Passive aggressive chains

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Abstract

In this paper, each local retail market consist of establishments run by local entities, and those run by a large national chain. Largely motivated by the observation that industries for which chains typically use uniform pricing are also industries for which a large proportion of establishments are chain-run, I argue that a chain's commitment to charge a uniform price across all heterogeneous markets induces it to crowd out the locally run stores when uniform pricing effectively softens price competition. The aggressive behavior is driven by the chain's desire to protect its profits from entry under the accommodative pricing regime. Of some consolation to consumers, the scope of this policy is reduced as it becomes more detrimental to consumers. In some sense, potential entry of local competitors can align the interests of the chain and consumers.

Keywords: Chain stores, entry deterrence, concentration, retail network.

JEL Classification: L11, L22, L25, L49.

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Table 1: Variability of chain shares (Source: CANSIM, 2006)

Percentage of chain-establishments in Canada		
Retail industry	Chain (in %)	π_{chain}/π_{local}
New automobiles	2	0.99
Used automobiles	6	0.95
Furniture	22	1.06
Home furnishing	17	0.57
Computer	2	1.01
Hardware	17	1.03
Supermarkets	21	0.99
Pharmacies	18	0.95
Gasoline	18	1.12
Clothing	51	1.07
Shoes, accessories and jewelery	45	1.04
Sporting goods and hobbies	18	1.04
General	26	1.03

1 Introduction

The chain store is a common fixture of the modern retail landscape in every city, large or small. Although chains have significant cost and financing advantages over locally operated stores, these local merchants still coexist with their evolved counterparts in most retail industries. In fact, local stores still constitute an overwhelming majority of the establishments in certain industries in Canada[1]. More generally, there is variability of chain shares across different industries, ranging from 2% to 51%. These observations cannot be explained by the relationship between concentration and the industry specific ratios of market size to fixed costs alone. As Sutton (1991) points out, different concentration levels can reflect variation in the toughness of price competition. In the context of chain versus stand-alone stores, the toughness of price competition is reflected through the chain's general pricing policy.

A chain must often decide on its pricing policy before establishing the ideal number of stores in each prospective local market. They make a choice between committing to the same price (for the same products) across all local markets, or allowing prices to vary depending on each market's characteristics. Geographic price discrimination[2] is a popular policy among supermarket chains in the United States[3], as evidenced by the variability of prices across

[1]Refer to Table 1 in the paper by Dinlersoz (2004) for industry level chain shares in the United States.

[2]Refer to González-Benito and González-Benito (2004) for a micro-marketing perspective of the role that geo-demographics play in price discrimination.

[3]More recently, a report by the Heart and Stroke Foundation of Canada (2009) found that those living

members belonging to the same chain (Chintagunta, Dubé, and Singh, 2003). Price dispersion of multi-firm retail gasoline prices have also been attributed to price discrimination (Shepard, 1991). On the other hand, uniform pricing is used by many clothing and cosmetic retailers, as well as large department stores[4]. These observations would suggest that industries for which uniform pricing is popular are also industries that contain a significant portion of chain-run stores. This correlation motivates the question: will switching from local to uniform pricing policy induce the chain to proliferate stores aggressively in each local market? My objective is to analyze the relationship between a chain's pricing policy, and market structure.

Committing to set a uniform price is essentially a promise to charge one price that will inevitably be too high in poor markets, and too low in affluent markets. When deciding on what to set this single price to, a chain must account for all the market conditions. If the chains give affluent markets a lot of weight, then the uniform price will largely reflect these markets and be skewed upwards. In this case, the importance of affluent markets will suppress the chain's urge to undercut the prices set by local competitors. Consequently, the local independents will reciprocate this behavior by setting higher prices themselves. In other words, the uniform price commitment can be equivalent to a commitment to soften price competition for most markets. It is not surprising that many local supermarket retailers in the United Kingdom have admitted to preferring competing chains to choose uniform over local pricing policy (Competition Commission, 2008). As higher prices under uniform pricing improve revenue for all stores, the scope of entry among independents increases. The chain's response to the potential influx in entry is by crowding each local market with its own stores to ensure that it receives a sufficient portion of gains from suppressed price competition so as to rationalize uniform pricing. A key implication from this paper is that if we observe a chain that uses uniform pricing with the intention of softening price competition, it must be the case that it dominates each local market on the extensive margin.

The intuition is inspired by a combination of the *fat-cat* and *top-dog* effects (Fudenberg and Tirole, 1984). Although uniform pricing softens price competition, it necessarily induces entry deterrence if the uniform price is sufficiently high; the commitment to uniform pricing is consistent with a chain who chooses an accommodative pricing policy, but a not-so accommodative store proliferation strategy. Here, entry deterrence through store proliferation

in certain locations were charged prohibitively high prices for healthy food. This is highly suggestive of local pricing on the part of national chains.

[4]This assertion is made based on information given by public representatives of large clothing retailers, along with the idea that clothing retailers often use standardized price tags across all local markets that serve as a commitment to uniform pricing policy (Dobson and Waterson, 2005). Other forms of commitments include public availability of prices through their website, which would suppress any incentive to deviate from their one price policy.

largely mimics deterrence through brand proliferation in the ready-to-eat cereal industry, which allow the incumbent firms to credibly protect excess profits from avoiding price competition (Schmalensee, 1978). The main difference here is that entry deterrence proceeds after establishing the general pricing policy, and not the other way around. Store proliferation helps instrument the pricing policy. A caveat to this strategy is that if the uniform price is expected to be very high, the chain would have to incur greater entry deterrence costs; here, endogenous entry creates real costs that the chain has to consider when debating whether to adopt the policy or not.

An alternative story to explain why there are so many chain run establishments in certain industries is based on the argument that there are complementaries between the size of a chain's product line, and the number of stores (Basker, Klimek and Hoang Van, 2008). There is some evidence of a positive correlation between product line length and the number of stores. Unfortunately, the applicability of this story is limited to the general merchandise retail industry (i.e., big box discounters such as Wal-Mart); it cannot explain why chains dominate on the extensive margin in other industries such as clothing and beauty products. In general, these type of chains have not increased their product lines to the extent that would validate Basker, Klimek and Hoang Van's story. In comparison, the story used in this paper could have some explanatory power in industries beyond general merchandising. A similar explanation to their's is that the chain has a larger minimum efficient scale, and thus, larger markets will lead to larger but fewer chains (Dinlersoz, 2004). While this correlation has potential to explain cross-market variation in chain shares, it cannot say very much about cross-industry variation in chain shares, which my paper can potentially address

The interaction between pricing policy, establishment investment and price competition is modelled by upgrading the chain store pricing model used by Dobson and Waterson[5] (2005, 2008). The extensions are in the form of endogenous market structure, and market specific heterogeneity. Their main objective is to find market and competitive conditions for which uniform pricing is optimal, given that whether or not the national chain faces competition by a local independent is exogenously predetermined. Assuming that market structure is exogenous precludes any analysis regarding the implication of pricing policy on the distribution of chain and locally run stores. Dobson and Waterson find that the parameter space in which uniform pricing preferred over local pricing for the chain corresponds to region

[5]Their model is largely an extension of the weak-market-strong-market analysis done by Holmes (1989), who first discovered that uniform pricing may be better than discriminatory pricing in the context of separable markets. His result was later strengthened by Armstrong and Vicker's (2001) generalization, where (price discriminating) each oligopolist compete in consumer utility space. Winter (1997) looks at an intermediate case between uniform and discriminatory pricing by analyzing the incentive to bound the price differential in a weak and strong market.

in which the preferences are reversed for consumers. I find quite the opposite: consumers and the chain would both agree that uniform pricing is less desirable if the policy leads to a high mark up. While there are potentially significant costs associated with uniform pricing[6], I argue that the likelihood of this policy actually being chosen diminishes as it becomes more harmful to consumers.

In some respects, this paper is also related to Etro (2006), who demonstrates that a market leader will overinvest if entry by followers is endogenous. For comparability, the chain can be interpreted as the market leader who is the only player who can invest in the number of establishments, while the local retailers can be interpreted as followers. Because my model has an additional commitment device in the form of pricing policy, aggressive store proliferation is conditional on the effectiveness of the pricing policy at softening price competition. That said, I restore a strong link between high mark ups and overinvestment, which Etro attempts to weaken.

Throughout the paper, I focus on a class of chain-store proliferation strategies that generate a constant share of chain-run establishments across all of the markets. Under these types of configurations, structural comparisons between uniform and pricing policy are lucid. Furthermore, I demonstrate that this strategy can be sustained as an equilibrium strategy under a linear demand framework.

After imposing linearity on each consumer's demand, the model demonstrates that consumer heterogeneity can make uniform pricing more harmful to consumers. This observation is interesting because consumer heterogeneity also undermines the credibility of uniformity. Much like the degree to which this policy can soften price competition, the chain will likely choose a *credible* pricing policy in the best interests for most of the communities. Unlike the incentive to proliferate stores, this result is independent on the local rivals' entry decision. It is also shown that the uniform price need not be less than the arithmetic mean of the discriminatory prices, as in Holmes' (1989) model. Potential correlations between the model's primitives are possible in my case, which may skew the uniform price above or below the average discriminatory price. For example, if there is a positive correlation between a local market's population, and its inhabitants' willingness-to-pay, then the uniform price will be skewed upwards.

The model is presented in Section 2. Section 3 outlines the equilibrium price and store configuration strategies conditional on the chosen policy. My main result is found in Section 4, which is later supplemented in Section 5 by analyses of a linear demand model, nested in the original framework. Section 6 provides concluding remarks.

[6] For example, refer to Industry Canada's Project Summaries 2005-2006 found at http://www.ic.gc.ca/eic/site/oca-bc.nsf/eng/ca02070.html.

2 Model

A national chain and local independents operate in M geographically distinct local markets indexed by m. Each local market contains S_m consumers, and is served by $J_m = J_m^C + J_m^I$ retail establishments, where the number of chain-run and identical independent establishments are J_m^C and J_m^I respectively. There is a dominant chain that owns all of $\sum_{m=1}^{M} J_m^C$ establishments, while each stand-alone owns at most one of the J_m^I independently run stores in each market m. Since the chain and an independent offers a single differentiated product, an establishment receives total demand of $Y_m^i = \frac{S_m}{J_m} D_m(p_m^i, p_m^j)$ where $i, j \in \{C, I\}$. Much like Schmalensee (1978), I assume multiplicative separability of the components of demand that depend on the number of stores and prices. Moreover, $\frac{1}{J_m}$ is decreasing in J_m^C and $\frac{J_m^C}{J_m}$ is non-decreasing and concave in J_m^C, which ensures that total revenue does not fall with J_m^C.

There is a fixed cost associated with opening a new establishment. For the standalones, opening an establishment costs F^I, while each establishment costs the chain F^C. It is assumed that the dominant firm is more efficient, due to scale, and can set up each establishment at a lower cost; that is, $F^C < F^I$. Both types face the same (negligible) constant marginal cost of $c \approx 0$. An independent establishment will only bear the set-up cost once, while the dominant chain has to pay $J_m^C F^C$ in each market m in order to open J_m^C stores. Equal marginal costs are reasonable if a chain and stand-alone both offer a product under the same category, with similar wholesale prices, despite these products being of different brands or perceived qualities. With this notation in place, the market specific profits for any given outlet of type $i, j \in \{C, I\}$ is given by $\pi_m^i = Y_m^i(p_m^i - c) - F^i$. Therefore, an independent retailer in market m has profits π_m^I, while the chain who opens multiple stores per market makes a total profit of $\sum_{m=1}^{M} \pi_m^C J_m^C$.

2.1 Timing and assumptions

The model implicitly assumes that the dominant chain is an incumbent firm. This way, the chain can make commitments related to pricing policy and investments in establishments before the standalones enter their respective local districts. I assume that there are no informational asymmetries, and that the dominant chain has rational expectations. That said, I enumerate the sequence of decisions that the chain and independents make:

1. **Pricing policy**: In the first stage, the chain commits to setting either market specific prices (local pricing), or the same price (uniform pricing) set for all local markets. This policy decision is observed by all agents.

2. **Chain-store proliferation**: The chain immediately sets up J_m^C stores in each of the

$m = 1, ..., M$ local markets, correctly anticipating how many independents will enter each market.

3. **Free entry of standalones**: Knowing the number of chain store establishments in each market, a stand-alone decides whether or not to enter its respective market. Entry occurs until the total number of independents J_m^I in each market is such that all active independents make zero profits.

4. **Betrand-Nash prices**: All establishments compete in prices. If the chain chose uniform pricing, then it will choose a single price that maximizes its total profits across all markets, while if the chain chose local pricing, then it will choose a price specific to each market. The optimal prices under a local pricing regime for the chain and identical independents are p_m^C and p_m^I respectively, while under uniform pricing, they are q^C and q_m^I for the chain and independents. Once the prices are chosen, consumers make their purchases. Each customer has no scope for arbitrage between the geographically distinct markets.

To focus on the private incentive for uniform pricing, I assume that deviating from a commitment is costly for the chains[7]. Devices that make deviation costly may include the promotion of prices through national advertising, integral price tags, most-favored-customer clauses and/or public statements[8]. Ultimately, these devices have to force the chain to bear some decentralization cost that it would not have had to bear if it did not deviate from its commitment. This cost prevents the chain who has committed to uniform pricing from deviating to local pricing when it knows that the independents will charge high prices under the uniform pricing regime. I demonstrate in the last section that if individual demands are linear, the incentive to deviate is minimized if the set-up costs for the chain and standalones are similar.

For smooth log-supermodularity of the price competition sub-game, I assume that prices are strategic complements, in the sense that raising one's own price is increasingly profitable as the rival's price increases. The precise assumption is that $\frac{\partial_m^2 \pi_m^i}{\partial p_m^i \partial p_m^j} \geq 0$. A negative own-price effect, $\frac{\partial D_m(p_m^i, p_m^j)}{\partial p_m^i} < 0$, and positive cross-price effects, $\frac{\partial D_m(p_m^i, p_m^j)}{\partial p_m^j}, \frac{\partial^2 D_m(p_m^i, p_m^j)}{\partial p_m^i \partial p_m^j} \geq 0$, are a sufficient conditions for the price competition sub-game to be classified as log-supermodular in prices. I make an additional assumption that the demand function is symmetric, so

[7]Dobson and Waterson (2005), Holmes (1989), and Winter (1997) also make this assumption either explicitly or implicitly.

[8]Refer to Dobson and Waterson (2008) for examples of well documented public statements made by grocery chains in the United Kingdom.

that a unique symmetric equilibrium exists (Vives, 2005). Finally, I make the standard assumption that the absolute value of the own-price effect exceeds the cross-price effect, i.e., $\left|\frac{\partial D_m(p_m^i, p_m^j)}{\partial p_m^i}\right| > \left|\frac{\partial D_m(p_m^i, p_m^j)}{\partial p_m^i}\right|$.

3 Pricing policy outcomes

3.1 Local pricing

Here, the chain commits to price discriminate across spatially distinct markets. There is no arbitrage of consumers across markets. Given that the chain sets p_m^C optimally and the configuration of stores is $\{J_m^C, J_m^I\}_{m=1,\ldots,M}$, each identical independent in market m chooses a symmetric p_m^I that solves $\max\{\pi_m^I\}$. Analogously, the chain selects an optimal p_m^C subject to p_m^I being set optimally. Smooth supermodularity of price competition implies that the two first order necessary conditions hold under a symmetric equilibrium $p_m^I = p_m^C = p_m$ is a unique symmetric equilibrium that solves the first order conditions.

Knowing that entering a market will generate $R_m = S_m D_m(p_m, p_m)(p_m - c)$ for either retailer type, the J_m^I independents will enter the market until $J_m = J_m^C + J_m^I$ is such that sub-game profits are zero. Correctly anticipating J_m^I as defined above, the chain store will choose the sequence of configurations $\{J_m^C\}_{m=1,\ldots,M}$ such that profits are maximized, which generates the optimal chain-store proliferation condition[9]

$$\frac{R_m(p_m, p_m)}{J_m^C + J_m^I} - [\frac{R_m(p_m, p_m) J_m^C}{(J_m^C + J_m^I)^2} + F^C] = 0.$$

The condition expresses the trade-off between the revenue expanding effect of opening more stores and the costs associated with store set-up and own-business stealing effects. Solving these conditions gives us the sub-game configuration of stand-alone and chain stores as defined by $J_m^I = \frac{F^C R_m(p_m, p_m)}{(F^I)^2}$ and $J_m^C = \frac{R_m(p_m, p_m)}{F^I} - \frac{F^C R_m(p_m, p_m)}{(F^I)^2}$ respectively. Using these values, the equilibrium share of chain-run establishments under local pricing is

$$r_L(F^C, F^I) = \frac{J_m^C}{J_m^C + J_m^I} = 1 - \frac{F^C}{F^I}.$$

Should the chain choose a local pricing strategy, each local market's concentration can be fully explained by the chain and independents' set-up costs alone. Using this equilibrium share, the chain will receive profits of $\pi_L^C = r_L^2 \sum_{m=1}^M R_m(p_m, p_m)$. One interesting observation is that if $\frac{F^C}{F^I} < \frac{2}{3}$, the proportion that maximizes the chain's profits (only) exceeds the

[9] I assume here that J_m^C can be approximated as a real number.

industry optimal level, r_L^*, which is obtained from the implied condition from the industry optimal configuration $\{J_m^C, J_m^I\}_{m=1,...,M}$

$$1 - \frac{F^C}{F^I} = \frac{J_m^C}{J_m} - \frac{J_m^I}{J_m} = (1 - r_L^*) - r_L^*.$$

The main implication is that industries for which the chain is relatively efficient will lead to too many of its establishments. Unlike r_L, r_L^* is increasing with F^C, which suggests that the industry optimal proportion gives sufficient weight to the retailer type who has the greatest need for high revenues in order to cover the aggregate set-up costs.

3.2 Uniform pricing

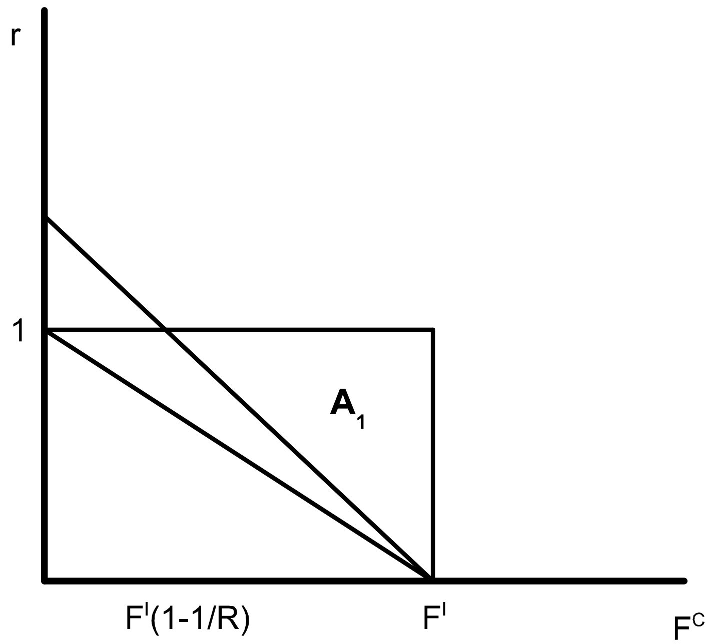
Here, the chain commits to charge a uniform price across spatially distinct markets. Therefore, the chain sets a uniform q^C for all markets that solves $\max\{\sum_{m=1}^M \pi_m^C J_m^C\}$ subject to $p_m^C = p_n^C = q^C$ for all $m \neq n$. Each standalone sets its prices conditional that the chain chooses the uniform price optimally. Much like the local pricing regime, a solution is for all independents to charge the same price as the chain's universal price, that is, $q_m^I = q^C = q$ for all $m = 1, ..., M$. For the store proliferation and endogenous entry stages, I restrict myself at looking at a class of configurations $\{J_m^C, J_m^I\}_{m=1,...,M}$ that satisfy the following property:

Definition 1 *A sub-game configuration $\{J_m^C, J_m^I\}_{m=1,...,M}$ has a constant proportion of establishments run by the chain if $\frac{J_m^C}{J_m} = r$ for all $m = 1, ..., M$ where r is some constant.*

The advantage of looking at these type of configurations is that it makes comparisons of chain store shares under different policies transparent. Otherwise, the explicit solution of the configuration sub-game will be a distribution of chain store numbers across markets. For the case of linear direct demands, a sub-game configuration with a constant proportion of chain shares can be sustained provided that the average number of consumers and willingness-to-pay is sufficiently large.

With $\frac{J_m^C}{J_m} = r$ and the free entry condition for the independents, the number of chain stores under constant proportions is given by $J_m^C = \frac{rR_m(q,q)}{F^I}$, which gives the chain profits of $\pi_U^C = r \cdot r_L \sum_{m=1}^M R_m(q, q)$. Here, the profits under uniform pricing do have a similar form as under local pricing. The exact value of r is the value that balances the implied costs and benefits of uniform pricing, which is determined in Section 4; in other words, the optimal proportion is not simply $r = 1$, as some readers may think based on the profits under uniformity. To analyze the implications of uniform pricing, it is not necessary to have an exact value. All we need is to find the threshold value of r that rationalizes the choice of uniformity.

Figure 1: Chain shares conducive to uniform pricing



4 Pricing policy implications

In the first stage of the game, the dominant chain commits to uniform pricing, it must be the case that $\pi_U^C \geq \pi_L^C$, which implies that

$$r \geq r_L \frac{\sum_{m=1}^{M} R_m(q,q)}{\sum_{m=1}^{M} R_m(p_m,p_m)} = r_U.$$

Since $r \geq r_U$ rationalizes uniform pricing policy, the chain's store proliferation strategy will necessarily be more aggressive under this policy if $\frac{r_U}{r_L} \geq 1$. Supposing that $r_U > r_L$, the relationship between r and the chain's set up cost F^C can be illustrated in the figure below. The lower line corresponds to the equilibrium proportion of chains induced by local pricing, while the line above it represents the minimum proportion of chains required to rationalize uniform pricing. All proportions that lie above this line represent rationalized configurations under uniform pricing. The total area of these proportions, A_1, represent the scope of uniform pricing. Given that the space of all possible configurations (for a fixed F^I) lies in the rectangle of area F^I, the relative scope of uniform pricing is represented by $\frac{A_1}{F^I}$. For example, if $r_U = r_L$, then the two lines overlap, and therefore the area above and below them will be equal, thereby making the relative scope of uniform pricing equal to $\frac{1}{2}$.

Proposition 1 *If demand is weakly concave in prices and the uniform price is sufficiently* *large, then the proportion of chains induced by uniform pricing exceeds the proportion under local pricing, should uniform pricing be chosen.*

Proof. The proposition holds if $\frac{r_U}{r_L} \geq 1$ holds. This constraint may be written as

$$0 \approx c \leq \frac{\sum_{m=1}^{M} S_m\{D_m(p_m, p_m)p_m - D_m(q, q)q\}}{\sum_{m=1}^{M} S_m\{D_m(p_m, p_m) - D_m(q, q)\}} = \bar{c}.$$

Then rearranging the terms reveals that $\bar{c}$ will be positive if and only if

$$LHS(q) = q > -\frac{\sum_{m=1}^{M} S_m D_m(p_m, p_m)(p_m - q)}{\sum_{m=1}^{M} S_m\{D_m(p_m, p_m) - D_m(q, q)\}} = RHS(q).$$

As $LHS(0) = 0$ and $RHS(0) \geq 0$ using the result[10] that $D_m(x, x) \geq D_m(y, y)$ for all $x < y$. Therefore, if $LHS'(q) = 1 > 0 > RHS'(q)$, then the two curves must eventually intersect, and hence, for large enough q, the condition above holds. It can be shown that $RHS(q)$ is unambiguously decreasing if

$$\sum_{m=1}^{M} S_m\{D_m(p_m, p_m) - D_m(q, q)\} \geq 0,$$

which requires that q is sufficiently high so that $D_m(p_m, p_m) \geq D_m(q, q) \geq 0$ in most of the markets m, where the second inequality follows from the supposition that uniform pricing policy is chosen rationally by the chain. ■

If the equilibrium price under uniform pricing is large, then the policy has the effect of pacifying price competition in most communities. This will draw in more local competitors, and provide the chain incentive to pair passive price policy with aggressive entry deterrence. Consequently, a large uniform price will decrease the scope of this policy. The section thus far demonstrates that the fixed costs alone cannot explain the concentration of chain stores in each local market, as the degree of price competition, dictated by the chain's uniform pricing policy, will have a profound impact whether or not the local competitors are crowded out of their respective markets.

Corollary 2 *If demand is weakly concave in prices, then the scope for uniform pricing is reduced as the uniform price increases.*

Proof. A consequence of the first proposition is that $\frac{r_U}{r_L} \geq 1$ is more likely to hold as q increases under the aforementioned conditions. As r_L is independent of q, it must be that

[10] Shown using second order McLaurin series expansions, weak concavity of demand with respect to prices, and the assumption that the own price effect on demand outweighs the cross price effect.

r_U increases with q. Therefore, as the minimum proportion of chains required to rationalize uniform pricing increases, the chain requires a stronger incentive to choose this policy. ■

It is clear that a high uniform price will make more consumers worse off. Only those with the most inelastic demands will truly benefit from the policy. If the price is high enough, there will be enough local markets where the policy is detrimental that in aggregate, the compensating variation would be negative. However, the consumers can be comforted by the fact that this policy becomes less feasible as it becomes potentially more harmful to the consumer. That said, conditions that make the uniform price very high may also prevent the consumer from ever seeing the high mark up. The idea that the chain has set up more stores to instrument the policy may align its interests with those of its customers. In stark contrast, Dobson and Waterson (2005) find that the parameter space that corresponds to the region in which uniform pricing is preferred by the chain is also the region in which local pricing is preferred by the consumer. Indeed, their model generates disagreement between the consumer and chain's preferences between the two policies.

We can now better understand why that the scope for uniform pricing increases as the chain loses its cost advantage over the independents. If the standalones can set up their establishments at comparable (low) costs, then the additional market share the chain needs to rationalize uniform pricing is smaller than if the standalones' costs are high. The reason for this result is that if the independents have low costs, they would enter regardless of whether the price equilibrium has high (uniform) or low (local) prices. So the higher their fixed costs, the more likely that the independents are marginal firms whose entry behaviors are sensitive to the sub-game prices. That said, the chain's establishment investment should increase commensurately to prevent this opportunistic behavior of inefficient standalones, in that the difference $(r_U - r_L)$ increases as $\frac{F^C}{F^I}$ decreases. A consequence of this result is that any government imposed entry cost on the chain that increases F^C, may induce it to choose a more harmful pricing policy. An example of this entry cost would be the chain store taxes fueled by the anti-chain movement between 1920-1940 (Schraegger, 2005). Consequently, while the tax policy may stem chain expansion in favor of local merchants, consumers ultimately bear the cost.

4.1 Taxonomy of passive aggressiveness

At this point, we know that a chain will choose the uniform pricing policy only if it is profitable to do so. This necessarily implies that it will have a greater market share should it choose this policy. Moreover, I have relied on simple diagrams to show existence of a region in the parameter space that is conducive to uniform pricing, and how its boundary of this region shifts with the correlation between population and reservation values. This type of analysis abstracts away the detailed effects of the pricing policy itself. Although we know that uniform pricing implies a greater proportion of chain stores, it remains ambiguous as to how many more chain stores there would be under the pricing regime. To assess the effect that policy has on the absolute number of chain stores, I need to decompose the effect that the policy has on the chain's choice in establishment investment and prices. This leads me to conclude that the optimal configuration of stores under a uniform pricing policy must be chosen to reconcile the costs and benefits associated with this policy.

Although the policy is not in the form of an investment, it is still a commitment nevertheless. As emphasized earlier, this commitment is rationalized only if the chain has some level of market power. But achieving market power is not free, as the chain must then commit to opening a greater number of stores per market at some proportional cost. The chain is willing to incur this cost provided that it can reap the benefits associated with higher (uniform) prices once the independents have entered. The cost associated with overinvesting in establishments pays off if the chain can ensure that it is the primary beneficiary of the higher prices come in the last stage. Some of this model's intuition is related to Fudenberg and Tirole's (1984) treatment of strategic pre-commitment. They find examples in which pre-price competition investments (such as advertising) can induce softer price competition upon entry because the incumbent would have a weak incentive to undercut (match) prices given its stock of informed (and loyal) customers. The investment pacifies the incumbent in the final stage, making it like a fat cat.

However, their framework may not translate directly into my results. Although there is passiveness in price competition, this fat cat effect is not explicitly driven by a positive association between opponents' sub-game prices and the number of chain stores. A sub-game configuration of stores with a constant proportion of chains would imply that sub-game prices are independent of the number of stores the chain sets, regardless of whether the policy is uniform or local. In some sense, there exists no (obvious) strategic relationship between investment and sub-game prices. Moreover, the investment in establishments reduces the scope of entry and may not improve profits for the chain. This would seem to suggest that this investment has elements of aggressive behavior, as entry is certainly not accommodative in this case. Therefore, uniform pricing policy can be broken into two strategic effects as opposed to one direct and one strategic effect. The first effect is suppressed price competition, while the second effect is entry deterrence. Loosely speaking, the chain is *passive aggressive.* Using these two effects, I find the optimal level of establishment proliferation is set at a level that rationalizes the choice of uniform pricing.

Consider a profit function conditioned under a constant sub-game chain share outcome. This means that the chain's profits are

$$\pi_A^C = \sum_{m=1}^{M} [r(A)R_m(p_m^C(A), p_m^I(A)) - F^C J_m^C(A)]$$

where $A \in \{L, U\}$ denotes the policy chosen. Suppose that local pricing is the status quo, then switching to the uniform policy will imply that $p_m^C(U) = p_m^I(U) = q$ for all m, while remaining at status quo will generate $p_m^C(L) = p_m^I(L) = p_m$. Uniform pricing is rationalized only if $r(U) \geq r_U > r(L) = r_L$, which means that if $\{J_m^C(L)\}_{m=1,\ldots,M}$ was the status quo configuration of stores, the new distribution under uniform pricing, $\{J_m^C(U)\}_{m=1,\ldots,M}$ must be such that $J_m^C(U) \geq J_m^C(L)$ for all m. Therefore, the change in store numbers and prices are denoted as $\Delta_L J_m^C = J_m^C(U) - J_m^C(L)$ and $\Delta_L p_m^I = q - p_m$ respectively. With this notation in place, the effect of switching to uniform pricing is

$$\sum_{m=1}^{M} \frac{\partial \pi_A^C}{\partial J_m^C} \Delta_A J_m^C + \sum_{m=1}^{M} \frac{\partial \pi_A^C}{\partial p_m^I} \Delta_A p_m^I$$

where $\frac{\partial D_m}{\partial p_m^I} > 0$ as prices are strategic complements. Evaluated with $A = L$ as the base policy, the effect takes the form

$$-F^C \sum_{m=1}^{M} (J_m^C(U) - J_m^C(L)) + r_L \sum_{m=1}^{M} S_m \frac{\partial D_m}{\partial p_m^I} (p_m - c)(q - p_m).$$

Achieving the optimal uniform price policy requires that this quantity be equal to zero. If the correlation between population and willingness to pay is sufficiently large, then the second term will be positive, as the uniform price will more likely exceed the local price. The first term must be negative, as chain rationality requires that $J_m^C(U) \geq J_m^C(L)$ for all m. This term may be thought of as the cost associated with implementing uniform pricing policy, while the second term is the benefit from suppressed competition conditional that the uniform price is sufficiently high. Therefore, the optimal configuration of stores under uniform pricing, $\{J_m^C(U)\}_{m=1,\ldots,M}$, will satisfy the following the constraint

$$\sum_{m=1}^{M} J_m^C(U) = \sum_{m=1}^{M} J_m^C(L) + \frac{r_L \sum_{m=1}^{M} S_m \frac{\partial D_m}{\partial p_m^I} (p_m - c)(q - p_m)}{F^C}.$$

As the chain's fixed cost per store increases, the total number of stores falls. This is consistent with the logic that as the chain loses its cost advantage over the standalones, then many of the standalones who choose to enter would still have entered under local prices. Under the cost/benefit argument, the chain will suppress its entry deterring efforts, as doing so would be cost saving. Moreover, the total amount of establishment investment increases under uniform prices with the cross price sensitivity so that the policy's cost matches the increased benefit from competition suppression. Therefore, the constant proportion of chain-run establishments necessary for uniform pricing to be an optimal policy

$$r_U^* = \frac{r_L \sum_{m=1}^M R_m(p_m, p_m) + \frac{r_L}{1-r_L} \sum_{m=1}^M S_m \frac{\partial D_m}{\partial p_m^I}(p_m - c)(q - p_m)}{\sum_{m=1}^M R_m(q, q)}$$

As $p_m \geq c$ and $r_U \geq r_L$ for q sufficiently large, this proportion is bounded above by

$$\overline{r} = r_L + \frac{r_L}{1 - r_L} \frac{\sum_{m=1}^M S_m \frac{\partial D_m}{\partial p_m^I}(p_m - c)}{\sum_{m=1}^M S_m D_m(q, q)}.$$

What this section shows is that the solution can be refined to a single value $r_U^* \in [r_U, \overline{r}]$. The upper bound for r_U^* reveals that it too moves upwards as the uniform price increases, as $D_m(q, q)$ decreases with q. That is, both the upper and lower bounds for r_U^* increase with q, which is consistent with the corollary that stating a decreasing scope for uniform pricing with q. Another observation is that the upper bound increases with r_L, much like the lower bound.

5 Model with linear demands

Consider the case of linear direct demands[11] $D_m(p_m^i, p_m^j) = w_m - ap_m^i + bp_m^j$, $i \in \{C, I\}$, where $a > b$ and w_m is a proxy for willingness-to-pay. This demand function is clearly weakly concave in prices, so the first condition of the proposition is satisfied. A stronger own price effect makes sense, as we should not expect the competitor's price to have a greater impact on the other's quantity demanded. The specified individual demand also satisfies an additional condition that the price effects are the same cross-sectionally. Without this additional constraint, many of the following results would still hold, but only after separating the potentially confounding effects with the other two parameters, S_m and w_m. That said, I provide this more restrictive specification in order to answer four additional questions:

1. When will the uniform price be high?
2. How burdensome is the assumption of credible commitment to the announced policy?
3. Will uniform pricing be particularly harmful as consumers become more heterogeneous across markets?

[11] Derived in the appendix.

4. Is the sub-game configuration of chain establishments that exhibits constant proportions actually optimal?

Answering the first question would refine the conditions for the first proposition. The second question is necessary to determine how large the assumed decentralization costs would have to be for credible commitment. As the third question shows, cross-sectional heterogeneity results in an additional distributional parameter for which the consumer and chain would agree is the ideal policy. Given that this paper focuses on sub-game configurations that satisfy constant chain-shares, question four illustrates that constant proportions can be sustained under very reasonable conditions.

5.1 Local versus uniform prices

To illustrate when the uniform price would be large, note that the symmetric sub-game prices under local and uniform price regimes are $p_m = \frac{w_m}{2a-b}$ and $q = \frac{\sum_{m=1}^{M} \gamma_m w_m}{2a-b}$ respectively, with $\gamma_n = \frac{S_n}{\sum_{m=1}^{M} S_m}$ and $\sum_{m=1}^{M} \gamma_m = 1$. The uniform price is a convex combination of discriminatory prices, so the (generalized) common result that it lies between discriminatory prices holds. If $(\gamma_m, w_m)_{m=1,\ldots,M}$ are drawn from some joint distribution, then the uniform price can be re-written as $q = \frac{MCov(\gamma,w)+E(w)}{2a-b}$, where $Cov(\gamma, w)$ is the sample covariance[12] between γ and w, while $E(w)$ is the sample mean[13] of w. Hence, the uniform price increases if the average willingness to pay is high and/or population is positively correlated with willingness-to-pay. Moreover, the possibility of negative/positive correlation skews the uniform price below/above the average price, $q - E(p) = \frac{MCov(\gamma,w)}{2a-b} \lesseqgtr 0$. This result can be interpreted as such: if there is positive correlation, the chain will place more weight on the heavily populated cities' willingness-to-pay when forming the uniform price, thereby creating a skewing effect, which is not captured by previous models, like Holmes' (1989) weak-market-strong-market model.

5.2 Credible commitment

A potential limitation of this paper is the assumption that the chain credibly commits to the uniform pricing policy, should it decide to announce it in the first period. There may be a significant cheap talk problem requiring the assumption of a large decentralization cost associated with deviating from the announced policy come time of price competition. That

[12]Defined as $Cov(\gamma, w) = \frac{1}{M}\sum_{m=1}^{M} \gamma_m w_m - \frac{1}{M}\sum_{m=1}^{M} \gamma_m (\frac{1}{M}\sum_{m=1}^{M} w_m)$.
[13]Defined as $E(w) = \frac{1}{M}\sum_{m=1}^{M} w_m$.

is, once the local retailers have entered the market, they set their price as if the chain will actually follow through with its uniform pricing policy. The greater the payoff associated with reneging on the uniform pricing regime, the greater the decentralization cost needed for credible commitment. This section illustrates the cheap talk problem in greater detail than Dobson and Waterson, and offers conditions on the parameters that would minimize the incentive to deviate, and hence, minimize the caveat associated with assumed credible policy commitment.

Once all of the chain run establishments have been set up, and all of the local retailers have entered, the chain who earlier committed to uniform pricing could decide to charge a different price instead, given that the local retailers are charging q^C in good faith. The deviating chain's price would be $p_m^d = \frac{w_m + ac + bq}{2a}$, which is greater than the uniform price if $q^C < p_m$ and less than the uniform price if $q^C > p_m$ (as one would expect). Once entry decisions have been made, r and r_L are fixed, so the deviant's profits are

$$\pi_d(q) = \frac{r \cdot r_L}{4a} \sum_{m=1}^{M} S_m \sum_{m=1}^{M} \gamma_m (w_m - ac + bq)^2.$$

On the other hand, abiding to the original policy choice will yield profits of,

$$\pi_u(q) = r \cdot r_L \sum_{m=1}^{M} S_m \sum_{m=1}^{M} \gamma_m (w_m - (a-b)q)(q-c).$$

Some algebra reveals that $\frac{d\pi_d(q)}{dq} = \frac{d\pi_u(q)}{dq} = r \cdot r_L b(q-c) \sum_{m=1}^{M} S_m$. This means that deviant and non-deviant profits move in the same direction for all q, implying that the relative payoff associated with choosing p_m^d is constant with respect to q. That said, we can choose any q to evaluate the profitability of reneging on the uniform policy. When both of these functions are evaluated at $q = c$, the potential gain has an upper bound of

$$\frac{r \cdot r_L}{4a} M E(S)[(1 - 2(a-b)c) \sum_{m=1}^{M} \gamma_m w_m^2 + (a-b)^2 c^2].$$

Since $c \approx 0$ and $\gamma_m \leq 1$ for all m, the simplified upper bound is

$$\frac{r \cdot r_L}{4a} M^2 E(S)[Var(w) + E(w)^2],$$

where the variance of w is defined as $Var(w) = \frac{1}{M} \sum_{m=1}^{M} w_m^2 - (\frac{1}{M} \sum_{m=1}^{M} w_m)^2$. The incentive to deviate is quite strong if the chain operates in many markets that on average, contain a large number of consumers who have high willingness-to-pay with a lot of variability across markets. These conditions would make reneging on the announced policy attractive for the chain; especially so if the own price effects are large, as a deviating chain could certainly increase its profits through quantity. This result may be interpreted as such: the commitment to charge a uniform price can never be credible if the number of local markets is very large, as the gain from deviation is unbounded. Capturing all of the cross sectional heterogeneity with in a single price is particularly burdensome as the number of local markets becomes large, which introduces pressure to relax the uniform pricing policy. Under this scenario, the assumption regarding a sufficiently high decentralization cost is burdensome. If constrained to charge the same price across markets, the chain will lose mark-ups for those markets for which the uniform price is less than the discriminatory price, and lose demand in those markets for which the uniform price exceeds the discriminatory price. With sufficient cross-sectional variability, these losses would exceed any benefit associated with softened price competition.

Recall that the distance $(r_U - r_L)$ decreases as r_L decreases. A small r_L will allow the minimum proportion of chain shares associated with uniform pricing to be closer to r_L so as to make uniform pricing unilaterally rational for the chain. To add to the previous result, small r_L can also quell some of the temptation to deviate. Consequently, the incentive to deviate from the announced strategy is almost eliminated as $F^C \to F^I$.

5.3 The effect of heterogeneity

A model with heterogeneous markets allows me to investigate whether variability of willingness-to-pay can make uniform pricing more or less harmful to consumer welfare. This section reveals that a high uniform price is not the only facet that aligns the chain and consumers' interests regarding pricing policy. As the heterogeneity increases, so too does the harm that uniformity inflicts onto consumers. To the consumers' benefit, the commitment to uniform pricing lacks credibility with variability as shown in the previous section, as the chain's incentive to deviate from uniformity grows stronger with consumer heterogeneity.

This is done by first defining each market's compensating variation[14], which is then aggregated across all markets. This measure captures the monetary amount by which consumers would need to be compensated to maintain the same level of utility after price policy moves from local to uniform. Aggregating this measure across market is saying that the regulator cares about the well being of the consumers in each market equally much, in that these welfare measures are not weighted by their respective populations. The aggregated compensating surplus can be simplified as

[14] Defined as $CV_m = \int_{p_m}^{q} (D_m(z,p_m) + D_m(q,z))dz = q(2w_m + bp_m - aq) - \frac{1}{2}(a-b)[q^2 - (p_m)^2] - p_m(2w_m + bp_m - aq)$.

$$\sum_{m=1}^{M} CV_m = [2ME(w) + \frac{(a+b)(ME(w)+ac)}{2a-b}]q$$
$$- q^2[\frac{M(a+b)}{2}] - \frac{2}{2a-b}(Var(w) + (E(w))^2 + acME(w)).$$

It is no surprising that a high uniform price will lead to a negative aggregated compensating surplus. A less obvious result is that a large $Var(w)$ can yield a similar qualitative result. Variability of willingness-to-pay will imply the existence of communities for which their w is very low, and other communities where w is very high. Those less affluent communities will be especially hurt by uniform pricing. Combined with a large price mark up, there will not only be more communities suffering from a consumer surplus loss, but more suffering from substantial loss.

5.4 Constant chain shares equilibrium

Many of the implications from the model are derived by comparing uniform price sub-game configurations that generate constant shares chain run establishments cross sectionally. In this section, I explore whether these constant shares r are representative of the true optimal configurations. To do this, I maintain the assumptions regarding the functional form of demand. Suppose now that the chain shares across markets is not constant,

$$\gamma_n = \frac{S_n r_n}{\sum_{m=1}^{M} S_m r_m} = \frac{s_n r_n}{M(Cov(S,r) + E(S)E(r))}$$

where $r_n = \frac{J_n^C}{J_n}$, $Cov(S,r)$ is the sample covariance between size and chain proportions, and $E(S)$ is the average market size. The dominant chain will now choose an optimal distribution $\{r_m\}_{m=1,\ldots,M}$ in the establishment investment stage jointly with $(S_m, w_m)_{m=1,\ldots,M}$. Some algebra reveals that the equilibrium price under uniform pricing is simplified as

$$q = \frac{Cov(Sw,r) + E(r)(Cov(S,w) + E(S)E(w))}{(2a-b)(Cov(S,r) + E(S)E(r))}.$$

Unlike the equilibrium price under a constant proportions sub-game, q now depends on the configurations of store numbers that correspond to the shares $\{r_m\}_{m=1,\ldots,M}$, which ultimately makes the store investment stage slightly more complicated, as the optimal solution has to reconcile for the endogeneity of price with respect to the configurations. One can show that if $Cov(S,r) = Cov(Sw,r) = 0$, q reduces to the original price equation used throughout the paper. The chain will now maximize the function (derived by substituting the free entry condition into the profit function)

$$\pi_U^C = (1 - \frac{F^C}{F^I}) \sum_{m=1}^{M} r_m S_m (w_m - (a-b)q)(q-c)$$

with respect to $\{r_m\}_{m=1,\ldots,M}$. The first order condition for each r_n has the equation

$$R_n(q,q) - \frac{2(a-b)}{2a-b} S_n w_n + \frac{S_n w_n}{M(2a-b)(Cov(S,r)+E(S)E(r))} \\ + M(2a-b)(Cov(S,r)+E(S)E(r))q$$

set to zero. Summing all of these conditions will yield an aggregated first order condition

$$(q-c)M(Cov(S,w)+E(S)E(w)) - q(q-c)M(a-b) + qM(Cov(S,r)+E(S)E(r)) \\ = cM(Cov(S,w)+E(S)E(w)) + \frac{2(a-b)M(Cov(S,w)+E(S)E(w))}{2a-b}.$$

An optimal configuration with a constant share of chain stores, r, across all local markets can be sustained if the condition above holds even when $Cov(S,r) = Cov(Sw,r) = 0$. The proposition below demonstrates that this equilibrium can be sustained provided that the average market size is sufficiently large, and that the correlation is positive.

Proposition 2 *If the average population and willingness-to-pay are both sufficiently large, then a sub-game configuration of stores with a constant proportion of chain run establishments can indeed be sustained as the optimal strategy.*

Proof. The aggregated first order condition will hold if and only if $LHS(q) = RHS(q)$, which are defined as

$$LHS(q) = (q-c)M(Cov(S,w)+E(S)E(w)) + qM(Cov(S,r)+E(S)E(r)),$$

$$RHS(q) = q(q-c)M(a-b) + A,$$

$$A = cM(Cov(S,w)+E(S)E(w)) + \frac{2(a-b)M(Cov(S,w)+E(S)E(w))}{2a-b}.$$

For $Cov(S,w) > 0$, $LHS(0) < RHS(0)$ and $LHS''(q) = 0 < 2M(a-b) = RHS''(q)$. It follows that for there to exist a price q that satisfies the aggregated conditions, we need the two curves to intersect. This will surely not happen if $LHS'(q) < RHS'(q)$. So the presumption that these curves will indeed intersect implies that $LHS'(q) > RHS'(q)$. Under a sub-game configuration of stores with a constant proportion of chain run establishments, $Cov(S,r) = Cov(Sw,r) = 0$, and $E(r) = r$, where $r \in [0,1]$ is some constant. It follows that any r that solves $LHS(q) = RHS(q)$ must satisfy

$$r > [\frac{a-b}{2a-b}\frac{1}{E(S)^2} - \frac{1}{2}](Cov(S,w) + E(S)E(w)) = \underline{r}.$$

If $E(S) > \sqrt{2}$ and $E(w) > Cov(S,w)/\sqrt{2}$, then the first bracket is negative, while the second bracket is positive. Therefore, if $E(S)$ and $E(w)$ satisfy the stated conditions, then $\underline{r} < 0$. This means that *any* $r \in [0,1]$ would satisfy the necessary condition, and thus, a constant share r is optimal. ■

6 Summary

To facilitate passive price competition through uniform prices, the chain needs a significant share of each local market its stores operate in so as to opportunistic entry of its local competitors. Doing so allows the chain to capitalize on any benefits associated with suppressed price competition. This required share increases if the effect of high prices has a greater effect on entry of stand-alone stores, which is the case if their fixed costs are high enough that entry is conditional that prices are soft. Unlike previous models of strategic pre-commitments, the prices are higher in the final stage not because its establishment investment directly affects its and its competitors' pricing decision, but because the investment ensures that it receives a sufficient share of the gain from suppressed competition to make uniform pricing meaningful. A consequence of this result is that the chain's incentive to set a uniform price is likely to diminish as the policy becomes more harmful to consumers.

7 Appendix

7.1 Derivation of direct demands

The symmetric demand function in this paper can be derived[15] using the quadratic utility

$$U(y) = \alpha_m^C y_m^C + \alpha_m^I y_m^I - \frac{1}{2}[\beta^C (y_m^C)^2 + 2\nu y_m^C y_m^I + \beta^I (y_m^I)^2]$$

[15] Refer to the Vives (1999) for more details.

where y_m^C and y_m^I denote quantities of goods carried by the chain and independent. It is assumed that the utility function is concave, and that $\beta^C\beta^I - \nu^2 > 0$. If the consumer maximizes her utility taking the prices as given, then the inverse demand functions are

$$p_m^C = \alpha_m^C - \beta^C y_m^C - \nu y_m^I$$

$$p_m^I = \alpha_m^I - \beta^I y_m^I - \nu y_m^C.$$

Inverting these demands give us the direct demands

$$y_m^C = w_m^C - a^C p_m^C + b p_m^I$$

$$y_m^I = w_m^I - a^I p_m^I + b p_m^C$$

with $w_m^i = \frac{\alpha_m^i \beta^j - \alpha_m^j \nu}{\Delta}$, $a^i = \frac{\beta^j}{\Delta}$, $b = \frac{\nu}{\Delta}$ and $\Delta = \beta^C\beta^I - \nu^2$. These direct demands correspond to the symmetric demand function used in the paper provided that $w_m^C = w_m^I = w_m$ and $a^C = a^I = a$. The second condition implies that $\beta^C = \beta^I = \beta$, and this implies that $\alpha_m^C = \alpha_m^I = \alpha_m$ for all m.

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