

Tariffs and Markups in Retailing^{*}

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Abstract

Conventional wisdom suggests that domestic manufacturers benefit from cost advantages vis-à-vis their foreign rivals. Tariffs on imported products or exchange rate depreciations are typically expected to raise relative prices of foreign goods and shift residual demands of domestic substitutes outwards. Here we show that these changes in wholesale/manufacturing prices can be offset and even dominated by adjustments in retail mark-ups. Retailers have an incentive to charge the highest mark-ups for low-cost products, and to adjust the mark-ups on these products most actively. Thus, if the procurement costs of some foreign products rises, retailers will shift these cost increases towards the most efficient domestic products thereby mitigating the benefits of a protectionist tariff. We show that this effect can dominate the traditional substitution effect.

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1 Introduction

Recent empirical evidence suggests that wholesalers and retailers play an active role in international trade (Blum et al. 2010, Bernard et al. 2010, and Francois and Wooton 2010). This evidence is noteworthy because most studies on the gains from international trade focus exclusively on adjustments in the manufacturing sector. But with an extra layer of firms between manufacturers and consumers, the issue of the pass-through of price changes from global markets to local consumers becomes important.

In this paper we examine the role of the retailer pass-through for one of the key questions in international trade: How are domestic firms affected when foreign firms become less competitive due to exogenous changes in costs. Most importantly, this question relates to the effects of tariffs, but also applies to other cost changes that affect primarily foreign producers, such as changes in real exchange rates or foreign wages. Conventional wisdom suggests that domestic manufacturers benefit from a tariff on the products of foreign competitors. The intuition is that domestic consumers will shift their expenditures towards domestic products because their relative price has fallen (substitution effect). 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.

Here we show that the validity of this argument depends crucially on the market structure in the retail sector and on how retailers adjust their mark-ups. In particular, we show that the demand for domestic products can actually go down when wholesale prices of foreign varieties increase and that this outcome is most likely for the most efficient domestic products. For this question, the focus is not on the direct pass-through, i.e. the effect of cost changes on the prices of goods affected directly by the cost change. The focus is on the indirect pass-through, i.e. on the prices of goods not directly affected by the cost shock. We will show that retailers have an incentive to adjust the mark-ups of all products in their portfolio

in response to changes in wholesale prices even if it is only a subset of wholesale prices that actually change. And we will show that this retail mark-up effect works in the opposite direction of the traditional substitution effect and can even dominate it.

Our model provides an explanation for why domestic manufacturers are affected in ambiguous ways by foreign cost shocks. The most direct evidence for this is presented by Hellerstein (2009). She studies the effect of exchange rate shocks on retail prices of beer and finds that adjustments in retail mark-ups are an important part of the pass-through. While her focus is on the direct pass-through, she does report ambiguous effects of a currency depreciation on the sales of domestic manufacturers (Hellerstein, 2009, table 7). There is also evidence for the indirect pass-through from the marketing literature. Besanko et al. (2005) provides evidence for the importance of adjustments in retail mark-ups across brands. They study how changes in wholesale prices (trade promotions) are passed on to consumers and how it affects retail prices of competing brands. They find mixed signs (28% positive, 35% negative, 37% zero), and report that the likelihood of a positive cross-brand pass-through is larger for larger competing brands.¹ These papers attribute this ambiguity to a combination of different elasticities of substitution and strategic interactions between manufacturers and retailers.

We take a different route. In our framework retailers sell a bundle of products and compete in a Hotelling way against other retailers for spatially differentiated consumers. Consumers have quasi-linear preferences with identical elasticities of substitution and care about prices and distance to the next retail outlet. As a consequence, retail outlets enjoy some local geographical monopoly power that allows them to raise the retail price above wholesale prices. In this setup, the optimal pricing decision of retailers is a trade-off between exploiting the local monopoly power by raising prices, and expanding their catchment areas by lowering prices. This trade-off is determined endogenously and depends, among other things, on the set of wholesale prices. We will show that in this setup retailers charge

¹Their results are supported by Dubé and Gubta (2008) responding to criticism by McAlister (2007).

product-specific mark-ups, and adjust their mark-ups for each product differently. As a consequence, the effect of foreign cost shocks on domestic varieties depends on the (traditional) substitution effect and on the retail mark-up effect. Our most important result is that the retail mark-up effect can dominate the substitution effect and that it is more likely to dominate for the most efficient domestic varieties. However, regardless of whether the retail mark-up effect dominates, it is still present which mitigates the benefits to domestic firms from trade protection.

Our paper contributes to the growing literature on mark-up effects and pass-through in global markets. One branch of this literature analyzes the importance of demand curvature for the pass-through of costs into prices (see Weyl and Fabinger, 2013, and Mrázová and Neary, 2014, for recent contributions). This literature emphasizes that the size of the pass-through depends on the convexity of the demand function and is incomplete if the demand function is less than log-convex. This also applies to multi-product manufacturing firms (Eckel and Neary, 2010; Amir et al., forthcoming; Mayer et al. 2014; De Loecker et al., 2014; Armstrong and Vickers, 2016).

There is also a growing literature on the role of retailers' mark-ups in global markets. Nakamura and Zerom (2010) study pass-through in the coffee market and provide evidence for the importance of mark-up adjustments and local costs for retail coffee prices. Hellerstein (2009) provides evidence for the importance of adjustments in retail mark-ups in the beer market. And 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. On the theory side, Raff and Schmitt (2012) 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. Finally, Moorthy (2005) shows how the cross-brand pass-through can be divided into a negative demand substitution force and positive strategic complementarity force, and

that the strategic effect is larger in the presence of competition in the retail sector.

Our paper emphasizes that a positive cross-product price effect is a necessary condition for a negative demand effect, but it is not sufficient. In fact, the strategic complementarity effect alone cannot deliver a negative demand effect because it is based on an outward shift of residual demands, leading to an increase of both prices and outputs. We go one step further: We switch off the strategic effect in our model and show that even without strategic interactions, market demand for domestic products can go down when wholesale prices of foreign products rise. The key to this result is the fact that retailers re-evaluate the trade-off between the extensive margin (attracting new customers) and the intensive margin (raising profits from existing customers), and shift relative mark-ups away from more expensive products and charge higher mark-ups on products that have become relatively less expensive.

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. Section 5 provides a generalization of our results. Finally, Section 6 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, τd_h^2 where d_h is the distance traveled to retailer h and τ 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 receive 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 $\gamma > \eta > 0$ and N is the number of varieties available at each retailer which we assume to be fixed and identical.² 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

²We discuss the rationale for assuming $N_L = N_R = N$ in our treatment of retailers.

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 visit a retailer) 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 charged 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 the 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 retailers 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 levied on product i affect the retailers’ procurement costs we assume that

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

The first assumption ($dc_i/dt_i > 0$) is very general.³ 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 ($dc_j/dt_i = 0 \quad \forall i \neq j$) 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

³This is also consistent with the empirical literature; see Levinsohn (1993), Harrison (1994), and De Loecker et al. (2012).

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

$$\pi_L = M\hat{\delta}\Upsilon_L \tag{10}$$

where

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

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 .⁴ 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

⁴In the Appendix, we show that the second order conditions are satisfied for maximum given our assumption that η , γ , and N are strictly positive.

$\bar{p} = (\alpha + \bar{c})/2$. 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:⁵

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

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 and the average price:

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

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

Note that the prices are a weighted average of α 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 ε plays an important role and measures the relative value of the elasticity of the exten-

⁵Note that $\frac{Q}{N} = \bar{q} = \frac{(\alpha - \bar{p})}{\eta N + \gamma}$.

sive 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 one 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 that 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).⁶ 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 Υ , 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

⁶Amir et al. (forthcoming) illustrates that there are no cross-cost pass-through in a model with a multi-product monopolist and quadratic utility. Armstrong and Vickers (2016) provides a general model of pass-through for a multi-product monopolist and shows for a large class of utility functions there is no cross-cost pass-through.

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, ε , 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 compe-

tition 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 ε), 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 ε . 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 ε : $\psi(\varepsilon) = \varepsilon/(2 - \varepsilon)$, $\psi(0) = 0$, 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 ε than mark-ups for high-cost goods.

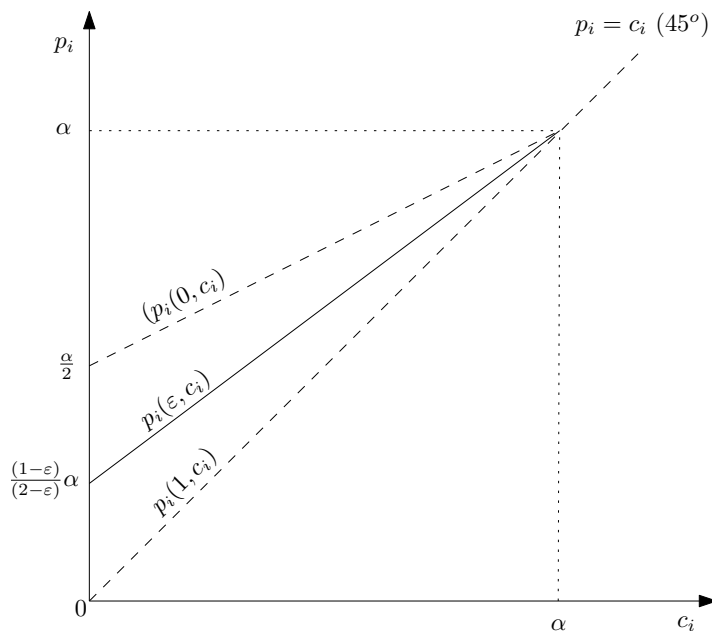


Figure 1: $p_i(\varepsilon, c_i) = \frac{(1-\varepsilon)\alpha + c_i}{2-\varepsilon}$

It is important to recall that ε is determined by parameters, but perhaps more importantly the moments of the cost distribution as well. This means that the markups (and 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 ε in equilibrium. Use our equilibrium prices, (14) and (15), and evaluate ε 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

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

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 ε , so that (20) uniquely determines ε .

Equation (20) clearly shows that $\varepsilon = \Upsilon/\tau$ is increasing in σ_c^2 , even if \bar{c} remains constant. A higher variance in costs leads to a higher variance in prices, and this raises ε because it leads to higher profits per consumer Υ . 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.⁷ 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

⁷At 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).

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 ε , ε is increasing in outputs (both individual q_i and aggregate Q , weighted by the respective substitution parameters γ and η) and decreasing in the retail travel costs τ . 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 ε). But if travel costs between retailers are high (high τ), 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 ε) in order to squeeze more profits out of inframarginal consumers. We summarize the effect of all the parameters on ε in the following lemma.

Lemma 1. *The measure of competitiveness depends positively with respect to increases in σ_c^2 , η , τ , α , and N , and decreases in γ and \bar{c} .*

Proof.

$$\begin{aligned} \frac{d\varepsilon}{d\sigma_c^2} &= \frac{N}{F_\varepsilon(\varepsilon)\tau\gamma} > 0 & \frac{d\varepsilon}{d\eta} &= \frac{1}{F_\varepsilon(\varepsilon)\tau} \left[\frac{N(\alpha - \bar{c})}{(\eta N + \gamma)} \right]^2 > 0 \\ \frac{d\varepsilon}{d\tau} &= \frac{F(\varepsilon)}{\tau F_\varepsilon(\varepsilon)} > 0 & \frac{d\varepsilon}{d\gamma} &= \frac{-1}{F_\varepsilon(\varepsilon)} \left[\frac{(\alpha - \bar{c})^2}{(\eta N + \gamma)^2} + \frac{\sigma_c^2}{\gamma^2} \right] \frac{N}{\tau} < 0 \\ \frac{d\varepsilon}{d\alpha} &= \frac{N}{\tau F_\varepsilon(\varepsilon)} \left[\frac{2(\alpha - \bar{c})}{\eta N + \gamma} \right] > 0 & \frac{d\varepsilon}{d\bar{c}} &= \frac{-N}{\tau F_\varepsilon(\varepsilon)} \left[\frac{2(\alpha - \bar{c})}{\eta N + \gamma} \right] < 0 \\ \frac{d\varepsilon}{dN} &= \frac{1}{\gamma\tau F_\varepsilon(\varepsilon)} \left[\left(\frac{(N\eta + \gamma - \eta)\gamma(\alpha - \bar{c})^2}{(\eta N + \gamma)^2} \right) + \sigma_c^2 \right] > 0. \end{aligned}$$

□

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 single foreign variety (indexed by F).⁸ 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:⁹

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

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

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

Finally, using these two comparative statics, we can write down the change in domestic output with respect to the foreign varieties' cost:

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

⁸Again, we are focused on a change in cost due to a tariff, however our analysis holds for any reason the cost of a variety would change; e.g. exchange rate changes or even domestic policy affecting domestic goods.

⁹For exposition, we suppress the term dc_F/dt as this will not change the qualitative results.

This is our main equation of analysis and we can establish the following proposition:

Proposition 1. *The effect of a tariff depends on two counteracting effects: A direct substitution effect and an indirect retail mark-up effect. The direct substitution effect tends to increase the output of domestic varieties and the indirect retail mark-up effect tends to decrease demand for domestic varieties.*

Proof. The total effect can be decomposed into $dq_d/dc_F = (\partial q_d/\partial \bar{c})(d\bar{c}/dc_F) + (\partial q_d/\partial \varepsilon)(d\varepsilon/dc_F)$. The first term, $(\partial q_d/\partial \bar{c})(d\bar{c}/dc_F)$, isolates changes in domestic output due to changes in average costs \bar{c} . Since $\partial q_d/\partial \bar{c} = \eta N / [\gamma(2 - \varepsilon)(\eta N + \gamma)] > 0$ and $d\bar{c}/dc_F = 1/N > 0$, it follows that $(\partial q_d/\partial \bar{c})(d\bar{c}/dc_F) > 0$. The second term isolates changes in domestic output due to changes in the degree of competition between retailers ε . It is clearly negative since $\partial q_d/\partial \varepsilon = q_d/(2 - \varepsilon) > 0$ and $d\varepsilon/dc_F = -(2 - \varepsilon)2q_F/[F_\varepsilon(\varepsilon)\tau] < 0$. \square

The *direct* effect 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. It depends on how elastic demand for a domestic product responds to changes in the average price, $\partial q_d/\partial \bar{p} = \eta N \gamma^{-1}(\eta N + \gamma)^{-1}$ and on how average prices respond to changes in average costs, $\partial \bar{p}/\partial \bar{c} = (2 - \varepsilon)^{-1}$. Not surprisingly, this effect depends on the substitutability parameter η (note that η captures by how much residual demand is shifted when outputs of other varieties change, $\eta = -dp_i/dQ$): If the products are good substitutes (high η), this effect is stronger. In this case the shift of consumer demand away from the more expensive foreign products is more pronounced. Furthermore, this effect is increasing in our measure for the degree of competition between retailers ε . If ε is large, mark-ups in retailing are small, and this leads to a higher pass-through of cost increases into retail prices (higher $\partial \bar{p}/\partial \bar{c}$).

The *indirect* effect works through changes in ε : The increase in the tariff on foreign varieties is (at least partly) passed on to consumers. This leads to higher average retail prices, lower consumer demand, and consequently lower profits from individual customers

(Υ falls). 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 both foreign *and* domestic varieties. This effect is decreasing in ε ($F_{\varepsilon\varepsilon} > 0$) and hence in the degree of competition between retailers. If ε is low, competition in retailing is low, and this gives retailers more scope to raise their mark-ups.

Proposition 1 proves that the effect of a tariff on domestic output is overestimated if the retail mark-up effect is not taken into account. But we can go one step further and show under what conditions the retail mark-up effect can actually dominate the direct substitution effect and under what conditions this cannot be the case.

Proposition 2. *If the substitution parameter η is sufficiently small, the retail mark-up effect dominates the direct substitution effect.*

Proof. Let $\eta = 0$, so that $q_i = \gamma^{-1} (2 - \varepsilon)^{-1} (\alpha - c_i)$ and $F(\varepsilon) = \tau^{-1} \gamma^{-1} N [(\alpha - \bar{c})^2 + \sigma_c^2]$. Then, $\partial q_d / \partial \bar{c} = 0$ and $dq_d / dc_F < 0$. □

If η is equal to zero, all products are essentially unrelated. As a consequence, consumer demand does not depend on average prices any more, but only on the retail price of the respective product. These prices depend on the wholesale price c_i and on the retail mark-up ε : $q_i = q_i(c_i, \varepsilon)$. In this case, the direct substitution effect vanishes. The indirect retail mark-up effect is still present because profits per consumer will still go down if a subset of products is hit by a price increase. Thus, a tariff on foreign products will lead to a reduction in output of domestic varieties. By continuity, this will also hold for a neighborhood around η such that $\eta > 0$ and $0 < \varepsilon < 1$. We explore the effect of ε through travel costs in our next proposition.

Proposition 3. *If $\eta > 0$, the direct substitution effect will always dominate the retail mark-up effect if travel costs are very low ($\tau \rightarrow 0$) or very high ($\tau \rightarrow \infty$) at $\delta = 1/2$.*

Proof. Substitute $\tau = F(\varepsilon)^{-1} \gamma^{-1} N \left[\frac{\gamma}{\eta N + \gamma} (\alpha - \bar{c})^2 + \sigma_c^2 \right]$ from (23) into (26), so that the retail mark-up effect can be rewritten as

$$\left(\frac{\partial q_d}{\partial \varepsilon} \right) \left(\frac{d\varepsilon}{dc_F} \right) = - \frac{2F(\varepsilon)}{F_\varepsilon(\varepsilon)} \frac{\gamma q_F q_d}{N} \left[\frac{\gamma (\alpha - \bar{c})^2}{(\eta N + \gamma)} + \sigma_c^2 \right]^{-1}.$$

Then, if $\tau \rightarrow \infty$, it follows that $\lim_{\tau \rightarrow \infty} \varepsilon = 0$ and $F(0)/F_\varepsilon(0) = 0$, so that $(\partial q_d / \partial \varepsilon) (d\varepsilon / dc_F) = 0$ and $dq_d / dc_F > 0$. Furthermore, if $\tau \rightarrow 0$, $\lim_{\tau \rightarrow 0} \varepsilon = 1$ and $F(1)/F_\varepsilon(1) = 0$, so that again $(\partial q_d / \partial \varepsilon) (d\varepsilon / dc_F) = 0$ and $dq_d / dc_F > 0$. \square

This proposition shows that the size of the retail mark-up effect depends on the degree of competition between retailers, which in turn depends on the degree of geographical differentiation of the two retail outlets, and thus on the travel costs. If travel costs are infinite at $\delta = 1/2$ (one has to think of the travel cost function as being convex and having a vertical asymptote at $\delta = 1/2$) the two geographical markets are essentially completely segregated and there is no competition between retailers. Thus, retail mark-ups are monopoly mark-ups and depend only on the intensive margin [$\varepsilon = 0$: $p_i(0, c_i) = (\alpha + c_i) / 2$]. Consequently, there is no retail mark-up effect. If travel costs are zero, the two retail outlets are not differentiated, and the retail market is perfectly competitive. In this case, $\varepsilon = 1$ and $p_i(1, c_i) = c_i$. In this case there is also no retail mark-up effect because retailers cannot charge any mark-ups.

We can also calculate the degree of competition between retailers – expressed in $\varepsilon \in [0, 1]$ – where the retail mark-up effect is largest relative to the direct substitution effect. For this we need to take into account that the substitution effect also depends on ε through the term $(2 - \varepsilon)^{-1}$, and that in addition to the term $F(\varepsilon) F_\varepsilon(\varepsilon)^{-1}$ the two output terms q_F and q_d in the retail mark-up effect also depend on ε , so that the term to be maximized is actually $F(\varepsilon) F_\varepsilon(\varepsilon)^{-1} (2 - \varepsilon)^{-1}$. This term has a maximum at $\varepsilon^* = 2 - \sqrt{2} \approx 0.59$. Thus, if τ is such that in (23) $\varepsilon = \varepsilon^*$, the relative retail mark-up effect is largest.

We next illustrate the importance of where the domestic and foreign variety lie in the cost distribution.

Proposition 4. *The retail mark-up effect is more likely to dominate for a low-cost domestic good or if the tariff is levied on a low-cost foreign product.*

Proof. For two different domestic products q'_d and q''_d , the difference in the overall effect is $dq'_d/dc_F - dq''_d/dc_F \propto c'_d - c''_d$. Similarly, for two different foreign products this difference is $dq_d/dc'_F - dq_d/dc''_F \propto c'_F - c''_F$. Thus, dq_d/dc_F is smaller for low values of c_d and c_F . \square

The indirect retail mark-up effect depends positively on the output of the domestic product q_d and the output of the foreign variety q_F . The dependence on q_F is straightforward from (25): If the tariff base 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):

$$\frac{d\zeta_i}{dc_F} = \frac{\partial\zeta_i}{\partial\varepsilon} \frac{d\varepsilon}{dc_F} = \frac{(\alpha - c_i)}{(2 - \varepsilon)} \frac{2}{F_\varepsilon(\varepsilon)} \frac{q_F}{\tau} > 0. \quad (27)$$

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. Thus, the output of a domestic variety is more likely to fall in response to a tariff if this domestic variety or the foreign variety subject to the tariff are very efficient.¹⁰ 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 27), 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 2. Since the cost of the domestic varieties does not change,

¹⁰This 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.

any change in output is entirely driven by changes in the residual demand for a domestic variety. Figure 2 depicts the inverse residual demand $c_i(q_i)$ facing an individual domestic manufacturer. To keep notation simple, 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. Since retail mark-ups magnify changes in consumer prices in response to changes in producer prices, 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 2 illustrates how demand is then shifted inwards for low-cost goods and outwards for high-cost goods.

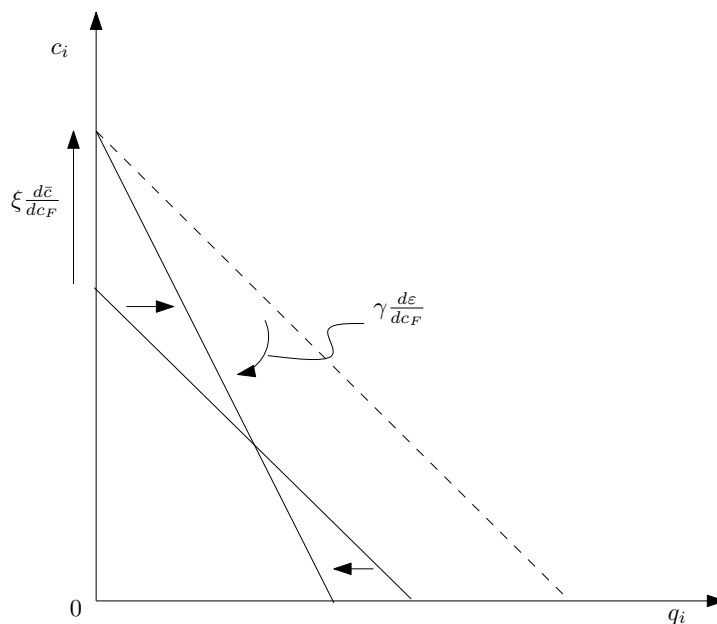


Figure 2: $c_i = (1 - \xi)\alpha + \xi\bar{c} - (2 - \varepsilon)\gamma q_i$

We next provide a fairly general parameterization in which the retail mark-up effect dominates the direct effect. From Proposition 3, it follows that this is more likely to happen when ε is medium, so for this illustration, we assume $\varepsilon = 1/2$. Furthermore, Proposition

4 shows that the retailer effect is going to be stronger for varieties with lower costs in the distribution, therefore we focus our attention on varieties with average costs to put a reasonable bound on our analysis. With these assumptions in hand, it follows that $q_d = q_F = \bar{q} = \frac{2}{3} \left[\frac{(\alpha - \bar{c})}{(\eta N + \gamma)} \right]$, $F_\varepsilon(\varepsilon) = 6$, and

$$\tau = \frac{4N}{9} \left[\frac{(\alpha - \bar{c})^2}{\eta N + \gamma} + \frac{\sigma_c^2}{\gamma} \right].$$

Therefore

$$\left. \frac{dq_d}{dc_F} \right|_{q_d=q_F=\bar{q}, \varepsilon=\frac{1}{2}} = \frac{8N}{27\tau\gamma(\eta N + \gamma)} \left[\left(\frac{2\eta N - \gamma}{2N} \right) \frac{(\alpha - \bar{c})^2}{(\eta N + \gamma)} + \frac{\eta\sigma_c^2}{\gamma} \right]. \quad (28)$$

It is clear that a necessary condition for (28) to be negative is for $2\eta N < \gamma$. This condition is in line with Proposition 2 which states the importance of η being small in order for the retail competition effect to dominate. Moreover, it is helpful for the variance of costs to be low and $(\alpha - \bar{c})$ to be high. Finally, a sufficient condition for the retail competition effect to outweigh the direct effect for varieties in which c_d and c_F are less than \bar{c} is for equation (28) to be weakly negative.

5 Generalizations

In this section we want to present some generalizations of our framework in order to understand how much of the retail mark-up effect depends on the specific assumptions about demand. Assume indirect utility at retailer h is given by the general function

$$V_h = V(\mathbf{P}_h, I, d_h) \quad (29)$$

where \mathbf{P}_h is the vector of all prices at retailer h . Then, the catchment area is determined by

$$V(\mathbf{P}_L, I, \hat{\delta}) = V(\mathbf{P}_R, I, 1 - \hat{\delta}). \quad (30)$$

Using Roy's identity, the responsiveness of this catchment area with respect to changes in individual prices can be expressed as

$$\frac{d \ln \hat{\delta}}{d \ln p_i} = -\frac{\lambda}{\nu \hat{\delta}} p_i q_i, \quad (31)$$

where λ denotes the marginal utility of income and $\nu \equiv \partial V / \partial \hat{\delta} + \partial V / \partial (1 - \hat{\delta})$ is the aggregate effect of changes in $\hat{\delta}$ on indirect utility.

The responsiveness of profits per consumer is given in general terms by

$$\frac{d \ln \Upsilon_L}{d \ln p_i} = \frac{p_i q_i}{\Upsilon_L} + \sum_{j=1}^N \frac{(p_j - c_j) q_j}{\Upsilon_L} \frac{\partial \ln q_j}{\partial \ln p_i}. \quad (32)$$

Given our definition of ε , we can express ε in general terms:

$$\varepsilon \equiv -\frac{\left. \frac{d \ln \hat{\delta}}{d \ln p_i} \right|_{\mathbf{p}=\mathbf{c}}}{\left. \frac{d \ln \Upsilon_L}{d \ln p_i} \right|_{\mathbf{p}=\mathbf{c}}} = \frac{\lambda \Upsilon_L}{\nu \hat{\delta}}. \quad (33)$$

Then, the first order condition of profit maximization can be written as

$$\frac{d \ln \Upsilon_L}{d \ln p_i} = -\frac{d \ln \hat{\delta}}{d \ln p_i} = \varepsilon \frac{p_i q_i}{\Upsilon_L} \quad (34)$$

and the output of any variety can be expressed as

$$q_i = -\frac{1}{(1 - \varepsilon)} \sum_{j=1}^N (p_j - c_j) \frac{\partial q_j}{\partial p_i}. \quad (35)$$

At this point it is noteworthy that without retail competition, the first order condition

reduces to $d \ln \Upsilon_L / d \ln p_i = 0$, or $q_i = -\sum_{j=1}^N (p_j - c_j) \partial q_j / \partial p_i$. This is equivalent to the case where $\varepsilon = 0$. Thus, when ε falls, the profit maximum requires a lower marginal profit per consumer $d \ln \Upsilon_L / d \ln p_i$ for all varieties, and since this must be falling in p_i it requires a higher p_i and consequently a lower q_i for any i . This shows that the existence of the retail mark-up effect does not depend on the specific assumptions of demand.

However, assumptions about the demand function are important when it comes to the changes in ε . Given (33), these changes depend on three parameters (in a symmetric equilibrium $\hat{\delta}$ is constant at 1/2):

$$\frac{d \ln \varepsilon}{d \ln c_F} = \frac{d \ln \lambda}{d \ln c_F} + \frac{d \ln \Upsilon_L}{d \ln c_F} - \frac{d \ln \nu}{d \ln c_F} \quad (36)$$

The first term captures how marginal utility of income λ changes. The second term is the effect of profits per consumer on ε . And the third term measures how changes in the marginal utility of travel costs affect ε .

The first term is always zero if we have quasi-linear preferences. It is also zero if the economy consists of a continuum of industries so that the effect of a cost change for individual products in only one industry does not have an impact on the aggregate income. The second term is always negative since an increase in procurement costs must reduce profits per consumer. This is the main effect driving our results. Finally, the third effect depends on the exact specification of travel costs of consumers. In our case, we assumed that this was zero. In principle, this effect can go either way, but if we assume that the disutility of travel enters the utility function in an additive separable way, this continues to hold. Thus, our result $d \ln \varepsilon / d \ln c_F < 0$ clearly hold for any quasi-linear preferences with additive separable travel costs. In other systems of demand it may hold as long as $-d \ln \Upsilon_L / d \ln c_F > d \ln \lambda / d \ln c_F - d \ln \nu / d \ln c_F$.

6 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 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 (ε); i.e. the ease in which a retailer can maintain its consumer base.

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. Though this result depends on the parameters of the model and utility, it is important to note that the presence of the retailer mark-up effect certainly dampens any potential gains to domestic firms as long as $-d \ln \Upsilon_L / d \ln c_F > d \ln \lambda / d \ln c_F - d \ln \nu / d \ln c_F$. 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. 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.

Our paper contributes to several branches of literature. Nominally, our paper is a contribution to the theory of trade policy. It is important to realize that the effect of tariffs on domestic manufacturers does not only depend on the market structure in manufacturing, but also depends on the degree of competition in retailing. Secondly, and closely related, our paper also contributes to our understanding of the effects of foreign cost shocks on domestic competitors. It is a widely held belief that lower foreign wages hurt domestic manufacturers. Again, we show that this is not necessarily true and that it depends on the degree of

competition in the retail sector. Finally, our paper contributes to a larger literature in IO and marketing on the cross-brand pass-through of wholesale prices in retailing. This literature provides empirical evidence for an ambiguous cross-brand effect, and tries to understand the sources of this ambiguity. Previous studies have focused on differences in the elasticities of substitution across products (brands) in combination with strategic interaction. This approach is difficult to implement in general equilibrium studies. We show that this ambiguity can be rationalized by profit-maximizing retailers even when all products or brands have identical elasticities of substitution.

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A Appendix

A.1 Second Order Conditions

Recall that our first order conditions are

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

Consequently, the second partial derivative is

$$\frac{\partial^2 \pi_L}{\partial p_i^2} = M \left(\Upsilon \frac{\partial^2 \hat{\delta}}{\partial p_i^2} + 2 \frac{\partial \Upsilon}{\partial p_i} \frac{\partial \hat{\delta}}{\partial p_i} + \hat{\delta} \frac{\partial^2 \Upsilon_L}{\partial p_i^2} \right)$$

where

$$\begin{aligned} \frac{\partial \hat{\delta}}{\partial p_i} &= -\frac{1}{2\tau} \frac{1}{\gamma} \left[\frac{\gamma(\alpha - \bar{p}_L)}{N\eta + \gamma} - (p_i - \bar{p}_L) \right] \\ \frac{\partial^2 \hat{\delta}}{\partial p_i^2} &= \frac{1}{2\tau} \frac{1}{\gamma} \left(1 - \frac{\eta}{N\eta + \gamma} \right) \\ \frac{\partial \Upsilon_L}{\partial p_i} &= \frac{\alpha}{N\eta + \gamma} - \frac{2p_i - c_i}{\gamma} + \frac{N\eta(2\bar{p} - \bar{c})}{(N\eta + \gamma)\gamma} \\ \frac{\partial^2 \Upsilon_L}{\partial p_i^2} &= \frac{2}{\gamma} \left(\frac{\eta}{N\eta + \gamma} - 1 \right). \end{aligned}$$

Therefore

$$\frac{\partial^2 \pi_L}{\partial p_i^2} = M \left(\frac{1}{\gamma} \hat{\delta} \left(\frac{\Upsilon}{2\tau \hat{\delta}} - 2 \right) \left(1 - \frac{\eta}{N\eta + \gamma} \right) + 2 \frac{\partial \Upsilon}{\partial p_i} \frac{\partial \hat{\delta}}{\partial p_i} \right).$$

Evaluated at the equilibrium: $\varepsilon \equiv \frac{\Upsilon}{2\tau\delta}$, $\frac{\partial\hat{\delta}}{\partial p_i} = -\frac{\hat{\delta}}{\Upsilon} \frac{\partial\Upsilon_L}{\partial p_i}$ and $\frac{\partial\Upsilon_L}{\partial p_i} = \Upsilon_L \left(\frac{q_i}{2\tau\delta} \right) > 0$, we are left with

$$\frac{\partial^2\pi_L}{\partial p_i^2} = M\hat{\delta} \left(\frac{1}{\gamma} (\varepsilon - 2) \left(1 - \frac{\eta}{N\eta + \gamma} \right) - \frac{2}{\Upsilon} \left(\frac{\partial\Upsilon_L}{\partial p_i} \right)^2 \right).$$

Since $\varepsilon \in (0, 1)$ and $\frac{\eta}{N\eta + \gamma} \in (0, 1)$ it follows that $\frac{\partial^2\pi_L}{\partial p_i^2} < 0$ and our solution is a maximum.

A.2 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, κ_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

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

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

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

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:

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

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

A.3 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):

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

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 δ or on the profits per consumer Υ 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.