International Trade with Heterogeneous Retailers[1]

Horst Raff
Institut für Volkswirtschaftslehre
Christian-Albrechts-Universität zu Kiel
24098 Kiel, Germany
Email: raff@econ-theory.uni-kiel.de

Nicolas Schmitt
Department of Economics
8888 University Drive
Simon Fraser University
Burnaby BC, V5A 1S6, Canada
Email: schmitt@sfu.ca

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Abstract

We construct a model of heterogeneous retailers to examine the effects of trade liberalization on the number and size distribution of retailers. We find that retailers selling imports become larger and more profitable while those selling domestic products become smaller and less profitable. Competition in the retail sector rises, forcing the least efficient retailers to exit the market. This raises average retail productivity.

1 Introduction

The purpose of this paper is to understand how the retailing sector responds to globalization and in particular to the increased scope to import consumer products. We are particularly interested in the effects of trade liberalization on the size of the domestic retailing sector, the number of retailers, their size distribution, the degree of competition among retailers, and on the welfare effects of these changes. To do so we build a simple model à la Melitz (2003) where retailers, not producers, are heterogenous in size.

Today the retail sector in most countries is much larger both in absolute and in relative terms than it was 50 years ago. In the US for instance, the share of employment in retailing has increased from 12.6% in 1958 to 16.4% in 2000; this corresponds to roughly a doubling of the total employment in this sector over the period (Jarmin et al., 2005). This has been accompanied by a profound modification in the structure of retail markets irrespective of the particular retail segment. For instance, while the total population in the US has increased by 56% between 1960 and 2000, the number of retail establishments serving them grew by only 17% (Jarmin et al., 2005). Not surprisingly, this is due to the growth of large national chains, using large establishments, that have displaced small single location stores. Whereas large retail firms (with at least 100 establishments) represented 18.6% of US retail sales in 1967, their share has increased to 36.9% in 1997 and the average size of these establishments is twice as large as it was 40 years ago (Jarmin et al., 2005). Overall, the retail and manufacturing sectors have similar ratios of single to multi-units firms but, not surprisingly, multi-unit retailers operate more establishments on average than multi-unit manufacturers. More significantly, the number of establishments operated by multi-unit retailers has increased dramatically between 1977 and 1997 whereas it has decreased in manufacturing during the same period.[1]

The size distribution of retail establishments also depends on market size. Campbell and Hopenhayn (2005) show that establishments tend to be larger

[1] Retail sector dynamics also reveal interesting facts. Entry and exit rates play an important role since both rates are much higher in retailing than in manufacturing (see Jarmin et al., 2004). It appears that productivity gains in retailing come almost exclusively from the entry process (Foster et al., 2006). Moreover Caves (1998) reports that, although entrants exhibit size heterogeneity at the time of entry, entry and exit are concentrated in the smallest size classes. In particular, entering firms are typically 47% smaller than the average (at the four-digit level industry).

in larger markets. The effect of market size on the dispersion of establishments' size, however, is ambiguous. The size and size distribution of retail establishments is also likely to depend on technology. That is, lower costs lead to larger estabishments. The case of Wal-Mart seems to be an extreme example where technological advantages have led to strong company growth both in absolute terms and relative to competitors. But these effects go beyond the case of a particular retailer.

However, market growth and technological progress may not be the only drivers of retail market structure and the size distribution of retailers. It is reasonable to assume that imports, by lowering retailing costs, have also played a role. If it is the case, then one should expect that retail segments where the share of large retailers is high correspond to segments where the share of imports is high as well. In many retail segments, such as electronics, computers, cameras, housewares, toys, games, clothing, and footwear, retailers in developed countries rely heavily on imports. For instance, in 2003, the share of imports in Canada was 55% for clothing, 82% for clothing accessories, 86% for footwear, 100% for audio, video, small electrical appliances, as well as for toys and games (Jacobson, 2006, Table 33). It is precisely in these sectors that the market share of large Canadian retailers is the highest: the market shares of the 80 largest retailers in 2004 represented 61% for clothing and accessories, 68% for home electronics, computers and cameras, 57% for housewares, 55% for toys and games and 49% for food. On average, this share was 27% for all the commodities sold by Canadian retailers (Jacobson, 2006, Table 6).

If it is the case that international trade has shaped the structure of retail markets and the size distribution or retailers, then these changes should also, in turn, influence the volume and structure of international trade. Large retailers, in particular, are likely to absorb a significant amount of imports. Wal-Mart again provides an extreme example: it alone accounts for 15% of total US imports from China (Basker and Van, 2007). Similarly, Javorcik, Keller and Tybout (2006) report that the main effect of Nafta on the Mexican soaps, detergents and surfactant industry was less due to the reduction in trade costs or to the entry of foreign manufacturers than to 'the fundamental change in relationship' between manufacturers and retailers once Walmex (Wal-Mart of Mexico) entered the market.

The paper continues as follows. A simple model of retailing and trade is presented in Section 2. The equilibria of the model and comparative static results are derived in Section 3. Section 4 provides Conclusions. The

Appendix contains proofs.

2 The Model

In this section, we develop a simple model of the retailing sector in one country. There is a continum of retailers, and each of them sells a single product to consumers. Whereas retailers sell only in their domestic market (their service is non-traded), they can buy the goods they distribute from local manufacturers or import them from foreign manufacturers. Producers (domestic or foreign) have no choice but to use the retailing sector to reach consumers.

From the consumer's point of view, the products are differentiated varieties indexed by $i \in \Omega$. Similar to Melitz and Ottaviano (2008), all consumers share the same utility function:

$$U = \alpha \int_{i\in\Omega} q_i^c di - \frac{1}{2}\beta \int_{i\in\Omega} (q_i^c)^2 \, di - \frac{1}{2}\gamma \left(\int_{i\in\Omega} q_i^c di \right)^2 + y, \tag{1}$$

where q_i denotes the quantity of the variety i, and y the consumption of the numeraire good. Parameter β describes the degree of substitutability between varieties. If $\beta = 0$, varieties are perfectly substitutable, and consumers care only about their total consumption level, $Q^c = \int_{i\in\Omega} q_i^c di$. The degree of differentiation between varieties increases with β. Note that we remain vague here about the nature of the differentiation. It could be due to product differentiation or to retailer differentiation through different characteristics that consumers value, such as location or different customer services. It is more natural to interpret the model as one of retailer differentiation.

Assuming that the demand for the numeraire product is positive, the inverse demand faced by each retailer i is

$$p_i = \alpha - \beta q_i - \gamma Q^c. \tag{2}$$

The market demand faced by retailer i is

$$q_i(p_i^j) \equiv L q_i^c = \frac{\alpha L}{\gamma N + \beta} - \frac{L}{\beta} p_i^j + \frac{\gamma N}{\gamma N + \beta} \frac{L}{\beta} \bar{p}, \quad \forall i \in \Omega^*, \tag{3}$$

where

$$\bar{p} = \frac{1}{N} \int_{i\in\Omega^*} p_i^j di,$$

and where subscript j indicates wether product i is a domestic ($j = D$) or an imported ($j = I$) product.

Labor, the only factor of production in this country, is inelastically supplied in a perfectly competitive market and is perfectly mobile between the production and the retailing sectors. Since the numeraire good is produced under constant returns technology at unit cost and its market is competitive, the price of labor in this economy is equal to one. The marginal cost of domestic production and of retailing corresponds therefore respectively to the number of labor units required in the production and in the retailing services of each product. We assume that the marginal cost of domestic production is w and the marginal cost of retailing is c.

Retailing involves two additional costs: a sunk (and thus irrevocable) cost of market entry, F_E, and a fixed cost of importing, F_I. This fixed cost includes the cost of maintaining buying offices, cooperating with foreign partners to source goods, acquiring information, etc. Production (domestic or foreign) involves no fixed or sunk cost but foreign production is assumed to be cheaper than domestic production. For simplicity, we normalize the marginal cost of foreign producers to zero. Importing involves however a per unit cost equal to t.

We assume that retailers first decide wether to enter the market and thus whether to incur the sunk cost F_E. Upon entering, each retailer learns about its specific level of marginal retailing cost c or, equivalently, its productivity $1/c$. We assume that the distribution of c is given by $G(c)$ with support on $[0, c_M]$. Thus, since the entry cost is sunk, only retailers able to cover their marginal cost survive and produce. All the other retailers exit the sector. As is often assumed in the literature on heterogeneity, we assume a Pareto distribution

$$G(c) = \left(\frac{c}{c_M}\right)^k$$

with $k \geq 1$. When $k = 1$, the distribution is uniform over $[0, c_M]$. As k increases, the relative number of retailers with high unit cost increases. Campbell and Hopenhayn (2005) find that there are significant productivity differences among retailers, with few big, technologically advanced firms competing with many relatively inefficient firms. This suggest that.k is rather large.

Once retailers have taken their entry decision, each retailer decides from which source to buy goods, domestic or foreign. To buy a foreign good, a retailer has to pay the additional fixed cost F_I. Hence, the surviving retailers maximize

$$(p_i^D - c - w)q_i(p_i^D) \tag{4}$$

when buying domestically and

$$(p_i^I - c - t)q_i(p_i^I) - F_I \tag{5}$$

when buying from abroad. Taking the number of retailers/products N and average price level in the retail market $\bar{p}$ as given when choosing their profit-maximizing price, it is easy to check that the profit-maximizing markups must satisfy

$$(p_i^D - c - w) = \frac{\beta}{L}q_i(p_i^D) \text{ and } (p_i^I - c - t) = \frac{\beta}{L}q_i(p_i^I),$$

where retailer i's profit-maximizing prices when buying from domestic (foreign) sources are respectively,

$$p_i^D = \frac{1}{2}\left[c + w + \frac{\beta\alpha + \gamma N\bar{p}}{\gamma N + \beta}\right] \text{ and } p_i^I = \frac{1}{2}\left[c + t + \frac{\beta\alpha + \gamma N\bar{p}}{\gamma N + \beta}\right].$$

Defining $c_D \equiv \frac{\beta\alpha+\gamma N\bar{p}}{\gamma N+\beta} - w$, the equilibrium prices and outputs of a retailer with marginal cost c are

$$p^D(c) = w + \frac{1}{2}\left[c_D + c\right]; \tag{6}$$

$$p^I(c) = \frac{1}{2}\left[c_D + w + c + t\right]; \tag{7}$$

$$q^D(c) = \frac{L}{2\beta}\left(c_D - c\right); \tag{8}$$

$$q^I(c) = \frac{L}{2\beta}\left(c_D + w - c - t\right), \tag{9}$$

and profits are

$$\pi^D(c) = \frac{L}{4\beta}\left(c_D - c\right)^2 - F_E; \tag{10}$$

$$\pi^I(c) = \frac{L}{4\beta}\left(c_D + w - c - t\right)^2 - F_E - F_I. \tag{11}$$

Figure 1 illustrates the productivity distribution in the retail sector given $k > 1$ along with the two critical thresholds c_D and c_I. Retailers whose productivity is sufficiently high ($1/c > 1/c_I$) import because $\pi^I(c) > \pi^D(c)$; retailers whose productivity is in the middle range ($1/c_D \leq 1/c \leq 1/c_I$) buy domestically produced goods because $\pi^D(c) \geq \pi^I(c)$; and retailers whose productivity is low ($1/c < 1/c_D$) are not active because they are not able to cover their variable costs.

We use this simple model to characterize equilibria in two scenarios. The first scenario is autarky equilibrium in which the retailers sell only domestic goods. The second scenario is one with arbitrary non-prohibitive trade costs in which retailers have the choice to sell either domestic or foreign products.

3 Characterization of the Equilibria

3.1 Autarky

Each retailer's entry decision is based on its expected profit $\int_0^{c_D} \pi^D(c)dG(c) - F_E$. With free entry in the retailing sector, the expected profit must be equal to zero. Thus, given (10), the free-entry condition is

$$\frac{L}{4\beta} \int_0^{c_D} (c_D - c)^2 \, dG(c) = F_E. \tag{12}$$

This condition determines the level of marginal cost, c_D, at which a retailer makes exactly zero profit. Retailers with a lower (higher) marginal cost make positive (negative) profits. Given $G(c)$, it is easy to find out that (12) implies

$$c_D = \left[\frac{2(1+k)(2+k)\beta c_M^k F_E}{L} \right]^{\frac{1}{2+k}}. \tag{13}$$

We impose $c_D < c_M$ which implies that $c_M > (2(1+k)(2+k)\beta F_E/L)^{\frac{1}{2}}$.

Note that with a marginal cost equal to or slightly less than c_D a retailer's gross profit is too small to recoup the entry cost. Since the entry cost is sunk, however, a retailer with a marginal cost less than or equal to c_D does not exit the market since he is able to cover his variable costs.

It is also useful to derive the number of retailers serving this autarkic economy. Since the marginal retailer is just indifferent between exiting and surviving, $q_i(c_D) = 0$ and $p_i(c_D) = c_D + w$ (see (6)). Combining with (3), the number of retailers is

$$N = \frac{\beta(\alpha - w - c_D)}{\gamma(w + c_D - \bar{p})}; \tag{14}$$

$$= \frac{2\beta(1+k)}{\gamma}\left[\frac{\alpha - c_D - w}{c_D}\right], \tag{15}$$

since $\overline{p} = \frac{1}{N}\int_{i\in\Omega^*} p_i^j di = w + \frac{c_D(1+2k)}{2+2k}$.

Since the average retail price (equal to the average retailing cost) is a positive function of c_D, (13) and (15) are telling us a lot about the impact of marginal changes of the exogenous variables on c_D and N. In particular, less differentiated products or retailers (lower β), lower entry cost (lower F_E), and more consumers (higher L) decrease c_D and thus average retail price. Hence, they all imply tougher competition among retailers (see (6)) and lower markups. A lower unit product cost w also leads to tougher competition (and lower $\overline{p}$) and to the entry of additional retailers (higher N).

3.2 Non-prohibitive Trade Cost

Suppose now that the barrier to trade is sufficiently low to allow for imports. The expected profit of a retailer then becomes

$$\frac{L}{4\beta}\int_0^{c_I}(c_D + w - c - t)^2\, dG(c) + \frac{L}{4\beta}\int_{c_I}^{c_D}(c_D - c)^2\, dG(c) - F_I\int_0^{c_I} dG(c) - F_E.$$

Using the Pareto distribution, the free-entry condition can then be written as:

$$\frac{c_D^{k+2}}{(k+1)(k+2)} + (w-t)c_I^k\left(\frac{w-t}{2} + c_D - \frac{kc_I}{1+k}\right) - \frac{2\beta}{L}\left(c_M^k F_E + F_I c_I^k\right) = 0. \tag{16}$$

Once the entry decision has been taken, a retailer still has to select from which source to buy its product. It is indifferent between buying at home and buying abroad if $\frac{L}{4\beta}(c_D - c)^2 = \frac{L}{4\beta}(c_D + w - c - t)^2 - F_I$ (see (10) and (11)). This condition can be rewritten as:

$$c_I - c_D - \frac{(w-t)}{2} + \frac{2\beta F_I}{L(w-t)} = 0. \tag{17}$$

We assume that $c_I \leq c_D$ so that the most inefficient surviving retailers never strictly prefer sourcing abroad. This implies that

$$\frac{L}{4\beta}(w-t)^2 \leq F_I. \tag{18}$$

We also assume that importing is more profitable to the most efficient retailers than buying domestically. Thus, at $c = 0$, we require

$$F_I < \frac{L}{4\beta}\left((w-t)^2 + 2c_D(w-t)\right). \tag{19}$$

These two assumptions together with the quadratic form of the profit function ensure that the value of c_I solving (17) is unique.

The two cut-off values of the marginal cost, c_D and c_I, are implicitly determined by (16) and (17). We can show that c_D increases and c_I decreases with t. This has the following implications:

Proposition 1 *Trade liberalization eliminates the least efficient retailers, thereby raising average retailer productivity. It induces more retailers to source goods from abroad.*

Proof: Differentiating totally (16) and (17) and using Cramer's rule (see Appendix), we find

$$\begin{aligned}\frac{dc_D}{dt} = \frac{1}{|D|}(2c_I^k\left[w-t+c_D-\frac{kc_I}{1+k}\right] \\ + kc_I^{k-1}\left[\frac{1}{2}+\frac{2\beta F_I}{L(w-t)^2}\right]\left[2(w-t)(c_D-c_I)+(w-t)^2-\frac{4\beta F_I}{L}\right]).\end{aligned}$$

Observing that (17) can be rewritten as $2(w-t)(c_D-c_I)+(w-t)^2-\frac{4\beta F_I}{L}=0$, we get:

$$\frac{dc_D}{dt} = \frac{2c_I^k}{|D|}(w-t+c_D-\frac{kc_I}{1+k}) > 0 \tag{20}$$

since $w > t$, $c_D > c_I$ and $k < 1+k$.

Similarly,

$$\begin{aligned}\frac{dc_I}{dt} = \frac{1}{|D|}(-\left[\frac{1}{2}+\frac{2\beta F_I}{L(w-t)^2}\right]\left[\frac{2c_D^{1+k}}{1+k}+2(w-t)c_I^k\right] \\ + 2c_I^{k+1}\left[c_D-\frac{kc_I}{1+k}+w-t\right]).\end{aligned}$$

Substituting $\frac{2\beta F_I}{L(w-t)^2} = \frac{1}{(w-t)}(c_D - c_I + \frac{w-t}{2})$ (see (17)) in the above expression and simplifying, we get

$$\frac{dc_I}{dt} = \frac{2}{|D|}\left\{-\frac{c_D^{1+k}}{1+k}\left[1 + \frac{c_D - c_I}{w-t}\right] + \frac{c_I^{1+k}}{1+k}\right\} < 0, \tag{21}$$

where $|D| = \frac{2c_D^{k+1}}{(k+1)} + 2(w-t)c_I^k$ (see Appendix). Note that $\frac{dc_I}{dt} < 0$ provided $c_D^{1+k}(w - t + c_D - c_I) > (w-t)c_I^{1+k}$ which holds since $w > t$ and $c_D > c_I$. ■

Thus, in terms of Figure 1, trade liberalization decreases on both ends the range of productivities over which the retailers buy domestic goods (i.e., $1/c_D$ increases and $1/c_I$ decreases). This implies that the productivity range over which retailers buy foreign products unambiguously increases.

It is now straightforward to determine how trade liberalization affects the size and the profitability of retailers. These effects summarized in the following Proposition:

Proposition 2 *With trade liberalization, retailers selling domestic products become smaller and less profitable, and retailers selling imported products become larger and more profitable.*

Proof: Differentiating (8) and (10) with respect to t and using (20), it is easy to check that, for retailers selling domestic goods,

$$\frac{dq_D}{dt} = \frac{L}{2b}\frac{dc_D}{dt} > 0 \text{ and } \frac{d\pi_D}{dt} = \frac{L}{2\beta}(c_D - c)\frac{dc_D}{dt} > 0.$$

Next, we show that $\frac{dc_D}{dt} < 1$. Rewriting and manipulating (20),

$$\frac{dc_D}{dt} = \frac{(1+k)(w-t) + c_D + k(c_D - c_I)}{(1+k)(w-t) + \frac{c_D^{1+k}}{c_I^k}}. \tag{22}$$

Thus, $\frac{dc_D}{dt} < 1$ if $c_D + k(c_D - c_I) < \frac{c_D^{1+k}}{c_I^k}$ or if $1 + k(1 - \frac{c_I}{c_D}) < \frac{c_D^k}{c_I^k}$. When $k = 1$, this inequality boils down to $(c_D - c_I)^2 > 0$ and when $k > 1$, the RHS of the above inequality increases faster than the LHS. Since $0 < \frac{dc_D}{dt} < 1$, it is easy to check that, for retailers selling imported goods,

$$\frac{dq_I}{dt} = \frac{L}{2b}\left[\frac{dc_D}{dt} - 1\right] < 0 \text{ and } \frac{d\pi_I}{dt} = \frac{L}{2\beta}(c_D + w - t - c)\left[\frac{dc_D}{dt} - 1\right] < 0.$$

■

Hence, trade liberalization creates two classes of retailers: smaller retailers selling domestic products and larger retailers selling foreign products. This has obvious effects on competition.

Proposition 3 *Trade liberalization unambiguously increases competition in the retailing sector.*

Proof: The average price among surviving retailers is $\bar{p} = \frac{1}{N}\int_{i\in\Omega^*} p_i di$. With the two types of retailers, it is equal to

$$\overline{p} = w + \frac{c_D(1+2k)}{2(1+k)} - \frac{(w-t)}{2}\frac{c_I^k}{c_D^k}. \tag{23}$$

Hence, $\overline{p}$ is unambiguously lower than its autarkic level and it converges to the autarkic level since, as t rises, c_I necessarily goes to zero (all retailers buy domestic goods). It is indeed easy to check that

$$\frac{d\overline{p}}{dt} = \left(\frac{1+2k}{2+2k}\right)\frac{dc_D}{dt} + \frac{1}{2}\frac{c_I^k}{c_D^k} + \frac{k(w-t)}{2}\frac{c_I^k}{c_D^k}\left[\frac{1}{c_D}\frac{dc_D}{dt} - \frac{1}{c_I}\frac{dc_I}{dt}\right] > 0, \tag{24}$$

since all the terms on the RHS are positive. Note that the increased competition affects all the retailers since

$$\frac{dp_D}{dt} = \frac{1}{2}\frac{dc_D}{dt} > 0 \text{ and } \frac{dp_I}{dt} = \frac{1}{2}\left[\frac{dc_D}{dt} + 1\right] > 0.$$

■

With imports, the number of retailers/varieties is still determined by (14) but both c_D and $\overline{p}$ take now different values than in autarky. It can be checked that

$$sign\frac{dN}{dt} = sign\left\{(\overline{p} - \alpha)\frac{dc_D}{dt} + (\alpha - w - c_D)\frac{d\overline{p}}{dt}\right\}. \tag{25}$$

The first expression is negative (since $\overline{p} < \alpha$) and the second expression is positive so that the sign of $\frac{dN}{dt}$ is ambiguous. However, we can show that:

Proposition 4 *When t is near its prohibitive level, the number of retailers unambiguously increases with trade liberalization. For lower values of t, the effect on the number of retailers is generally ambiguous. However, if k is sufficiently high and/or if t is sufficiently low, the number of retailers decreases with trade liberalization.*

Proof: When t is near its prohibitive level, $\overline{p} = w + \frac{c_D(1+2k)}{2(1+k)}$ and $\frac{d\overline{p}}{dt} = \left(\frac{1+2k}{2+2k}\right)\frac{dc_D}{dt}$ (since $c_I = 0$). Substituting these expressions into (25), we get

$$sign\frac{dN}{dt} = sign\left\{(w-\alpha)\frac{dc_D}{dt}\right\} < 0. \tag{26}$$

For arbitrary t,

$$sign\frac{dN}{dt} = sign\{\left(\frac{w-\alpha}{2+2k}\right)\frac{dc_D}{dt} + \left(\frac{w-t}{2}\right)\frac{c_I^k}{c_D^k}\left(\frac{k(\alpha-w-c_D)}{c_D} - 1\right)\frac{dc_D}{dt}$$
$$+\frac{(\alpha-w-c_D)}{2}\frac{c_I^k}{c_D^k} - \frac{(\alpha-w-c_D)}{c_I}\frac{c_I^k}{c_D^k}\left(\frac{w-t}{2}\right)\frac{dc_I}{dt}.$$

Only the first term is unambiguously negative and its weight in the sum quickly decreases with higher values of k. Since the second term is positive when k is large and the last two terms are unambiguously positive, we conclude that $sign\frac{dN}{dt} > 0$ when k is sufficiently high. Next, observe that the weight on all the terms but the first one increases with lower t. This is the case not only because lower t increases directly the weight of the second and fourth terms, but also because c_D falls and c_I/c_D increases with lower t. Hence, if the number of retailers decreases with trade liberalization, it requires a sufficiently low value of t. ■

Hence, we conclude that trade liberalization either increases the number of retailers thoughout the range of non-prohibitive barriers to trade (because k is low enough), in which case the rate of this change decreases with lower t. Or, more likely, trade liberalization first leads to an increase and then to a decrease in the number of retailers.

The indirect utility function to evaluate welfare is

$$U = I + \frac{1}{2}\left(\gamma + \frac{\beta}{N}\right)^{-1}(\alpha - \bar{p})^2 + \frac{1}{2}\frac{N}{\beta}\sigma_p^2 \tag{27}$$

Using (14) to substitute for N, we obtain

$$U = I + \frac{(\alpha - w - c_D)}{2\gamma}\left(\alpha - \overline{p} + \frac{\sigma_p^2}{w + c_D - \overline{p}}\right). \tag{28}$$

How does trade liberalization affect social welfare? First, since $\frac{dc_D}{dt} > 0$ and $\frac{d\overline{p}}{dt} > 0$, note that $(\alpha - w - c_D)(\alpha - \overline{p})$ unambiguously increases with lower

t. Second, defining $f = (\alpha - w - c_D)/(w + c_D - \overline{p})$, it is easy to check that $sign(df/dt) = sign\{\overline{p}(dc_D/dt) + (\alpha - w - c_D)(d\overline{p}/dt)\} > 0$. Thus, given σ_p^2 held constant, this second effect of a decrease in t runs against the first one.

Third, the variance of retail prices is

$$\sigma_p^2 = \frac{1}{N}\left\{\int_{i\in\Omega_I}(p_i^I - \overline{p})^2 di + \int_{i\in\Omega_D}^{c_D}(p_i^D - \overline{p})^2 di\right\}, \tag{29}$$

where Ω_I (Ω_D) is the set of retailers selling imported (domestic) products. It can be checked that

$$\sigma_p^2 = \frac{(w-t)}{2}\left\{\frac{(w-t)}{2}\left(1 - \frac{c_I^k}{c_D^k}\right) + \frac{c_D - c_I}{1+k}\right\}\frac{c_I^k}{c_D^k} + \frac{kc_D^2}{4(2+k)(1+k)^2}. \tag{30}$$

Note the following points about the variance. First, in autarky, the variance of retail prices is equal to the last term of (30). Since the first two terms are positive for a positive non-prohibitive barrier to trade (since $c_D > c_I$ and $w > t$), the variance of prices is higher with restricted trade than without trade.[2] Second, the variance of prices has an inverted U-shaped form with respect to the non-prohibitive barrier to trade. To see this, consider t approaching autarky (from non-prohibitive level). In this case, c_I^k/c_D^k converges to zero so that the variance converges to its autarkic level. As t approaches free trade, c_I^k/c_D^k increases but now the two terms in the curled bracket decreases. They converge to zero when the parameters are such that c_I exactly converges to c_D as t approaches zero (see (18)). We conclude that *the variance of retail prices is not lower with trade than it is without trade. Moreover, with trade liberalization, the variance of retail prices increases when t is high and decreases when t is low.*

This makes intuitive sense. Trade liberalization creates two types of retailers: those who import and those who do not. Because it is the more efficient retailers who import, the ability to import give them a competitive advantage with respect to those who do not. At the margin, this must increase the price difference between importers and non-importers and thus the variance of retail prices. When trade liberalization reaches more and more retailers (i.e., more retailers import), this effect must decrease. Indeed if all the retailers import, the price difference among them must reflect the

[2] This statement assumes that the direct effects through the first two terms is greater than the indirect effect of lower c_D associated with lower t.

difference in technology only and thus the same variation as in autarky given a Pareto distribution.

The above remarks suggest that several contradictory forces are at play and that it the welfare effects of trade liberalization are generally ambigous.

4 Conclusions

This paper examined how trade liberalization changes the number and the size distribution of retailers and how this affects average retail prices and social welfare....

5 Appendix

Totally differentiating (**??**) and (17), we have

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} dc_D \\ dc_I \end{pmatrix} = \begin{pmatrix} b_1 \\ b_2 \end{pmatrix} dt,$$

where

$$\begin{aligned} a_{11} &= \frac{2c_D^{k+1}}{(k+1)} + 2(w-t)c_I^k \\ a_{12} &= kc_I^{k-1}\left[2(w-t)\left(c_D - c_I\right) + (w-t)^2 - \frac{4\beta}{L}F_I\right] \\ a_{21} &= -1 \\ a_{22} &= 1 \end{aligned}$$

and

$$\begin{aligned} b_1 &= 2c_I^k\left[w - t + c_D - \frac{kc_I}{k+1}\right] \\ b_2 &= -\frac{1}{2} - \frac{2\beta F_I}{L(w-t)^2} \end{aligned}$$

Let $|D|$ be the determinant of the matrix, i.e., $|D| = a_{11}a_{22} - a_{21}a_{12}$:

$$|D| = \frac{2c_D^{k+1}}{(k+1)} + 2(w-t)(1-k)c_I^k + kc_I^{k-1}\left((w-t)^2 + 2c_D(w-t) - \frac{4\beta}{L}F_I\right).$$

Using (17), it can be rewritten as

$$|D| = \frac{2c_D^{k+1}}{(k+1)} + 2(w-t)c_I^k > 0.$$

Using Cramer's Rule, we have

$$\frac{dc_D}{dt} = \frac{1}{|D|}\begin{vmatrix} b_1 & a_{12} \\ b_2 & a_{22} \end{vmatrix}$$

and

$$\frac{dc_I}{dt} = \frac{1}{|D|}\begin{vmatrix} a_{11} & b_1 \\ a_{21} & b_2 \end{vmatrix}$$

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Figure 1: Productivity Distribution of Retailers