International Trade with Heterogeneous Retailers\textsuperscript{1}

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Abstract

We construct a model of trade with heterogeneous retailers to examine the effects of trade liberalization on the number and size distribution of retailers. We find that retailers sourcing their goods through direct imports become larger and more profitable while those sourcing domestically become smaller and less profitable. Competition and the volume of international trade in the retail sector rise, forcing the least efficient retailers to exit the market. We then apply the model to study the degree of pass-through of import into retail prices and the effect of retail market regulation. We show that the pass-through is always incomplete and that its size depends on observable industry characteristics. We also show that restrictions on the ability of the retailing industry to adjust to trade liberalization, such as through size constraints, have significant curtailing effects on retail competition and on the degree of pass-through.
1 Introduction

The purpose of this paper is to examine how the retailing sector responds to globalization and, in particular, to the increased scope to import consumer products. We are particularly interested in (i) the effects of trade liberalization on the structure of the domestic retailing sector and the degree of competition among retailers; (ii) how the structure of retail markets affects the transmission of external shocks, such as changes in exchange rates, into domestic consumer prices; and (iii) how retail market regulation affects consumer prices, imports and social welfare. To study these issues we build a simple model of international trade with heterogeneous retailers.

The structure of retail markets has changed dramatically in recent decades. Industry concentration has increased markedly, driven by the emergence of large national chains operating large establishments. This concentration process has had a significant effect on international trade, as large retailers increasingly engage in direct imports of consumer goods from low-wage countries like China. Wal-Mart provides an extreme example: it alone accounts for over 18% of total US imports from China (Broda and Romalis, 2008). Basker and Van (2008b) find that between 1997 and 2002 the biggest US retailers had a more than three times higher marginal propensity to import from China than smaller retailers. They argue that the expansion of big retailers accounts for 19% of the growth in US imports of consumer goods from China.

The strong impact of changes in retail market structure on international trade in consumer goods does not come as a surprise. Distribution margins, consisting mostly of retail costs and retailer mark-ups, typically account for 30 to 50 percent of the retail prices of these goods (Campa and Goldberg, 2006a). Any change in the cost structure and competition in the retail sector will thus have strong effects on consumer prices and hence on the demand for domestic and imported goods.

External shocks should, in turn, affect retail market structure. Since it is mostly large retailers that engage in direct importing, any reduction in import prices, whether through a reduction in trade barriers or exchange-rate movements, benefits these retailers disproportionately. By making large retailers more competitive, lower import prices tend to squeeze out smaller retailers. This will have effects on consumer prices and social welfare.

Two examples illustrate that an understanding of the interaction between international trade and retail market structure is not only of theoretical in-
terest but has direct relevance for economic policy. First, the effectiveness of monetary and exchange-rate policy depends crucially on how external shocks are passed through into consumer prices. Empirical evidence suggests that consumer prices tend to react very little to changes in import prices. In fact, this observation constitutes a major puzzle in international macroeconomics (Bacchetta and van Wincoop, 2003). Recent research on this issue (Campa and Goldberg, 2006a, 2006b; Hellerstein, 2008) implies that the retail sector plays a central role in explaining the low degree of pass-through, since distribution margins make up such a large share of consumer prices. By relating the pass-through of import prices into consumer prices to potentially observable industry characteristics such as the level of trade costs, market structure and technology, our model is able to shed some light on this so-called “exchange-rate disconnect puzzle”.

Second, some countries, including France, Belgium and Japan, have a tradition of directly regulating retail markets, especially by limiting the size of retail establishments. Our model permits us to examine how such regulations affect retail market structure, imports and consumer prices. This is especially interesting as there is evidence that, in the United States, relatively poor consumers benefit from the existence of large retailers such as Wal-Mart and from the high volume of non-durable products that these retailers import from China (Broda and Romalis, 2008). In France, however, there is evidence that lower import prices are not passed on to consumers, and consumers bitterly complain about the lack of price competition at the retail level (Economist, 2008).

The next subsection gives a more detailed account of the stylized facts of retailing. This is followed by an overview of the existing literature and a preview of the remaining sections of the paper.

1.1 Stylized Facts

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 United States, 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 market segment. For instance, while the total population in the United States 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

Trade liberalization has played a role in this process, in addition to technological innovation. The mechanism, explored in the current paper, through with lower trade costs affect retail markets is illustrated by a recent survey of Austrian, German and Swiss retailers (Zentes, Hilt and Domma, 2007).2 Retailers source their goods in two basic ways, namely through domestic sourcing and direct imports. Domestic sourcing, which accounts for 71 to 74% of retail sales, refers to the purchase of domestically produced goods and of goods imported by domestic agents, including wholesalers, importers, buying cooperatives, and domestic wholesale subsidiaries of foreign exporters. These indirect imports account for 35-37% of total sourcing and hence roughly half of total domestic sourcing. Direct imports by retailers accounted for the remaining 26-29% of total sourcing in 2006. Roughly 54% of these direct imports came in the form of direct purchases from manufacturers, including producers of own-label (or store-brand) goods. Another 15% were handled by the retailers’ own overseas buying offices. Interestingly, retailers with own overseas buying offices sourced around 40% of direct imports through these offices. Overall, imported products (imported both directly and indirectly)

1Retail sector dynamics also reveal interesting facts. Entry and exit rates play an important role: 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 industry classification level).

2This survey is based on interviews with purchasing managers of 86 retailers in Germany, Austria and Switzerland accounting for about 50% of total retail sales in the region.
accounted for between 61 and 66% of sales of the retailers surveyed.

There is a close link between the size of the retailer and the choice of sourcing channel. Only big retailers engage in direct importing and among these, only the biggest retailers operate their own overseas buying offices. Small and medium-sized retailers tend to rely on domestic sourcing. Direct importing, according to Zentes, Hilt and Domma (2007), is associated with significantly lower variable costs. It allows retailers to bypass additional layers of intermediaries, and buying offices can directly identify the lowest-cost supplier for specific items. Increasingly these suppliers are in low-wage Asian countries: more than half of direct imports by retailers come from Asia, with China being the dominant supplier. The reason why only big retailers choose the direct import channel, however, is that it is associated with large fixed costs. These include costs of operating buying offices, searching for suppliers, developing products, specifying product standards, training suppliers, and monitoring quality. Buying offices can indeed be quite large. For instance, KarstadtQuelle AG, Germany’s biggest apparel and sixth-largest food retailer, operated 23 buying offices with a total of 1,100 employees before re-organized its direct importing business in 2006 (Zentes, Hilt and Domma, 2007).

Trade liberalization in this setting disproportionately benefits big retailers who grow even bigger as a result, and hence displace smaller competitors. In turn, the growth of big, import-intensive retailers leads to a rise in imports. There is ample circumstantial evidence that this mechanism is indeed very important. As already mentioned above, large retailers like Wal-Mart make up a big and growing share of consumer good imports from low-wage Asian countries. Moreover, if it is the case that cheaper imports disproportionately benefit big retailers, 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

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3Another survey (Foreign Trade Association, 2002, p. 9) of 23 European apparel and textile retailers with combined turnover of around €138 billion cites the "sheer number of people involved, from Buying Departments to Sourcing Offices to suppliers...who need to exchange real time information...”
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). Similarly Basker and Van (2008b) find that over the period 1997 to 2002 US imports from China and other less-developed countries rose especially quickly in retail sectors with the largest consolidation into chains.

1.2 Related Literature

Our paper is related to at least three strands of literature, namely studies linking retailer market structure to domestic and external shocks, to studies examining the pass-through of import into consumer prices, and to papers on firm heterogeneity in trade.

The size distribution of retail establishments depends partly on market size. Campbell and Hopenhayn (2005) show that establishments tend to be larger in larger markets. The effect of market size on the dispersion of establishment 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 establishments. The case of Wal-Mart, which by some measures is today the biggest company in the world (Fishman, 2006), 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 are not the only drivers of retail market structure and the size distribution of retailers. Trade liberalization, too, has played a role. In highlighting the role of international trade, our paper is most closely related to Basker and Van (2008a) who study the effects of trade liberalization on competition between a chain retailer and small single-market retailers. They find that trade liberalization raises the size of the chain retailer, and that the growth of the chain gives an additional boost to imports. However, their paper is silent about changes in the mass and size distribution of retailers and about welfare effects.

Other papers examining the interaction between trade liberalization and retail market structure include Raff and Schmitt (2008) who study the effects of trade liberalization in an oligopoly model with buyer power; Francois and Wooton (2008) who show that market structure in distribution becomes
increasingly important for trade as tariffs fall; and Richardson (2004) who studies market access to retail distribution. Another related paper is by Javorcik, Keller and Tybout (2006). They examine the effect of NAFTA on the Mexican soaps, detergents and surfactant industry. They argue that these effects were 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.

In the pass-through literature the paper most closely related to ours is by Hellerstein (2008). She bases her empirical study of pass-through on a model with Bertrand oligopolies at both the manufacturing and retailing level. This set-up generates endogenous mark-ups, like in our paper. However, unlike in our model, market structure remains fixed. Endogenizing market structure and examining how changes in this structure affect pass-through is precisely our contribution to this literature.

Finally, the model we develop builds on Melitz and Ottaviano (2008) who consider the selection of firms into export markets.

1.3 Outline of the Paper

The paper continues as follows. In Section 2, we present a simple model of international trade with heterogeneous retailers in which retailers’ choice of sourcing channel—direct imports or domestic sourcing—is endogenous. The equilibria of the model and comparative static results for marginal changes in trade costs are derived in Section 3. In this section we show that trade liberalization indeed benefits large retailers the most, because their use of direct imports implies that they sell a larger fraction of imported goods even before liberalization. Some medium-sized retailers that relied on domestic sourcing before now switch to direct imports. Both effects increase competition in the retail market and squeeze out small retailers. We show that this reduces the average retail price. However, the change in the mass of retailers is generally ambiguous.

In Section 4 we use the model to study the pass-through of import prices into retail prices and the effect of retail market regulation. In particular, we examine how the level of trade costs and technology parameters affect the pass-through rate in two scenarios: (i) a long-run scenario in which the number of retailers is allowed to adjust to guarantee zero expected profits; and (ii) a short-run scenario in which the mass of retailers in the market
is fixed. Comparing the two scenarios allows us to determine how the pass-through rate depends on the free entry and exit of firms. As for retail market regulations, we investigate their effect not only on prices and competition in the retail sector, but also on sourcing choices and the degree of pass-through. Section 5 concludes. Appendix 1 contains proofs, and Appendix 2 summarizes comparative static results for the short-run version of the model.

2 The Model

In this section, we develop a simple model of a retailing sector that sources the goods it distributes both domestically and abroad. There is a continuum of retailers selling only in their domestic market (their services are non-traded). From the consumer’s point of view, the products sold by different retailers are differentiated varieties. This could be because each retailer sells a different bundle of goods, or because the retailers themselves are differentiated. Retailer differentiation occurs when consumers value different retailer characteristics, such as location or customer services. It is more natural to interpret our model as one of retailer differentiation. We index retailers by $i \in \Omega$, and assume that all consumers share the same utility function:

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

(1)

where $q_i^c$ denotes the quantity per capita bought from retailer $i$, and $y$ the consumption of the numeraire good. Parameter $\beta$ describes the degree of substitutability between retailers. If $\beta = 0$, retailers 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 retailers increases with $\beta$.

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

$$p_i = \alpha - \beta q_i^c - \gamma Q^c.$$  

(2)

Denoting by $L$ the number of consumers and by $N$ the mass of active retailers, the market demand faced by retailer $i$ can be expressed as a function of the average retail price $\bar{p}$:

$$q_i(p_i) \equiv Lq_i^c = \frac{\alpha L}{\gamma N + \beta} - \frac{L}{\beta} p_i + \frac{\gamma N}{\gamma N + \beta} \frac{L}{\bar{p}},$$  

(3)
where

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

and where \( \Omega^* \) is the set of active retailers.

Labor, the only factor of production, is inelastically supplied and perfectly mobile between the production and the retailing sectors. Since the numeraire good is produced by a competitive industry under constant returns technology and a unit labor requirement of one, the price of labor in the economy is equal to one. All costs are therefore expressed in terms of labor requirements.

We assume that retailers first decide whether 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 \([0, c_M]\). Since the entry cost is sunk, only entrants able to cover their marginal cost are active in the market. All remaining entrants are inactive, i.e., do not buy or sell any goods. We assume that retail productivity follows a Pareto distribution with cumulative distribution function

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

where \( k \geq 1 \). When \( k = 1 \), the distribution is uniform on \([0, c_M]\). As \( k \) increases, the distribution shifts toward high marginal costs. 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 suggests that in practice \( k \) is rather large.

Once a retailer has entered the market, he has to decide from which source to buy goods. There are two options: domestic sourcing and direct imports. We make two simplifying assumptions, namely that (i) each firm buys from only one source; and (ii) domestic sourcing involves only domestically produced goods. Direct imports involve a per-unit trade cost \( t \) and a fixed cost \( F_I \). 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, and denote the marginal cost of domestic production by \( w > 0 \).
Hence, active retailers that buy domestically maximize
\[ (p_i - c - w)q_i(p_i), \]  
whereas active retailers relying on direct imports maximize
\[ (p_i - c - t)q_i(p_i) - F_I. \]
Taking the mass of active retailers \( N \) and average retail price \( \bar{p} \) as given when setting their price, it is easy to check that the profit-maximizing markups must satisfy
\[ (p^D_i - c - w) = \frac{\beta}{L}q_i(p^D_i) \quad \text{and} \quad (p^I_i - c - t) = \frac{\beta}{L}q_i(p^I_i), \]
where the superscript \( D \) indicates domestic sourcing, and \( I \) indicates direct imports. Retailer \( i \)'s profit-maximizing prices when buying from domestic (foreign) sources are respectively,
\[ p^D_i = \frac{1}{2} \left[ c + w + \frac{\beta \alpha + \gamma N \bar{p}}{\gamma N + \beta} \right] \quad \text{and} \quad p^I_i = \frac{1}{2} \left[ c + t + \frac{\beta \alpha + \gamma N \bar{p}}{\gamma N + \beta} \right]. \]
Defining \( c_D = \frac{\beta \alpha + \gamma N \bar{p}}{\gamma N + \beta} - w \), the equilibrium prices and outputs of a retailer with marginal cost \( c \) are
\[ p^D(c) = w + \frac{1}{2} [c_D + c]; \]  
\[ p^I(c) = \frac{1}{2} [c_D + w + c + t]; \]  
\[ q^D(c) = \frac{L}{2\beta} (c_D - c); \]  
\[ q^I(c) = \frac{L}{2\beta} (c_D + w - c - t); \]  
and profits are
\[ \pi^D(c) = \frac{L}{4\beta} (c_D - c)^2 - F_E; \]  
\[ \pi^I(c) = \frac{L}{4\beta} (c_D + w - c - t)^2 - F_E - F_I. \]
Only retailers with marginal costs less than or equal to \( c_D \) will remain active, because only they will be able to cover their marginal cost. Active retailers have to select from which source to buy their goods. A retailer is indifferent between domestic sourcing and direct imports if \( \pi^D(c) = \pi^I(c) \). This condition defines a critical value of the marginal cost \( c_I \),

\[
c_I = c_D + \frac{(w - t)}{2} - \frac{2\beta F_I}{L(w - t)}, \tag{12}
\]
such that firms with \( c \leq c_I \) prefer direct imports and firms with \( c > c_I \) domestic sourcing. We assume that \( c_I < c_D \) so that the least efficient active retailers prefer domestic sourcing. This implies that

\[
\frac{L}{4\beta} (w - t)^2 < F_I. \tag{13}
\]

We also assume that importing is more profitable for the most efficient retailers than domestic sourcing. Thus, at \( c = 0 \), we require

\[
F_I < \frac{L}{4\beta} \left( (w - t)^2 + 2c_D(w - t) \right). \tag{14}
\]

These two assumptions together with the quadratic form of the profit function ensure that the value of \( c_I \) solving (12) is unique.

The two cut-off values of the marginal cost, \( c_D \) and \( c_I \), define three categories of retailers. Retailers whose marginal cost is sufficiently small (\( c \leq c_I \)) engage in direct imports; retailers whose marginal costs are in the middle range (\( c_I < c \leq c_D \)) source goods domestically; and retailers with high marginal costs (\( c > c_D \)) are not active because they are not able to cover their marginal costs.

Given these cutoffs we can compute the average retail price of active retailers as

\[
\bar{p} = \frac{1}{G(c_D)} \left( \int_0^{c_I} p^I(c) dG(c) + \int_{c_I}^{c_D} p^D(c) dG(c) \right). \tag{15}
\]

Since the marginal active retailer is just indifferent between buying and not buying, we have \( q^D(c_D) = 0 \) and \( p^D(c_D) = w + c_D \). Using this price in (3), the mass of active retailers can be calculated as

\[
N = \frac{\beta (\alpha - w - c_D)}{\gamma (w + c_D - \bar{p})}. \tag{16}
\]
The mass of active retailers is related to the mass of entrants into the retail market, $N_E$, by the condition $N = N_E G(c_D)$. In equilibrium the mass of entrants has to be large enough so that the expected profit of a retailer is equal to zero:

$$\int_0^{c_I} \pi^I(c) dG(c) + \int_{c_I}^{c_D} \pi^D(c) dG(c) + \int_{c_D}^{c_M} (-F_E) dG(c) = 0.$$  \hspace{1cm} (17)

### 3 Characterization of the Equilibrium

In this section we characterize the long-run equilibrium of the model and examine the comparative statics with regard to infinitesimal changes in the trade cost $t$. The endogenous variables of the model are $\overline{p}$, $c_D$, $c_I$ and $N_E$. The equilibrium values of these variables are given by Equations (12), (16), (15) and (17). Using the Pareto distribution in the last two equations and setting $N = N_E G(c_D)$, these conditions can be rewritten as:

$$\frac{\beta(\alpha - w - c_D)}{\gamma(w + c_D - \overline{p})} - N_E G(c_D) = 0,$$  \hspace{1cm} (18)

$$c_I - c_D - \frac{(w - t)}{2} + \frac{2\beta F_I}{L(w - t)} = 0,$$  \hspace{1cm} (19)

$$\overline{p} - w - \frac{c_D (1 + 2k)}{2 (1 + k)} + \frac{(w - t)}{2} \frac{c_I^{k}}{c_D^{k}} = 0,$$  \hspace{1cm} (20)

and

$$\frac{c_D^{k+2}}{(k + 1)(k + 2)} + (w - t) c_I^{k} \left(\frac{w - t}{2} + c_D - \frac{k c_I}{1 + k}\right) - \frac{2\beta}{L} \left(c_I^{k} F_E + F_I c_I^{k}\right) = 0.$$  \hspace{1cm} (21)

To examine the comparative static effects of a marginal change in $t$, consider first the zero-profit condition (21). The partial derivative of this condition with respect to $c_I$ is zero. The reason for this can best be seen by going back to (17) and noting that, by definition, $\pi^I(c_I) = \pi^D(c_I)$. Hence we can use (21) to derive how a marginal change in $t$ affects $c_D$. Given the changes in $c_D$ we can then derive the adjustments in $c_I$ from Equation (19), and then the change in $\overline{p}$ from (20). We obtain the following results:
Proposition 1  Trade liberalization (i) lowers $c_D$, thereby forcing the least efficient retailers to become inactive; (ii) raises $c_I$, thereby inducing more retailers to source goods from abroad; and (iii) reduces the average consumer price $\bar{p}$.

Proof: see Appendix.

The intuition for these effects is straightforward. A reduction in the trade cost induces more retailers to engage in direct imports. Importers pass part of the cost reduction on to consumers in the form of lower retail prices. This raises competition in the retail sector, forcing those retailers that source their goods domestically to also cut their prices. Indeed, it is easy to show that

$$\frac{dp_D}{dt} = \frac{1}{2} \frac{dc_D}{dt} > 0 \quad \text{and} \quad \frac{dp_I}{dt} = \frac{1}{2} \left[ \frac{dc_D}{dt} + 1 \right] > 0.$$  (22)

The least efficient retailers can no longer cover their marginal costs and become inactive.

Since the retail sector is imperfectly competitive, retailers that source their goods from abroad pass only part of the reduction in trade costs on to the consumers. Their mark-ups, sales and profits must rise. Retailers that buy their goods domestically, on the other hand, are forced to cut their mark-ups, which leads to lower outputs and profits. These effects can be summarized as follows:

Proposition 2  Trade liberalization (i) lowers the sales, mark-ups and profits of retailers that source domestically; (ii) raises the sales, mark-ups and profits of retailers that engage in direct imports.

Proof: see Appendix.

The effects of trade liberalization discussed so far can also be shown to hold in the short run when the number of entrants is fixed (see Appendix 2). For fixed $N_E$ the decrease in $c_D$ induced by trade liberalization unambiguously reduces the mass of active retailers since $N = N_E G(c_D)$.

In the long run, however, firms respond to changes in expected profits by entering or exiting the retail sector. Propositions 1 and 2 indicate that trade liberalization indeed induces changes in expected profits. First, since trade liberalization reduces $c_D$, the likelihood $G(c_D)$ of earning a positive operating profit falls. Second, the profit earned by an importer rises and, since $c_I$ goes
up, so does the probability of being an importer. Third, the profit of a retailer buying goods domestically decreases, but so does the probability of falling into this category.

These effects suggest that the impact of trade liberalization on the total mass of retailers is generally ambiguous. In particular, it depends on the distribution of marginal costs, which is summarized by parameters $k$ and $c_M$. The total mass of active retailers can be derived from (16), and it can be checked that

$$\text{sign} \left\{ \frac{dN}{dt} \right\} = \text{sign} \left\{ (\overline{p} - \alpha) \frac{dc_D}{dt} + (\alpha - w - c_D) \frac{d\overline{p}}{dt} \right\}. \quad (23)$$

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 prove that:

**Proposition 3** (i) Near autarky, trade liberalization unambiguously leads to a decrease in the number of active retailers. (ii) Irrespective of $t$, a sufficient condition for trade liberalization to lead to a decrease in the number of active retailers is $\frac{\alpha - w}{c_D} > 1 + \frac{1}{k} + \frac{c_D^{1+2}}{w k^2 c_I}$. (iii) If $\frac{\alpha - w}{c_D} < 1 + \frac{1}{k}$, trade liberalization leads to an increase in the number of active retailers provided that $t$ is low enough and $c_I$ is sufficiently close to $c_D$.

**Proof:** see Appendix.

Hence, the effect of trade liberalization on the number of active retailers is very much industry-specific. In particular, if the demand is large relative to the inverse of cost distribution parameter $k$ (i.e., $\frac{\alpha - w}{c_D} \gg 1 + \frac{1}{k}$), the number of active retailers unambiguously falls with trade liberalization. From the determination of $c_D$, we know that this arises when the sunk cost of entry and/or the fixed cost of direct importing are small, when the technologically feasible range of retailer’s unit costs is small and/or when the probability of being a relatively high-unit-cost retailer is high ($k$ is high). The above attributes all have the characteristics of a relatively competitive retailing sector: not only are the entry and fixed importing costs low, but there is not a large difference between an efficient and an inefficient retailer ($c_D$ is relatively low because $c_M$ is low).

If, on the other hand, the probability of being an efficient retailer is not very different from being an inefficient one ($k$ is low), there is a wide range of technologically feasible unit costs ($c_M$ is high) and/or the retailing sector
is relatively concentrated (the sunk cost of entry is high, leading to a high $c_D$), then trade liberalization raises the number of active retailers when $t$ is low enough, at least when the fixed importing cost is not too high.

What is the impact of trade liberalization on welfare? The indirect utility function to evaluate welfare is

$$U = I + \frac{1}{2} \left( \gamma + \frac{\beta}{N} \right)^{-1} (\alpha - \bar{p})^2 + \frac{1}{2} \frac{N}{\beta} \sigma_p^2,$$  \hspace{1cm} (24)

where $\sigma_p^2$ denotes the variance of retail prices. This variance is given by:

$$\sigma_p^2 = \frac{1}{N} \left\{ \int_{i \in \Omega_I} (p_i^I - \bar{p})^2 di + \int_{i \in \Omega_D} (p_i^D - \bar{p})^2 di \right\}, \hspace{1cm} (25)$$

where $\Omega_I$ ($\Omega_D$) is the set of retailers selling imported (domestically sourced) products.

Welfare is obviously decreasing in $\bar{p}$ and increasing in $N$ and $\sigma_p^2$. Proposition 3 suggests that the welfare effect of trade liberalization will generally be ambiguous, simply because $N$ may rise or fall. To see when welfare is likely to rise with trade liberalization, consider how a change in $t$ affects $\sigma_p^2$. It can be checked that

$$\sigma_p^2 = \frac{(w - t)}{2} \left\{ \frac{(w - t)}{2} \left( 1 - \frac{c_I^k}{c_D^k} \right) + \frac{c_D - c_I}{1 + k} \right\} \frac{c_I^k}{c_D^k} + \frac{k c_D^2}{4(2 + k)(1 + k)^2}. \hspace{1cm} (26)$$

Note the following points about the variance. First, in autarky, the variance of retail prices is equal to the last term of (26). Since the first two terms are positive for a positive non-prohibitive trade cost (since $c_D > c_I$ and $w > t$), the variance of prices is higher with restricted trade than without trade.

Second, the variance of prices has an inverted U-shaped form with respect to $t$. To see this, consider $t$ approaching autarky (from the non-prohibitive level). In this case, $c_I^k/c_D^k$ converges to zero so that the variance converges to its autarky level. As $t$ approaches free trade, $c_I^k/c_D^k$ increases but now the two terms in the curled bracket decrease. They converge to zero in the special case where the parameters are such that $c_I$ exactly converges to $c_D$ as $t$ approaches zero (see (13)). However, the variance is systematically above its autarky level if $c_I < c_D$ in free trade.

\footnote{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 $t$.}
This makes intuitive sense. Because it is the more efficient retailers who rely on direct imports, the ability to import gives them a competitive advantage over those who do not. At the margin, this must increase the price difference between direct importers and retailers sourcing domestically and thus the variance of retail prices. When trade liberalization reaches more and more retailers (i.e., more retailers choose direct imports), this effect must decrease. Indeed if all retailers engage in direct imports, the price difference among them must reflect the difference in marginal retail costs only and thus exhibit the same variance as in autarky given a Pareto distribution. If only a fraction of retailers engage in direct importing, the variance must be higher in free trade than in autarky.

The above remarks suggest that utility is likely to rise with trade liberalization. Indeed several forces tend to go in the same direction: lower average retail prices, a typically higher variance of retail prices in free trade than in autarky, and a potentially higher number of retailers. Moreover when the number of retailers decreases, retail productivity rises as the least efficient retailers are eliminated.

To find out more we have to rely on simulations. Table 1 illustrates the case with the following parameters: \( \alpha = 5, \beta = .9, L = 5, F_E = 1, F_I = 3, w = .8, c_M = 3 \) and \( k = 2 \). It is thus a case where the demand is relatively large relative to \( 1/k \). In particular, \( \alpha - w > c_D(1/k + 1) \). In this case, trade liberalization leads to a monotonic decrease in the number of active retailers and a monotonic increase in the variance and in the level of utility.

<table>
<thead>
<tr>
<th>( t )</th>
<th>( c_D )</th>
<th>( c_I )</th>
<th>( \overline{y} )</th>
<th>( N )</th>
<th>( \sigma_p^2 )</th>
<th>( U - I )</th>
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<tr>
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<td>1.39</td>
<td>2.61</td>
<td>31.4</td>
<td>.16</td>
<td>24.9</td>
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<tr>
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<td>2.67</td>
<td>32.1</td>
<td>.15</td>
<td>23.9</td>
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<tr>
<td>.10</td>
<td>2.41</td>
<td>1.22</td>
<td>2.72</td>
<td>32.8</td>
<td>.14</td>
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<tr>
<td>.15</td>
<td>2.44</td>
<td>1.10</td>
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<td>33.5</td>
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<td>22.1</td>
</tr>
<tr>
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<td>.96</td>
<td>2.81</td>
<td>34.3</td>
<td>.12</td>
<td>21.3</td>
</tr>
<tr>
<td>.25</td>
<td>2.48</td>
<td>.79</td>
<td>2.84</td>
<td>35.1</td>
<td>.11</td>
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<tr>
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<tr>
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<td>2.50</td>
<td>.32</td>
<td>2.88</td>
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<tr>
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<td>2.88</td>
<td>36.8</td>
<td>.09</td>
<td>19.8</td>
</tr>
</tbody>
</table>

Table 2 illustrates the same case as in Table 1 but with \( k = 4 \) and \( c_M = 4 \). The second modification has been made necessary to satisfy one of the constraints.
Table 2:

<table>
<thead>
<tr>
<th>t</th>
<th>$c_D$</th>
<th>$c_I$</th>
<th>$\bar{p}$</th>
<th>N</th>
<th>$\sigma_p^2$</th>
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</tr>
<tr>
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<td>2.46</td>
<td>4.01</td>
<td>11.21</td>
<td>.126</td>
<td>3.46</td>
</tr>
<tr>
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<td>4.06</td>
<td>11.08</td>
<td>.12</td>
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<tr>
<td>.20</td>
<td>3.70</td>
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<tr>
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<tr>
<td>.52</td>
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<td>0</td>
<td>4.17</td>
<td>10.89</td>
<td>.094</td>
<td>2.44</td>
</tr>
</tbody>
</table>

The demand is relatively small with respect to $1/k$ (i.e., $\alpha - w < c_D(1/k + 1)$). Not surprisingly, this produces a much more concentrated retailing sector than in Table 1 (the average price is higher and the average number of active retailers is smaller). Trade liberalization in this environment first decreases the number of active retailers and then increases it. The variance and the utility, however, both rise monotonically with trade liberalization.

4 Applications

In this section we apply our model to two issues in international economics in which the structure of retail markets plays a central role. The first issue concerns pass-through of import into consumer prices, specifically the empirical observation that consumer prices tend to react very little to changes in import prices. The second issue concerns the effects of retail-market regulations, such as limits on the size of retail establishments as traditionally imposed in France, Belgium, Japan and elsewhere.

4.1 Pass-Through

Our model allows us to study the pass-through of changes in the import price $t$ into consumer prices both in the long and in the short run. The long-term pass-through rate for the average retail price is given by $\frac{dp}{dt}$ in (35). The long-term pass-through rates for the prices of domestic and imported products, given by $\frac{dp_D}{dt}$ and $\frac{dp_I}{dt}$ respectively, are proportional to $\frac{dc_D}{dt}$ (see (22)).
The associated long-term pass-through elasticities are given by
\[ \varepsilon^D_t = \frac{dpD_t}{dt} \frac{t}{pD}, \]
\[ \varepsilon^I_t = \frac{dpI_t}{dt} \frac{t}{pI}, \]
and \[ \bar{\varepsilon}_t = \frac{dp}{dt} \frac{t}{p}, \] respectively.

The following proposition summarizes the analytical results concerning the long-run pass-through:

**Proposition 4**
(i) The long-run pass-through elasticity is higher for imported products than for domestic products \((\varepsilon^I_t \geq \varepsilon^D_t)\). (ii) The long-run pass-through rate for both types of products is always less than one. (iii) The long-run pass-through rates for domestic and imported products are decreasing in \( t \). (iv) The long-run pass-through rate for the average retail price is decreasing in \( t \).

**Proof:** see Appendix.

The first result is to be expected since a change in \( t \) directly affects the price of an imported good and only indirectly the price of a domestic good. Indeed, \( \frac{dpI}{dt} = \frac{dpD}{dt} + \frac{1}{2} \). The second result implies that an increase in \( t \) is never fully passed on to the consumer price. In the case of imported goods, this is a direct result of monopolistic competition in the retail sector and linear demand. Imperfectly competitive firms absorb part of any cost change. For domestic products, the pass-through is incomplete, since the cost of importing only indirectly affects the consumer price via changes in the degree of retail competition. The third result comes from the fact that trade liberalization reduces \( c_D \). This must mean that the active firms are becoming more similar with trade liberalization and thus that competition is becoming more intense. This leads to a higher degree of pass-through. However, as long as the fixed cost of importing is positive, \( c_I < c_D \) and the pass-through rate remains below one even for imported goods. The last result is a corollary of the third result. If it is true that the pass-through rate for individual products (domestic or foreign) increases with trade liberalization, the same must hold for the pass-through rate with respect to the average price.

The short-run equilibrium and pass-through rates are presented in Appendix 2. Not surprisingly, the degrees of pass-through are qualitatively the same in the short- and in the long-run and only the rates differ. We use simulations to compare them.
4.2 Retail-Market Regulation

A limit on the size of retail establishments acts as a constraint on the output of the most efficient retailers. Suppose this constraint is given by \( \hat{q} \). Using \( \hat{q} \) in (3) and the definition of \( c_D \), we obtain the price charged by a constrained firm, \( \hat{p} \), as

\[
\hat{p} = c_D + w - \frac{\beta}{L} \hat{q}. \tag{27}
\]

Assuming that the marginal firm that is just constrained in its output is an importer, we can write the profit of a constrained firm as

\[
\hat{\pi}(c) = (c_D + w - \frac{\beta}{L} \hat{q} - c - t) \hat{q} - F_E - F_I. \tag{28}
\]

The critical value of the marginal cost \( \hat{c} \) at which a firm is just constrained is defined by \( \hat{q} = q_I(\hat{c}) \). Hence

\[
\hat{c} = c_D + w - t - \frac{2\beta}{L} \hat{q}. \tag{29}
\]

At this level of marginal cost we have \( \hat{\pi}(\hat{c}) = \pi^I(\hat{c}) \).

Ceteris paribus, a tightening of the constraint raises \( \hat{c} \), which implies that the output constraint hits even less efficient firms. Of course a change in \( \hat{q} \) also affects the other critical levels of the marginal cost, i.e., \( c_D \) and \( c_I \), together with the other endogenous variables, \( \bar{p} \) and \( N_E \). The long-run equilibrium values of the endogenous variables when the constraint is binding are given by equations (18), (19) and (29), as well as the new expected-zero-profit condition

\[
\int_0^{\hat{c}} \hat{\pi}(c) dG(c) + \int_{c_I}^{c_D} \pi^I(c) dG(c) + \int_{c_I}^{c_D} \pi^D(c) dG(c) + \int_{c_D}^{c_M} (-F_E) dG(c) = 0, \tag{30}
\]

and the new equation for the average retail price

\[
\bar{p} = \frac{1}{G(c_D)} \left( \int_0^{\hat{c}} \hat{p} dG(c) + \int_{c_I}^{c_D} p^I(c) dG(c) + \int_{c_I}^{c_D} p^D(c) dG(c) \right). \tag{31}
\]

To derive the comparative static effects of a marginal change in the constraint \( \hat{q} \), consider again the zero-profit condition. Since, by definition, \( \hat{\pi}(\hat{c}) = \pi^I(\hat{c}) \) and \( \pi^I(c_I) = \pi^D(c_I) \), the partial derivatives of (30) with respect to \( \hat{c} \) and \( c_I \) are zero. We therefore directly obtain from (30) the change
in $c_D$ for marginal changes in $\hat{q}$. The respective changes in $\hat{c}$ and $c_I$ then follow directly from (29) and (19). The following proposition presents these comparative-static effects:

**Proposition 5** A tightening of the output constraint $\hat{q}$: (i) raises $c_D$, thus allowing inefficient retailers to become active; (ii) raises $\hat{c}$, thereby limiting the output even of less efficient importers; and (iii) raises $c_I$, thereby inducing more retailers to source goods from abroad.

**Proof:** see Appendix.

The intuition for these results is as follows. A tighter constraint on the output of the most efficient retailers raises the residual demand for the unconstrained retailers. This allows the least efficient retailers to remain in business. The higher residual demand also allows retailers that before were too inefficient to engage in direct imports to source their goods from abroad. Thus, surprisingly, a tighter output constraint raises retailers’ propensity to import.

To determine the effect of a tighter constraint on the average retail price, we simplify (31) to obtain

$$\bar{p} = w + \frac{(1 + 2k)}{2(1 + k)}c_D - \frac{(w - t)}{2} \frac{c_D^k}{c_D^k} + \frac{1}{2(1 + k)} \frac{\hat{c}^{k+1}}{c_D^k}. \quad (32)$$

This equation shows that the change in the average retail price is induced by changes in the cut-off values $\hat{c}$, $c_D$ and $c_I$. A tighter $\hat{q}$ raises all three cut-off values. This has the following implications. An increase in $\hat{c}$ means that a larger fraction of retailers becomes constrained and thus have higher prices than without the constraint. The increase in $c_D$ also raises $\bar{p}$, since at the margin less efficient retailers remain active in the market. The rise in $c_I$ works against the first two effects. Retailers are more likely to source goods from abroad, which is associated with lower variable costs than sourcing goods domestically. One would expect that the first two effects dominate the last one, so that a tightening of the output constraint raises the average retail price. Formally, we can show that it is indeed the case if either $w - t$ is big and/or $F_I$ is small so that the firms switching to direct importing are relatively inefficient compared with the rest of the industry and thus have only a small market share.

We formally state these sufficient conditions in the following proposition:
Proposition 6 A tightening of the output constraint $\hat{q}$ raises the average retail price $\hat{p}$ if $w - t$ is sufficiently big and/or $F_I$ is sufficiently small.

Proof: see Appendix.

The impact of a tighter output constraint on the number of active retailers is generally ambiguous. Recall that the number of active retailers is given by (16). Hence, the constraint affects $N$ through two channels, namely through changes in $c_D$ and changes in $\hat{p}$. For a given level of $c_D$ an increase in $\hat{p}$ raises the number of active retailers. This is due to the fact that a higher average price induces entry. On the other hand, for given $\hat{p}$ an increase in $c_D$ reduces $N$. Since $N = N_E G(c_D)$ and $G'(c_D) > 0$, this can only be the case if fewer firms enter the industry.

Finally, retail-market regulation also affects the pass-through of import into consumer prices. In fact, when the output constraint is so restrictive that it affects all importing firms, the pass-through into the average retail price is zero. It follows that for a sufficiently tight constraint, i.e., for $\hat{q}$ sufficiently close to $q^I(\hat{c})$, the pass-through rate will be lower than when output is unconstrained.

Proposition 7 Retail-market regulation reduces the rate of pass-through of import prices into the average retail price if the output constraint is sufficiently tight.

Thus, even if retail-market regulation induces a larger mass of retailers to source from abroad, its impact on the most efficient retailers makes the average retail price less sensitive to variations in import prices.

5 Conclusions

By focusing on retailers’ total volume of sales, our model is highly stylized. However, it is precisely its simplicity that allows us to investigate how trade liberalization changes the structure of the retailing industry when retailers are heterogeneous. Because buying foreign products involves a fixed cost, only the most efficient retailers source goods from abroad. Trade liberalization is then shown to shift retail sales, mark-ups and profits toward retailers that engage in direct imports and away from those that source domestically only. This unambiguously leads to a more competitive retailing industry
simply because it favors efficient retailers at the expense of relatively small and inefficient ones. This more competitive environment is accompanied by a higher level of concentration in the short run, at least as judged by the number of active retailers. In the long run when there is free entry and exit of retailers, however, the number of active retailers depends very much on the characteristics of the retailing sector. In particular, in a competitive retailing sector\textsuperscript{5}, trade liberalization typically reduces the long-term number of active retailers. If, however, the retailing sector is not very competitive to start with, the long-term number of active retailers may well increase with trade liberalization especially if trade barriers are already low. As consumers care about the number of products and thus about the number of retailers, the welfare effect of trade liberalization is ambiguous if its effect on the number of products is ambiguous. However, the pro-competitive effect of trade liberalization is often strong enough for welfare to rise.

The model also has something to say about the sensitivity of retail prices to variations in import prices and thus about the degree of pass-through at the retail level. Pass-through is typically studied in connection with exchange rate variations. One can distinguish between two types of exchange-rate pass-through: (i) how changes in producer prices are passed through into import prices; and (ii) how changes in import prices are passed through into retail prices. Our model obviously captures the second type and suggests that retailer heterogeneity plays an important role in explaining the degree of pass-through. The reason is that changes in import prices trigger changes in the structure of retail markets (in terms of the mass of active retailers and sourcing decisions), which in turn affect retail prices. The model predicts that the degree of pass-through at the retail price level is lower for the average consumer price than for the retail price of imported products, and that it always remains imperfect even for imported products. Interestingly, the model also predicts that the degree of pass-through at the retail price level increases when trade barriers fall. This effect has two sources: (i) a direct effect that leads retailers to import more when trade costs decrease and which naturally makes the retail prices more sensitive to changes in the trade barrier; and (ii) an indirect effect that comes from the fact that the average unit retailing cost falls as less efficient retailers become inactive or exit the

\textsuperscript{5}That is, in a sector in which the number of active retailers is large and the average price low because the sunk cost of entry and the fixed importing cost are low, the range of technologically feasible unit costs is low, and/or the probability of being a high unit cost retailer is high.
market. Thus the importance of domestic retailing costs, an element that tends to isolate domestic prices from foreign influences, falls as well. The sensitivity of the retail prices also depends very much on the characteristics of the retail sector. Thus if some of these characteristics also change with trade liberalization (for instance, due to technological innovation), the rate of pass-through may well increase even more. These predictions are consistent with the empirical evidence presented, for instance, by Campa and Goldberg (2006b), and Campa and González Minguez (2006). The former find that the retail price sensitivity to import price variations has generally increased over the last decade, but that the degree of sensitivity is very much product specific. The latter show that differences in pass-through rates within the Euro area are driven mainly by differences in openness to non-Euro-area imports.

Finally, the model is also very much suited to understand the impact of restrictions on the size of retailers. In countries like France, Belgium or Japan, there is a tradition of protecting small local retailers by placing barriers on the expansion and particularly on the size of large retailers. Not surprisingly, restrictions on the volume of sales affect first and foremost the efficient retailers. We show that this allows inefficient retailers to remain active and makes the average retail price higher than it would otherwise be. Interestingly this makes the incentives to source products from abroad stronger for less efficient retailers, not weaker. We also show that it makes the retail price level less sensitive to change in the price of imported products. With higher average retail prices and a lower sensitivity of retail prices to foreign shocks, it should not be surprising if French consumers feel that their ‘pouvoir d’achat’ (purchasing power) has suffered as compared to consumers elsewhere in Europe (Economist, 2008).

The contrast with the United States is striking. Broda and Romalis (2008) show that because poor US households have a different composition of their consumption basket than rich households and because the price index of the poor’s consumption basket has declined relative to that of the rich, the impact of the rise in income inequality has been significantly smaller than first feared. One thing is certain, this would not have been possible without the instrumental role played by large retailers importing a large volume of products from low-cost Asian countries.

These two examples underline well the significant impact of the retailing sector in a more integrated world. Simply put, in the United States, the large retailers seem to allow poor consumers to keep up with the Joneses whereas in France consumers feel cheated by the retailers and do not see much benefit
in globalization. Of course much more needs to be done to understand the role and the impact of the retailing sector in today’s world. This is left for future research.

6 Appendix 1

Proof of Proposition 1

Totally differentiation of (21) yields

$$\frac{dc_D}{dt} = \frac{c_I^k (c_D + w - t - \frac{k c_I}{k+1})}{c_D^{k+1} + (w - t)c_I^k} > 0,$$

(33)
since \(c_D^{k+1} + (w - t)c_I^k = 2c_D^k(w + c_D - \bar{p}) > 0\) and \(w - t + c_D - \frac{k c_I}{k+1} > 0\) due to \(w > t\), \(c_D > c_I\) and \(k < 1 + k\). Note that \(\frac{dc_D}{dt}\) goes to zero as \(t\) approaches its autarky level since \(c_I\) approaches zero.

From (19) we obtain

$$\frac{dc_I}{dt} = \frac{dc_D}{dt} - \left( \frac{1}{2} + \frac{2 \beta F_I}{L(w - t)^2} \right)$$

Substituting for \(\frac{dc_D}{dt}\) we have

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

Using \(\frac{2 \beta F_I}{L(w - t)^2} = \frac{1}{(w - t)}(c_D - c_I + \frac{w - t}{2})\) (from (19)) in the above expression and simplifying, we get

$$\frac{dc_I}{dt} = 2c_D^k (w + c_D - \bar{p}) \left\{ - \frac{c_D^{1+k}}{1 + k} \left[ 1 + \frac{c_D - c_I}{w - t} \right] + \frac{c_I^{1+k}}{1 + k} \right\} < 0.$$  

(34)

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 \(c_D > c_I\). As \(t\) approaches zero, \(\frac{dc_I}{dt}\) becomes smaller since \(c_I\) increases. Indeed, \(\frac{dc_I}{dt} = 0\) when \(c_I = c_D\).
Using (20), it is easy to check that
\[
\frac{d\bar{\pi}}{dt} = \left(\frac{1 + 2k}{2 + 2k}\right) \frac{dc_D}{dt} + \frac{1}{2} \frac{c_f^k}{c_D^k} + \frac{k(w - t)}{2} \frac{c_I^k}{c_I^k} \left[\frac{1}{2} \frac{dc_D}{dt} - \frac{1}{2} \frac{dc_I}{dt}\right] \geq 0,
\]
(35)
since all the terms on the RHS are non-negative. Hence, \(\bar{\pi}\) is unambiguously lower than its autarky level and it converges to the autarky level since, as \(t\) rises, \(c_I\) necessarily goes to zero (all retailers source goods domestically).

**Proof of Proposition 2**

Differentiating (8) and (10) with respect to \(t\) and using (33), it is easy to check that, for retailers sourcing domestically,
\[
\frac{dq}{dt} = L \left(\frac{1 + k}{2} \frac{dc_D}{dt} + \frac{k(w - t)}{2} \frac{c_I^k}{c_I^k} \left[\frac{1}{2} \frac{dc_D}{dt} - \frac{1}{2} \frac{dc_I}{dt}\right]\right) \geq 0
\]
and
\[
\frac{d\pi}{dt} = L \left(\frac{1 + k}{2} \frac{(c_D - c)}{dc_D} \frac{dc_D}{dt} - \frac{1}{2} \frac{dc_I}{dt}\right) \geq 0.
\]
Next, we show that \(\frac{dc}{dt} < 1\). Rewriting and manipulating (33),
\[
\frac{dc_D}{dt} = \frac{(1 + k)(w - t) + c_D + k(c_D - c_I)}{(1 + k)(w - t) + \frac{c_I^k}{c_D^k}}.
\]
(36)
Thus, \(\frac{dc}{dt} < 1\) if \(c_D + k(c_D - c_I) < \frac{c_I^k}{c_D^k}\) or if \(1 + k(1 - \frac{c_D}{c_I}) < \frac{c_I^k}{c_D^k}\). When \(k = 1\), this inequality reduces to \((c_D - c_I)^2 > 0\), and when \(k > 1\), the RHS of the above inequality increases faster than the LHS. Since \(0 \leq \frac{dc}{dt} < 1\), it is easy to check that, for retailers selling imported goods,
\[
\frac{dq}{dt} = L \left[\frac{dc_D}{dt} - 1\right] < 0 \quad \text{and} \quad \frac{d\pi}{dt} = L \left[\frac{c_D + w - t}{2} - c\right] \left[\frac{dc_D}{dt} - 1\right] < 0.
\]

**Proof of Proposition 3**

For arbitrary \(t\),
\[
\text{sign}\left\{\frac{dN}{dt}\right\} = \text{sign}\left\{\left(\frac{w - \alpha}{2 + 2k}\right) \frac{dc_D}{dt} + \frac{1}{2} \frac{c_f^k}{c_D^k} \left[\frac{k}{2} \frac{(\alpha - w - c_D)}{c_D} - 1\right] \frac{dc_D}{dt} + \frac{(\alpha - w - c_D)}{2} \frac{c_f^k}{c_D} \left[\frac{k}{2} \frac{(\alpha - w - c_I)}{c_I} - \frac{(w - t)}{2} \frac{dc_I}{dt}\right]\right\}
\]
24
(i) Since $\frac{dp}{dt} = 0$ in autarky, $\text{sign} \left\{ \frac{dN}{dt} \right\}$ depends on the sign of the third and fourth terms. They are both unambiguously positive. (ii) The second term is positive provided that $\alpha - w c_D > 1 + \frac{1}{k}$. The sum of the two first terms is positive when $\frac{\alpha - w}{c_D} < \frac{(1+k)(w-t)z^k A}{c_D}$ where $A = k(\alpha - w - c_D) - c_D$ and $z = c_I/c_D$. These two inequalities define a non-empty range for $\frac{\alpha - w}{c_D}$ provided $\frac{\alpha - w}{c_D} > 1 + \frac{1}{k} + \frac{c_I}{w + k c_D}$. Since the other terms of $\text{sign} \frac{dN}{dt}$ are positive, the condition is sufficient but not necessary for $\text{sign} \frac{dN}{dt} > 0$.

(iii) Suppose that, when $t$ is low enough, $c_I$ is approximately equal to $c_D$. In that case, $\frac{dc}{dt} = 1$ and $\frac{dc}{dt} = 0$. It is then easy to verify that $\text{sign} \frac{dN}{dt} < 0$ when $\frac{\alpha - w}{c_D} < 1 + \frac{1}{k}$.

Proof of Proposition 4

(i) Since $\frac{dp}{dt} = \frac{1}{2} \frac{dc}{dt}$, $\frac{dp}{dt} = \frac{dc}{dt} + \frac{1}{2}$, $p^D = \frac{1}{2}[2w + c_D + c_I]$, $p^l = \frac{1}{2}[c_D + w + c + t]$, the long-term pass-through elasticities, $\varepsilon^p_I$ and $\varepsilon^l_I$, are such that $\varepsilon^l_I \geq \varepsilon^p_I$ for given $c$ and for $0 \leq t \leq t_p$, where $t_p$ denotes the prohibitive trade cost. (ii) The incompleteness of the pass-through is easy to see from the prices knowing that, as long as $c_I < c_D$, then $0 < \frac{dc}{dt} < 1$. (iii) The fact that the degree of pass-through is higher with lower $\varepsilon^l_I$ comes from the comparison of $\frac{dc}{dt}$ for $t$ near autarky and free trade. Indeed $\frac{dc}{dt}(t_p) = 0$ since $c_I = 0$, whereas $0 < \frac{dc}{dt}(t = 0) < 1$ (and equal to one when $c_D = c_I$). This implies that a given change in $t$ has a larger impact on prices for lower values of $t$. (iv) When $t = t_p$, $\frac{dc}{dt} = 0$ and when $t = 0$, $\frac{dc}{dt} = \frac{1}{2}(1 + \frac{1+2k}{1+k} + \frac{kw}{2c_D})$ when $c_I$ is approximately equal to $c_D$. Hence the impact on the average price of a change in $t$ increases with lower values of $t$.

Proof of Proposition 5

Totally differentiating (30) yields

$$\frac{dc_D}{d\hat{q}} = -\frac{2\beta \varepsilon^{k+1}_l}{L \left( \frac{c_I^{k+1}}{(k+1)} + (w-t) c_k^l \right)} < 0.$$  \hspace{1cm} (37)

From (29) and (19) we obtain

$$\frac{dc}{d\hat{q}} = \frac{dc_D}{d\hat{q}} - \frac{2\beta}{L} < 0,$$

$$\frac{dc_I}{d\hat{q}} = \frac{dc_D}{d\hat{q}} < 0.$$
Proof of Proposition 6

\[
\frac{d\tilde{p}}{dq} = \frac{1 + 2k}{2(1+k)} \frac{dc_D}{dq} - \frac{k(w-t)(c_D-c_I) c^{-1}_I dc_D}{c^{k+1}_D dq} \\
+ \frac{c^k (c_D(1+k) - k\tilde{c}) dc_D}{2(1+k)c^{k+1}_D dq} - \frac{2\beta c^k}{L c^k_D}.
\]

Since \(\frac{dc_D}{dq} < 0\) and \((c_D(1+k) - k\tilde{c}) > 0\), we have \(\frac{d\tilde{p}}{dq} < 0\) if the second term, i.e.,

\[
\frac{k(w-t)(c_D-c_I) c^{-1}_I dc_D}{c^{k+1}_D dq},
\]

is sufficiently small. Using (19) we can rewrite this term as:

\[
\left(\frac{2\beta F_I}{L} - \frac{(w-t)^2}{2}\right) \frac{k c^{-1}_I dc_D}{c^{k+1}_D dq}.
\]

Hence \(F_I\) small and/or \((w-t)\) big are sufficient for \(\frac{d\tilde{p}}{dq} < 0\).

7 Appendix 2: Short Run Equilibrium

In the short run, the equilibrium values of \(\tilde{p}, c_D\) and \(c_I\) are given by Equations (18), (19) and (20). Total differentiation of these equations yields

\[
\begin{bmatrix}
  a_{11} & a_{12} & 0 \\
  0 & -1 & 1 \\
  1 & a_{32} & a_{33}
\end{bmatrix}
\begin{bmatrix}
  \frac{d\tilde{p}}{dt} \\
  \frac{dc_D}{dq} \\
  \frac{dc_I}{dq}
\end{bmatrix} = 
\begin{bmatrix}
  0 \\
  b_2 \\
  b_3
\end{bmatrix}
\]

where

\[
a_{11} = \frac{\beta (\alpha - w - c_D)}{\gamma (w + c_D - \tilde{p})^2} > 0, \quad (41)
\]

\[
a_{12} = -\left(\frac{\beta (\alpha - \tilde{p})}{\gamma (w + c_D - \tilde{p})^2} + \frac{N G k c^{-1}_I}{c^k_M}\right) < 0, \quad (42)
\]

\[
a_{32} = -\left(\frac{1 + 2k}{2(1+k)} + \frac{k(w-t) c^{-1}_I}{2c^{k+1}_D}\right) < 0, \quad (43)
\]

\[
a_{33} = \frac{k(w-t) c^{-1}_I}{2c^k_D} > 0, \quad (44)
\]
and

\[
b_2 = -\left(\frac{1}{2} + \frac{2\beta F_I}{L(w - t)^2}\right) < 0, \quad (45)\]

\[
b_3 = \frac{c^*_I}{2c^*_D} > 0. \quad (46)
\]

Let \( |D| \) denote the value of the determinant, which in this case is

\[
|D| = -a_{11}(a_{32} + a_{33}) + a_{12}. \quad \text{Using (41) to (44) we obtain}
\]

\[
|D| = \frac{\beta(\alpha - w - c_D)}{\gamma(w + c_D - \overline{p})^2} \left( \frac{1 + 2k}{2(1 + k)} + \frac{k(w - t)c^*_I}{2c^*_D} - \frac{k(w - t)c^*_I}{2c^*_D} \right)
\]

\[
- \frac{\beta(\alpha - \overline{p}) - N_kc^*}{c^*_M}
\]

\[
= \frac{\beta(\alpha - w - c_D)}{\gamma(w + c_D - \overline{p})^2} \left( \frac{1 + 2k}{2(1 + k)} + \frac{k(w - t)c^*_I}{2c^*_D} - \frac{k(w - t)c^*_I}{2c^*_D} \right)
\]

\[
- \frac{\beta(\alpha - w - c_D) + \beta(w + c_D - \overline{p})}{\gamma(w + c_D - \overline{p})^2} \frac{N_kc^*}{c^*_M}
\]

\[
= -\frac{\beta(\alpha - w - c_D)}{\gamma(w + c_D - \overline{p})^2} \left[ \left(1 - \frac{1 + 2k}{2(1 + k)} \right) + \frac{k(w - t)c^*_I(c_D - c_I)}{2c^*_D} \right]
\]

\[
- \frac{\beta(w + c_D - \overline{p})}{\gamma(w + c_D - \overline{p})^2} \frac{N_kc^*}{c^*_M} < 0.
\]

Using Cramer’s Rule, we have

\[
\frac{d\overline{p}}{dt} = \frac{1}{|D|} \begin{vmatrix}
0 & a_{12} & 0 \\
b_2 & -1 & 1 \\
b_3 & a_{32} & a_{33}
\end{vmatrix}
\]

\[
= \frac{a_{12}(b_3 - a_{33}b_2)}{|D|} > 0,
\]

since \( |D| < 0, a_{12} < 0 \) and \( (b_3 - a_{33}b_2) > 0 \);

\[
\frac{dc_D}{dt} = \frac{1}{|D|} \begin{vmatrix}
a_{11} & 0 & 0 \\
0 & b_2 & 1 \\
1 & b_3 & a_{33}
\end{vmatrix}
\]

\[
= \frac{-a_{11}(b_3 - a_{33}b_2)}{|D|} > 0,
\]
since $|D| < 0$, $a_{11} > 0$ and $(b_3 - a_{33}b_2) > 0$;

$$\frac{dc_I}{dt} = \frac{1}{|D|} \begin{vmatrix} a_{11} & a_{12} & 0 \\ 0 & -1 & b_2 \\ 1 & a_{32} & b_3 \end{vmatrix} = \frac{a_{12}b_2 - a_{11}b_3 - a_{11}a_{32}b_2}{|D|} < 0,$$
since $|D| < 0$, and

\[
\begin{align*}
    a_{12}b_2 - a_{11}b_3 - a_{11}a_{32}b_2 & = b_2(a_{12} - a_{11}a_{32}) - a_{11}b_3 \\
    & = \left( \frac{1}{2} + \frac{2\beta F_I}{L(w-t)^2} \right) \left[ \left( \frac{\beta(\alpha - w^2)}{\gamma(w+c_D - \bar{F})^2} + \frac{N_E\kappa^k_{D-1}}{\beta M} \right) \\
    & - \frac{\beta(\alpha - w - c_D)}{\gamma(w+c_D - \bar{F})^2} \left( \frac{1 + 2k}{2(1+k)} + \frac{k(w-t)c_I^k}{2c_D^{k+1}} \right) \right] \\
    & - \frac{\beta(\alpha - w - c_D)}{\gamma(w+c_D - \bar{F})^2} \left( \frac{1 + 2k}{2(1+k)} + \frac{k(w-t)c_I^k}{2c_D^{k+1}} \right) \beta(\alpha - w - c_D) c_I^k \\
    & - \frac{\beta(\alpha - w - c_D)}{\gamma(w+c_D - \bar{F})^2} \left( \frac{1 + 2k}{2(1+k)} + \frac{k(w-t)c_I^k}{2c_D^{k+1}} \right) \beta(w+c_D - \bar{F}) c_I^k \\
    & = \left( \frac{1}{2} + \frac{2\beta F_I}{L(w-t)^2} \right) \left[ \frac{\beta(\alpha - w - c_D)}{\gamma(w+c_D - \bar{F})^2} \left( \frac{1}{1+k} \right) + \frac{\beta(w+c_D - \bar{F})}{\gamma(w+c_D - \bar{F})^2} \left( \frac{k}{1+k} \right) \\
    & + \beta(\alpha - w - c_D) c_I^k \gamma(w+c_D - \bar{F})^2 2c_D^k \\
    & = \left( \frac{1}{2} + \frac{2\beta F_I}{L(w-t)^2} \right) \left[ \frac{\beta(\alpha - w - c_D)}{\gamma(w+c_D - \bar{F})^2} + \frac{\beta(w+c_D - \bar{F})}{\gamma(w+c_D - \bar{F})^2} \right] \\
    & - \frac{\beta(\alpha - w - c_D)}{\gamma(w+c_D - \bar{F})^2} \left( \frac{1}{2} \frac{2\beta F_I}{L(w-t)^2} - \frac{c_I^k}{2c_D^k} \right) \\
    & = \frac{\beta(\alpha - w - c_D)}{\gamma(w+c_D - \bar{F})^2} \left( \frac{1}{2} + \frac{2\beta F_I}{L(w-t)^2} - \frac{c_I^k}{2c_D^k} \right) \\
    & + \left( \frac{1}{2} + \frac{2\beta F_I}{L(w-t)^2} \right) \beta(w+c_D - \bar{F}) \gamma(w+c_D - \bar{F})^2 > 0.
\end{align*}
\]
References


