibrium quality level is to begin with. From Proposition 1 we know that, for $c = 0$, equilibrium quality is higher in the larger market under local pricing by both chains. This implies that a unilateral switch to national price setting can be profitable only if this leads to quality competition being relaxed in the larger market. But this requires that national price setting leads to lower prices in the larger market, which in turn requires that competition is less intense in this market.[15] Thus, in the absence of output-dependent costs of quality provision, national pricing (by one or both chains) is an SPNE only for parameter

[15] If $c = 0$, equilibrium prices are always lower (higher) in the market with more (less) intense competition under local price setting (cf. Proposition 1).

configurations where competition is less intense in the larger market.

This result changes if higher quality provision implies higher marginal production costs (i.e., if $c > 0$). In each of Figures 1b–1d, there exists a parameter set with national pricing as equilibrium strategies in cases where competition is more intense in the larger market, and this set is larger when c is higher. The intuition is related to the ranking of equilibrium prices under local price setting, which is analytically given by (14) and summarized in Proposition 1. If c is strictly positive, and if market sizes are different, the equilibrium price (under local pricing) is higher in the market with more competition if this market is larger and if the difference in competition intensity between the markets is sufficiently low. Or equivalently, for a given difference in competition intensity, the equilibrium price is higher in the market with more competition if this market is sufficiently larger than the other market. In these cases, national price setting implies that price and quality go down in the larger market, which in turn paves the way for national pricing as an equilibrium outcome in cases where competition is more intense in the larger market.[16] The equilibrium configurations displayed in Figures 1b–1d also reveal that, if national pricing is an equilibrium strategy in cases where competition is more intense in the larger market, it is an equilibrium strategy for both chains.

5.2.2 "Strong" quality competition with full cost internalization

Now consider cases in which competition is relatively stronger along the quality dimension. In Figures 2a–2d we display the equilibrium configurations for a higher value of b, namely $b = 2$, while maintaining all other parameter values at the same levels as in Figures 1a–1d. In addition to the previously defined color codes, black-striped areas depict parameter configurations for which no SPNE exists.

Consider first Figure 2a, which shows the equilibrium configurations for $c = 0$. Compared with Figure 1a, there are two notable differences. First, within the chosen parameter range, national pricing is an equilibrium strategy (by one or both chains) for a larger set of parameter values. Second, and perhaps more importantly, this set covers predominantly cases in which competition is more intense in the larger market. These differences are related to the nature of the strategic responses to national price setting, as analyzed in Section 4.1. The parameter configurations considered in Figure 2a correspond to Regime 2 and 3 (as defined in Section 4.1), where a price increase (reduction) by one chain is met by a quality reduction (increase) by the competing chain in one (Regime 2) or both (Regime 3) markets.

Consider, for simplicity, the case of Regime 3. A unilateral switch from local to national pricing by one chain implies that the price and quality go up (down) in the market with more (less) intense competition (as long as $c = 0$). For parameter configurations corresponding to Regime 3, the competing chain will respond by reducing (increasing) price and quality in

[16] As long as $\alpha = 1$, equilibrium quality is always higher in the larger market under local pricing, even if $c > 0$ (cf. Proposition 1).

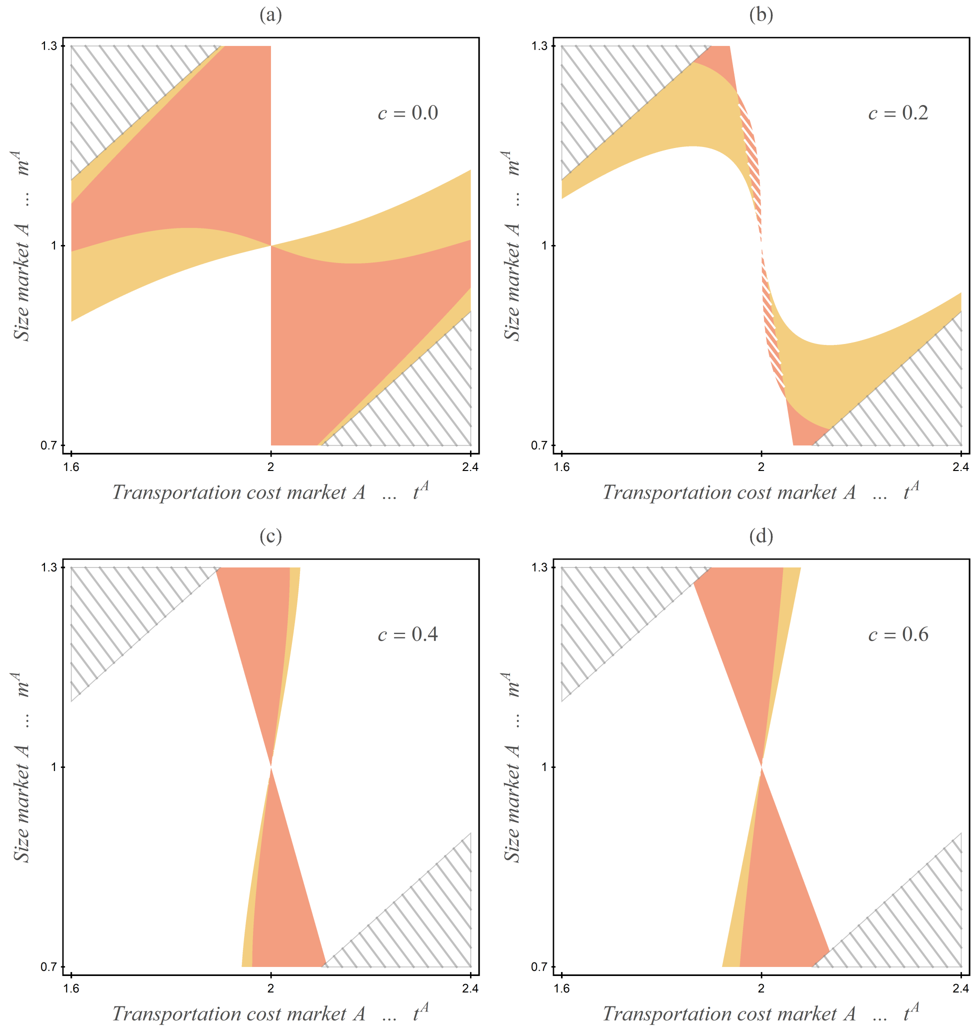

Figure 2. Equilibrium pricing strategies under "strong" quality competition and full cost internalization. The red (orange) area has national pricing by both chains (one chain). White stripes indicate that there are two equilibria, the second one with local pricing by both chains. (Gray stripes indicate that the stability conditions are violated.)

the market with more (less) competition. Since, by assumption, competition is strong along the quality dimension relative to the price dimension, the quality changes have a stronger effect than the price changes on demand reallocations between the two chains. The above described quality responses imply that the chain that switches to national price setting will experience a demand gain (loss) in the market with more (less) intense competition, and the gain will more than offset the loss if the market with more intense competition is sufficiently larger than the other market. This effect explains that national price setting can arise as an equilibrium outcome in cases where competition is more intense in the larger market, even if the costs of quality provision do not affect marginal production costs.

However, as we successively increase the value of c in Figures 2b–2d, the parameter configuration eventually switches back to Regime 1. This can be seen from (11), which shows that a higher value of c increases the scope for a positive strategic relationship between own price and rival's quality, which is the characteristic feature of Regime 1 as defined in Section 4.1. Thus, the equilibrium configurations in Figures 2c and 2d are very similar to the ones displayed in Figures 1c and 1d. Although the value of b is higher in the former set of figures, the qualitative nature of the strategic relationship between the two chains is similar in both sets.

5.2.3 "Weak" quality competition with no cost internalization

Finally, let us explore the importance of quality cost internalization by the chains. Suppose that $\alpha = 0$, implying that all quality costs are borne by the stores and not internalized by the chains at any stage of the game. Note that with $\alpha < 1$, because the chain does not fully internalize the stores' profits, the specific division of revenues and profits (the sharing rule) will affect the outcome (unlike the case when $\alpha = 0$). In the following we will assume that the chain and the stores use a 50-50 revenue sharing rule, but with all quality costs borne by the local stores ($\alpha = 0$). The equilibrium configurations in this scenario are displayed in Figures 3a–3d, for the same parameter values (except for α) as in Figures 1a–1d.

Compared with Figures 1a–1d, there are two notable differences. First, national pricing is an equilibrium strategy for a much larger set of parameter values when quality costs are not internalized by the chains. Second, national pricing is an equilibrium mainly for cases in which competition is more intense in the larger market, even in the absence of output-dependent quality costs (as in Figure 3a).

Consider once more the effect a unilateral switch from local to national pricing. Recall that, if $\alpha = 0$, the price is lower in the market with more intense competition (cf. Proposition 1), implying that national pricing yields a price increase in this market and a price reduction in the other. Thus, for given quality levels, national pricing yields a gain (loss) in the most (less) competitive market. In the absence of quality competition, the gain is smaller than the loss (cf. Proposition 3). The presence of quality competition implies additional gains and losses related to changes in demand and in the costs of quality provision. However, changes in the costs of quality provision are irrelevant for the optimal pricing strategy of the chains, as long as these costs are not internalized. The only effects that matter for the chains, with respect to quality competition, are the demand effects brought about by changes in relative quality provision. Since prices are strategic complements, and since price and quality move in the same direction for each store, national pricing by one chain implies that both price and quality go up (down) for both chains in the market with more (less) intense competition. However, since the strategic responses are smaller in magnitude than the initial changes in price and quality by the chain that switches to national pricing, the

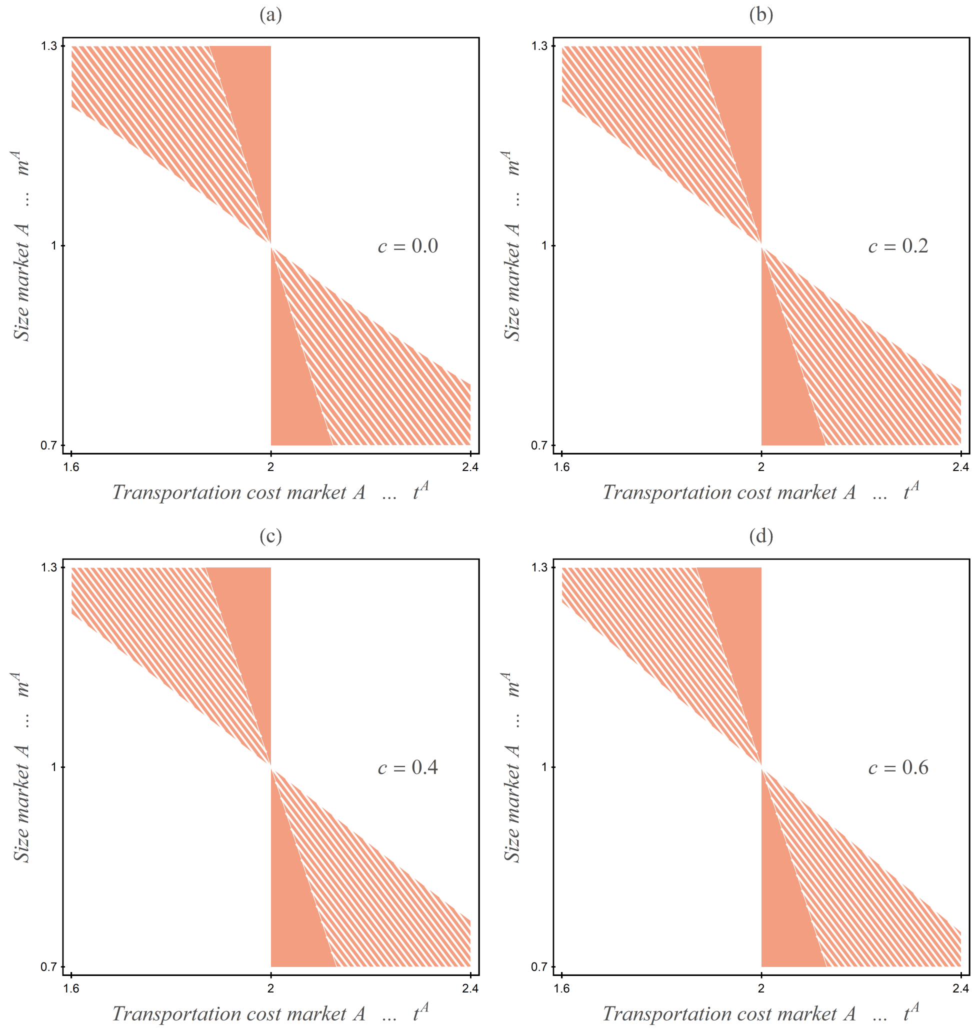

Figure 3. Equilibrium pricing strategies under "weak" quality competition and no cost internalization. The red area has national pricing by both chains. White stripes indicate that there are two equilibria, the second one with local pricing by both chains.

latter chain offers higher (lower) quality than its competitor in the more (less) competitive market. Thus, when quality costs are not internalized, the presence of quality competition *increases* both the gains and the costs of national pricing. It turns out that these added demand effects of changes in relative quality provision are sufficient to make the gains of national pricing outweigh the costs, if the market with more intense competition (where the gains occur) is larger than the other market (where the losses occur). Notice also that all equilibria with national pricing in Figures 3a–3d have national pricing by both chains. Thus, if it is profitable for one chain to switch from local to national pricing, it is also profitable for the competing chain to follow suit.

Summing up, we have already shown analytically (by Proposition 3) that national pricing is never a Nash equilibrium in the absence of quality competition. Due to continuity, this must also hold for values of b sufficiently close to zero. The above analysis, based on numerical simulations for $b > c \geq 0$, therefore allows us to reach the following conclusion:

Proposition 4 *If the degree of local quality competition is sufficiently strong, there exist parameter sets in which the subgame perfect Nash equilibrium implies national pricing by either one or both chains.*

When seen in conjunction, Propositions 3 and 4 suggest that the presence of local quality competition enlarges the scope for national pricing to be an equilibrium strategy. This is a key result emanating from our analysis.

5.3 National quality standards

A potential concern with the above analysis is that we have assumed that quality is decided locally and that the chain is unable to commit to a national quality standard. Although we argue that this is a reasonable assumption due to non-verifiability of quality, it might nevertheless be interesting to know whether equilibrium outcomes in which both chains set *local* qualities but one or both chains set a *national* price (indicated by the red and orange areas in Figures 1-3), survive if we allow either firm to commit to a national quality standard.

In the following we will focus on the cases in which the chain and local stores act like they are vertically integrated (i.e., $\alpha = 1$). First, we may note that the equilibrium outcomes depicted in Figure 1, with local qualities and either one or two national prices, all survive when a uniform quality standard is feasible. This suggests that our results are robust to the assumption of national quality standards, at least for some parameter values.

When we analyze the cases in Figure 2, on the other hand, in which the degree of quality competition is stronger ($b = 2$), we find that the outcomes with local qualities and either one or two national prices will survive in part of the parameter space, but not everywhere. In Figure 4a we have replicated the case presented in Figure 2a ($b = 2, c = 0$). Next to it, in Figure 4b, we depict (in gray) the areas in which the outcomes with local qualities (and either one or two national prices) do not survive. In other words, in the gray areas it is profitable for at least one of the chains to deviate to a strategy that in some way involves a uniform quality standard. Nevertheless, we can see that, at least for this particular example, there are still large areas in the (t^A, m^A)-space in which the equilibrium outcome has local qualities with either one or two national prices.

6 Welfare effects of national pricing

How are the consumers in the two markets affected by the retail chains' choice of pricing strategy? And what are the effects on total welfare? Below we address these two questions in turn.

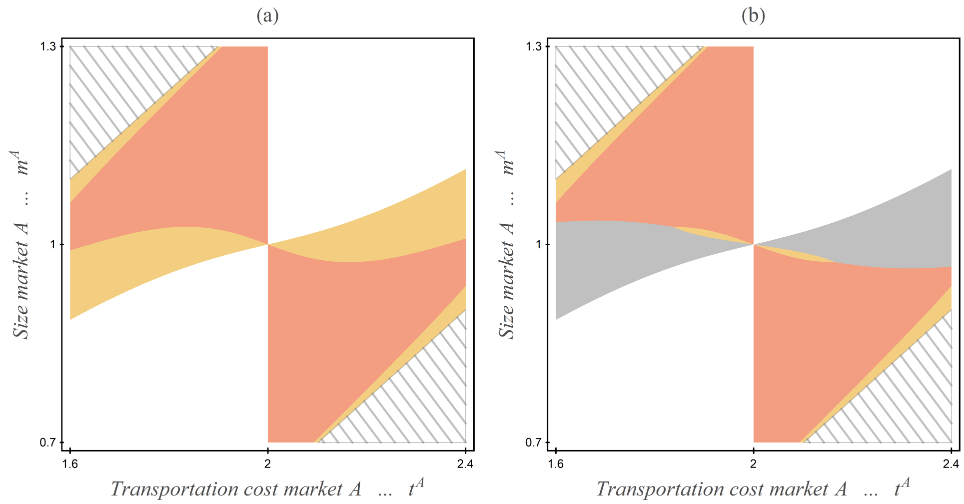

Figure 4. The gray region shows the area in which equilibria with national prices and local qualtities do not surive (when a national quality standard is feasible).

6.1 Consumer welfare

Since the price and quality effects of a switch from local to national pricing usually go in opposite directions in the two markets, a typical outcome is that consumers in one market benefit at the expense of a lower consumers' surplus in the other market. However, this is not necessarily the case if the markets are sufficiently asymmetric along the two dimensions considered (competition intensity and market size), as we will show below.

If we compare the two symmetric equilibria with, respectively, local and national pricing by both chains, relative prices and qualities are the same in both markets in both equilibria, so the effect of national pricing on consumers' surplus in Market j, denoted by ΔCS^j, is simply given by

$$\Delta CS^j = b\left(s^j_{NN} - s^j_{LL}\right) - \left(p_{NN} - p^j_{LL}\right). \tag{29}$$

If prices go up as a result of national pricing, consumers' surplus increases only if consumers' valuation of the corresponding quality increase more than outweighs the price increase, and *vice versa*. Using (25)-(26), we derive

$$\Delta CS^j = \frac{m^{-j}t^j\left(p^j_{LL} - p^{-j}_{LL}\right)\left(2kt^j - b\left(b-c\right)m^j\right)\left(2kt^{-j} + bc\left(1-\alpha\right)m^{-j}\right)}{\Phi}. \tag{30}$$

Recall that $\Phi > 0$. The sign of (30) is therefore determined by the signs of the first two bracketed factors in the numerator. If the price is higher in Market j under local pricing ($p^j_{LL} > p^{-j}_{LL}$), national pricing – which then leads to a lower price in Market j – benefits consumers in this market if the relative degree of quality competition is sufficiently low, such that $2kt^j > b\left(b-c\right)m^j$. If the latter condition also holds for the other market, consumers in that market will suffer as a result of national pricing, because the quality increase is not sufficient to compensate for the price increase. From (11), we see that this case is characterized by a positive strategic relationship between own price and rival's quality in both markets, and corresponds to what we have dubbed Regime 1 in the previous analysis.

However, if the markets are sufficiently asymmetric, the sign of $2kt^j - b(b-c)m^j$ might differ in the two markets. Suppose for example that $t^A > t^B$ and $m^A < m^B$, such that $2kt^A > b(b-c)m^A$ and $2kt^B < b(b-c)m^B$. This case corresponds to what we have defined as Regime 2 in Section 4.1 and implies $\partial s_i^A\left(p_{-i}^A\right)/\partial p_{-i}^A > 0$ and $\partial s_i^B\left(p_{-i}^B\right)/\partial p_{-i}^B < 0$. In this case, national pricing by both chains implies that price and quality go down in Market A but increase in Market B, which is the largest and most competitive market. In Market A, the price reduction is sufficiently large to increase consumers' surplus, despite the corresponding drop in quality. However, in Market B, where national pricing leads to higher prices and quality, the quality increase more than outweighs the increase in price, leading to a larger surplus to consumers also in this market. Thus, national pricing benefits consumers in both markets.[17]

To say something more about the relationship between (i) the effects of national pricing on consumers' surplus, and (ii) the market size and degree of competition in each market, it is convenient first to define

$$m := \frac{m^A + m^B}{2} \tag{31}$$

and

$$t := \frac{t^A + t^B}{2} \tag{32}$$

which is the mean market size and the mean unit transportation cost of the two markets. Using (30), we may then state the following proposition, which compares the situation with national pricing by both chains to the situation with local pricing by both chains.

Proposition 5 *(i) Suppose that prices are lowest in Market j under local pricing,* $p_{LL}^j < p_{LL}^{-j}$*. National pricing by both chains then yields strictly higher consumers' surplus in both markets compared to local pricing, as long as Market j is sufficiently large (and Market −j sufficiently small):*

$$m^j > \max\left\{\frac{2kt^j}{b(b-c)}, \frac{2mb(b-c) - 2k(2t - t^j)}{b(b-c)}\right\} = \overline{m}\left(t^j\right).$$

Similarly, national pricing by both chains yields strictly lower consumers' surplus in both markets compared to local pricing, as long as Market j is sufficiently small (and Market −j

[17]Notice that such an outcome is impossible if there is only price competition (i.e., in the absence of local quality competition), in which case national price setting implies a gain (loss) for consumers in the market where the price goes down (up).

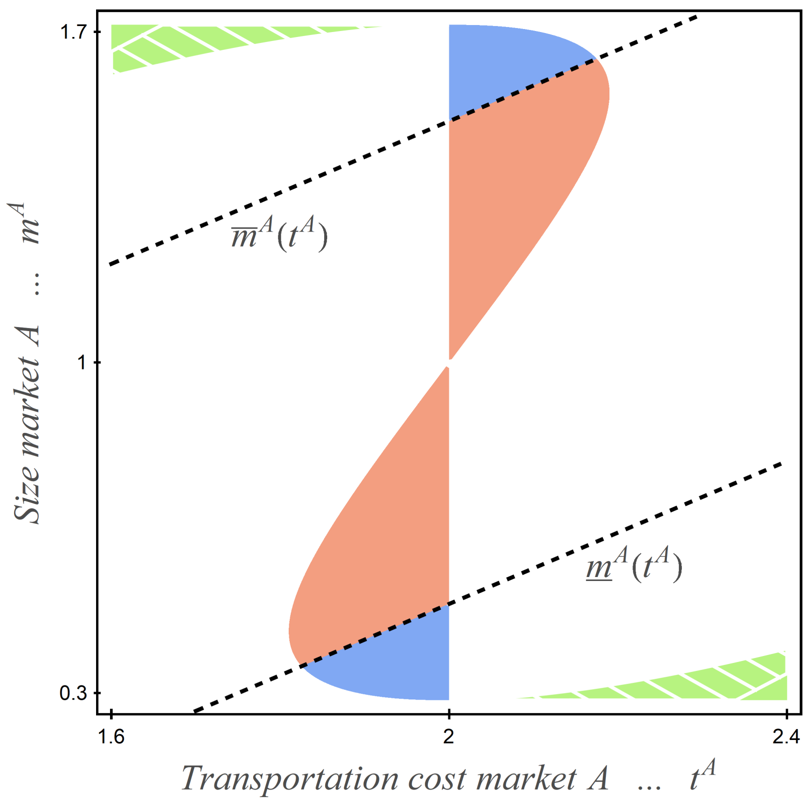

Figure 5. The figure replicates the example from Figure 1a, but allowing for a wider range of market sizes. The green (blue) area has consumers' surplus going up (down) when both chains moves to national pricing.

sufficiently large):

$$m^j < \min\left\{\frac{2kt^j}{b(b-c)}, \frac{2mb(b-c)-2k(2t-t^j)}{b(b-c)}\right\} = \underline{m}(t^j).$$

(ii) Suppose instead that prices are highest in Market j under local pricing, $p^j_{LL} > p^{-j}_{LL}$. National pricing by both chains then yields strictly higher consumers' surplus in both markets compared to local pricing, as long as Market j is sufficiently small (and Market $-j$ sufficiently large), $m^j < \underline{m}(t^j)$, and strictly lower consumers' surplus in both markets as long as Market j is sufficiently large, $m^j > \overline{m}(t^j)$.

To get a sense of how national pricing affects consumers' surplus *in equilibrium*, we have plotted two new figures above, Figures 5 and 6. In Figure 5 we have replicated the case from Figure 1a ($b = 1.5$, $c = 0$), except we allow for a wider range of market sizes (on the vertical axis), and we now only color the areas in which national pricing by *both* chains is an equilibrium outcome. In the blue (green) area in Figure 5, consumers' surplus goes down (up) in both markets when both chains move from local to national pricing. In the

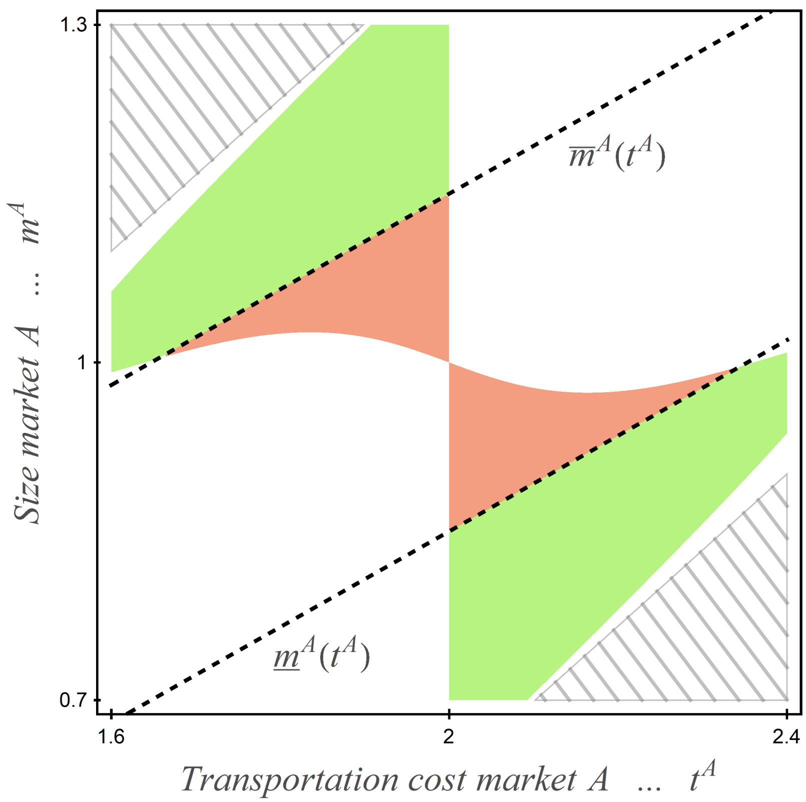

Figure 6. The figure replicates the example from Figure 2a. The green area has consumers' surplus going up when both chains moves to national pricing.

red area, national pricing causes consumers' surplus to go up in one market and down in the other. In Figure 6 we have replicated the case from Figure 2a (using the same range of market sizes). In this example, in which the degree of quality competition is stronger ($b = 2$, $c = 0$), consumers' surplus goes up in both markets under national pricing for a wide range of parameter values (the green area). In concordance with the above analysis, we see that the green and blue areas in these figures are all characterized by sufficiently asymmetric markets, where competition is more intense in the larger market.

6.2 Total welfare

In order to derive the effect of national pricing on total welfare, it is instructive first to derive the socially optimal levels of quality provision in the two markets. Since, by assumption, both chains have the same costs, the socially optimal outcome implies equal quality provision across the two stores in each market (but not necessarily across the two markets). Furthermore, the assumption of fixed total demand implies that social welfare does not depend directly on prices. Under symmetry, total welfare in Market j is given by[18]

$$W^j = 2m^j \int_0^{\frac{1}{2}} \left(bs^j - tx\right) dx - m^j cs^j - k \left(s^j\right)^2, \tag{33}$$

where s^j is the quality provided by each of the two stores in Market j. Maximizing (33) with respect to s^j, the socially optimal level of quality in Market j is given by

$$s^j = \frac{(b-c)\, m^j}{2k}. \tag{34}$$

By comparing (34) with (13), it is easy to confirm that the socially optimal quality level corresponds to the equilibrium quality level under local pricing, if all quality costs are internalized by the chain. Thus, under local pricing and full cost internalization, socially optimal quality provision is achieved in equilibrium. This confirms the equivalent result derived by Ma and Burgess (1993), who also show that this result hinges critically on the assumption of simultaneous price and quality decisions.[19]

As long as national price setting affects local quality provision, which we have shown that it generally does, the above result has an obvious implication for the total welfare effect of national versus local pricing. Formally, this effect is given by[20]

$$\Delta W = \sum_j \left(m^j \left((b-c)\left(s^j_{NN} - s^j_{LL}\right)\right)\right) - k\left(\left(s^j_{NN}\right)^2 - \left(s^j_{LL}\right)^2\right). \tag{35}$$

Setting $\alpha = 1$, and using (13) and (23), the effect is given by

$$\Delta W|_{\alpha=1} = -\left(m^A\right)^2 \left(m^B\right)^2 b^2 \frac{\left(2k\left(t^A - t^B\right) + c\,(b-c)\left(m^A - m^B\right)\right)^2}{8k\left(\left(m^A t^B + m^B t^A\right) k + m^A m^B bc\right)^2} < 0. \tag{36}$$

Thus, under full cost internalization ($\alpha = 1$), total welfare is always lower when both chains set national rather than local prices. Since, under local pricing, each store provides a socially optimal level of quality, national pricing implies a distortion of quality provision away from the social optimum in each market. In other words, since qualities are already at the welfare-maximizing level in each market under local pricing, national pricing reduces welfare regardless of whether quality increases or decreases. This is clearly true also in the case where only one chain practices national pricing. Thus:

Proposition 6 *If quality costs are fully internalized by the chains, total welfare is maximized if both chains practice local pricing.*

[18] Notice that total transportation costs are also minimsed in a symmetric outcome, where the indifferent consumer is located at the midpoint of Z^j.

[19] If quality and prices are chosen sequentially, firms have an incentive to set suboptimally low quality in order to dampen price competition.

[20] ΔW measures the change in total welfare if both chains adopt national instead of local pricing.

Notice that this result also applies to the cases where national pricing benefits consumers in both markets (e.g., the green areas in Figure 5). In these cases, a switch from national to local pricing would lead to an increase in chain profits that would more than outweigh the loss in consumers' surplus. The following implication is immediate:

Corollary 1 *For parameter configurations that yield Nash equilibria where consumers in both markets benefit from national pricing, the game is a Prisoners' Dilemma for the firms.*

7 Concluding remarks

National pricing strategies are prevalent in many retail markets. At the same time it seems clear that competition in most markets is multidimensional; firms not only compete on the basis of prices, but on a wide range of other attributes ranging from opening hours to customer friendliness and a lot of other things. In this paper we have dubbed these attributes as quality. The basic question we ask is why firms may find it profitable to use a uniform national pricing strategy over a wide range of different market conditions in local markets.

The most prominent theory of the received literature is that national pricing may lead to a dampening-of-competition effect in markets with intense competition that may outweigh the loss from lower prices in more concentrated local markets. We show that this main result obtained from the previous literature is not particularly robust to different specifications of demand and local market structure. In our model, absent competition along the quality dimension, national pricing will never arise as an equilibrium outcome. This suggests that multidimensional competition can be an important factor in explaining why firms choose national pricing in some instances. We show that national pricing may be an equilibrium strategy for at least one of the chains provided that the local quality competition is sufficiently strong.

With multidimensional competition, welfare implications are more complicated and harder to assess. We show that national pricing might benefit consumers even in markets where such a pricing strategy leads to higher prices. This raises challenges for competition policy. Another important challenge to competition policy is how to assess mergers in markets where either one or all firms adopt national pricing. Modern merger policies tend to look at pricing pressure measures to evaluate effects of mergers and sometimes mergers are remedied by requiring divestitures in local markets where the merging parties overlap. This policy seems to presume that competition is one-dimensional in price only, and that pricing is local. Needless to say, national pricing and multidimensional competition makes the task of finding optimal merger remedies considerably more complicated. This and other interesting aspects of national pricing are left for future research.

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Appendix: Definition of strategic regimes in Section 4.1

Notice first that, from (12)-(13), equilibrium quality in Market j when both chains practice local price setting can be written as $s^j_{LL} = (m^j b/2kt^j)\, p^j_{LL}$. Thus, the relationship between price and quality for each chain, in each market, is exactly the same in the two equilibria (local pricing by both chains versus national price setting by one chain). This implies that equilibrium quality responses to national price setting always go in the same direction as the equilibrium price responses. Using (12), (17) and (18), the price differences across the two equilibria are given by

$$p_{NL} - p^A_{LL} = \left(t^B - t^A\right)\left(3kt^B - m^B b^2\right)\left(4kt^A - m^A b^2\right)\frac{m^B t^A}{\Theta}, \tag{A1}$$

$$p_{NL} - p^B_{LL} = -\left(t^B - t^A\right)\left(3kt^A - m^A b^2\right)\left(4kt^B - m^B b^2\right)\frac{m^A t^B}{\Theta}, \tag{A2}$$

$$p^A_{LN} - p^A_{LL} = \left(t^B - t^A\right)\left(2kt^A - m^A b^2\right)\left(3kt^B - m^B b^2\right)\frac{m^B t^A}{\Theta}, \tag{A3}$$

$$p^B_{LN} - p^B_{LL} = -\left(t^B - t^A\right)\left(3kt^A - m^A b^2\right)\left(2kt^B - m^B b^2\right)\frac{m^A t^B}{\Theta}. \tag{A4}$$

Given the condition $b^2 < \max\left\{3kt^A/m^A, 3kt^B/m^B\right\}$, it follows from (A1)-(A2) that $p_{NL} > (<)\, p^A_{LL}$ and $p_{NL} < (>)\, p^B_{LL}$ if $t^B > (<)\, t^A$. Furthermore, it follows from (A3)-(A4) that, if $b^2 < 2k\underline{\theta}$ (Regime 1), then $p^A_{LN} > (<)\, p^A_{LL}$ and $p^B_{LN} < (>)\, p^B_{LL}$ if $t^B > (<)\, t^A$; and if $b^2 > 2k\overline{\theta}$ (Regime 3), then $p^A_{LN} < (>)\, p^A_{LL}$ and $p^B_{LN} > (<)\, p^B_{LL}$ if $t^B > (<)\, t^A$. Finally, if $2k\underline{\theta} < b^2 < 2k\overline{\theta}$ (Regime 2), a closer inspection of (A3)-(A4) reveals that, if $t^j < t^{-j}$, then $p^A_{LN} < (>)\, p^A_{LL}$ and $p^B_{LN} < (>)\, p^B_{LL}$ if $t^j/m^j < (>)\, t^{-j}/m^{-j}$.