International Trade and Retailing*

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Abstract

The New Trade Theory predicts that international trade lowers prices for consumers and raises the choices available to them. This study shows that both predictions may no longer hold once adjustments in retailing are taken into account. We present a new model of retailing in general equilibrium and establish a trade-off between the number of products stocked and the number of retail outlets. The results demonstrate that international trade can lead to higher consumer prices if the retail market is relatively less competitive, and that retail assortments do not rise if consumers have a sufficiently low preference for diversity.

Keywords: International Trade, Retailing, Diversity, Market Structure, Welfare, Monopolistic Competition.

JEL Classification: F12, L11, L81

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1 Introduction

The modern theory of international trade identifies an expansion in the choices for consumers and an increase in their real income as the key gains from trade (Krugman, 1979, 1980, for the seminal theoretical contributions; Broda and Weinstein, 2006, for a recent empirical investigation). These propositions are based on adjustments in the market structures of manufacturing industries. International trade enlarges the markets for manufacturers and makes their operations more profitable, so that the equilibrium number of firms in an integrated global economy is larger than the number of firms in any national economy under autarky. As a consequence, product diversity rises and consumers can choose from a larger menu of differentiated varieties. In addition, demand becomes more elastic and firms can realize economies of scale, so that producer prices fall and real incomes rise.

Changes in the market structure of manufacturing industries are important for consumers, but they are only one part of the story. Typically, consumers do not buy their products directly from manufacturers but travel to local retail outlets for their purchases. Hence, the choices available to consumers and the prices paid are also affected by the market structure in retailing, in particular by the local availability of retail outlets, by the assortment sizes of local retailers and by the retail mark-ups. Whether consumers can choose from a larger range of products at lower prices depends upon whether local retailers find it profitable to expand the number of products in their assortment and how retail mark-ups change. Thus, for a full assessment of the impact of international trade on a country's welfare we have to take into account how the market structure in retailing is affected.

Surprisingly, the retail sector has received very little attention in the theory of international trade. Previous studies on international trade and retailing have focused either on strategic issues between manufacturers and retailers in partial equilibrium (Richardson, 2004; Raff and Schmitt, 2005, 2006, 2007), or on the role of intermediaries in overcoming informational barriers in international markets (Rauch, 2001; Rauch and Casella, 2003; Feenstra and Hanson, 2004). This lack of attention is particularly striking since the retail industries in most industrialized countries have gone through immens structural changes over the past decades that have had an equally immens impact on the local availability of manufactured products. There is overwhelming evidence that the level of concentration has increased significantly and that the overall number of retail outlets has declined (Dobson and Waterson, 1999; Clarke, 2000; Dawson, 2001; Dobson et al., 2001; Blanchard and Lyson, 2002, 2003; Weiss and Wittkopp, 2005; U.S. Department of Commerce, 2006). At the same time, the average number of products stocked in supermarkets has risen significantly (Competition Commission, 2000; Richards and Hamilton, 2006) and the number of gigantic supermarkets, so-called superstores, has even increased in absolute terms despite the overall decline in retail outlets (Dobson et al., 2001; Dobson et al., 2003). In addition, there is evidence that retail gross margins have risen (Dobson et al., 1998; Dobson and Waterson, 1999, Competition Commission, 2000; U.S. Census Bureau, 2008). Today, the retail sectors in many countries are characterized by larger and more profitable but fewer retail outlets than some decades ago.

This paper establishes a link between international trade in monopolistically competitive industries and the market structure in retailing in a general equilibrium framework. It addresses two questions: First, how can international trade contribute to the recent developments in the retail industries? And second, in how far do these adjustments in the retailing industries alter our prediction regarding the welfare implications of international trade? By incorporating a retailing sector into an otherwise standard general equilibrium model of intra-industry trade we will be able to isolate mechanisms through which international trade can affect the market structure in retailing and calculate their welfare implications. I want to state clearly upfront that I do not claim that international trade is *solely* responsible for these developments in the retailing industries. These industries have been affected by many different shocks simultaneously, such as increases in consumer mobility, changing shopping habits or technological progress (internet). However, I do argue that international trade is a distinct force in these developments, and that the adjustments triggered in the retailing industries have to be taken into account when assessing the welfare implications of international trade. We will see that a retail equilibrium implies a trade-off between product diversity and retail density, and that because of this trade-off international trade can actually lower a country's welfare.

The model presented here takes the general setup of a Krugman (1979, 1980)-type model of intra-industry trade with regard to consumer preferences (Dixit-Stiglitz) and manufacturing firms (horizontally differenciated, with fixed and variable labor costs) and adds a spatial component for the retailing industry based on the monocentric city model à la Alonso (1964) and the spatial model by Salop (1979) used in industrial organization. The economy has a circular structure where consumers (who are also workers) live on a circle around a Central Business District (CBD) and travel to the nearest local retailer for their purchases. The modeling of retailing, in particular the modeling of a retailer's cost function builds on recent contributions in industrial organization and agricultural economics, in particular on Sullivan (1997), Smith (2004), Ellickson (2006, 2007), and Richards and Hamilton (2006), as well as on an industry study by the UK Competition Commission (2000). Retailers can locate freely anywhere on the circumference of this circle and make four distinct decisions: (1) Whether to enter or not, (2) where to locate, (3) what mark-ups to charge, and (4) how many products to offer. Under some circumstances, the retailers will also charge slotting fees from manufacturing firms. Because the market structure in retailing is determined endogenously, this framework allows us to study how international trade affects not only retail prices but also the equilibrium number of retailers, their catchment areas and assortment sizes.

The base model is described in great detail in the next section. Then we conduct three comparative static exercises: International trade in the form of an increase in the number of countries integrated in the global economy (section 3), internal economic growth in the form of an increase in the labor supply and an increase in consumer mobility in the form of a fall in travel costs for consumers (section 4). In section 5 we show that when consumers have a very low preference for diversity, retailers have an incentive to limit the number of products stocked. This leads to the payment of slotting allowances and changes the way the economy adjusts to shocks. Finally, we present a number of extensions to the base model that illustrate how the framework can accommodate asymmetries or address policy issues.

2 A General Equilibrium Model of Retailing

Let us begin by outlining the geographical structure of our framework (Figure 1). Suppose that the economy of a country is populated by a mass of L consumers who live on a circle with circumference Ω around a central business district (CBD). The mass of consumers is uniformly distributed across the circumference of this circle, so that the population density is identical at all points and given by L/Ω.

Figure 1 *The Symmetric Retailing Equilibrium*

In order to purchase manufactured goods, consumers travel to one of R retail outlets that are located on various points on this circle. This travel is costly so that consumers will restrict their shopping spree to a single outlet (one-stop shopping). The catchment areas of retailers are determined endogenously by the marginal consumer who is just indifferent between two retail outlets. In a symmetric equilibrium, catchment areas are related to the number of retail outlets because the sum of all catchment areas must add up to the circumference of the circle:

$$2\delta R = \Omega \tag{1}$$

Retailers buy goods at wholesale prices from manufacturing firms located in the CBD (or abroad) and sell them to consumers at a margin. There are N manufacturing firms in the global economy and k identical countries. We restrict our analysis to symmetric equilibria and discuss the impact of asymmetries in chapter 6.

2.1 Consumers

Consumers maximizes a standard CES utility function:

$$U_\iota = \frac{1}{t_\iota} X, \tag{2}$$

where $X \equiv N^{1+\rho-\frac{\sigma}{\sigma-1}} \left(\sum_{i=1}^{N} x(i)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$, is a basket of N differentiated goods $x(i)$, $\sigma > 1$ is the elasticity of substitution between these varieties, $\rho > 0$ captures the "love of variety",[1] and t_ι denotes iceberg travel costs for consumer ι. These travel costs arise because consumers have to travel to a retail outlet to buy goods for consumption.[2] The size of these travel costs depends on the distance δ_ι between the location of a particular retail outlet and the location (home) of consumer ι, so that $t_\iota = t(\delta_\iota)$. Because of these travel costs, consumers have a strong preference for "one-stop shopping" and in a symmetric equilibrium run all their errands

[1] Some readers may be more familiar with a reduced variant of X where $\rho = \frac{1}{\sigma-1}$, so that $X = \left(\sum_N x(i)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$. The advantage of this approach here is that it distinguishes explicitly between the "love-of-variety" effect ρ and the elasticity of substitution between varieties σ (Neary, 2003).

[2] Throughout the analysis, we assume that direct marketing is not an option, so that manufacturing firms need to sell their products through retailing firms.

in a single shopping trip (Stahl, 1987; Competition Commission, 2000; Smith and Hay, 2005). We assume that travel costs are convex and use the following specific functional form:

$$t_\iota = \exp\left(\tau \delta_\iota\right). \tag{3}$$

The retail outlets are located on various points on the circumference of the circle, so that the distance δ_ι can be expressed as the shortest arcdistance between the home of the consumer and the location of the retail outlet. Note that (3) implies $t_\iota(0) = 1$ and $d \ln t_\iota / d \ln \delta_\iota = \tau \delta_\iota > 0$. The parameter τ is a technological parameter that captures all exogenous influences on consumer travel costs, like infrastructure and consumer mobility.

Each consumer/worker household supplies one unit of labor. We use labor as our numeraire so that the wage rate and a houshold's income is normalized to one. Then, maximization of (2) subject to the budget constraint $\sum_N p(i) x(i) \leq 1$ yields demand for individual varieties of X:

$$x(i) = p(i)^{-\sigma} P^{\sigma-1}. \tag{4}$$

Here, $P \equiv N^{\frac{\sigma}{\sigma-1}-1-\rho} \left(\sum_N p(i)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ is the price index of the composite good X. We assume that N is large, but not large enough for consumers to disregard the price index effect (Yang and Heijdra, 1993). Hence, the value of the price elasticity of demand is given by $-d \ln x(i) / d \ln p(i) = \sigma + (1-\sigma)\left[p(i)/P\right]^{1-\sigma}$, which reduces to

$$-\frac{d \ln x}{d \ln p} = \sigma\left(1 - \frac{1}{N}\right) + \frac{1}{N} \tag{5}$$

in a symmetric equilibrium. The price elasticity is a weighed average of the substitution effect (σ) and the income effect (1), and its value rises when N rises. The consideration of the price index effect is important for two reasons. First and foremost, it provides a rationale for retailers to offer sales on individual items in order to make a retail outlet more attractive for consumers. Second, it eliminates the unsatisfactory result that the mark-up charged by manufacturing firms is unaffected by the degree of competition (Yang and Heijdra, 1993).

2.2 Manufacturing

Manufacturing firms produce single varieties of the differentiated good under increasing returns to scale.[3] Their profits are given by

$$\Pi_M = (p_W - \beta)\, Q - \alpha, \tag{6}$$

where α and β denote the fixed and variable labor requirements, p_W is the wholesale price and Q denotes world market demand.

International trade is free and there are no trade costs associated with exporting to foreign markets. World market demand comes from a mass of L consumers in k identical countries. Hence,

$$Q = kLx. \tag{7}$$

Because retailers charge a mark-up μ, retail prices differ from wholesale prices:

$$p = (1 + \mu)\, p_W. \tag{8}$$

The mark-up charged by retailers has no influence on the perceived price elasticity of manufacturing firms as they treat the retail mark-up as given. Hence, from the perspective of a manufacturing firm: $d \ln p_W / d \ln x = d \ln p / d \ln x$. Then, given equations (5), (6) and (7), the profit maximizing wholesale price is

$$p_W = \beta \left[1 + \frac{N}{(\sigma - 1)\,(N - 1)} \right]. \tag{9}$$

Note that the mark-up charged by manufacturing firms ($p_W/\beta - 1$) depends on the elasticity of substitution between varieties (σ) and on the number of manufacturing firms in the global economy (N). The mark-up falls when N rises because demand becomes more elastic when the number of competitors rises.

Manufacturing firms enter or exit the global market until profits are driven down to zero. Using (4), (6), (7), (8) and (9), the condition for a free-entry profit-maximizing equilibrium

[3] The analysis is limited to symmetric equilibria and indices are supressed for simplicity.

in the manufacturing industry is

$$kL = \alpha (1 + \mu) (\sigma N - \sigma + 1) . \tag{10}$$

2.3 Retailing

Retailers buy products from manufacturers at the wholesale price p_W and sell them with a mark-up (8) to local consumers. The profits of a retailer j are given by

$$\Pi_R (j) = 2\delta_j \frac{L}{\Omega} \sum_{i=1}^{N_j} [p (i) - p_W] x (i) - \gamma N_j \tag{11}$$

The first term on the right hand side of (11) denotes a retailer's gross profits. They consist of gross profits per consumer $\sum_{i=1}^{N_j} [p (i) - p_W] x (i)$ times population density L/Ω over its catchment area $2\delta_j$, where δ_j captures the catchment area to one side of its location on the circle.

The second term, γN_j, is the labor requirement necessary to provide N_j goods. We will refer to these costs as the costs of provision. The costs of provision depend positively on the number of varieties in the assortment (Competition Commission, 2000, in particular chaper 10 and its appendix), but are sunk in the sense that once a retailer has decided upon its product assortment, the costs of providing these goods do not depend on the actual sales. One can think of these costs as expenditures for in-store service personnel or labor services in departments such as purchasing or storage (Sullivan, 1997).[4] Equation (11) does not exhibit any marginal costs of retailing. Their relevance is limited with respect to the mechanisms described here, so we can safely ignore them.

Given the utility of consumers and their "love of variety", the product assortment offered by a retailer can be interpreted as an index of the quality of a retail outlet (Ellickson, 2006, 2007). A trip to a retail outlet with a larger assortment of products allows a consumer to purchase a larger variety of goods and realize a higher utility. Hence, our model can be interpreted as a model with both vertical (quality) and horizontal (location) differentiation.

Retailers maximize profits by choosing the optimal mark-up μ. In a symmetric equilibrium,

[4] More complex specifications for the costs of provision lead to qualitatively similar results as long as the number of varieties remains an independent argument in the cost function.

the profit-maximizing mark-up is identical across all products and retailers and satisfies (see Appendix 8.1)

$$\mu = -\frac{1}{N}\left(\frac{d\ln\delta}{d\ln\mu}\right)^{-1} - 1. \tag{12}$$

Note that the profit-maximizing mark-up does not depend on the price elasticity of individual products [equation (5)], but solely on the elasticity of the retailers catchment area ($d\ln\delta/d\ln\mu$). This is because, in contrast to (single-product) manufacturing firms, retailing firms sell a basket of goods and internalize demand linkages between these goods. A reduction in the price of one product may increase revenues on this product, but with a binding budget constraint consumers must finance the extra expenditures through a reduction in expenditures on other products. This is known as the "cannibalization effect" and it is particularly relevant in the context of retailing. Here, "cannibalization" is perfect in the sense that consumers spend their entire income at a single retail outlet (one-stop shopping), so that their expenditures are equal to their income (which is normalized to one) and independent of the mark-up charged by the retail outlet [$\sum_N p(i)\,x(i) = 1$].

For a retailer, "cannibalization" implies that inframarginal revenues (from sales to customers within a retailer's catchment area) are independent of the retailer's mark-up. However, changes in the mark-up do affect a retailer's external margin, i.e. its catchment area. A higher mark-up makes a retail outlet less attractive to consumers and reduces the retailer's catchment area. This is why the profit-maximizing mark-up in (12) depends on the elasticity of the catchment area δ.

The elasticity of the catchment area can be calculated by looking at the marginal consumer who is just indifferent between two retail outlets. Given (2), (4) and (9), the elasticity of the catchment area with respect to a retailer's mark-up is

$$\frac{d\ln\delta}{d\ln\mu} = -\frac{1}{N}\frac{\mu}{(1+\mu)}\frac{1}{2\delta\tau}. \tag{13}$$

In a symmetric equilibrium, the mark-up is identical across products and retailers, and the catchment areas of all retail outlets must cover the circumference of the circle. By substituting (13) into (12) and using (1) we can express the optimal mark-up as a function of the mobility of consumers (τ) and the density of retail outlets (R/Ω):[5]

$$\mu = \frac{\tau\Omega}{R}. \tag{14}$$

An increase in either the mobility of consumers (a fall in τ) or the density of retail outlets (an increase in R/Ω) reduces the local monopoly power of a retailer and leads to a lower mark-up.

There is free entry in retailing, too. Hence, in equilibrium retail profits are zero: $\Pi_R = 0$. Using equations (1), (11) and (14), the zero profit condition can be expressed as

$$\frac{\tau\Omega}{R+\tau\Omega}L = R\gamma N. \tag{15}$$

Note that we use the same symbol N for the product assortment of a retailer and for the number of manufacturing firms and that the latter is determined by the zero profit condition (10) in manufacturing. Hence, we implicitly assume that retailers take all products available on the world market into their assortments. This is not trivial because providing products is costly for retailers and we need to make sure that they do not find it profitable to restrict their assortment. Technically, this implies that $d\Pi_R(j)/d\ln N_j$ is positive when evaluated at zero profits. For the moment, we simply assume that this condition is satisfied and treat the retailers' assortments as being determined by the zero profit condition in manufacturing. We will come back to this in section 5 where we discuss the implications of this assumptions and how the equilibrium is determined when this condition is not satisfied.

2.4 The General Equilibrium

Equations (10), (14) and (15) determine the retail mark-up μ, the number of manufacturing firms N and the number of retailers R. Wholesale and retail prices (in units of labor, p_W and p) as well as the real wage ($1/p$) are then given by (9) and (8), and consumption and output levels by (4) and (7). The labor market is in equilibrium as well. Let national labor markets be perfectly competitive and completely segregated. The supply of labor is exogenously given by the number of consumers/workers L. The demand for labor consists of demand

[5] Equation (13) shows the impact of a change in an *individual* mark-up on the catchment area. If a retailer varies *all* mark-ups symmetrically, the impact is N times as high. Thus, the term $1/N$ disappears in the calculation of (14).

for manufacturing $(N/k)(\alpha+\beta Q)$ and demand for retailing $(R\gamma N)$. Using the equilibrium values for N, R and Q, we find that labor markets are in equilibrium, too:

$$\frac{N}{k}(\alpha+\beta Q)+R\gamma N=\left(Np_W x+\frac{\mu}{1+\mu}\right)L=L \tag{16}$$

In order to illustrate the equilibrium graphically we reduce the system of equations to two equations in the number of manufacturing firms N and the number of retailers R. The first of these two is the zero profit condition in the retailing industry (15). The second equation is derived by substituting the retail mark-up (14) into the zero profit condition in the manufacturing industry (10):

$$kL=\alpha\left(1+\frac{\tau\Omega}{R}\right)(\sigma N-\sigma+1). \tag{17}$$

The equilibrium is illustrated in Figure 2. The upward sloping curve is the zero profit condition in the manufacturing industry ($\Pi_M^{\max}=0$). The downward sloping curve represents the zero profit condition in the retailing industry ($\Pi_R^{\max}=0$).

Figure 2 *The General Equilibrium*

The two zero profit conditions in Figure 2 highlight an important difference in the relationship between manufacturing firms and retailers. Retailers are the "friends" of manufacturing firms in the sense that profits in manufacturing are increasing in the number of retailing firms. The reason for this is that an increase in the number of retailers lowers retail mark-ups, and this boost consumer demand for manufacturing products. The reverse relationship has the opposite effect: Manufacturing firms are the "enemies" of retailers. An increase in the supply of differentiated manufacturing products raises the retailers' costs of provision, and this cost increase leads to a consolidation in the retailing industry. Hence, the zero profit condition in the retail industry creates a trade-off between diversity (the number of products offered) and the retail density.

3 International Trade

Let us think of international trade as an enlargement of the global market in the form of an increase in the number of countries integrated in the global economy (an increase in k). Graphically, the manufacturing zero profit condition ($\Pi_M^{\max} = 0$) shifts to the right. This shift resembles the traditional result of the new trade theory: For a given market structure in retailing ($R = \bar{R}$), an increase in the global market clearly raises the number of firms and, thus, the number of differentiated products available for consumption. Note, however, that N rises by less than k in relative terms: $d \ln N / d \ln k|_{R=\bar{R}}^{\Pi_M^{\max}=0} = (\sigma N - \sigma + 1) / (\sigma N) < 1$. Hence, the number of firms per country, N/k, falls. There are two effects: First, an increase in k implies a larger demand (and a larger labor supply to satisfy demand), so that the aggregate number of firms supported in the global market rises. Second, the accompanying increase in the number of differentiated products makes demand more elastic, so that all firms have to lower their mark-ups. Consequently, firm output rises and the increase in the number of firms is less than proportionate to the increase in the size of the global market.

The retailing zero profit condition is not directly affected by an increase in k. Technically, this can be checked by confirming that equation (15) is indeed independent of k. Intuitively, the retailing equilibrium is not affected because retailers sell ony locally and compete only against other local retailers. Hence, an increase in the size of the global market has no direct effect on the market structure in retailing.

Figure 3 *International Trade*

Figure 3 illustrates that the new equilibrium is at a higher N and a lower R. The reason for the increase in the number of manufacturing firms is still the increase in global demand (and labor supply) described above, only that this increase is now even further dampened by adjustments in the retailing industry. These adjustments are triggered by the increase in the number of manufactured products available on the world market. As retailers add new products to their assortments, their costs of provision rise, and this cost increase leads to a consolidation in the local retail market. Hence, the number of local retailers R falls. The increase in N is dampened by the fall in R because retail mark-ups rise, and the accompanying increase in consumer prices partly offsets the initial increase in demand.

Mathematically, we obtain the following solutions (see Appendix 8.2):

$$\frac{d\ln R}{d\ln k} = -\frac{1}{\Delta} < 0, \qquad \frac{d\ln N}{d\ln k} = \frac{1}{\Delta}\frac{(2R+\tau\Omega)}{(R+\tau\Omega)} > 0, \tag{18}$$

where $\Delta \equiv \frac{(2R+\tau\Omega)}{(R+\tau\Omega)}\frac{\sigma N}{(\sigma N-\sigma+1)} + \frac{\tau\Omega}{(R+\tau\Omega)} > 1$. The mathematical solutions confirm our graphical analysis. In particular, they proof that the number of retailers falls and that the increase in the number of manufacturing firms is less pronounced than without adjustments in the retailing industry. This latter point can be seen by rearranging $d\ln N/d\ln k$ in (18): $\frac{d\ln N}{d\ln k} = \frac{1}{\Delta}\frac{(2R+\tau\Omega)}{(R+\tau\Omega)} = \left(\frac{\sigma N}{\sigma N-\sigma+1} + \frac{\tau\Omega}{2R+\tau\Omega}\right)^{-1} < \left(\frac{\sigma N}{\sigma N-\sigma+1}\right)^{-1} < 1$.

Proposition 1 *International trade leads to a fall in the number of local retailers. The aggregate number of manufacturing firms in the global economy rises.*

The changes in the retail mark-up and the wholesale prices follow from (14) and (9):

$$\frac{d\ln\mu}{d\ln k} = \frac{1}{\Delta} > 0, \qquad \frac{d\ln p_W}{d\ln k} = -\frac{1}{\Delta}\frac{N(2R+\tau\Omega)}{(N-1)(\sigma N-\sigma+1)(R+\tau\Omega)} < 0. \tag{19}$$

As equation (14) shows, the retail mark-up is inversely proportionally related to the number of retailers. Hence, as the number of retailers falls, and the distance between retailers grows [$d\ln\delta = -d\ln R$ because of (1)], the local monopoly power of retailers rises. As a consequence, retailers are able to raise their mark-ups. On the other side, wholesale prices and mark-ups in manufacturing fall even though the number of manufacturing firms per country has fallen, too ($d\ln N/d\ln k < 1$). But in contrast to retailers, manufacturing firms are competing globally and their mark-ups depend on the degree of competition in the global economy. And because the aggregate number of manufacturing firms rises, demand becomes more elastic and manufacturers are forced to lower their prices.

Proposition 2 *International trade raises the mark-ups in retailing while mark-ups in manufacturing fall.*

The results in (19) convey an important message. The manufacturing industry and the retailing industry are affected in a fundamentally different way by international trade. Because manufacturing firms compete globally, they are confronted with a *more competitive* environment when new countries join the global market. Retailers compete only locally. Therefore, they are only indirectly affected through a larger availability of manufactured products worldwide. Because this raises their costs of provision, some retailers have to exit, and the remaining retailers face a *less competitive* environment. As a consequence of these diverse effects, the mark-ups in manufacturing fall and those in retailing rise.

The fact that retail mark-ups rise is not only interesting in itself, it is also highly relevant for the impact of international trade on consumer prices. One of the potential gains from trade that is frequently cited from the textbook theory is that international trade lowers prices for consumers. We have seen that wholesale prices fall indeed, but consumer (or retail) prices (p) depend on retail mark-ups, too. And with retail mark-ups rising, the total impact on consumer prices is ambiguous.

The mathematical solution for the impact on consumer prices can be derived from (8):

$$\frac{d\ln p}{d\ln k} = \frac{\mu}{1+\mu}\frac{d\ln \mu}{d\ln k} + \frac{d\ln p_W}{d\ln k} = \frac{\left[\sigma\left(N-1\right)^2-1\right]\tau\Omega - 2NR}{\Delta\left(R+\tau\Omega\right)\left(N-1\right)\left(\sigma N-\sigma+1\right)} \gtreqless 0. \tag{20}$$

Obviously, equation (20) can be either positive or negative, depending, among other variables, on the market structures in retailing and in manufacturing, R and N. If $R > \frac{\tau\Omega}{2N}[\sigma\left(N-1\right)^2 - 1]$, then $d\ln p/d\ln k < 0$ and vice versa.

Figure 4 *The Effect on Consumer Prices*

Figure 4 illustrates that consumer prices fall when the retail market is relatively competitive compared to the manufacturing industry and rise when the manufacturing industry is relatively more competitive. The reason for why relative competitiveness in the two industries matters for the impact of international trade on consumer prices is because it affects the size of the adjustments in the mark-ups of these two industries. The more competitive an industry is, the less mark-ups will respond to changes in the market structure. Take for example the Dixit-Stiglitz approximation: If $N \to \infty$, mark-ups in manufacturing are essentially fixed by the elasticity of substitution σ. In this case, wholesale prices do not fall at all, and the rise in the retail mark-up translates directly into an increase of consumer prices: $\lim_{N\to\infty}\frac{d\ln p}{d\ln k} = \frac{1}{2}\frac{\tau\Omega}{R+\tau\Omega} > 0$.

Since we use labor as our numeraire, the real wage is given by the inverse of consumer prices ($1/p$). Therefore, when consumer prices rise, the real wage falls and vice versa. This implies that as a result of the adjustments in the retail industry, international trade can actually lower real wages.

Proposition 3 *The impact of international trade on consumer prices and on the real wage is ambiguous. The real wage falls if mark-ups in manufacturing are low compared to mark-ups in retailing.*

Finally, let us address the welfare effects of international trade. The fact that real wages may fall is an important first step in this direction, but consumer do not only value real income, they also value diversity. In addition, there are travel costs that depend on the the consumer's distance to the nearest retail outlet. Because these travel costs depend on a consumer's location, individual utility levels differ. Average utility is defined as $\tilde{U} \equiv \frac{1}{\delta} \int_0^\delta U_\iota d\iota$ and, given (2), can be expressed as $\tilde{U} = N^\rho / \left(p\tilde{t}\right)$, where $\tilde{t}$ is the harmonic mean of travel costs $\tilde{t} \equiv \delta \left(\int_0^\delta (t_\iota)^{-1} d\iota \right)^{-1}$. The relative change in average utility is

$$d \ln \tilde{U} = \rho d \ln N - d \ln p - d \ln \tilde{t}. \tag{21}$$

Equation (21) nicely illustrates the three factors determining the relative change in average utility: The first term ($\rho d \ln N$) is the love-of-variety effect. It depends on the relative change in the number of varieties ($d \ln N$) weighed by the consumers' preference for diversity (the parameter ρ). The second term is the relative change in the real wage ($-d \ln p$) and the third term is the relative change in mean travel costs ($d \ln \tilde{t}$).

The last term, the relative change in mean travel costs, depends on changes in the size of the catchment area (δ) and on changes in the mobility of consumers (τ). Since there is a strictly inverse relationship between catchment areas and the number of retailers [equation (1)], a consolidation in retailing will raise mean travel costs. Given (3), the relative change in $\tilde{t}$ can be expressed as $d \ln \tilde{t} = -\frac{t(\delta)-\tilde{t}}{t(\delta)} \left(d \ln R - d \ln \tau\right)$, where $\frac{t(\delta)-\tilde{t}}{t(\delta)} = 1 - \tau\delta \left(e^{\tau\delta} - 1\right)^{-1} \in (0,1)$ can be interpreted as a measure of the relative curvature of travel costs.

The total impact of international trade on average utility is given by $\frac{d \ln \tilde{U}}{d \ln k} = \rho \frac{d \ln N}{d \ln k} - \frac{d \ln p}{d \ln k} - \frac{d \ln \tilde{t}}{d \ln k}$ and is ambiguous. The first term on the right hand side, the love-of-variety effect, is clearly positive. The last term, the travel cost effect, is clearly negative. And the term in the middle, the change in the real wage, is itself ambiguous.

By substituting previous results we obtain

$$\frac{d\ln\tilde{U}}{d\ln k}=\underbrace{\left[\rho+\frac{N}{\left(N-1\right)\left(\sigma N-\sigma+1\right)}\right]\frac{d\ln N}{d\ln k}}_{\text{positive}}+\underbrace{\left[\frac{\mu}{1+\mu}+\frac{t\left(\delta\right)-\tilde{t}}{t\left(\delta\right)}\right]\frac{d\ln R}{d\ln k}}_{\text{negative}}. \tag{22}$$

Equation (22) shows that the change in average utility can be traced back to the underlying changes in the market structure in manufacturing and retailing. The first term, the increase in the global number of manufacturing firms, clearly raises average utility because of two effects: First, the increase in the number of firms raises the number of differentiated products available in the world market, and consumers value diversity (*love-of-variety effect*). Second, the increase in competition among manufactured firms lowers manufacturing mark-ups, and this tends to lower prices and raise real wages (*competition effect*). The second term in (22), the decrease in the number of local retailers, clearly lowers average utility. Again, there are two effects: First, the consolidation in retailing allows retailers to increase their mark-ups. This tends to raise prices and lower real wages (*retail mark-up effect*). And second, the average distance between retailers rises, so that consumers have to travel longer distances to run their errands (*travel cost effect*). The sum of all these effects may be positive or negative, depending on their relative sizes.

Proposition 4 *The aggregate welfare effect of international trade is ambiguous. The love-of-variety effect and the competition effect in manufacturing tend to raise welfare, while the retail mark-up effect and the travel cost effect tend to lower welfare.*

4 Internal Economic Growth and Increase in Consumer Mobility

This framework allows us not only to analyze the impact of international trade on the market structure in retailing (and the feedback effects on consumers), we are also able to study how *(a)* internal economic growth (in the form of an increase in the population L) and *(b)* an increase in consumer mobility (a fall in τ) affect the retailing industry.

(a) We beginn by looking at an increase in L. In our $R-N$ diagram, an increase in L leads to an outward shift of both zero profit conditions, but the shift of the retail locus is larger than the shift of the manufacturing locus: $\frac{d\ln N}{d\ln L}\Big|_{R=\bar{R}}^{\Pi_R^{\max}=0} = 1$ and $\frac{d\ln N}{d\ln L}\Big|_{R=\bar{R}}^{\Pi_M^{\max}=0} = \frac{\sigma N - \sigma + 1}{\sigma N} < 1$. The new equilibrium is at a larger number of manufacturing firms and a larger number of retailers.

Figure 5 *Internal Economic Growth*

In many models of intra-industry trade, an increase in the size of the global market and an increase in the size of a local market have isomorphic effects on the market structure in manufacturing (Krugman, 1979). Our analysis shows that the two shocks are quite different in their effect on the retail market. The reason for this is that internal economic growth affects retailers directly by affecting local demand for retail services, whereas external growth affects retailing only indirectly. Specifically, an increase in L raises the population density and boosts local sales. As a consequence, local retailers make more profits (c.p.), and this leads to additional entry in retailing.

The manufacturing locus shifts outwards, too, because the increase in L implies also an increase in demand for manufacturing products. However, a note of caution is in order: In the symmetric setup chosen here (and in the mathematical derivative of the outward shift above), an increase in L implies that the population in *all* countries increases. This is in a way unsatisfactory because it combines internal economic growth (an increase in the local population) with external growth (an increase in the population in all other countries). Thus, the outward shift of the manufacturing locus shown here is stronger than it would be if only the population of a single country increases. In fact, in the extreme case with a continuum of countries, the increase in L in a single country had no effect on aggregate demand for manufacturing firms in the global economy, and the manufacturing locus would remain unaffected in this case. However, a quick glance at Figure 5 also reveals that making this differentiation is only important quantitatively and not qualitatively.

Mathematically, we have $d\ln R/d\ln L = \Delta^{-1}(\sigma - 1)/(\sigma N - \sigma + 1) > 0$ and $d\ln N/d\ln L = 2/\Delta > 0$. Since the equilibrium numbers of both manufacturers and retailers rises, the mark-ups in the two industries both fall: $d\ln p_W/d\ln L < 0$ and $d\ln \mu/d\ln L < 0$. In this case, the impact on consumer prices is unambiguously negative, so that the real wage rises clearly: $d\ln p/d\ln L < 0$. Since mean travel costs also fall in response to an increase in the number of retailers ($d\ln\tilde{t}/d\ln R < 0$), the welfare effect of an increase in L is unambiguously positive:

$$\frac{d\ln\tilde{U}}{d\ln L} = \rho\underbrace{\frac{d\ln N}{d\ln L}}_{(+)} - \underbrace{\frac{d\ln p}{d\ln L}}_{(-)} - \underbrace{\frac{d\ln\tilde{t}}{d\ln L}}_{(-)} > 0. \tag{23}$$

Proposition 5 *Internal economic growth raises the number of both retailers and manufacturers. Mark-ups in both industries fall and the real wage as well as welfare rise unambiguously.*

The core difference between an increase in the number of countries in the global economy (k) and an increase in the size of the population (L) is that the former has no direct impact on the retailing industry whereas the latter affects retailers directly through an increase in local sales.

(b) Let us now consider an increase in the mobility of consumers in the form of a fall in τ. According to (3), a fall in τ flattens the travel cost curve, so that consumers have lower absolute and marginal travel costs at any $\delta_\iota > 0$. A fall in τ shifts both zero profit conditions downwards in our $R-N$ diagram. The shift of the manufacturing locus is larger than the shift of the retailing locus ($d\ln R/d\ln\tau|^{\Pi_M^{\max}=0}_{N=\bar{N}} = -1$ and $d\ln R/d\ln\tau|^{\Pi_R^{\max}=0}_{N=\bar{N}} = -R/(2R+\tau\Omega) > -1$), so that the new equilibrium is at a higher N and a lower R.

Figure 6 *Increase in Consumer Mobility*

The market structure effects of an increase in consumer mobility are similar to those of international trade. Both lead to an expansion in the aggregate number of manufacturing firms (and products) and a consolidation in the retailing industry. Wholesale prices (p_W) also fall in both scenarios. However, there is a decisive difference in how these two shocks affect retail margins. While retail margins rise when the global economy grows, they actually fall when consumers become more mobil. To see this note first that the decrease in the number of retailers is less than proportionate: $d\ln R/d\ln\tau < 1$. Then, (14) implies that $d\ln\mu/d\ln\tau = 1 - d\ln R/d\ln\tau > 0$. Hence, a fall in τ pushes retail margins down.

The reason for why retail margins fall when consumer mobility rises is that a fall in travel costs makes a retailer's demand more elastic. When consumers are more mobile, they respond more elastically to changes in prices. As a consequence, a retailer's optimal mark-up falls. This leads to a consolidation in the retail industry until the surviving retailers can make up in catchment areas what they lost in margins.

An increase in consumer mobility leads to a consolidation in the retail sector because it lowers retail margins by raising the price elasticity of demand. This is a demand side shock. An increase in the number of countries integrated in the global economy leads to higher retail margins because the increase in the costs of provision lead to a consolidation in the retail sector. This is a supply side shock. Therefore, even though both shock have the same impact on the market structure in retailing, their impact on mark-ups is distinctly different.

Having established that a fall in τ leads to lower mark-ups, the analysis of consumer prices and welfare is essentially straightforward. Since wholesale prices fall in response to the increase in N ($d\ln p_W/d\ln\tau > 0$), consumer prices must also fall ($d\ln p/d\ln\tau > 0$). Finally, the indirect effect of larger catchment areas on travel costs is dominated by the direct effect of a lower τ ($d\ln\tilde{t}/d\ln\tau = d\ln R/d\ln\tau - 1 > 0$). Therefore, welfare rises unambiguously:

$$\frac{d\ln\tilde{U}}{d\ln\tau} = \left[\rho + \frac{N}{(N-1)(\sigma N - \sigma + 1)}\right]\underbrace{\frac{d\ln N}{d\ln\tau}}_{(-)} + \left[\frac{\mu}{1+\mu} + \frac{t(\delta) - \tilde{t}}{t(\delta)}\right]\underbrace{\left(\frac{d\ln R}{d\ln\tau} - 1\right)}_{(-)} < 0 \quad (24)$$

Proposition 6 *An increase in consumer mobility leads to an increase in the number of manufacturing firms and a decrease in the number of retailers. Mark-ups fall in both industries, so that consumer prices also fall (the real wage rises) and welfare rises unambiguously.*

When comparing our results in the previous two sections with the stylized facts presented in the introduction we notice that two shocks appear to match our observations. Both international trade and an increase in consumer mobility are predicted to lead to a simultaneous increase in the number of products stocked and a fall in the number of retail outlets. But only our international trade shock is also consistent with an increase in retail margins. Naturally, this is no proof that international trade is responsible (let alone solely responsible) for the developments in the retail industries. This is ultimately an empirical question that cannot be answered in theory. However, these observations are strong signs that international trade may be an important driver of these phenomena.

5 Assortment Sizes and Slotting Allowances

In section 2.3 we assumed that retailers find it always profitable to add products to their assortments when they become available on the world market. We have already pointed out that this assumption is not trivial because the provision of goods is costly. In this section we want to discuss the conditions under which this assumption is valid and how the equilibrium is determined when retailers want to restrict their assortment sizes.

First, we calculate the profit maximizing product assortment of a retailer by assuming that retailers choose mark-ups and assortments simultaneously. An increase in a retailer's assortment raises its costs of provision, but it also makes this retail outlet more attractive for consumers because it offers more choices. These two effects must be weighed off against each other. The profit maximizing assortment size (denoted by an asterisk) N^* and the corresponding equilibrium number of retailers R^* as well as their mark-ups μ^* are then given by

$$N^* = \frac{\rho^2 L}{(1+\rho)\,\gamma\tau\Omega}, \qquad R^* = \frac{\tau\Omega}{\rho} \qquad \text{and} \qquad \mu^* = \rho. \tag{25}$$

In a symmetric equilibrium, the assortment size in retailing must be identical to the number of manufacturing firms in the global economy.[6] Hence, the profit maximizing product assortment in retailing and the zero profit condition in manufacturing are two competing conditions for the determination of N, only one of which can be binding. The profit maximizing assortment is binding if ρ is below a certain threshold $\rho < \breve{\rho}$, where $\breve{\rho} > 0$.[7] If consumers have a high "love of variety" ($\rho > \breve{\rho}$), they respond strongly in their outlet decisions to changes in a retailer's assortment size. In this case, retailers find it profitable to take as many products as possible into their assortments and the number of manufactured products is determined by the zero profit condition in manufacturing. But if consumers have a low "love of variety" ($\rho < \breve{\rho}$), they look primarily for low retail prices. In that case, the costs of adding products to a retailer's assortment dominate the advantage of a larger assortment, so that retailers find it profitable to limit the range of products offered.

If the profit maximizing assortment is binding ($\rho < \breve{\rho}$), retailing firms create an arti-

[6] Because of economies of scale, a manufacturer serving all retailers can alway charge a price below the average costs of a manufacturer serving only a subset of retailers. Therefore, in equilibrium all manufacturing products are listed with all retailers.

[7] See equation (46) in Appendix 8.4.

ficial bottleneck that generates scarcity rents for manufacturing firms because the number of products listed in the retail assortment is smaller and the wholesale price is higher than in the equilibrium with zero profits. However, these scarcity rents cannot be appropriated by the manufacturers. Without barriers to entry, manufacturing firms not listed will find it profitable to offer "slotting allowances"[8] to retailers in order to have their products placed on their shelves. The ensuing competition between manufacturers for the scarce retail shelve space raises these slotting allowances until profits in manufacturing are driven down to zero.

The payment of slotting allowances by manufacturing firms to retailers suggests that the scarcity rents are passed on to the retailing firms. However, for the same reason these rents cannot be appropriated by retailers, either. Without barriers to entry in retailing, retailers are not only competing against their neighboring rivals, they are also competing against potential entry at their own location. Hence, the slotting allowances paid by manufacturing firms are passed on to final consumers.

In reality, slotting allowances usually take the form of either cash payments or free goods. Here, it is most convenient to think of slotting allowances as of the "iceberg" type, i.e. manufacturing firms ship out a larger quantity of goods than what they get paid for: $\Pi_M(i) = (p_W(i) - \beta s(i)) Q(i) - \alpha$, where $s(i) > 1$ are the iceberg slotting allowances. Note, however, that in contrast to transportation costs, slotting allowances are not variable costs but fixed payments in units of goods. As a type of market entry fee they do not enter into the firm's pricing decision, so that the wholesale price $p_W(i)$ continues to be determined by equation (9).

Technically, we assume that manufacturing firms choose prices and slotting allowances simultaneously. While final consumers perceive the various manufactured products as differentiated and care about the diversity offered by local retailers, they do not care about the composition of this diversity. Hence, when it comes to adding varieties to a retailer's assortment, the different manufactured products are essentially perfect substitutes. As a consequence, the competition between manufacturers for the scarce retail space is Bertrand in nature and slotting allowances rise until effective prices (net of slotting allowances, p_W/s) are

[8] "'Slotting allowances' are one class of payments that may be made for shelf access. They are lump-sum, up-front payments from a manufacturer (...) to a retailer to have a new product carried by the retailer and placed on its shelves." (Federal Trade Commission, 2001).

down to average costs. The equilibrium slotting allowances are given by (see Appendix 8.4):

$$s^* = \left[1 - (1+\rho)\frac{\alpha N^*}{kL}\right]\frac{\sigma(N^*-1)+1}{(\sigma-1)(N^*-1)}. \tag{26}$$

Consumers are the beneficiaries of these slotting allowances. For every unit they purchase they get $s-1$ units for free ("take one, get $s-1$ for free" offers). Average utility is then given by $\tilde{U} = N^{\rho}(s/p)/\tilde{t}$, where s/p is the effective real wage (including slotting allowances): $s/p = \left[1-(1+\rho)\frac{\alpha N^*}{kL}\right]/\left[(1+\rho)\beta\right]$.

We see that if the profit maximizing assortment is binding, the determination of the equilibrium is quite different. It also has profound effects on how the markets respond to shocks:

Proposition 7 *International trade: If consumers have a low "love of variety" ($\rho < \breve{\rho}$), an increase in the number of countries (k) has no impact on the market structure in retailing or in manufacturing. However, consumer are better off because of larger slotting allowances.*

From the explicit solutions of N^*, R^* and μ^* in (25) it is immediately obvious that all three parameters are unaffected by changes in k. Just as in the previous section there is no direct effect of a change in k on the retailing sector because retailers sell only locally. But in contrast to the previous section, there is no indirect effect via entry in the manufacturing industry, either, because the equilibrium number of manufacturing products and firms is determined in the retailing sector as well. An increase in k still makes manufacturing more profitable, but this does not lead to entry but to an increase in slotting allowances. Log differentiation of (26) yields $d\ln s^*/d\ln k = (1+\rho)\frac{\alpha N^*}{kL}/\left[1-(1+\rho)\frac{\alpha N^*}{kL}\right] > 0$. As a consequence, average utility rises even though N, p and $\tilde{t}$ all remain constant: $d\ln\tilde{U}/d\ln k = d\ln s^*/d\ln k > 0$.

This is an important result. It shows that a larger international market does not necessarily lead to an increase in the local choices for consumers. This depends on whether local retailers find it profitable to expand their assortments. If they do, we have seen in the previous section that this may lead to a consolidation in the retailing industry with ambiguous welfare effects. If they don't, then the analysis in this section shows that market structures and prices in both retailing and manufacturing remain unaffected. However, consumers are better off because they benefit from the fiercer global competition between manufacturers for the scarce retail space that leads to an increase in slotting allowances.

Note that the result of locally constant assortments does not contradict studies emphasizing the growth in *imported* varieties (e.g., Broda and Weinstein, 2006). In our symmetric setup, the share of imported varieties is given by $(k-1)/k$, and this is clearly increasing in k irrespective of how the market structure in manufacturing adjusts. In the case where assortments remain constant, an increase in k leads to a proportional decrease in N/k. Hence, an increase in the share of imported varieties leads to a change in the composition in local retail assortments. However, our results also indicate that one must exercise extreme caution when drawing welfare implications from the fact that more varieties are imported.

Analyzing other shocks (internal growth, mobility) is also straightforward:

Proposition 8 ***(a)*** *Internal growth: An increase in L leads to larger assortments and higher slotting allowances, but leaves the market structure in retailing unaffected.* ***(b)*** *Mobility: A fall in τ leads to larger assortments and a consolidation in the retailing sector. Slotting allowances fall.*

Proof. Log differentiation of (25) and (26) yields **(a)** $d\ln N^*/d\ln L = 1$, $d\ln R^*/d\ln L = 0$, and $d\ln s^*/d\ln L > 0$; **(b)** $d\ln N^*/d\ln \tau = -1$, $d\ln R^*/d\ln \tau = 1$, and $d\ln s^*/d\ln \tau > 0$. ■

We see that shocks that have a direct impact on the retailing sector also have an impact on the size of the assortments. An increase in L raises local demand for retailing services, and this leads to a corresponding increase in the size of assortments. A fall in τ reduces travel costs and makes demand for retailing services more elastic. This leads to a consolidation in the retailing sector that in turn allows retailers to increase their assortment sizes. These results are qualitatively similar to the results in the previous section.

6 Extensions

This framework can be extended in various directions. Following Melitz (2003), a by now popular extension is to introduce heterogeneity in the productivity of manufacturing firms. In principal, this could be done here as well, but would not lead to new insights regarding the adjustments in the retailing industry.[9] Instead, we focus on two asymmetries that have

[9] Because of complete cannibalization, neither retail mark-ups nor assortment sizes depend on the costs in manufacturing. Hence, introducing heterogeneous manufacturers leads to the well know selection effects in

a direct impact on the retailing industries: Consumers' preference for diversity and zoning regulations. In addition, we present a simple extension with a market for housing and rents.

6.1 Asymmetric Preferences for Diversity

Suppose that all countries are identical except for their consumers' "love of variety", so that the parameter $\rho = \rho(i)$ is country specific. Then, countries with a high ρ are governed by the regime described in section 2.4 and countries with a low ρ are governed by the regime described in the previous section. The critical country $\breve{k}$ is determined in Figure 7, where $\kappa(\rho)$ is the sum of all countries with a $\rho(i) \geq \rho$, and $\breve{\rho}(k)$ is taken from equation (46) in Appendix 8.4. We will refer to the countries with a high "love of variety" [$\rho(i) > \breve{\rho}\left(\breve{k}\right)$] as diversity-loving countries, or just D countries, and countries with a low "love of variety" [$\rho(i) < \breve{\rho}\left(\breve{k}\right)$] as sales-loving countries (S countries).

Figure 7 *Mixed Regime*

The market structures in manufacturing and in retailing in all D countries is given by equations (15) and (17) with $k = \breve{k}$. In these countries, retailers find it profitable to include all products available on the world market into their assortments. Hence, their market structures are all identical. The number of manufacturing firms (and products) in these countries is constrained by the size of the market ($\breve{k}$) and by the fixed costs in manufacturing.

The market structures in all S countries is given by equations (25) with $\rho = \rho(i)$ for each country i. Note that if $\rho(i) < \breve{\rho}\left(\breve{k}\right)$ then the size of retail assortments and the market structure in retailing depend on ρ and are thus different across countries. Countries with a strictly lower "love of variety" [$\rho(i) < \rho(j)$] have strictly smaller retail assortments [$N(i) < N(j)$] and strictly more competitive retail markets [$R(i) > R(j)$ and $\mu(i) < \mu(j)$]. The market structures in the two types of countries are illustrated in Figure 8.

The diagram on the left illustrates the market structure in D countries where the $\Pi_M^{\max}\left(\breve{k}\right) = 0$ locus is given by $\breve{k}L = \alpha\left(1 + \frac{\tau\Omega}{R}\right)(\sigma N - \sigma + 1)$ [the $\Pi_R^{\max} = 0$ locus is as in (15)]. The diagram on the right illustrates the market structure of one particular S economy i. Here, the $d\Pi_R/dN = 0$ locus is given by $\gamma N(i)[R(i) + \tau\Omega] = \rho(i) L$. Note that the location of the

manufacturing, but has no impact on the adjustment processes in the retailing sector.

$d\Pi_R/dN = 0$ curve depends on the country specific parameter $\rho(i)$. A lower $\rho(i)$ implies that this locus shifts to the left as indicated by the gray dashed lines.

Figure 8 *Market Structures in the Mixed Regime*

Because entry into the S markets is restricted, firms have to cover their fixed costs (α) in the D markets and offer slotting allowances to retailers in the S markets. With fixed costs covered in D, slotting allowances in S will rise until effective prices are down to marginal costs:

$$s(i) = \frac{\sigma[N(i) - 1] + 1}{(\sigma - 1)[N(i) - 1]} \quad \text{and} \quad \frac{p_W(i)}{s(i)} = \beta. \tag{27}$$

Note, however, that the fact that fixed costs are covered in D does not mean that firms are located in D. It simply means that fixed costs are paid out of revenues generated in these markets. Since labor is immobile internationally, and labor markets have to clear at a national level, an equilibrium with agglomeration is not possible and firms remain spread out across all countries.

The effects of international trade now depend on the type of countries integrated:

Proposition 9 ***(a)*** *An increase in the number of D countries (an increase in $\breve{k}$) has asymmetric effects on the two types of countries. In all D countries, the number of manufactured products available to consumers rises and the number of retail outlet falls. The impact on welfare is ambiguous depending on the four effects described in (22). In S countries, the market structure in retailing and the sizes of assortments are unaffected. As slotting allowances do not change, either, welfare is unaffected.* ***(b)*** *An increase in the number of S countries (an increase in $k - \breve{k}$ while $\breve{k}$ remains constant) has neither market structure effects nor welfare effects in either type of country. Irrespective of the different market structure effects, the share of imported varieties in local assortments increases in all cases.*

Proof. (a) An increase in $\breve{k}$ leads to an outward shift of the $\Pi_M^{\max}\left(\breve{k}\right) = 0$ locus in Figure 8. The $\Pi_R^{\max} = 0$ and $d\Pi_R/dN = 0$ loci are unaffected. As shown in (27), slotting allowances are independent of $\breve{k}$. (b) If $k - \breve{k}$ rises but $\breve{k}$ remains constant, the $\Pi_M^{\max}\left(\breve{k}\right) = 0$ locus is not shifted, either. Then, the increase in $k - \breve{k}$ has no effect on the market structures in either type of country. ■

These results illustrate how (endogenously determined) differences in retail market structures affect how countries adjust to increasing global markets. It also shows that neither an increase in the number of globally active manufacturing firms nor an increase in the number of traded varieties are sufficient conditions for the realization of gains from diversity by local consumers.

6.2 Zoning Regulations

Many countries use zoning regulations to regulate the land use in primarily urban areas. These zoning regulations can act as a barrier to entry and affect the market structure in national retail markets (Gable et al., 1995; OECD, 2000; Boylaud and Nicoletti, 2001).

Suppose that a national or regional zoning regulation aims at ensuring a high local retail density. For this purpose, it specifies a maximum distance between two retailers. In our setup this is equivalent to regulating the maximum catchment areas of individual retail outlets. Hence, let us assume that an administration sets a $\bar{\delta}_Z$ and that this zoning regulation is binding in the sense that $\bar{\delta}_Z < \delta^{\text{equilibrium}}$. This situation is illustrated graphically in Figure 9 for a diversity-loving country.

Figure 9 *Zoning Regulations*

The diagram on the left is a graphical illustration of equation (1) in a $\delta - R$ space. The diagram on the right is basically a replica of Figure 2. The main insight to be gained from this diagram is that zoning regulations do not only regulate the spatial distribution of retailing, but they also affect the market structure in retailing and the number of products stocked by retailers. If the zoning regulation is binding, the distance between retailers is smaller than it would be without the regulation. This implies that there are more retailers with lower retail mark-ups. As a consequence, each retailer has a smaller assortment than without the zoning regulation.

Since the zoning regulation determines the market structure in the retailing industry, this market structure can no longer adjust to shocks. Hence, if the zoning regulation is binding, the impact of international trade on the local availability of goods is similar in nature to the case where retailers limit the number of goods. It has no effects on the number of products stocked or on the retail density. It only changes the composition of assortments and the slotting allowances paid by manufacturers.

6.3 Market for Housing and Rents

The last extension deals with our geographical framework. In section 2 we assume that consumers are uniformly distributed across the circumference of the circle. What we do not state explicitly but assume implicitly is that consumers cannot move to other locations. Let us now consider in how far our results depend on this particular assumption by introducing a market for housing and allowing consumers to move.

Let consumers choose their location based on the utility of living in this location and the rental price of housing. Assume that each consumer requires one unit of housing and that he or she pays a rent of r to a housing society. Ownership of this society is dispersed among the population so that rent income stays within the country. We assume that housing requires land of zero mass in order to ensure that demand for land by a mass of consumers (L) is finite.

The log of utility of a consumer living in location ι is then given by $\ln U_\iota = \rho \ln N - \ln p - \ln t_\iota - \ln r_\iota$. A moving equilibrium requires that utility is identical across locations:

$$\ln r_\iota - \ln r_\kappa = \ln t_\iota - \ln t_\kappa \qquad \forall\ \iota \neq \kappa. \tag{28}$$

The economic intuition is straightforward: Since travel costs are the only differences between locations, they determine the differences in rental prices.

Given equation (28), it is clear that any change in travel costs for a particular location will be offset by corresponding changes in land rents. If the distance between retailers rises as a consequence of international trade, then this will not lower utility of consumers because they are compensated for the increase in travel costs by lower rental prices for housing. Hence, the travel cost effect disappears.

The disappearance of the travel cost effect does not resolve the ambiguity of the welfare effects. As the negative retail mark-up effect prevails, there are still positive and negative effects pulling in different directions. But the explicit consideration of a housing market does make a positive welfare effect more likely.

7 Conclusion

This study analyzes how the retail industry adjusts to global shocks and how these adjustments affect the welfare implications of those shocks. The starting point of the analysis is the realization that a free entry equilibrium in retailing creates a trade-off between diversity (the number of products stocked) and the retail density (the number of retail outlets in a given geographical area). This trade-off is caused by the fact that providing goods is costly for retailers and that an increase in these costs of provision reduces the number of retailers that a given market can support.

The New Trade Theory predicts that an enlargement of the global market lowers prices for consumers (because demand becomes more elastic and manufacturers can realize economies of scale) and raises the choices available to them (because a larger market can support more firms). Our results show that both predictions do not necessarily hold if adjustments in the retail industry are taken into account. First of all, the choices available to local consumers may not rise even if the number of manufacturing firms in the global market rises because local retailers may not find it profitable to expand their assortment sizes. Our analysis shows that this is the case if local consumers have a low preference for diversity. Second, consumer price may rise even though producer prices fall because retail mark-ups rise in response to a consolidation in the retail industry. Our analysis shows that this can happen when the market structure in retailing is less competitive relative to the market structure in manufacturing.

In the introduction we presented a number of stylized facts about the recent developments in the retailing industries of industrialized countries. Among those were an increase in the assortment sizes and a fall in the number of outlets. Our analysis provides two possible explanations for these outcomes: International trade and consumer mobility. Both shocks lead to an increase in the number of products stocked (at least for countries with a high preference for diversity) and a reduction in the number of retail outlets. Which one of these two shocks is ultimately driving our observations is, of course, an empirical question. However, our theoretical results enable us to identify an important difference between these two shocks. While an increase in consumer mobility makes demand for retail services more elastic and is, thus, a demand-side shock, international trade is a supply-side shock because it drives up the costs of provision. Hence, international trade tends to raise mark-ups in retailing while an increase in consumer mobility tends to lower them.

In order to integrate retailing into a general equilibrium model of international trade we have to greatly simplify the way retailers interact with both consumers and manufacturers. In particular, our assumption of a monopolistically competitive retail industry circumvents all strategic issues between retailers and suppliers, and the assumption of Dixit-Stiglitz preferences in combination with one-stop shopping prevents an analysis of vertical differentiation in retail formats (discounters, specialty shops etc.). These issues are certainly important and should take center stage for future research. But in exchange for leaving out these issues we obtain a fairly simple framework that allows us to study how the market structure in retailing interacts with the market structure in manufacturing. Our results help to gain a better understanding of how globalization affects consumers.

8 Appendix

8.1 Retail Mark-up

Given $p(i) = \left[1 + \mu_j(i)\right] p_W(i)$ and equations (4) and (9), a retailer's revenues on individual varieties can be expressed as

$$p(i)\, x(i) = \frac{\left[1 + \mu_j(i)\right]^{1-\sigma}}{\sum_{i=1}^{N} \left[1 + \mu_j(i)\right]^{1-\sigma}}. \tag{29}$$

By substituting (29) into (11), the profits of a retailer can be expressed as

$$\Pi_R(j) = 2\delta_j \frac{L}{\Omega} \sum_{i=1}^{N_j} \frac{\mu_j(i)\left[1 + \mu_j(i)\right]^{-\sigma}}{\sum_{i=1}^{N} \left[1 + \mu_j(i)\right]^{1-\sigma}} - \gamma N_j \tag{30}$$

By taking the derivative of the retailer's profits with respect to the mark-up of an individual variety $d\Pi_R(j)/d\mu_j(i)$ and setting this derivative equal to zero, we obtain

$$\begin{aligned} \frac{d \ln \delta_j}{d \ln \mu_j(i)} &= \left[\frac{\sigma \mu_j(i)}{1 + \mu_j(i)} - 1\right] \frac{\mu_j(i)\left[1 + \mu_j(i)\right]^{-\sigma}}{\sum_{i=1}^{N_j} \mu_j(i)\left[1 + \mu_j(i)\right]^{-\sigma}} \\ &\quad + \frac{(1-\sigma)\,\mu_j(i)}{1 + \mu_j(i)} \frac{\left[1 + \mu_j(i)\right]^{1-\sigma}}{\sum_{i=1}^{N} \left[1 + \mu_j(i)\right]^{1-\sigma}}. \end{aligned} \tag{31}$$

In a symmetric equilibrium, where $\frac{\mu_j(i)\left[1+\mu_j(i)\right]^{-\sigma}}{\sum_{i=1}^{N_j}\mu_j(i)\left[1+\mu_j(i)\right]^{-\sigma}} = \frac{\left[1+\mu_j(i)\right]^{1-\sigma}}{\sum_{i=1}^{N_j}\left[1+\mu_j(i)\right]^{1-\sigma}} = \frac{1}{N_j}$, this reduces to

$$\frac{d\ln\delta_j}{d\ln\mu_j} = \frac{1}{N_j}\left(\frac{\mu_j}{1+\mu_j} - 1\right) \tag{32}$$

and can be rearranged as in (12).

The elasticity of the catchment area with respect to the mark-up and the assortment size can be calculated by adapting the approach in Helpman (1981). Using (4) and (9), the utility of a particular consumer shopping at retailer j can be expressed as

$$U(j) = \frac{1}{e^{\tau\delta_j}} N_j^{\rho-\frac{1}{\sigma-1}} \left\{\sum_{i=1}^{N_j}\left[1+\mu_j(i)\right]^{1-\sigma}\right\}^{\frac{1}{\sigma-1}} \tag{33}$$

The marginal consumer is just indifferent between two adjacent retail outlets j and $j+1$. We obtain

$$\frac{N_j^{\rho-\frac{1}{\sigma-1}}}{e^{\tau\delta_j}} \left\{\sum_{i=1}^{N_j}\left[1+\mu_j(i)\right]^{1-\sigma}\right\}^{\frac{1}{\sigma-1}} = \frac{N_{j+1}^{\rho-\frac{1}{\sigma-1}}}{e^{\tau(D-\delta_j)}} \left\{\sum_{i=1}^{N_{j+1}}\left[1+\mu_{j+1}(i)\right]^{1-\sigma}\right\}^{\frac{1}{\sigma-1}}, \tag{34}$$

where D is the distance between retailers j and $j+1$, so that $\delta_{j+1} = D - \delta_j$. By taking logs and rearranging we can solve for the distance δ_j between retailer j and the marginal consumer:

$$\delta_j = \frac{D}{2} + \frac{1}{2\tau}\left(\rho - \frac{1}{\sigma-1}\right)\ln N_j + \frac{1}{2\tau(\sigma-1)}\ln\left(\sum_{i=1}^{N_j}\left[1+\mu_j(i)\right]^{1-\sigma}\right) - \ln\Phi, \tag{35}$$

where $\Phi \equiv N_{j+1}^{\rho-\frac{1}{\sigma-1}}\left(\sum_{i=1}^{N_{j+1}}\left[1+\mu_{j+1}(i)\right]^{1-\sigma}\right)^{\frac{1}{\sigma-1}}$ is taken as constant by retailer j. In a symmetric equilibrium, the total derivative of (35) reduces to

$$\rho d\ln N_j - \sum_{i=1}^{N_j}\frac{1}{N_j}\frac{\mu_j(i)}{\left[1+\mu_j(i)\right]}d\ln\mu_j(i) = 2\tau\delta_j d\ln\delta_j, \tag{36}$$

which allows us to calculate the elasticity of δ_j with respect to an individual mark-up $\mu_j(i)$:

$$\frac{d\ln\delta_j}{d\ln\mu_j} = -\frac{1}{N_j}\frac{\mu_j}{\left(1+\mu_j\right)}\frac{1}{2\delta_j\tau}, \tag{37}$$

8.2 Comparative Statics

By taking log-differentials of equations (15) and (17) we obtain the following set of equations:

$$\begin{bmatrix} \frac{(2R+\tau\Omega)}{(R+\tau\Omega)} & 1 \\ -\frac{\tau\Omega}{(R+\tau\Omega)} & \frac{\sigma N}{(\sigma N-\sigma+1)} \end{bmatrix} \begin{pmatrix} d\ln R \\ d\ln N \end{pmatrix} = \vec{\Psi} \tag{38}$$

where

$$\vec{\Psi} \equiv \begin{pmatrix} 0 \\ 1 \end{pmatrix} d\ln k + \begin{pmatrix} 1 \\ 1 \end{pmatrix} d\ln L + \begin{pmatrix} \frac{R}{(R+\tau\Omega)} \\ -\frac{\tau\Omega}{(R+\tau\Omega)} \end{pmatrix} d\ln \tau$$

and

$$\Delta \equiv \begin{vmatrix} \frac{(2R+\tau\Omega)}{(R+\tau\Omega)} & 1 \\ -\frac{\tau\Omega}{(R+\tau\Omega)} & \frac{\sigma N}{(\sigma N-\sigma+1)} \end{vmatrix} = \frac{(2R+\tau\Omega)}{(R+\tau\Omega)} \frac{\sigma N}{(\sigma N-\sigma+1)} + \frac{\tau\Omega}{(R+\tau\Omega)} > 1.$$

By applying Cramer's rule we obtain the solutions shown in the text.

The result for the change in the retail mark-up follows from (14):

$$d\ln \mu = d\ln \tau - d\ln R. \tag{39}$$

The percentage change in the wholesale price is derived from taking log-differentials of (9):

$$d\ln p_W = -\frac{N}{(N-1)(\sigma N-\sigma+1)} d\ln N. \tag{40}$$

8.3 Profit Maximizing Assortment Size

Given $\mu_j(i) = \mu_j$, the derivative of $\Pi_R(j)$ with respect to $\ln N_j$ is

$$\frac{d\Pi_R(j)}{d\ln N_j} = 2\delta_j \frac{L}{\Omega} \frac{\mu_j}{1+\mu_j} \frac{d\ln \delta_j}{d\ln N_j} - \gamma N_j \tag{41}$$

By using (1) and (14) and imposing symmetry, the optimal assortment size $d\Pi_R(j)/d\ln N_j = 0$ can be expressed as

$$\gamma N = \frac{L}{R} \frac{\tau\Omega}{R+\tau\Omega} \frac{d\ln \delta}{d\ln N}. \tag{42}$$

Here, on the left hand side are a retailer's marginal costs of a percentage increase in N (the costs of provision) and on the right hand side are marginal revenues (due to a larger catchment area).

The elasticity of the catchment area with respect to the assortment size ($d\ln\delta/d\ln N$) can be calculated from (36):

$$\frac{d\ln\delta}{d\ln N}=\frac{\rho R}{\tau\Omega}. \tag{43}$$

Combining (42) and (43) yields

$$\gamma N=\frac{\rho L}{R+\tau\Omega}. \tag{44}$$

Equations (15) and (44) can be solved for the optimal N^* and R^*.

8.4 Slotting Allowances

A manufacturers profits without slotting allowances are given by $\Pi_M=[p_W(i)-\beta]\,Q(i)-\alpha$ and can be expressed in a symmetric equilibrium as

$$\Pi_M=\frac{kL}{(1+\mu)(\sigma N-\sigma+1)}-\alpha \tag{45}$$

If the optimal assortment decision is binding, then these profits are positive when evaluated at μ^* and N^* from (25). This is the case if $kL>\alpha\left[\frac{\sigma\rho^2 L}{\gamma\tau\Omega}-(\sigma-1)(1+\rho)\right]$, or

$$\rho<\breve{\rho}\equiv\frac{1}{2}\frac{(\sigma-1)}{\sigma}\frac{\tau\Omega}{L}\gamma+\sqrt{\frac{\gamma\tau\Omega k}{\sigma\alpha}+\frac{(\sigma-1)}{\sigma}\frac{\tau\Omega}{L}\gamma\left(1+\frac{1}{4}\frac{(\sigma-1)}{\sigma}\frac{\tau\Omega}{L}\gamma\right)} \tag{46}$$

If condition (46) holds, manufacturing firms are willing to offer slotting allowances in order to be listed with the retailing firms. These slotting allowances are paid in free goods, so that a manufacturer agrees to deliver $s-1$ units for free in order to get access to the retailing shelves: $\Pi_M=[p_W-\beta]\,Q-\alpha-(s-1)\,\beta Q$. Profits can then be expressed as

$$\Pi_M(s,N,kL,\mu,\alpha)=\frac{[(1-s)(\sigma-1)(N-1)+N]\,kL}{[(\sigma-1)(N-1)+N](1+\mu)\,N}-\alpha. \tag{47}$$

These profits are positive when evaluated at N^* and μ^* and are decreasing in s. The equilibrium slotting allowances push profits down to zero, $\Pi_M(s^*,N^*,kL,\mu^*,\alpha)=0$, and can be calculated explicitly from (47):

$$s^* = \left(1 - (1+\rho)\frac{\alpha N^*}{kL}\right)\frac{\sigma(N^*-1)+1}{(\sigma-1)(N^*-1)} \tag{48}$$

With s^* the labor market is in equilibrium as well. Because slotting allowances are paid in goods, they have to be taken into account when calculating labor demand:

$$\frac{N^*}{k}(\alpha + \beta s^* Q) + R^*\gamma N^* = \frac{N^* px}{1+\rho}L + \frac{\rho}{1+\rho}L = L \tag{49}$$

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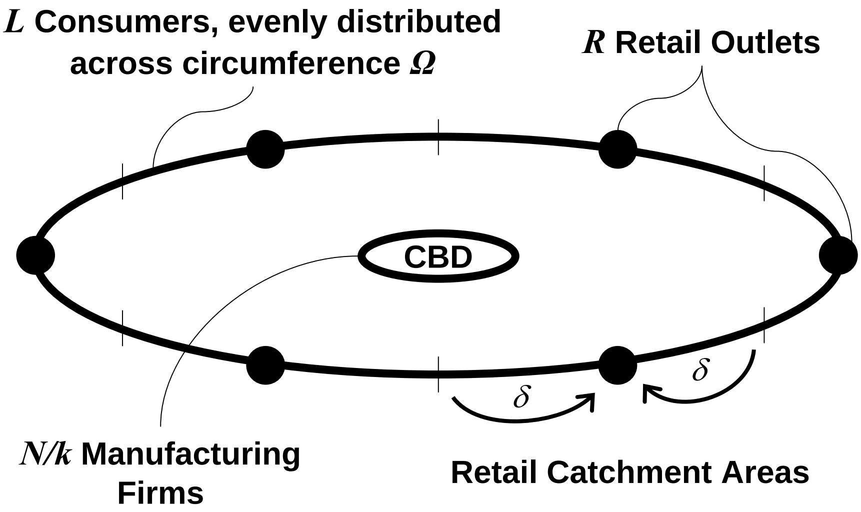

Figure 1: The Symmetric Retailing Equilibrium

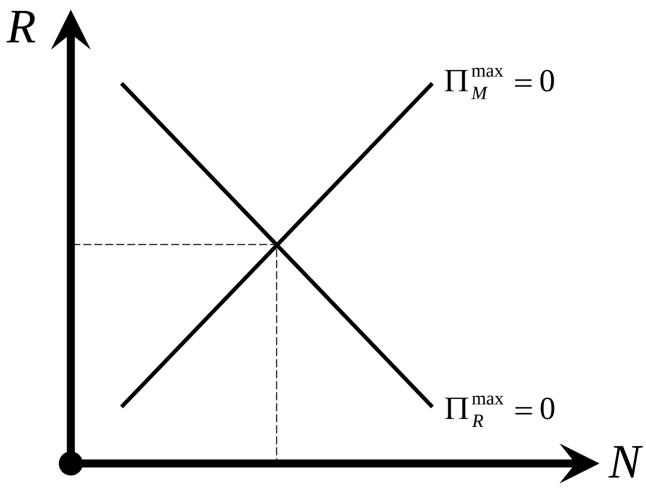

Figure 2: The General Equilibrium

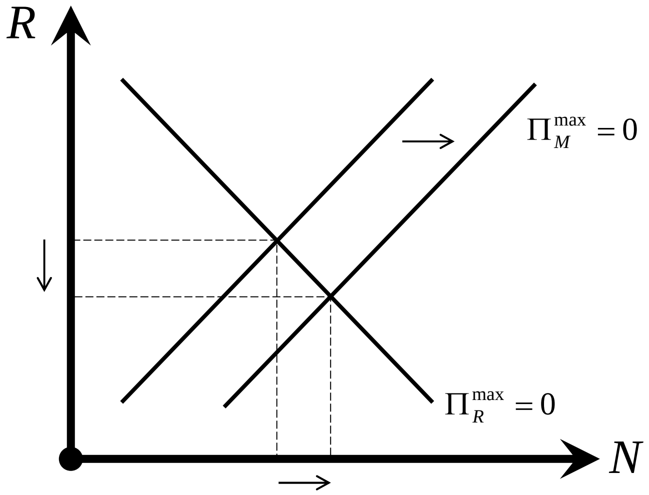

Figure 3: International Trade

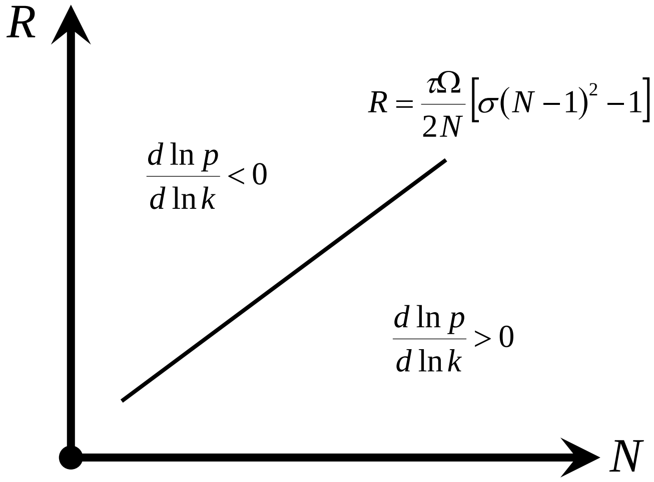

Figure 4: The Effect on Consumer Prices

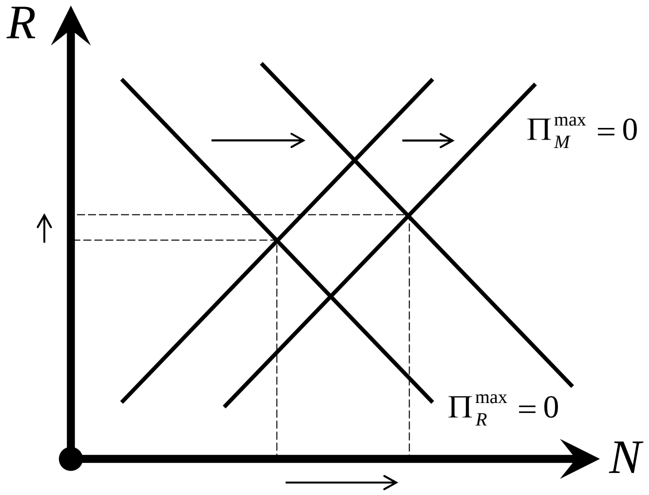

Figure 5: Internal Economic Growth

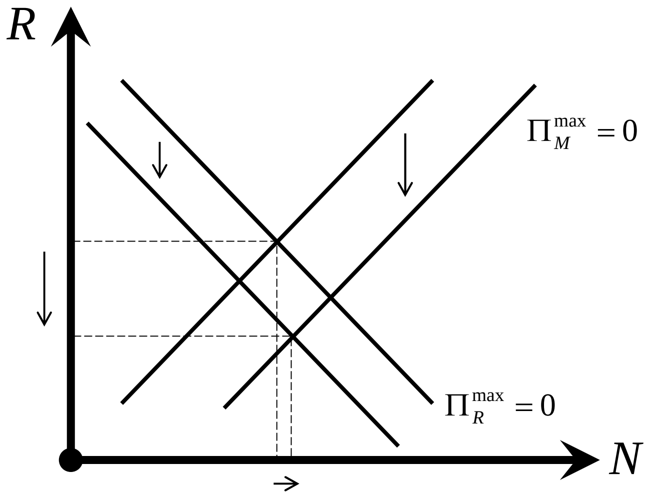

Figure 6: Increase in Consumer Mobility

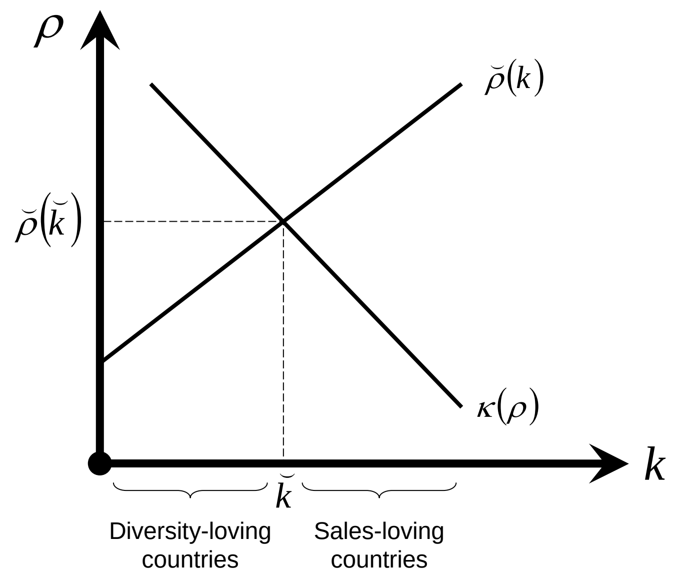

Figure 7: Mixed Regime

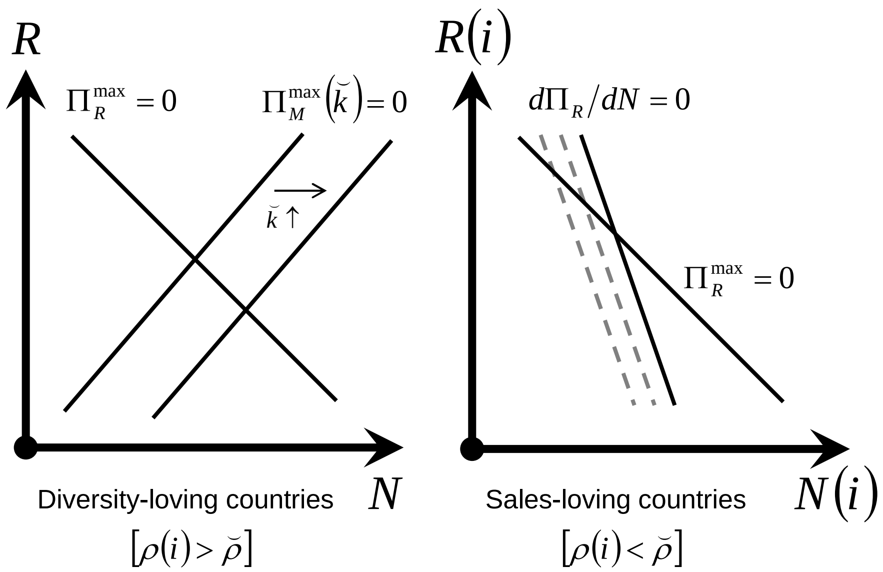

Figure 8: Market Structures in the Mixed Regime

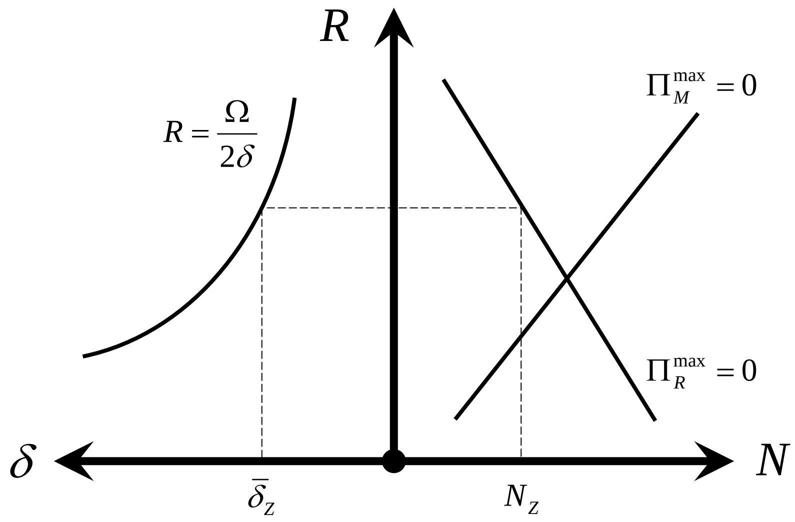

Figure 9: Zoning Regulations