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# Tariffs Passing Through Retailers: Do Tariffs Actually Protect Domestic Manufacturers?\*

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WORKING PAPER: COMMENTS WELCOME

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## Abstract

Historically, tariffs have been an attractive policy tool to protect domestic industries. The benefits of such a policy are based on theoretical models that assume foreign manufacturers sell directly to consumers. However, recent empirical evidence suggests that wholesalers and retailers play an active role in international trade. We present a model of retailers that illustrates how accounting for these strategic intermediaries can actually make some domestic manufacturers worse off in response to an increased tariff. Moreover, any production gains that occur are biased towards higher cost domestic manufacturers. This result is not driven by the cannibalization effect of the multi-product firm literature rather it is the fact that retailers compete over the marginal consumer (the extensive margin).

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# 1 Introduction

Recent empirical evidence suggests that wholesalers and retailers play an active role in international trade (see Blum et al. 2010, Bernard et al. 2010, and Francois and Wooton 2010). This evidence is noteworthy because most of the theoretical analysis on the gains from international trade focus on adjustments in the manufacturing sector and assume that lower manufacturing prices are perfectly passed on to consumers. But with an extra layer of firms between manufacturers and consumers, lower manufacturing prices do not necessarily translate into lower consumer prices. In particular, if the wholesale or retail sector is only imperfectly competitive, the issue of the pass-through of price changes from global markets to local consumers becomes important.

Consequently, the role local retail markets plays in cost shock pass-through has been subject to prior inquiries. Raff and Schmitt (2009) analyze how changes in the market structure of local retail markets can affect the pass-through of reductions in trade costs in a monopolistically competitive retail market. They find that selection effects in the retail markets can have similar effects for prices and welfare as selection effects in manufacturing markets. In an empirical study, Hellerstein (2009) analyzes the pass-through of exchange rate changes in the beer market and finds that a significant portion of the costs of exchange rate changes are borne by local retailers. Berner and Birg (2012) provide evidence that the pass-through in the retail sector depends on the type of outlet and may be different for consumers with different levels of income.

This paper addresses the role of retailers for the effect of a tariff on domestic producers. Conventional wisdom suggests that domestic manufacturers benefit from a tariff on the products of foreign competitors. The intuition is that the domestic consumer will shift their expenditures towards domestic products because their relative price has fallen. As a consequence, demand for domestic products increases, and this will typically create jobs and boost profits of domestic producers. This is, in fact, a key political justification for levying tariffs: Tariffs are an attractive instrument because they appear to allow governments to

raise revenues and boost domestic employment at the same time.

Our paper emphasizes that there is a countervailing effect if one takes into account how retailers adjust their mark-ups in response to a tariff. Retail markets are not perfectly competitive, and retailers adjust their mark-ups when their procurement costs change. In particular, if a tariff increases the cost of a subset of (foreign) products, they shift relative mark-ups away from these products and charge higher mark-ups on products that have become relatively less expensive. These adjustments in the retail mark-ups counteract the initial impact of the tariff on domestic consumer prices. In this paper, we analyze the determinants of the size of this effect, and how this effect changes the implications of a tariff for domestic producers. The main point of our paper is that due to these changes in retail mark-ups, demand for (some) domestic goods may actually go down when a tariff is levied, leading to the exact opposite effect of what is politically desired. We also show that it is the smallest and most unproductive domestic firms that benefit most from a tariff.

For our analysis, we assume that retailers are horizontally differentiated. In our design, there are two retailers at the two end points of a line that compete for the costumers who live in the space between these two retailers. We assume that the consumers are uniformly distributed along the line, and that they make a single trip to one of the two retailers to run their errands (one stop shopping). When deciding where to shop, consumers do not only look at the distance to the nearest retail outlet, but also take the prices at these outlets into account. This implies that retail mark-ups do not only affect the intensive margin of how much consumers buy, but also the extensive margin of how many consumers actually visit a retail outlet. It is this extensive margin that drives our results, and emphasizes the importance of the competition in the retail sector for the effects of a tariff.

The existence of an extensive margin is important in a broader theoretical context. The point of this paper is that changes in the profit margins of one good have an impact on the profit margins of another good within the assortment of the retailer. In another context, Amir et al. (2010) have shown that under commonly used demand specifications, multi-product

monopolists do not take demand cross-effects into account. Since we are using similar demand specifications, this result implies that the effect we describe does not occur when retailers are monopolists who do not have to worry about the extensive margin. However, in reality retailers are very rarely pure monopolists, and typically face some competition, in particular on a geographical dimension. We show that in the presence of competition, the level of competition for extensive margin plays an important role in the response of retailing pricing to changes in tariffs.

The rest of the paper proceeds as follows. Section 2 sets up the model. Section 3 characterizes the equilibrium, and Section 4 analyzes the effects of a change in the tariff on a foreign good. Finally, Section 5 concludes.

## 2 Model

### 2.1 Consumers

There is a mass,  $M$ , of consumers that are located uniformly along a line segment with one of two retailers ( $h = L, R$ ) at each end. A consumer's location is indexed by  $\delta \in [0, 1]$ , the distance from the left end of the city. A consumer must choose to buy from one of two retailers and incurs a cost, measured in the numeraire,  $\tau d_h^2$  where  $d_h$  is the distance traveled to retailer  $h$  and  $\tau$  captures all exogenous influences on consumer travel costs, such as infrastructure and consumer mobility. Each consumer has quasi-linear preferences (Dixit, 1981; Vives, 1985; Ottaviano et al., 2002; Melitz and Ottaviano, 2008), and the utility the consumers receives from going to retailer  $h$  is:

$$U_h = q_0 - \tau d_h^2 + \alpha \sum_{i=1}^N q_i - \frac{1}{2} \gamma \sum_{i=1}^N q_i^2 - \frac{1}{2} \eta \left[ \sum_{i=1}^N q_i \right]^2 \quad (1)$$

where  $\gamma > \eta > 0$ . Thus the consumer will choose the retailer that yields the highest utility.

We assume that the consumers have positive demand for the numeraire ( $q_0 > 0$ ) and that

the consumer does not realize her decision of  $q_i$  has any affect on  $Q \equiv \sum_{i=1}^N q_i$ . Consequently, the willingness to pay for variety  $i$  is

$$p_i = \alpha - \gamma q_i - \eta Q. \quad (2)$$

The demand for a variety by one consumer can be found by inverting (2) and is given by

$$q_i = \frac{1}{\gamma} \left( \frac{\gamma}{\eta N + \gamma} \alpha + \frac{\eta N}{\eta N + \gamma} \bar{p} - p_i \right), \quad \forall i \in [1, N] \quad (3)$$

where  $N$  is the number of varieties and  $\bar{p} = (1/N) \sum_{i=1}^N p_i$ . Therefore, aggregate demand for the differentiated good is given by

$$Q = \frac{N}{\eta N + \gamma} (\alpha - \bar{p}). \quad (4)$$

Next, by normalizing the price of the numeraire ( $p_0 = 1$ ), we can see that the indirect utility function associated with a consumer going to retailer  $h$  is

$$V_h = I - \tau d_h^2 + \frac{1}{2} \left( \frac{N}{N\eta + \gamma} \right) (\alpha - \bar{p}_h)^2 + \frac{1}{2} \frac{N}{\gamma} \sigma_{p_h}^2 \quad (5)$$

where  $I$  is the consumer's income and  $\sigma_p^2 = (1/N) \sum_{i=1}^N (p_i - \bar{p})^2$  represents the variance of prices. Given the indirect utility function, the location of the consumer who is indifferent between purchasing from retailer  $L$  and retailer  $R$  (assuming all consumers buy) is the point  $\hat{\delta}$  such that

$$I - \tau \hat{\delta}^2 + \frac{1}{2} \left( \frac{N(\alpha - \bar{p}_L)^2}{N\eta + \gamma} \right) + \frac{1}{2} \frac{N}{\gamma} \sigma_{p_L}^2 = I - \tau (1 - \hat{\delta})^2 + \frac{1}{2} \left( \frac{N(\alpha - \bar{p}_R)^2}{N\eta + \gamma} \right) + \frac{1}{2} \frac{N}{\gamma} \sigma_{p_R}^2$$

or

$$\hat{\delta} = \frac{1}{2} + \frac{N}{4\tau\gamma} \left\{ \frac{\gamma}{N\eta + \gamma} [(\alpha - \bar{p}_L)^2 - (\alpha - \bar{p}_R)^2] + [\sigma_{p_L}^2 - \sigma_{p_R}^2] \right\}. \quad (6)$$

It is clear from equation (6) that the consumer is concerned with both the average and variance of prices for the basket of goods sold by each retailer. For instance, if both retailers have identical average prices but different variance, the consumer in the middle would choose the retailer with the higher variance. This is because although a higher variance results in some varieties having a higher price, it also means that some varieties have a lower price. This allows the consumer to shift consumption from higher priced varieties to the lower priced varieties increasing the consumer's welfare. Similarly, holding the price variance equal, the consumer prefers the retailer with the lower average price. Equation (6) also shows that if the two retailers have identical average prices with the same variance, the second term disappears and  $\hat{\delta} = 1/2$ . That is, as one would expect, in a symmetric equilibrium each retailer gets exactly half of the market.

## 2.2 Retailer

The profits of a retailer are given by

$$\pi = M\hat{\delta} \left[ \sum_{i=1}^N (p_i - c_i)q_i \right], \quad (7)$$

where  $p_i$  is the retail price charge by the retailer for good  $i$ , and  $c_i$  is the procurement costs of good  $i$ .

The procurement cost  $c_i$  consists of the DDP price (incoterm for “delivered duty paid”, includes price paid to the manufacturer, transportation to destination and import tariffs) and the retailer's marginal costs of providing the good. We assume that the two retailers have identical marginal costs and that there are no strategic interactions between the manufacturers and the retailers and among the manufacturers themselves:

$$c_{iL} = c_{iR} \quad \text{and} \quad \frac{dc_i}{dc_j} = 0 \quad \forall i \neq j. \quad (8)$$

These assumptions imply that the two retailer face identical costs for the same products.

They do not (necessarily) imply that the costs for all products are the same: We do allow for product heterogeneity in the sense that the costs for different products may be different ( $c_i \neq c_j$ ).

With regard to how a tariff on product  $i$  affect the retailers' procurement costs we assume that

$$\frac{dc_i}{dt_i} > 0 \text{ and } \frac{dc_j}{dt_i} = 0 \forall i \neq j. \quad (9)$$

The first assumption ( $dc_i/dt_i > 0$ ) is very general. It just states that a tariff raises the procurement costs of foreign products for local retailers. This assumption certainly holds if there is perfect competition in manufacturing (as in Eaton and Kortum, 2002) or if manufacturers charge a constant markup (as in Bernard et al., 2003), so that any tariff is perfectly passed on to retailers. But it also holds if the pass-through from manufacturing to retailing is imperfect and a part of the tariff is borne by the manufacturer (as in Melitz and Ottaviano, 2008).

The second assumption ( $dc_j/dt_i = 0 \forall i \neq j$ ) is a bit more restrictive. It states that the retailers' procurement costs for domestic products are unaffected by a tariff. This assumption still holds under perfect competition or if manufacturers charge a constant mark-up, but it would not necessarily hold in a monopolistically competitive market with linear demand. In this case, a tariff on foreign products would shift the residual demand curve of domestic manufacturers outwards, thereby allowing them to raise their mark-ups, so that  $dc_j/dt_i > 0$ . However, we show in the appendix that our results hold in this case, too. In fact, if  $dc_j/dt_i > 0$ , a negative effect on domestic outputs is even more likely.

Regarding the retailers' assortment, we assume that both retailers offer the same (fixed) number of varieties  $N_L = N_R = N$ . The assumption of a fixed product range is a simplification that allows us to focus on the cross-price effects without having to address issues of optimal assortment and the possibility of slotting allowances. One way to rationalize the assumption of fixed assortments is regulation. Many countries, states or communities regulate the size of retailers in land-use plans, and this regulation often acts as a bound on

the size of a retailer's assortment. Another possible explanation for why assortments may be unaffected by tariffs is by assuming that retailers are actually carrying all varieties available on the world market, but entry and exit in manufacturing takes time. This would be consistent with the short run equilibrium in Melitz and Ottaviano (2008). In the end, this is a helpful simplification, but our results do not depend on it: In the appendix we provide a simple extension with an endogenous product range and show that this does not affect our main results.

Using the demand for a variety, (3), the profit function becomes

$$\pi_L = M\hat{\delta}\Upsilon_L \quad (10)$$

where

$$\Upsilon_L = \frac{1}{\gamma} \sum_{i=1}^N (p_i - c_i) \left( \frac{\gamma}{\eta N + \gamma} \alpha + \frac{\eta N}{\eta N + \gamma} \bar{p}_L - p_i \right) \quad (11)$$

is the profit per consumer and  $M\hat{\delta}$  is the total mass of consumers shopping at retailer  $L$ .

### 3 Equilibrium

To characterize the equilibrium, we need to find each  $p_i$  for both retailers that maximizes its profits. Differentiating (10) with respect to  $p_i$  yields the generic first order condition:

$$\frac{\partial \pi_L}{\partial p_i} = M \left( \Upsilon \frac{\partial \hat{\delta}}{\partial p_i} + \hat{\delta} \frac{\partial \Upsilon_L}{\partial p_i} \right) = 0 \quad (12)$$

for all  $i$ . As can be seen by equation (12), the retailer has to weigh the effects of a change in the price of variety  $i$  on two margins. The first margin is how changing the price affects the indifferent consumer (the extensive margin) and thus its consumer base; this is given by:

$$\frac{\partial \hat{\delta}}{\partial p_i} = -\frac{1}{2\tau} \frac{1}{\gamma} \left[ \frac{\gamma(\alpha - \bar{p}_L)}{N\eta + \gamma} - (p_i - \bar{p}_L) \right] = -\frac{q_i}{2\tau} < 0.$$

Note that if  $p_i > \bar{p}$ , raising the price of variety  $i$  has a positive effect on the market share by increasing the variance of prices, however this is countered by the negative affect of increasing the average price. The second margin is the intensive margin; i.e. how the price affects the profit from each consumer in the retailer's consumer base:

$$\frac{\partial \Upsilon_L}{\partial p_i} = \frac{\alpha}{N\eta + \gamma} - \frac{2p_i - c_i}{\gamma} + \frac{N\eta(2\bar{p} - \bar{c})}{(N\eta + \gamma)\gamma}.$$

At the optimum, the retailer chooses a vector of prices such that these margins offset each other:

$$\frac{\partial \Upsilon_L}{\partial p_i} = \Upsilon_L \left( \frac{q_i}{2\tau\hat{\delta}} \right) \quad (13)$$

for all  $i$ . Since outputs are restricted to non-negative values ( $q_i \geq 0 \forall i$ ),  $\partial \Upsilon_L / \partial p_i \geq 0 \forall i$  and  $\bar{p} < (\alpha + \bar{c})/2$ . This is the first noticeable departure from a model that considers the retailer to be a monopolist. Since the monopolist only needs to be concerned with the intensive margin, it will choose a  $p_i$  such that  $\frac{\partial \Upsilon_L}{\partial p_i} = 0$ , which results in an equilibrium of  $\bar{p} = (\alpha + \bar{c})/2$ . Thus, relative to a monopolist, the increased competition lowers the average prices of the consumption basket offered by the retailer, which we will explain in more detail shortly.

Since we are only considering a symmetric equilibrium, we will drop the retailer  $L$  subscript henceforth. Summing up our first order conditions, (13), yields the following relationship:<sup>1</sup>

$$\begin{aligned} \left( \frac{N}{\eta N + \gamma} \right) [\alpha + \bar{c} - 2\bar{p}] &= \frac{Q\Upsilon}{2\tau\hat{\delta}} \\ \Rightarrow \frac{[\alpha + \bar{c} - 2\bar{p}]}{(\alpha - \bar{p})} &= \frac{\Upsilon}{2\tau\hat{\delta}}. \end{aligned}$$

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<sup>1</sup>Note that  $\frac{Q}{N} = \bar{q} = \frac{(\alpha - \bar{p})}{\eta N + \gamma}$ .

For conciseness, we make the following definition:

$$\varepsilon \equiv \frac{\Upsilon}{2\tau\hat{\delta}}.$$

Inserting this back into our general first order condition, equation (12), we can solve for the price of variety  $i$ :

$$p_i = \left( \frac{1}{2 - \varepsilon} \right) [(1 - \varepsilon)\alpha + c_i]. \quad (14)$$

Furthermore, the average price is

$$\bar{p} = \left( \frac{1}{2 - \varepsilon} \right) [(1 - \varepsilon)\alpha + \bar{c}]. \quad (15)$$

Note that the prices are a weighted average of  $\alpha$  and the cost  $c$ . The weights are  $(1 - \varepsilon) / (2 - \varepsilon)$  and  $1 / (2 - \varepsilon)$  where  $\varepsilon \in (0, 1)$  and  $(1 - \varepsilon) / (2 - \varepsilon) + 1 / (2 - \varepsilon) = 1$ . This term  $\varepsilon$  plays an important role and measures the relative value of the elasticity of the extensive margin evaluated at prices equal to marginal costs. To see this note the following

$$\begin{aligned} \left. \frac{d \ln(\Upsilon)}{d \ln(p_i)} \right|_{p_i=c_i} &= \frac{c_i q_i}{\Upsilon} && \text{Intensive margin} \\ \left. \frac{d \ln(\hat{\delta})}{d \ln(p_i)} \right|_{p_i=c_i} &= \frac{-c_i q_i}{2\tau\hat{\delta}} && \text{Extensive margin} \\ \Rightarrow \varepsilon &\equiv \frac{\Upsilon}{2\tau\hat{\delta}} = - \left. \frac{d \ln(\hat{\delta}) / d \ln(p_i)}{d \ln(\Upsilon) / d \ln(p_i)} \right|_{p_i=c_i}. \end{aligned}$$

At the optimal price, this ratio of elasticities  $-(d \ln \hat{\delta} / d \ln p_i) / (d \ln \Upsilon / d \ln p_i)$  is equal to one which can be seen by the first order condition (12). However, when evaluated at the competitive price, this term is between zero and can be interpreted as a *measure of the degree of competition between retailers*. If there is no competition between retailers ( $\varepsilon = 0$  because  $d \ln \hat{\delta} / d \ln p_i = 0$ ), the elasticity of the extensive margin is zero, and the retailer will charge prices equal to the prices of a monopolists. In this case,  $p_i = \frac{1}{2}(\alpha + c_i)$  and  $\bar{p} = \frac{1}{2}(\alpha + \bar{c})$

(monopoly pricing). But if competition is fierce and the elasticity of the extensive margin is just as large as the elasticity of the intensive margin ( $\varepsilon = 1$ ), any price increase will lower profits and retailers will not be able to raise prices above marginal costs. In that case,  $p_i = c_i$  and  $\bar{p} = \bar{c}$  (competitive pricing). In general, retail prices are decreasing in the extent of the competition between retailers:  $dp_i/d\varepsilon = -(\alpha - c_i)/(2 - \varepsilon)^2 < 0$ . Note also that this measure of competition between retailers is endogenous. The larger the profits from an individual customer  $\Upsilon$ , the more valuable it becomes to attract customers, and competition becomes fiercer.

Now that we have characterized the equilibrium prices, we can analyze other important characteristics of prices. The first such characteristic is the variance of prices:

$$\begin{aligned} \sigma_p^2 &= \left(\frac{1}{4}\right) \sigma_c^2 && \text{Monopoly} \\ \sigma_p^2 &= \left(\frac{1}{2 - \varepsilon}\right)^2 \sigma_c^2 > \left(\frac{1}{4}\right) \sigma_c^2 && \text{Duopoly.} \end{aligned}$$

It can now be seen that consumers gain in two ways from the added competition of retailers; a lower average price and higher price variance. These expressions for the price variance show that retailers do not charge uniform mark-ups but that their mark-ups affect the variance of prices. Their ability to affect the variance in prices is limited by the competition in the retail sector:  $d\sigma_p^2/d\varepsilon > 0$ . In the monopoly case ( $\varepsilon = 0$ ), the price variance is lowest:  $\sigma_p^2 = \sigma_c^2/4$ . In the competitive case ( $\varepsilon = 1$ ), the price variance is highest and equal to the variance in costs:  $\sigma_p^2 = \sigma_c^2$ .

Actual markups in retailing are given by:

$$\zeta_i \equiv p_i - c_i = \left(\frac{1 - \varepsilon}{2 - \varepsilon}\right) (\alpha - c_i). \quad (16)$$

Again, the level of competition,  $\varepsilon$ , plays an important role. First, the markup for the retailer

is decreasing in the measure of competition:

$$\frac{d\zeta_i}{d\varepsilon} = -\frac{\alpha - c_i}{(2 - \varepsilon)^2} < 0. \quad (17)$$

Secondly, the effect of retail competition on retail mark-ups is decreasing in the wholesale price of the product. This can be seen by the cross-derivative:

$$\frac{d^2\zeta_i}{d\varepsilon dc_i} = \frac{1}{(2 - \varepsilon)^2} > 0. \quad (18)$$

This cross-derivative shows that retailers charge the highest mark-ups for low-cost products, and that the mark-ups of these low-cost products are also affected most when the competition in the retail sector changes. This is also the rationale for our earlier finding that the competition in the retail sector affects the variance of prices. If competition between retailers is low (low  $\varepsilon$ ), retailers charge high mark-ups, and the mark-ups are highest for the varieties with the lowest cost. This tends to reduce the variance in retail prices for consumers.

Figure 1 illustrates the relation between retail prices (on the vertical axis), procurement costs (on the horizontal axis), and our measure of retail competition  $\varepsilon$ . The dashed 45° line shows the profile of prices if the retail market is perfectly competitive:  $p_i = c_i$ . The dashed line above it shows the profile of prices that a retail monopolist would charge:  $p_i = (\alpha + c_i)/2$ . The real price profile is a weighed average of these two profiles,  $p_i = \psi(\varepsilon)c_i + [1 - \psi(\varepsilon)](\alpha + c_i)/2$ , where the weights depend on  $\varepsilon$ :  $\psi(\varepsilon) = \varepsilon/(2 - \varepsilon)$ ,  $\psi(0) = 0$ , and  $\psi(1) = 1$ . The distance between the price profile and the 45° line shows the mark-up  $\zeta_i = p_i - c_i$ . This figure illustrates three important facts: First, retail mark-ups are not symmetric, but are highest for low-cost goods and lowest for high-cost goods. Second, retail mark-ups depend on the degree of competition between retailers. And third, mark-ups for low-cost goods respond stronger to changes in  $\varepsilon$  than mark-ups for high-cost goods.

It is important to recall that  $\varepsilon$  is determined by parameters, but perhaps more importantly the moments of the cost distribution as well. This means that the markups (and

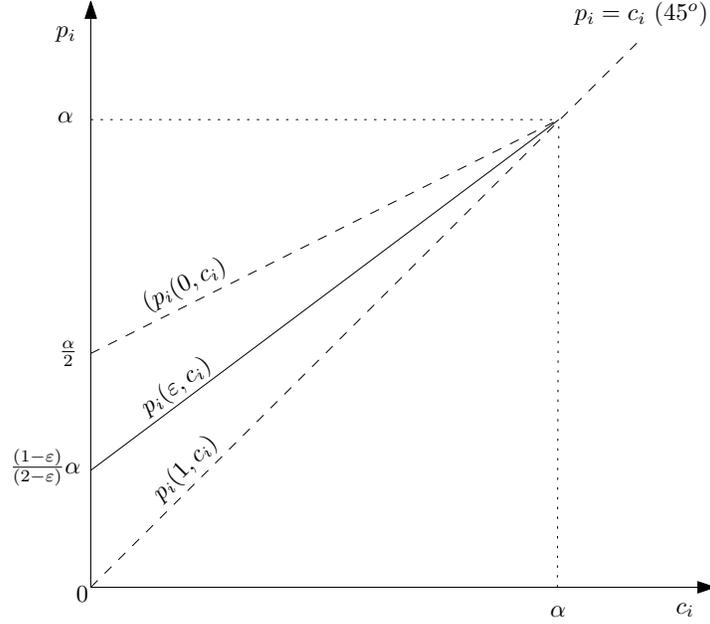


Figure 1:  $p_i(\varepsilon, c_i) = \frac{(1-\varepsilon)\alpha + c_i}{2-\varepsilon}$

consequently prices) for all varieties will be affected by anything that changes the moments of the cost distribution. This can directly be seen by calculating  $\varepsilon$  in equilibrium. Use our equilibrium prices, (14) and (15), and evaluate  $\varepsilon$  at  $\hat{\delta} = 1/2$  to obtain

$$\varepsilon = \frac{N(1-\varepsilon)}{\tau\gamma(2-\varepsilon)^2} \left[ \frac{\gamma(\alpha - \bar{c})^2}{\eta N + \gamma} + \sigma_c^2 \right]. \quad (19)$$

This can be rewritten as

$$F(\varepsilon) = \frac{N}{\tau\gamma} \left[ \frac{\gamma}{\eta N + \gamma} (\alpha - \bar{c})^2 + \sigma_c^2 \right], \quad (20)$$

where  $F(\varepsilon) \equiv \varepsilon(2-\varepsilon)^2(1-\varepsilon)^{-1}$ . Since

$$F_\varepsilon(\varepsilon) \equiv \partial F / \partial \varepsilon = (2-\varepsilon)(2\varepsilon^2 - 3\varepsilon + 2)(1-\varepsilon)^{-2} > 0,$$

the left hand side of (20) is strictly increasing in  $\varepsilon$ , so that (20) uniquely determines  $\varepsilon$ .

Equation (20) clearly shows that  $\varepsilon = \Upsilon/\tau$  is increasing in  $\sigma_c^2$ , even if  $\bar{c}$  remains constant.

A higher variance in costs leads to a higher variance in prices, and this raises  $\varepsilon$  because it leads to higher profits per consumer  $\Upsilon$ . As a consequence, competition for consumers (the extensive margin) becomes fiercer and, given (16), lowers mark-ups. This implies that a mean-preserving spread of the cost distribution tends to lower mark-ups in retailing.

This is a remarkable result because it shows that the mark-ups charged by multi-product retailers are different from the mark-ups charged by multi-product manufacturers. The mark-ups of multi-product manufacturers do not depend on the second moment of costs (or prices) because manufacturers are competing only on the intensive margin and do not depend on an “all-or-nothing” decision like a consumer’s choice of retail outlet.<sup>2</sup> This underlines the importance of the elasticity of the extensive margin and shows that the mechanisms described here are unique to the retail sector.

An alternative (and maybe more intuitive) way to express (20) is by using the expressions for outputs:

$$\frac{\varepsilon}{1 - \varepsilon} = \frac{1}{\tau} \left( \gamma \sum_{i=1}^N q_i^2 + \eta Q^2 \right). \quad (21)$$

As the left hand side of (21) is increasing in  $\varepsilon$ ,  $\varepsilon$  is increasing in outputs (both individual  $q_i$  and aggregate  $Q$ , weighted by the respective substitution parameters  $\gamma$  and  $\eta$ ) and decreasing in the retail travel costs  $\tau$ . The two terms on the right hand side of (21) show nicely how the intensive and the extensive margin interact in determining the degree of competition in retailing. If outputs are large, the additional profits generated from an additional customer are also large. As a consequence, competition at the extensive margin is fierce, and retail mark-ups are low (high  $\varepsilon$ ). But if travel costs between retailers are high (high  $\tau$ ), it becomes harder (more expensive) for consumers to switch retailers. This tends to strengthen the local market power of retailers and reduce competition. As a consequence, retailers raise their mark-ups (lower  $\varepsilon$ ) in order to squeeze more profits out of inframarginal consumers.

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<sup>2</sup>At least not if the marginal utility of income is fixed by an outside good as it is here. Without an outside good, a higher second moment of prices lowers marginal utility of income and shifts residual demands outwards. See Eckel and Neary (2010).

## 4 Change in trade costs

In this section we investigate the effect on the equilibrium in response to an increase in a tariff charged on a subset  $N_F \subset N$  of foreign varieties (indexed by  $F$ ).<sup>3</sup> We are particularly interested in the effect this will have on the quantity sold of the other domestic varieties (denoted with a subscript  $d$ ) in order to show how domestic producers are affected by the tariff and how this impact depends on the degree of competition in the retail sector. To begin, we use our equilibrium prices, (14) and (15), and equation (16) to find two generic equilibrium conditions:

$$q_i = \frac{1}{\gamma(2-\varepsilon)} \left[ \frac{\gamma}{\eta N + \gamma} (\alpha - c_i) + \frac{\eta N}{\eta N + \gamma} (\bar{c} - c_i) \right] \quad (22)$$

$$F(\varepsilon) = \frac{N}{\tau\gamma} \left[ \frac{\gamma}{\eta N + \gamma} (\alpha - \bar{c})^2 + \sigma_c^2 \right]. \quad (23)$$

Recall that we are mainly agnostic as to how a tariff affects the cost of a variety while only assuming  $dc_F/dt > 0$  and  $dc_d/dc_F = 0$  for any  $d \neq F$ . Focusing on only domestic firms and totally differentiating our symmetric equilibrium condition (22) with respect to  $c_F$  yields:<sup>4</sup>

$$(2-\varepsilon) dq_d - q_d d\varepsilon = \frac{\eta N_F}{\gamma(\eta N + \gamma)} dc_F. \quad (24)$$

Next, totally differentiate the second equilibrium condition, (23):

$$\frac{F_\varepsilon(\varepsilon)}{(2-\varepsilon)} d\varepsilon = -\frac{2Q_F}{\tau} dc_F < 0, \quad (25)$$

where  $Q_F$  is the aggregate output of all varieties subject to the tariff. Finally, using these two comparative statics, we can write down the change in domestic output with respect to

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<sup>3</sup>Since this is primarily a ‘‘Trade’’ paper, we are focused on a change in cost due to a tariff, however our analysis holds for any reason the cost of one variety would change; e.g. exchange rate changes or even domestic policy affecting domestic goods.

<sup>4</sup>For exposition, we suppress the term  $dc_F/dt$  as this will not change the qualitative results.

the foreign varieties' cost:

$$\frac{dq_d}{dc_F} = \frac{1}{(2-\varepsilon)} \frac{\eta N_F}{\gamma(\eta N + \gamma)} - \frac{2}{F_\varepsilon(\varepsilon)} \frac{Q_F q_d}{\tau}. \quad (26)$$

This is our main equation of analysis.

A first inspection of (26) shows that this derivative is not necessarily positive. The condition for a negative effect on domestic output is

$$\frac{1}{\gamma} \left( N + \frac{\gamma}{\eta} \right)^{-1} < \frac{2(1-\varepsilon)^2}{(2\varepsilon^2 - 3\varepsilon + 2)} \frac{1}{\tau} \frac{Q_F}{N_F} q_d. \quad (27)$$

In the context here this means that a domestic variety does not necessarily benefit from a tariff on foreign varieties. This result is counterintuitive at first because one would suspect that if foreign varieties become more expensive, domestic consumers will substitute away from foreign varieties and consume more of the now relatively cheaper domestic varieties. This is indeed the case, but what is not necessarily true is that domestic varieties actually become relatively cheaper for consumers. Retailers respond to the increase in the prices of foreign varieties with a shift of their mark-ups, charging relatively lower mark-ups on foreign varieties and higher mark-ups on domestic varieties. This increase in the mark-ups on domestic products can dominate the change in relative prices for domestic goods. We provide a numerical example of this condition in Figure 2.<sup>5</sup>

The intuition behind this result can best be seen by taking a closer look at equation (24). Output of domestic goods is affected by two effects: A direct effect through relative costs  $(\bar{c} - c_d)$ , and an indirect effect through the retail-markup which is driven by changes in  $\varepsilon$ :<sup>6</sup>

$$\frac{dq_d}{dc_F} = \underbrace{\frac{\partial q_d}{\partial \bar{c}} \frac{d\bar{c}}{dc_F}}_{\text{Direct (+)}} + \underbrace{\frac{\partial q_d}{\partial \varepsilon} \frac{d\varepsilon}{dc_F}}_{\text{Indirect (-)}}. \quad (28)$$

<sup>5</sup>For this graphical example, we have set,  $\alpha = 2.5$ ,  $\bar{c} = 1$ ,  $N = 4$ ,  $\sigma_c^2 \approx 0.279$ ,  $\gamma = 1$ , and  $\eta = \frac{7}{128}$ .

<sup>6</sup>Refer to equation (17) to see the relationship between  $\varepsilon$  and the markup,  $\zeta$ .

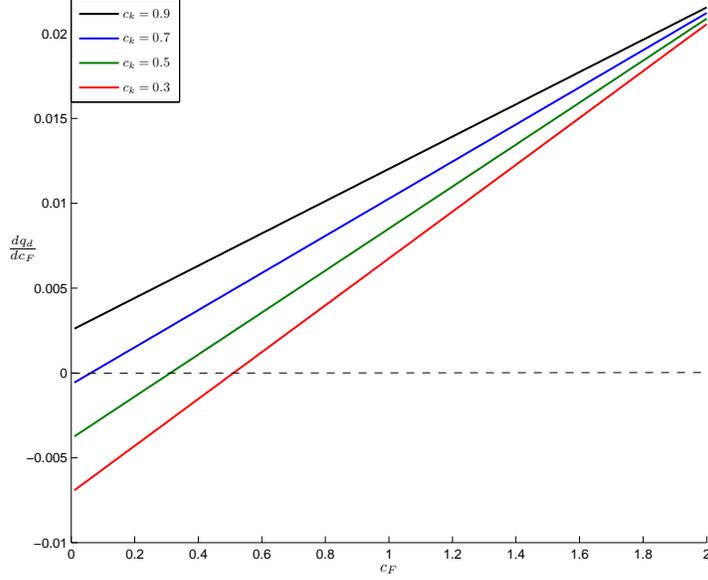


Figure 2:  $\frac{dq_d}{dc_F}$  as a function of  $c_F$

The direct effect is positive. It captures the conventional wisdom that changes in relative costs lead to changes in relative outputs and implies that a tariff on foreign varieties boosts demand for domestic varieties. Technically, it is given by

$$\frac{\partial q_d}{\partial \bar{c}} \frac{d\bar{c}}{dc_F} = \frac{1}{(2 - \varepsilon)} \frac{\eta N}{\gamma (\eta N + \gamma)} \frac{N_F}{N} > 0. \quad (29)$$

The direct effect depends on how elastic demand for a domestic product responds to changes in the average price:  $\partial q_d / \partial \bar{p} = \eta N \gamma^{-1} (\eta N + \gamma)^{-1}$ . Not surprisingly, this effect depends on the substitutability parameter  $\gamma$ : If the products are good substitutes (low  $\gamma$ ), this effect is stronger. In this case the shift of consumer demand away from the more expensive foreign products is more pronounced. The direct effect is also increasing in the share of products affected by the tariff  $N_F/N$  because a larger tariff base implies a larger increase in average costs and thus in the average price. And last but not least, this effect is increasing in our measure for the degree of competition between retailers  $\varepsilon$ . If  $\varepsilon$  is large, mark-ups in retailing are small, and this leads to a higher pass-through of cost increases into retail prices.

Without retailers, the direct effect would be the only effect that matters for domestic outputs. With retailers, however, there is also an indirect effect. The indirect effect works through changes in  $\varepsilon$ :

$$\frac{\partial q_d}{\partial \varepsilon} \frac{d\varepsilon}{dc_F} = -\frac{2q_d Q_F}{F_\varepsilon(\varepsilon) \tau} < 0 \quad (30)$$

The increase in the tariff on foreign varieties is partly passed on to consumers, leading to higher retail prices, lower consumer demand, and thus lower profits from individual customers. As a consequence, retailers care less about attracting customers (the extensive margin) and more about increasing their profits on the intensive margin by raising their mark-ups. This leads to higher prices across the product range and tends to lower demand for domestic varieties as well. This effect is decreasing in  $\varepsilon$  ( $F_{\varepsilon\varepsilon} > 0$ ) and hence in the degree of competition between retailers. If  $\varepsilon$  is low, competition in retailing is low, and this gives retailers more scope to raise their mark-ups.

The indirect effect depends also positively on the outputs of the domestic product  $q_d$  and the aggregate outputs of all foreign varieties  $Q_F$ . The dependence on  $Q_F$  is straightforward: If aggregate output of all varieties subject to the tariff is large, the cost increase affects a larger share of the retailers' sales. As a consequence, the mark-up response of the retailer is more pronounced. The output of the domestic product  $q_d$  plays a role because it has an influence on the change in its mark-up. The change in the markup on a domestic variety can be calculated from (16):

$$\frac{d\zeta_i}{dc_F} = \frac{\partial \zeta_i}{\partial \varepsilon} \frac{d\varepsilon}{dc_F} = \frac{(\alpha - c_i)}{(2 - \varepsilon)} \frac{2}{F_\varepsilon(\varepsilon)} \frac{Q_F}{\tau} > 0. \quad (31)$$

This equation shows that mark-ups of low-cost products respond stronger to changes in the competition among retailers:  $d\zeta_i/dc_F > d\zeta_j/dc_F$  if  $c_j < c_i$ . Consequently, this effect is more pronounced for larger outputs.

The discussion of the role of outputs for the indirect effect implies that this effect is large (and more likely to dominate) if (i) the marginal cost of the domestic product is small, and

if (ii) the average cost of all foreign varieties subject to the tariff is small. Put differently, the output of a domestic variety is more likely to fall in response to a tariff if this domestic variety and the foreign varieties subject to the tariff are very efficient.<sup>7</sup> It is noteworthy that this is *not* a statement relating to the degree of heterogeneity. In fact, heterogeneity (of products or costs) is not a necessary condition for a negative response of domestic output. The only thing that matters for the indirect mark-up effect is the absolute level of costs, and it does not disappear if products are symmetric. The retailer raises its mark-up on all domestic varieties (see equation 31), and the size of this increase is larger for low-cost products.

The role of the procurement cost of the domestic variety for the effect of a tariff on this variety is illustrated in Figure 3. Since the cost of the domestic varieties does not change, any change in output is entirely driven by changes in the residual demand for a domestic variety. Figure 3 depicts the inverse residual demand  $c_i(q_i)$  facing an individual domestic manufacturer. To keep notation simply, we define  $\xi \equiv \eta N / (\eta N + \gamma)$ . The direct (relative cost) effect leads to a parallel shift outwards of the residual demand function. This is the demand enhancing effect. The fact that it is a parallel shift implies that outputs at all levels of costs are affected in the same way. The indirect (retail mark-up) effect leads to a clockwise rotation of the demand function. Higher mark-ups in retailing make demand for manufactured goods more price elastic, and this reduces the slope of the demand function. The fact that the demand function is rotated implies that this effect is strongest for low levels of costs. Figure 3 illustrates how demand is then shifted inwards for low-cost goods and outwards for high-cost goods.

Regarding the role of heterogeneity, we can show that a larger heterogeneity of manufacturing prices (a mean-preserving spread of costs  $c$ ) makes a negative impact on domestic products less likely. We know from (20) that  $\varepsilon$  is increasing in  $\sigma_c^2$ . And our discussion of the direct and the indirect effect above revealed that a higher  $\varepsilon$  boosts the direct effect

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<sup>7</sup>This is an important consideration given the results of the heterogeneous firm literature (e.g. Melitz 2003) that more productive firms with relatively higher output are the firms that tend to export.

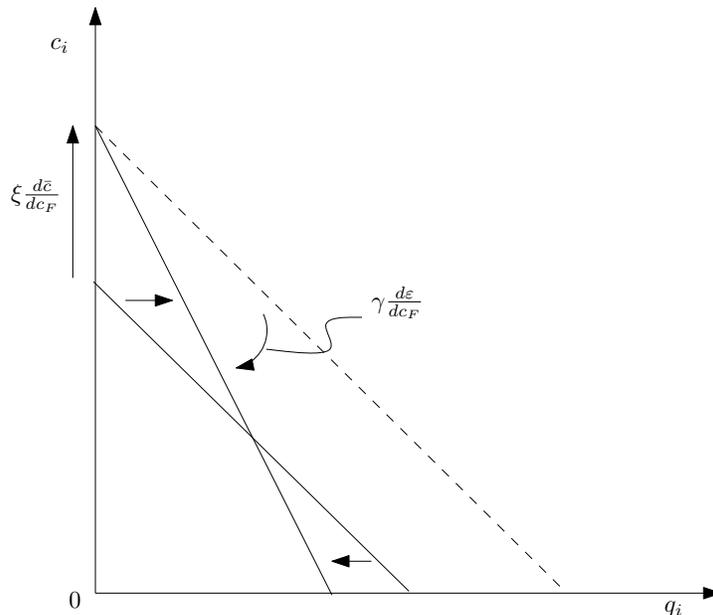


Figure 3:  $c_i = (1 - \xi)\alpha + \xi\bar{c} - (2 - \varepsilon)\gamma q_i$

and reduces the indirect effect. Therefore, if  $\sigma_c^2$  is high, the direct effect is more likely to dominate, and domestic output is more likely to increase in response to a tariff. The reason for this is that a mean-preserving spread in  $c$  increases competition between retailers (see discussion above following equation 20), and a larger amount of competition reduces the scope for mark-up adjustments in retailing.

The last factor that matters for the inequality in (27) is the cost to travel to a retailer  $\tau$ . This parameter actually has two counteracting effects on  $dq_d/dc_F$ : On the one hand, a larger  $\tau$  reduces competition between retailers because it becomes more costly for consumers to travel. This tends to raise mark-ups in retailing and to enable retailers to adjust their mark-ups more actively. In equation (20),  $\varepsilon$  depends negatively on  $\tau$ . On the other hand, a higher  $\tau$  reduces the importance of the extensive margin for retailers because it becomes harder to attract new customers that live further away. As a consequence, the indirect mark-up effect becomes smaller. From equation (25) we see that  $d\varepsilon/dc_F$  is decreasing in  $\tau$ .

As a consequence of these two effects, the relation between  $dq_d/dc_F$  and  $\tau$  is u-shaped and has a minimum at the level of  $\tau^*$  that corresponds to  $\varepsilon^*(\tau^*) = 2 - \sqrt{2} \approx 0.59$ .<sup>8</sup> The

<sup>8</sup>Too see this solve (23) for  $\tau$  and substitute this and (22) into (27). Then, the right hand side of (27)

fact that the optimal  $\tau^*$  places  $\varepsilon^*$  roughly in the middle, just a bit on the elastic side, underlines our argument that the extensive margin is important. In the two extreme cases where  $\tau$  goes to zero or to infinity, the market structure in retailing approaches perfect competition or monopoly. In perfect competition, the extensive margin is perfectly elastic, and retailers cannot charge any mark-ups. In monopoly, the extensive margin is perfectly inelastic, allowing retailers to maximize profits on the intensive margin alone. The following proposition summarizes our findings:

**Proposition 1.** *With imperfect (spatial) competition in retailing, a tariff on foreign products leads to higher mark-ups in retailing. This increase in retail mark-ups reduces demand for domestic varieties and can even dominate the conventional substitution effect. A negative impact on domestic sales is more likely if*

- $\gamma$  is large and  $\eta$  is small for given levels of output,
- the tariff applies to only a small subset of products within the retailers product range,
- average costs of foreign varieties and the costs of the domestic variety are low,
- cost heterogeneity is small, and
- travel costs to retailers are medium.

## 5 Conclusion

In this paper we set out to make a straightforward but important point; mainly that the added level of competition between retailers has a significant effect on how tariffs (or other cost shocks) get passed through onto other goods. The basic intuition is that retailers compete over the entire price distribution of a basket of goods in order to attract consumers who can be expressed as  $\varepsilon(1-\varepsilon)(2\varepsilon^2-3\varepsilon+2)^{-1}\Psi$ , where  $\Psi$  is a constant. This expression has a maximum at  $\varepsilon^* = 2 - \sqrt{2}$ .

prefer “one-stop shopping” and thus adjust all prices in response to a cost shock. The extent to which there are the cross-price effects are captured by our measure of competitiveness ( $\varepsilon$ ); i.e. the ease in which a retailer can maintain its consumer base. This is different than the cannibalization effect outlined in the multi-product firm literature.

There are two main takeaways from our analysis. The first and most surprising is that it is possible for some domestic manufacturers to actually be made worse off as a result of a supposed protectionist trade policy. This runs counter to the standard reasoning that raising the costs of a competitor automatically benefits a firm. The second and more robust result is that retailers do not adjust their markups uniformly and any benefits of trade protection are biased towards the least productive domestic firms. This certainly has implications for a government trying to maximize domestic welfare. The market structure and strategic interaction between retailers and manufacturers is obviously complicated and much more analysis is required. By allowing retailers to compete over the consumer base, we highlight the importance of understanding the role of retailers in the effectiveness of trade policy.

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# A Appendix

## A.1 Endogenous Mark-ups in Manufacturing

In this section we want to show that our main result holds if manufacturing firms choose their mark-ups endogenously. Profits of manufacturing firms are given by

$$\pi_m = (c_i - \kappa_i - t_i) q_i,$$

where  $c_i$  is the price charge by the manufacturing,  $\kappa_i$  is its marginal production costs, and  $t_i$  is the tariff. The manufacturer takes the retail mark-up as given and chooses the profit maximizing price  $c_i$  subject to the demand constraint

$$q_i = (2 - \varepsilon)^{-1} \frac{1}{\gamma} \left[ \frac{\gamma}{\eta N + \gamma} \alpha - c_i + \frac{\eta N}{\eta N + \gamma} \bar{c} \right].$$

The profit maximizing price is

$$c_i = \frac{1}{2} \left( \frac{\gamma}{\eta N + \gamma} \alpha + \frac{\eta N}{\eta N + \gamma} \bar{c} + \kappa_i + t_i \right).$$

This price depends on a tariff on this product  $t_i$ , but it also depends on the average price of all competing products  $\bar{c}$ . Hence,

$$\frac{dc_i}{dt_i} = \frac{1}{2} \left( \frac{\eta N}{\eta N + \gamma} \frac{d\bar{c}}{dt_i} + 1 \right) > 0$$

and

$$\frac{dc_i}{dt_j} = \frac{1}{2} \frac{\eta N}{\eta N + \gamma} \frac{d\bar{c}}{dt_j} > 0.$$

In order to calculate  $d\bar{c}/dt_j$  we aggregate over all  $c_i$  (keeping in mind that a tariff applies

only to foreign products). We obtain

$$\bar{c} = \frac{\gamma}{\eta N + 2\gamma} \alpha + \frac{\eta N + \gamma}{\eta N + 2\gamma} \left( \bar{\kappa} + \frac{N_F t}{N} \right).$$

Plugging  $c_i$  and  $\bar{c}$  into  $q_i$  and taking the derivative for a domestic product yields

$$(2 - \varepsilon) \frac{dq_d}{dt} = \frac{1}{2} \frac{\eta N_F}{\gamma (\eta N + 2\gamma)} + q_d \frac{d\varepsilon}{dt}.$$

Comparing this equation with equation (24) shows the direct substitution effect is smaller in this extension because domestic manufacturers raise their prices in response to the increase in average prices:

$$\frac{1}{2} \frac{\eta N_F}{\gamma (\eta N + 2\gamma)} < \frac{\eta N_F}{\gamma (\eta N + \gamma)}.$$

Since equation (21) is unaffected by this extension, our main result continues to hold.

## A.2 Endogenous Product Range

In this section we want to show that our main result holds if the retailer chooses its product range endogenously. Given our profit function, the first order condition for an optimal product range of retailer  $L$  is:

$$\frac{d\pi_L}{dN_L} = M \hat{\delta}_L (p_N - c_N) q_N + M \frac{d\hat{\delta}_L}{dN_L} \Upsilon_L = 0,$$

where the index  $N$  denotes the last product added to the product range. If the products differ in their marginal costs, we assume that a retailer adds products to its product range in the order of their marginal costs, beginning with the product with the lowest marginal costs. This implies that  $dc_N/dN \geq 0$ .

The first order condition is

$$\hat{\delta}_L(p_N - c_N)q_N + \frac{d\hat{\delta}_L}{dN_L}\Upsilon_L = 0.$$

The expression  $d\hat{\delta}_L/dN_L$  can be calculated from (6):

$$\frac{d\delta_L}{dN_L} = \frac{1}{4\tau\gamma} \left( \frac{\gamma}{\eta N_L + \gamma} (\alpha - \bar{p}_L) - (p_N - \bar{p}) \right)^2 = \frac{\gamma}{4\tau} q_N^2.$$

Putting this into our first order condition above shows that the retailer adds products to its assortment until the optimal output of the final variety is just equal to zero:  $q_N = 0$ . This implies that the marginal effect of changes in the size of a retailer's assortment on either its catchment area  $\delta$  or on the profits per consumer  $\Upsilon$  is also zero:

$$\begin{aligned} \frac{d\delta_L}{dN_L} &= \frac{\gamma}{4\tau} q_N^2 = 0 \\ \frac{d\Upsilon_L}{dN_L} &= (p_N - c_N) q_N = 0. \end{aligned}$$

Consequently, small changes in  $N$  do not affect the elasticity of the extensive margin  $\varepsilon \propto \Upsilon/\hat{\delta}$  and have, therefore, no effect on the mark-ups charged by the retailer. This implies that our main result is unaffected by this additional margin of adjustment.