

Manufacturers and Retailers in the Global Economy

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Abstract

In many consumer-goods industries retailers have become the gatekeepers of product variety. Manufacturers often have to pay so-called slotting allowances to retailers to obtain shelf space. We construct a general-equilibrium model of manufacturing and retailing in a global economy to study the causes and consequences of this development. We then investigate how the equilibrium in the retailing and manufacturing sectors reacts to shocks such as market integration or technological change. We examine how these shocks affect retail and wholesale prices, retailer product assortment, sales, slotting allowances, the allocation of labor between manufacturing and retailing, as well as social welfare. In the process we identify a novel gain from trade consisting of efficiency gains in the vertical distribution chain.

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1 Introduction

This paper develops a simple general equilibrium model with retailers acting as intermediaries between manufacturers and consumers. The paper has two main purposes. The first one is to propose a model capturing key features of the retailing and of the manufacturing industry in order to understand important characteristics of the links between these two sectors and how labor is allocated between them. The second purpose is to investigate how the equilibrium in the retailing and manufacturing sector reacts to shocks such as market integration or technological change. By doing so we are able to shed light on the circumstances under which retailers increase their assortment, slotting allowances rise, labor is reallocated from manufacturing to retailing, as well as the welfare impact of these changes. In the process we identify a novel gain from trade consisting of efficiency gains in the vertical distribution chain.

When considering intermediation and more specifically retail trade, several stylized facts should be taken into account. The first one is that, over the last 40 years, there has been a fundamental increase in the importance of services in general and of wholesale and retail trade in particular. In the United States, for instance, this shift took place especially strongly from the end of the 1970s and it took place at the expense of manufacturing. Simply put, US employment fell in manufacturing between 1970 and 1990, but rose by 71% in wholesale and retail trade (see Blum, 2008).¹ Today retailing alone is the second largest industry in the US in terms of employment (11% of total employment, a higher share than in manufacturing; US Bureau of Labor Statistics, 2009) and accounts for \$3.9 trillion in annual sales (2008).²

Second, retailers typically carry a large variety of products. In many retail sectors, product assortment has risen over time. According to Quelch and Kenny (1994), the number of consumer-packaged-goods stock-keeping units (SKUs) grew 16% each year between 1985 and 1992. Grocery retailing

¹In 1970, employment in wholesale and retail trade was 22% lower than in manufacturing and it was 31% higher in 1990. The switch in employment remains valid when corrected for the fact that retail and wholesale trade have a greater proportion of part-time jobs than manufacturing.

²Not including food services and drinking places (Table 1017: Retail Trade and Food Services, 2010 Statistical Abstract, US Bureau of Census). Note that the US wholesale market represents another \$4.5 trillion (2008) in sales split approximately equally between durable and non-durable goods (Table 2012).

is just one example in this respect, but a revealing one. In the US, this sector is dominated by supermarkets (i.e. stores with sales in excess of \$2 million annually).³ In 2008, there were 35,394 supermarkets selling on average 46,852 items. The average number of products sold by a supermarket has also increased significantly over the last 30 years and, with it, the size of supermarkets which has reached an average size of 46,755 square feet in 2008.⁴ Interestingly, this has resulted in a steady increase in the ratio of square footage to sales (see Klein and Wright, 2006, Figure 1).

Third, slotting allowances, which are lump-sum payments made by manufacturers to retailers to carry their products, are today an important feature of retailing used in a variety of product lines such as grocery food, tobacco, household supplies, health and beauty aid, textiles, shoes and footwear, and automotive parts (see Sundhir and Rao, 2006; Wilkie et al., 2002). These allowances, which first emerged in the early 1980s, are often explained by the fact that retailers are powerful gatekeepers. They are gatekeepers because they know that many products are new and that many of them fail, and they are powerful because, as large multi-product retailers, they often have little to lose by not selling a particular variety. Importantly, slotting allowances are not used by all retailers in a given segment of the market and they can vary a lot across products.⁵ This suggests that they are less the result of retailer characteristics than of the retailer-manufacturer relationship. Our general equilibrium model sheds light on the circumstances under which slotting allowances arise in equilibrium and on the factors determining their size.⁶

Fourth, intermediaries, whether at the wholesale or at the retail level, often engage in international trade. Bernard and al. (2010) documents in-

³In 2002, the sales of supermarkets represented 77% of all US grocery sales for a total sale value of \$547.1 billion and they collectively employed 3.2 million workers; see www.fmi.org.

⁴In 2002, the number of supermarkets was 32,981 selling on average 35,000 items and had an average size of 44,000 square feet; see FTC (2003).

⁵The FTC (2003) reports, for instance, that slotting allowances are higher and more prevalent for products like ice cream and salad dressings than they are for bread and hot dogs.

⁶It is also important to make clear that slotting allowances are not associated with high market concentration. Although concentration in retailing has been rising, often faster than at the manufacturing level (see Raff and Schmitt, 2010), it is important to keep market concentration in retailing separate from the use of slotting allowances and from the concept of ‘powerful’ retailers.

ternational trade activities at the wholesale and retail level in the US and find that 13% of importing firms are pure retailers responsible for a small proportion of overall US import value but 35% of the value of imports from China. Basker and Van (2008b) find that over the period 1997 to 2002 U.S. imports from China and other less-developed countries rose especially quickly in retail sectors and that Wal-Mart alone accounts for around 15% of total US imports from China (Basker and Van, 2008a). This phenomenon is not limited to the United States and has taken place in many industries, including electronics, computers, cameras, housewares, toys, games, clothing, footwear and groceries.⁷ Blum and al. (2009, 2010) find that considerable size difference exists between the foreign exporters and the importers in Chile they deal with. In particular, they find that large multi-product retailers facilitate trade for small exporters (and small exporting countries) because they provide an efficient way of reaching consumers who otherwise would be difficult to find.

We build a general equilibrium model with monopolistic competition among retailers and among manufacturers to examine these stylized facts and to explore the consequences for social welfare. The model has three main components. The first is a standard Krugman (1980) monopolistic-competition manufacturing sector. Each manufacturer produces a single variety of a consumer good with a technology involving fixed and constant marginal costs. Of course, this is a simplification as manufacturers are often multi-product firms; however they typically produce a much smaller number of varieties (see Eckel et al., 2009, for Mexico) than sold by retailers. The second component is the retailing sector through which all differentiated products are distributed. Retailers choose their product assortment and retail prices. These two choices give them power although limited by monopolistic competition. Moreover, each of them understands that distributing more varieties within its own store leads to a cannibalization effect in the sense that the demand for a new product ‘eats up’ some of the demand for the other varieties sold in the store. We model this cannibalization effect as in Feenstra and Ma (2008), who have developed this idea for multi-product manufacturers.⁸

⁷For 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).

⁸See Dhingra (2010) for an alternative model of cannibalization and for showing that intra-firm cannibalization is empirically relevant at the manufacturing level.

The third component is the critical link between the manufacturers and the retailers, namely the wholesale market. We assume that retailers negotiate wholesale prices with individual manufacturers. Even if this bargaining is efficient in the sense that the wholesale price maximizes the surplus of each retailer-manufacturer pair, there nevertheless exists a fundamental externality stemming from the fact that a retailer-manufacturer pair generally cannot take into account the effect of its decision on other retailer-manufacturer pairs. We show that this externality generates slotting allowances in equilibrium, and we determine the forces that affect them. We also demonstrate that, due to this externality, a greater share of labor is allocated to retailing, product variety is bigger, but sales of each variety and social welfare are smaller than in the second best.

Next we consider the comparative static properties of the model, concentrating on the effects of market integration and technological change in retailing. The model allows us to distinguish between two different types of integration. One is product-market integration, i.e., allowing manufacturers to export their products to more countries and allowing retailers to source differentiated products from different countries. The other is retail-market integration, i.e., allowing retail services to be tradable so that retailers have access to consumers at home and abroad. We find that the shift in employment from manufacturing into retailing and the rise in retailer product assortment are consistent with product-market integration, but that the increase in retailer market concentration and in slotting allowances per variety is better explained by technological change in retailing. We also show that retail-market integration yields greater gains than product-market integration, since it not only leads to lower average production costs and greater product variety, but also reduces the externality-induced inefficiency in the vertical distribution chain.

Our paper is linked to the literature in the following way. There is a growing literature on intermediaries in international trade and in particular on the role of intermediation and its impact on welfare and the gains from trade. It includes Akerman (2010), Antras and Costinot (2010), Blum et al. (2009), Bardhan et al. (2009), and Eckel (2009). The value-added of our paper is to provide a theoretical framework rooted in the standard monopolistic-competition trade model to shed light on the stylized facts discussed above and on the welfare consequences of product- and retail-market integration.

The role of international trade on retailers and the amplifying role of

scale economies and technological change have been analyzed by Basker and Van (2008a) who investigate the effects of trade liberalization on competition between a chain retailer (such as Wal-Mart) 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. Their model is a partial equilibrium model and focuses its attention on big-box retailers such as Wal-Mart. Retail markets have also been investigated by Campbell and Hopenhayn (2005) who show that establishments tend to be larger in larger markets.

Other papers examining the interaction between trade liberalization and retail market structure include Raff and Schmitt (2005, 2006, 2009, 2010). Raff and Schmitt (2005, 2006) examine the effects of trade liberalization on markets where manufacturers have power over retailers, while Raff and Schmitt (2009) study the effects of trade liberalization in a partial equilibrium oligopoly model where retailers have power over manufacturers. It shows that the gains from trade tend to be greater in industries characterized by powerful manufacturers as opposed to powerful retailers, and that trade liberalization in the case of retailer power may even reduce social welfare. Raff and Schmitt (2010) examine the effects of trade liberalization on retail market structure, retail mark-ups and the pass-through of import into consumer prices when retail market structure is endogenous and retailers are heterogeneous. Francois and Wooton (2008) show that market structure in distribution becomes increasingly important for trade as tariffs fall; and Richardson (2004) studies market access to retail distribution.

The literature on slotting allowances includes Shaffer (1991) where these allowances as tools controlled by and for the benefit of imperfectly competitive retailers whose purpose is essentially to soften price competition in retailing and shift rents from manufacturers to retailers. Others such as Sullivan (1992) and Klein and Wright (2006) view slotting allowances as a price for scarce shelf space.

The paper continues as follows. In Section 2, we present a simple general equilibrium model with manufacturers and retailers. The equilibrium in a closed economy is presented in Section 3. Comparative static results are presented in Section 4, and Section 5 deals with welfare effects and policy implications. Section 6 concludes, and the Appendix contains proofs.

2 The Model

In this section, we develop a simple model of manufacturing and retailing in general equilibrium. Consumers have Dixit-Stiglitz preferences over differentiated goods that are produced by manufacturers and distributed by multi-product retailers. Of particular interest is the wholesale market, in which manufacturers and retailers interact. Prices in that market are determined through bargaining. We first develop a model of a single economy and then turn to a world economy consisting of identical countries with integrated product and/or retail markets.

2.1 Households

The economy has L consumers/workers, each endowed with one unit of labor. Individual preferences are given by the utility function

$$U = y_0 + \rho \ln(Y_d), \quad \rho < 1, \quad (1)$$

where y_0 denotes the consumption of an outside good, taken as the numeraire, and Y_d is the aggregate individual consumption of the differentiated manufacturers. Letting $y_d(i)$ denote the quantity consumed of variety $i \in \Omega$, we assume that Y_d takes the following CES form:

$$Y_d = \left(\int_{i \in \Omega} y_d(i)^{\frac{\eta-1}{\eta}} di \right)^{\frac{\eta}{\eta-1}}, \quad (2)$$

where $\eta > 1$ is the elasticity of substitution between varieties.

Labor, the only factor of production, is inelastically supplied and perfectly mobile between the production and the retailing sectors. The numeraire good, y_0 , is produced by a competitive industry under constant returns to scale and a unit labor requirement of one. The price of labor is hence also equal to one. Maximizing utility subject to the consumer's budget constraint and aggregating individual demands over the L consumers yields the following total demand for variety i :

$$y(i) = \frac{\rho L}{P^{1-\eta}} p(i)^{-\eta}, \quad (3)$$

where $p(i)$ is the retail price of variety i , and P is the CES price index.

2.2 Firms

There are two kinds of firms, manufacturers and retailers. Firms are identical within each of these two groups. We also assume that retailers are large relative to manufacturers in the sense that each manufacturer produces a single variety and sells that variety exclusively through one retailer, whereas retailers carry many varieties.⁹ Each retailer decides what mass of varieties to carry and sets the retail price of each variety. Since the number of retailers and the mass of varieties carried by each retailer are endogenously determined, the total mass of manufacturers is also endogenous. Wholesale prices and transfers between retailers and manufacturers are determined through bargaining and free entry and exit; details on the bargaining process are presented below.

Our modelling of retailers as multi-product firms follows Feenstra and Ma (2008) who use this approach to study producers. There are R retailers. The mass of varieties handled by retailer r is $M_r > 0$. Given our assumption of exclusive dealing, each retailer carries a different set of varieties. Without loss of generality we choose the ordering of the products such that retailer 1 carries the first M_1 varieties, retailer 2 the following M_2 varieties, and so on. Hence the total mass of varieties consumed is $\bar{M} \equiv \sum_{r=1}^R M_r$, and the aggregate consumption of varieties is

$$Y = \left(\int_0^{M_1} y(i)^{\frac{\eta-1}{\eta}} di + \int_{M_1}^{M_1+M_2} y(i)^{\frac{\eta-1}{\eta}} di + \dots + \int_{\bar{M}-M_R}^{\bar{M}} y(i)^{\frac{\eta-1}{\eta}} di \right)^{\frac{\eta}{\eta-1}}. \quad (4)$$

Similarly, the CES price index is given by

$$P = \left(\int_0^{M_1} p(i)^{1-\eta} di + \int_{M_1}^{M_1+M_2} p(i)^{1-\eta} di + \dots + \int_{\bar{M}-M_R}^{\bar{M}} p(i)^{1-\eta} di \right)^{\frac{1}{1-\eta}}. \quad (5)$$

⁹Note that exclusive dealing is common in many industries. Even in grocery retailing, where you would perhaps least expect it, there is very little overlap between the products sold by different stores when one considers barcode data. Broda and Romalis (2009) find that only around 2% of the 61,119 food Universal Product Code categories sold by either Wal-Mart or Wholefoods are sold by both.

The choice between exclusive and non-exclusive dealing contracts has been studied in a trade context by Raff and Schmitt (2006, 2009). We have nothing new to add to the analysis of this choice and therefore do not model it here. However, we explain below why the restriction to exclusive contracts does not change the nature of our results.

With symmetric manufacturers wholesale prices will be identical across varieties sold by a retailer. The retailer hence sets the same retail price for all varieties in his assortment. Denoting the price retailer r charges for each of the varieties he sells by p_r , the CES price index (5) thus simplifies to

$$P = \left(\sum_{r=1}^R M_r p_r^{1-\eta} \right)^{\frac{1}{1-\eta}}. \quad (6)$$

Since retailers carry many varieties, a change in p_r has an effect on the price index P as long as $M_r > 0$. It is both realistic and useful to assume that retailers take this into account when setting prices. The usefulness of this assumption, as explained further below, comes from the fact that retailers acknowledge that adding a product to their assortment lowers the demand for the other products they carry. This "cannibalization" effect becomes bigger as the retailer adds products, thus putting a limit on product assortment. To see how this works, consider the price elasticity of demand for each variety sold by retailer r . Unlike in the usual CES framework, this elasticity is not constant but rather depends on r 's market share, s_r :

$$-\frac{\partial y_r}{\partial p_r} \frac{p_r}{y_r} = \eta(1 - s_r) + s_r, \quad (7)$$

with

$$s_r = \frac{M_r p_r y_r}{\sum_{r=1}^R M_r p_r y_r} = \frac{M_r p_r^{1-\eta}}{\sum_{r=1}^R M_r p_r^{1-\eta}}. \quad (8)$$

Hence for $M_r > 0$, the price elasticity is decreasing in retailer r 's market share.

Retailers are homogeneous in that they all use the same technology; we may therefore drop retailer subscripts whenever this can be done without causing confusion. Retailing involves a fixed cost, k_0 , as well as a cost per variety carried, k_1 . The former include the usual headquarter costs, including payments for information technology that plays a crucial role in retailing. An example of the latter is the cost of shelf space. These costs turn out to be important for the analysis; the marginal cost of selling a unit of a given variety does not play a crucial role and we normalize it to zero. Hence the labor requirement of a retailer carrying a mass of M varieties is given by

$$l^r = k_0 + k_1 M. \quad (9)$$

Manufacturers are single-product firms; their technology exhibits increasing returns to scale. We follow Krugman (1980) in assuming that production requires a fixed labor input, α , and a variable labor input, β , both identical across firms. Hence the total labor input required to produce y units of a given variety is given by

$$l^m = \alpha + \beta y, \quad \alpha, \beta > 0. \quad (10)$$

2.3 The Wholesale Market

The manufacturing and the retailing side of the economy are linked through the wholesale market. There are two forces that determine the wholesale price, w , and any payment or transfer, T , from a manufacturer to a retailer (where T can be negative). First, retailers and manufacturers have to bargain over the wholesale contract. Second, free entry by manufacturers and retailers assures that all rents are dissipated. It is this entry process that ties down the transfers between retailers and manufacturers in equilibrium.

We do not put much structure on the bargaining process, except to assume that (i) each retailer bargains simultaneously and bilaterally with each manufacturer whose product he intends to carry; and that (ii) bargaining is efficient in the sense that the wholesale price is chosen so as to maximize the joint surplus of each retailer-manufacturer pair. The reasoning behind (i) is simply that it would be difficult, even illegal, for a retailer to get together with all his suppliers to jointly fix wholesale prices.¹⁰ The reason for (ii) is that we do not want to introduce any market failures, specifically double marginalization, through an inefficient bargaining procedure. Rather, we want to put the focus on market outcomes that arise naturally when a multi-product retailer chooses his assortment but negotiates the wholesale price individually with each manufacturer.¹¹

¹⁰Note that the assumption of simultaneous bilateral bargaining between multi-product retailers and individual manufacturers (or of manufacturers dealing with more than one retailer) is standard in the industrial organization literature on buyer power. See Raff and Schmitt (2009) for a discussion of this literature in a trade context and further references.

¹¹As will become clear later on we would obtain the same wholesale prices and overall equilibrium allocation if we assumed that the manufacturers had all the bargaining power and individually made take-it-or-leave-it offers to the retailers. We show below how the equilibrium wholesale prices and allocation would change if we give all the bargaining power to the retailers and let them make take-it-or-leave-it offers to the manufacturers.

3 Equilibrium of the Closed Economy

In this section we characterize the equilibrium of the closed economy. For given w and T , a retailer chooses the retail price p and the mass of varieties M to maximize:

$$\max_{p, M} \Pi^r = M(p - w)y - M(k_1 - T) - k_0. \quad (11)$$

Substituting for y from (3), the corresponding first-order condition with respect to the retail price reads:

$$p = \left(1 + \frac{1}{(\eta - 1)(1 - s)}\right)w. \quad (12)$$

We observe that the higher is a retailer's market share, s , the higher is his mark-up. The first-order condition with respect to M can be written as:

$$(p - w)y - s(p - w)y = k_1 - T. \quad (13)$$

The left-hand side of (13) gives the marginal benefit of adding a variety. It has two elements: the first term is the additional operating profit generated by this variety. The second term represents the cannibalization effect, that is, the reduction in the demand for the other varieties sold by the retailer times the mark-up on these other varieties. The higher the retailer's market share, the bigger is this cannibalization effect. On the right-hand side of (13) we have the marginal cost of adding a variety, which consists of the direct cost, k_1 , minus any transfer received from the manufacturer producing the additional variety.

A manufacturer's profit, Π^m , is given by

$$\Pi^m = (w - \beta)y - T - \alpha. \quad (14)$$

The total surplus that is generated when a retailer adds the manufacturer's product to his assortment is obtained by solving (13) for T and substituting the resulting expression into (14). This gives:

$$(w - \beta)y + (1 - s)(p - w)y - k_1 - \alpha. \quad (15)$$

The wholesale price maximizing this surplus is given by the following first-order condition:

$$\frac{\eta y}{\eta - 1} + \left(\frac{\eta w}{\eta - 1} - \beta\right) \frac{dy}{dp} \frac{dp}{dw} = 0, \quad (16)$$

where dy/dp follows from (7) and dp/dw from (12). Solving (16) for the equilibrium wholesale price yields:

$$w = \beta + \frac{s\beta}{\eta(1-s)}. \quad (17)$$

The wholesale price thus exceeds the manufacturer's marginal cost by a margin that is increasing in the retailer's market share, s . (12) and (17) together imply that there is double marginalization, which means that sales of each variety are inefficiently low. This distortion is due to the cannibalization effect: the retailer/manufacturer pair takes into account that additional sales of one variety reduce demand for other varieties. This effect is stronger the greater the retailer's market share which implies that the wholesale price has to be increasing in the market share.¹²

In equilibrium free entry by manufacturers implies that $\Pi^m = 0$. As can be seen from (14), the transfer from the manufacturer to the retailer hence equals the the quasi-rents earned by the manufacturer, $(w - \beta)y$, net of the fixed cost of production, α :

$$T = (w - \beta)y - \alpha. \quad (18)$$

This transfer, provided it is positive, has a natural interpretation in the context of our model, namely as a slotting allowance. Slotting allowances thus arise precisely because the wholesale price exceeds the marginal production cost so that manufacturers earn a quasi-rent. Naturally, if a manufacturer did not earn any quasi-rent, he would be unable to pay a retailer for adding his products to the assortment.¹³

Using (17) and (18) in (13), we can solve for the output of each variety

$$y = (1-s) \frac{(k_1 + \alpha)(\eta - 1)}{\beta}. \quad (19)$$

¹²The surplus in (15) corresponds exactly to the profit a manufacturer could obtain if he were able to set T so as to extract the retailer's entire surplus of adding his product to the assortment. Obviously then the wholesale price in (17) is identical to the one the manufacturer would choose if he had all the bargaining power.

¹³Note that the cannibalization effect is a sufficient but not a necessary condition for the distortion in the wholesale price and the associated slotting allowances to arise. Shaffer (1991) shows that in a setting, in which each good is distributed by more than one retailer, a wholesale price exceeding marginal cost and slotting allowances may arise for strategic reasons: they can serve as commitment devices to soften price competition between retailers. In this sense, wholesale price distortions and slotting allowances do not depend on any special features of our model and certainly not on our assumption of exclusive dealing.

To close the model we impose zero-profit conditions on retailers and a labor-market clearing condition on the differentiated goods sector. The retailer zero-profit condition is obtained by setting the profit in (11) equal to zero. This yields an expression for the mass of varieties carried by each retailer as a function of the number of retailers:

$$M = \frac{k_0}{(k_1 + T)} (R - 1). \quad (20)$$

A second equation linking M and R is the labor-market clearing condition. Since in equilibrium a fraction ρ of the labor force is employed in the differentiated goods industry (i.e., in manufacturing and in retailing), this condition can be written as:

$$Rk_0 + RM(k_1 + \alpha) + RMy\beta = \rho L. \quad (21)$$

We can now easily solve for the equilibrium number of retailers,

$$\hat{R} = \frac{1}{\eta} \left(\frac{\eta - 1}{2} + \sqrt{\frac{(\eta - 1)^2}{4} + \frac{\eta \rho L}{k_0}} \right). \quad (22)$$

and the mass of varieties carried by each retailer:

$$\hat{M} = \left(\frac{\eta}{\eta(1 - \hat{s}) + \hat{s}} \right) \frac{k_0(1 - \hat{s})}{(k_1 + \alpha)\hat{s}}, \quad (23)$$

where $\hat{s} = 1/\hat{R}$.

Using (12) and (17) we observe that the equilibrium retail price exceeds the marginal production cost due to both the retailer mark-up and the wholesale mark-up:

$$\hat{p} = \left(1 + \frac{1}{(\eta - 1)(1 - \hat{s})} \right) \left(1 + \frac{\hat{s}}{\eta(1 - \hat{s})} \right) \beta. \quad (24)$$

The equilibrium value of output per variety can be obtained by using \hat{s} in (19):

$$\hat{y} = (1 - \hat{s}) \frac{(k_1 + \alpha)(\eta - 1)}{\beta}. \quad (25)$$

The equilibrium transfer from a manufacturer to a retailer is:

$$\hat{T} = \hat{s} \frac{(\eta - 1)}{\eta} (k_1 + \alpha) - \alpha. \quad (26)$$

If \hat{T} is positive, we observe a slotting allowance. Using (22) to identify the determinants of \hat{s} , we can state:

Proposition 1 *The equilibrium slotting allowance is increasing in the retailer fixed cost (k_0), the cost of adding a variety (k_1), the elasticity of substitution (η), and decreasing in the manufacturer's fixed cost (α) and the fraction of income spent on differentiated goods (ρL).*

Proof: see Appendix.

A slotting allowance may emerge, precisely because a multiproduct retailer's bargaining with each individual manufacturer takes into account the cannibalization effect and leads to a mark-up in the wholesale price. Without the resulting quasi-rent, the equilibrium transfer from the manufacturer to the retailer would be negative so as to compensate the manufacturer for his fixed cost.

However, setting a wholesale price above marginal cost also creates an externality that individual retailer/manufacturer pairs fail to internalize. Namely the quasi-rents earned by manufacturers and transferred to retailers imply that retailers take on too many varieties and thus generate excessive entry of firms into the manufacturing sector. This can be seen by comparing the equilibrium allocation outlined above to the second-best allocation—second best in the sense that we require the retailers' zero-profit conditions to be satisfied. In the second best, there is no externality, since the wholesale price maximizes not the joint payoff of a manufacturer/retailer pair but rather the entire surplus of each retailer and all the manufacturers selling through him. It is easy to establish that the second-best wholesale price is $w^B = \beta$ and the corresponding transfer that guarantees manufacturers zero profit is $T^B = -\alpha$, where the superscript B denotes the second-best allocation. Hence there is no slotting allowance in the second best, but rather a transfer from retailers to manufacturers to offset the latter's fixed costs. A wholesale price equal to the marginal cost of production implies that there is no double marginalization.¹⁴

¹⁴Note that the externality also disappears when all the bargaining power rests with the retailers so that they can set w and T . This corresponds to the case of *buyer power* examined in a different context by Raff and Schmitt (2009). In other words, buyer power is a means of implementing the second-best allocation. The opposite of buyer power is *seller power*, i.e. a situation in which the manufacturers have all the bargaining power and can make take-it-or-leave-it-offers to the retailers. As has already been discussed above,

Given w^B and T^B it is straightforward to establish that $R^B = \hat{R}$ and

$$M^B = \frac{\eta(1 - \hat{s}) + \hat{s}}{\eta} \hat{M} < \hat{M}, \quad (27)$$

$$y^B = \frac{\hat{y}}{(1 - \hat{s})} > \hat{y} \quad (28)$$

$$p^B = \left(1 + \frac{1}{(\eta - 1)(1 - \hat{s})}\right) \beta < \hat{p}. \quad (29)$$

The positive externality created by the cannibalization effect in the market allocation is reflected in (27): each retailer deals with more manufacturers than is socially optimal. The retailer's assortment is thus larger and the sales of each variety smaller than in the second best. These results can be summarized as follows:

Proposition 2 *In a closed economy the product assortment of each retailer is bigger and sales per variety are smaller than in the second best. The total mass of differentiated products in the economy is larger than in the second best.*

This has implications for the allocation of resources between manufacturing and retailing, and for welfare. In particular, it is immediate from (27) and (23) that in equilibrium too much labor is devoted to retailing compared to the second best, $\hat{R}(k_0 + k_1 \hat{M}) > \hat{R}(k_0 + k_1 M^B)$. Given that a fixed amount of labor is devoted to the differentiated good industry (ρL), this implies that less labor is left over for the production of differentiated products than in the second best.

The fact that in equilibrium retail prices are higher but the mass of varieties is also higher than in the second best makes the welfare comparison non-trivial. We can verify, however, that the effect of higher retail prices on the price index dominates the effect of greater product variety so that the following result holds:

Proposition 3 *In a closed economy more labor is allocated to retailing and social welfare is lower than in the second best.*

Proof: see Appendix.

the allocation under seller power is identical to the one obtained in the equilibrium of our model.

4 Product-Market Integration vs. Technological Change in Retailing

The question we want to investigate in this section is whether the model can help us shed light on the stylized facts about retailing discussed in the introduction, specifically the reallocation of labor from manufacturing to retailing, the rise in slotting allowances and the increased market concentration in retailing. We focus on two plausible drivers of these changes: product-market integration and technological change in retailing.

By product-market integration we mean a scenario in which goods become tradable across countries but retail services remain non-tradable.¹⁵ Manufacturers are thus able to reach more consumers by exporting goods to foreign markets. From the point of view of retailers, however, the number of households served does not change when product trade is liberalized, simply because there is no cross-border shopping. This scenario corresponds roughly to the general fall in trade costs and the integration of countries like China and the Central and Eastern European countries into the world economy. Basker and Van (2008a,b) and Broda and Weinstein (2006), among others, have documented the associated rise in consumer good imports, including imports specifically intermediated by retailers, and in the number of imported varieties.

Technological change in retailing, specifically the adoption of information and bar-code technology and more recently Radio Frequency Identification, has led to major improvements in inventory control, logistics and distribution (Basker, 2007). These improvements have dramatically lowered the cost of carrying additional varieties (k_0), while boosting retailer fixed costs (k_1) and raising the importance of economies of scale (Holmes, 2001).¹⁶ significantly reduced the is the other Basker (2007, 2011)

4.1 Product-Market Integration

We may examine the effects of product-market integration by considering a world consisting of identical countries indexed by $c = 1, \dots, C$ and studying

¹⁵We consider the case of retail-market integration in the next Section as it has interesting welfare and policy implications.

¹⁶See also Basker (2011) for empirical evidence on the effect of bar-code technology on retail productivity and the significant set-up costs associated with its adoption.

how free trade in goods between them affects the equilibrium. From the point of view of a manufacturer, free trade means that his market has expanded as he is now able to sell his products to C retailers, one each in the C countries comprising the integrated world economy. Another way of saying this is that the manufacturer is able to take advantage of economies of scale in production by spreading the fixed cost over C markets. In effect, the fixed cost of manufacturing per country becomes α/C .

Since product-market integration amounts to a reduction of the fixed cost of production per market, it neither affects the determination of the wholesale and retail prices, nor does it change the number of retailers. What changes is output and the number of varieties. To show this formally, we have to make a few straightforward modifications to our notation. Let the assortment that each retailer carries now be given by $M = CM_c$, where M_c is the number of varieties produced in country c . Let y_c denote the quantity sold in country c and T_c denote the transfer received by a retailer in that country.

With this notation we can examine how the labor market equilibrium in a given country is affected by free trade. In particular, only a mass RM_c of varieties sold by retailers in a given country are locally produced varieties, but each local producer now has an output equal to Cy_c . Hence $RM_c y_c \beta$ units of labor are needed to cover the variable labor requirement in production. The fixed labor requirement in production absorbs $RM_c \alpha/C$ units of labor, and the remaining labor is allocated to retailing. Hence the new labor market clearing condition in a country is

$$Rk_0 + RM \left(k_1 + \frac{\alpha}{C} \right) + RM_c y_c \beta = \rho L. \quad (30)$$

Noting that the number of retailers in each country and hence retailer market share remains unchanged at \hat{s} , we can compute the mass of varieties (local and imported) carried by a retailer and local consumption of each variety:

$$\tilde{M} = \left(\frac{\eta}{\eta(1 - \hat{s}) + \hat{s}} \right) \frac{k_0(1 - \hat{s})}{(k_1 + \alpha/C) \hat{s}}, \quad (31)$$

$$\tilde{y}_c = (1 - \hat{s}) \frac{(k_1 + \alpha/C)(\eta - 1)}{\beta}. \quad (32)$$

Product-market integration thus leads to a market equilibrium in which there is a larger mass of product varieties carried by each retailer ($d\tilde{M}/dC > 0$),

a larger total mass of varieties available to consumers (since the number of retailers remains unaffected), and a decrease in the consumption of each variety ($d\tilde{y}_c/dC < 0$).

While these effects are to be expected,¹⁷ a novel result is the implied impact of product-market integration on the allocation of labor between manufacturing and retailing. Since resources are being saved in manufacturing, product-market integration implies a shift in resources from manufacturing into the retail sector. This can be seen from (30) where the amount of labor allocated to retailing, $\hat{R}\tilde{M}k_1$, rises, the fixed labor requirement in manufacturing, $\hat{R}\tilde{M}\alpha/C$, declines, while the variable labor input in manufacturing, $\hat{R}\tilde{M}\tilde{y}_c\beta$, remains unchanged. What makes this reallocation of labor possible is the fact that while the mass of varieties available to consumers rises with market integration, the mass of varieties produced in each country falls so that less labor is required in manufacturing.

By replacing α with α/C in (26), we can compute the slotting allowance that a manufacturer has to pay each of the C retailers carrying his product:

$$\tilde{T}_c = \hat{s} \frac{(\eta - 1)}{\eta} (k_1 + \alpha/C) - \alpha/C. \quad (33)$$

Product-market integration obviously erodes the quasi-rent earned by the manufacturer, the first term in (33). However, it is straightforward to show that the fixed cost falls by even more so that, on balance, the slotting allowance rises as the number of countries in the world economy goes up. We may therefore state:

Proposition 4 *Product-market integration (i) has no effect on the number of retailers and total retail sales; (ii) raises the product assortment carried by each retailer and the total mass of varieties available to consumers; (iii) reduces the quantity consumed of each variety; (iv) raises slotting allowances; and (v) leads to a reallocation of labor from manufacturing to retailing.*

These results are consistent with two of the main stylized facts listed in the introduction, namely the rise in slotting allowances and the shift in employment from manufacturing to retailing. However, in our model product-market integration leaves retail market concentration unchanged. This suggests that other changes may be driving this stylized fact. A likely candidate is technological change in retailing.

¹⁷The change in consumption is non-standard in a model with CES preferences, but clearly is due to the fact that in our model the price elasticity of demand is not constant.

[I'm not sure if we should discuss the other stylized facts: an increase in retailer product assortment, retailer size and the square footage of retail space relative to sales. At the moment I prefer focusing on just a few key stylized facts. The other stuff just seems a bit confusing. If we want to include them, we should mention them at the beginning of the section.]

4.2 Technological Change in Retailing

As argued above, technological change in retailing has significantly reduced k_1 and raised k_0 . The effects of a fall in k_1 are straightforward, since there is no change in the number of retailers or in retail and wholesale prices. As can be immediately seen from (23), (25) and (26), the mass of varieties carried by each retailer rises, the output per variety and slotting allowances fall.

Turning to k_0 , we observe from (22) that an increase in k_0 reduces the equilibrium number of retailers ($d\hat{R}/dk_0 < 0$), which directly implies greater retail market concentration. A greater retailer market share leads to higher retail and wholesale prices, greater slotting allowances, and lower output per variety. The effect on the retailer product assortment, however, is non-trivial, since k_0 affects the equilibrium assortment directly and indirectly through the effect on the number of retailers. The direct effect is positive: an increase in k_0 requires retailers to carry a larger product assortment in order to avoid making losses. The indirect effect is associated with the problem of cannibalization and has a negative sign: an increase in market share implied by a rise in k_0 raises the cost of expanding the assortment, because adding a variety reduces demand for the other varieties carried by the retailer. However, we prove in the Appendix that the direct effect outweighs the indirect effect so that $d\hat{M}/dk_0 > 0$.

The combined effect of a fall in k_1 and a rise in k_0 can be summarized as follows:

Proposition 5 *A decrease in the retail cost per variety combined with an increase in the fixed cost of retailing (i) raises retail market concentration; (ii) increases the mass of varieties carried by each retailer; (iii) lowers consumption of each variety; and (iv) has an ambiguous effect on slotting allowances.*

Proof: see Appendix.

In other words, to reproduce in our model the main stylized facts listed in the introduction we require not just product-market integration but also

technological change in retailing, especially if one wants to generate retailers with higher market shares.

5 Welfare and Policy Implications

An important point of this paper is to demonstrate that there is a fundamental distortion in the relationship between independent multi-product retailers and manufacturers. Product-market integration, while raising social welfare due to gains from variety, leaves this distortion unchanged. In particular, even with product-market integration product variety is too large, output per variety too small and too much labor is allocated to retailing compared with the second best.

In this section we show that this distortion could be reduced through retail-market integration. In particular, we prove:

Proposition 6 *Retail-market integration (i) moves the equilibrium allocation closer to the second best; and (ii) raises social welfare by more than product-market integration alone.*

Proof: see Appendix.

Retail-market integration means that retailers gain access to foreign customers or, put another way, consumers engage in cross-border shopping. In our model this implies not just free trade in retail services, but rather *full market integration*. In fact, having an integrated retail market simply means that domestic products are exported by retailers instead of manufacturers.

Fully integrating both retail and product markets allows both manufacturers and retailers to spread their fixed costs, including the cost of carrying a variety, across markets and thus realize economies of scale. This is equivalent to an increase in market size, L , which, according to (22), raises the total number of retailers and thus lowers the market share of each retailer, \hat{s} . A lower retail market share reduces the distortion in the wholesale price, moving it closer to marginal cost β , as can be seen from (17). A lower wholesale mark-up is equivalent to a smaller slotting allowance. Another way to see this is to note that a smaller \hat{s} reduces the cannibalization effect, and hence the payment manufacturers have to offer retailers to obtain distribution for their products. The retail price declines due to the reduced wholesale price and because a retailer with a lower market share perceives a higher price

elasticity of demand and thus charges a smaller retail mark-up. Output of each variety obviously has to increase when retail prices fall.

To understand the effect of retail-market integration on retailer product assortment it is useful to rewrite (27) as:

$$\hat{M} = \left(\frac{\eta}{\eta(1 - \hat{s}) + \hat{s}} \right) M^B, \quad (34)$$

where the first term comes from the market distortion. The reduction in the cannibalization effect associated with a smaller \hat{s} increases directly M^B . However, the distortion also becomes smaller which decreases the first term. As shown in the Appendix, the effect on M^B dominates so that retailer product assortment rises. Social welfare must unambiguously rise, since retail prices fall and overall product variety in the economy increases. Finally, as the distortion in the wholesale market shrinks, equilibrium welfare approaches the second-best level.

6 Conclusions

Significant changes have occurred in retailing over the last forty years. These changes make an analysis of the relationship between retailers and manufacturers interesting and non-trivial. A better understanding of these changes is also important because of their consequences for the impact of freer trade whether it is at the product or at the retail service level.

In this paper we propose to analyze this relationship within the context of a standard monopolistic competition approach. In addition to introducing a link through the wholesale market between retailers and manufacturers, the main new characteristics of the model are that retailers are multi-product firms and that each of them understands that selling one more variety is not without impact on the demand for the other varieties he sells. When such retailers enter in a competitive relationship with manufacturers and bargain bilaterally with each manufacturer whose product they consider selling, then an externality necessarily arises. It is because, in such an environment, the bargaining pair is unable to take into account the effect of their decision on other manufacturers. This externality is thus directly linked to the fact that retailers are multi-product firms. It does not depend, however, on our simple modeling of manufacturers producing a single good. The same externality would persist with multi-product manufacturers as long as one manufacturer

is not the only provider of the products sold by a retailer and thus as long as each manufacturer produces a smaller mass of varieties than sold by a retailer. It is the presence of this externality that allows us to conclude that, with respect to the second-best outcome, retailers sell too many products in too small a quantity, at too high a price, and that too much resources are devoted to retailing as compared to manufacturing. It is also this externality that explains why slotting allowances emerge in equilibrium.

This approach allows us to examine the causes and consequences of the increase in retailer's market share, the trend toward big-box retailing and a greater emphasis on slotting allowances. We discovered that it is less due to trade liberalization at the product or at the retailing service level than to technological changes in retailing, such as the increased use of information and communication technology that has raised the fixed cost of retailing. A higher retailer fixed cost reduces the equilibrium number of retailers, raises the mass of manufacturers, makes retailers bigger, and leads to a rise in the slotting allowance per product. It should be emphasized that the fact that retail concentration does not rise as a result of product-market integration is in part due to the structure of the model particularly the fact that firms are identical. In a related paper that places much more emphasis on the retailing sector and much less on the links with manufacturers, Raff and Schmitt (2010) shows that product-market integration may indeed lead to higher concentration at the retail level when there is heterogeneity among retailers.

In the present model, free product trade leaves the number of retailers in a country unchanged but raises the product assortment each retailer carries. The economic process that is at work here is that the integration of markets allows manufacturers to realize economies of scale by selling to more customers; the mass of manufacturers in each country falls. Still consumers gain access to more varieties than before as they now turn to imported varieties. What makes this possible is that labor that is saved in the manufacturing sector is reallocated to retailing, allowing each retailer to carry more varieties, including a larger share of imported varieties. In the case of retail market integration there is an additional positive effect on welfare, since trade lowers the per-variety slotting allowance that a manufacturer must pay a retailer to induce him to carry its product. It leads to a less skewed allocation of resources between retailing and manufacturing than with free product trade alone.

In this paper we have assumed that retailers and manufacturers are in-

dependent and that manufacturers must bargain with retailers in order to have their product made available to consumers. Vertical integration could easily be examined in our model as well. In fact, to the extent that vertical integration eliminates the externalities between each retailer and the manufacturers it deals with the market outcome would be identical to the second best derived in Section 3. This shows one more time that the central point of this paper is linked to the externality that manufacturers and multi-product retailers generate when they must bargain. This externality is an important element to understand both the gains from trade generated by product- and by retail-market integration and the allocation of labor between retailing and manufacturing.

7 Appendix

7.1 Proof of Proposition 1

The changes in \hat{T} caused by changes in k_0 , k_1 , α and ρL are straightforward. To determine the comparative statics with respect to η rewrite \hat{T} as

$$\begin{aligned}\hat{T} &= \frac{(\eta - 1)(k_1 + \alpha)}{\left(\frac{\eta-1}{2} + \sqrt{\frac{(\eta-1)^2}{4} + \frac{\eta\rho L}{k_0}}\right)} \\ &= \frac{(\eta - 1)(k_1 + \alpha)}{D}\end{aligned}$$

Thus

$$\begin{aligned}\frac{\partial \hat{T}}{\partial \eta} &= \frac{1}{D^2} \left[(k_1 + \alpha) D - (\eta - 1)(k_1 + \alpha) \left\{ \frac{1}{2} + \frac{1}{2} \frac{\left(\frac{\eta-1}{2} + \frac{\rho L}{k_0}\right)}{\sqrt{\frac{(\eta-1)^2}{4} + \frac{\eta\rho L}{k_0}}} \right\} \right] \\ \text{sign} \frac{\partial \hat{T}}{\partial \eta} &= \text{sign} \left[D - \frac{\eta - 1}{2} \left\{ 1 + \frac{\left(\frac{\eta-1}{2} + \frac{\rho L}{k_0}\right)}{\sqrt{\frac{(\eta-1)^2}{4} + \frac{\eta\rho L}{k_0}}} \right\} \right] \\ &= \text{sign} \left[\sqrt{\frac{(\eta - 1)^2}{4} + \frac{\eta\rho L}{k_0}} - \frac{\eta - 1}{2} \left(\frac{\left(\frac{\eta-1}{2} + \frac{\rho L}{k_0}\right)}{\sqrt{\frac{(\eta-1)^2}{4} + \frac{\eta\rho L}{k_0}}} \right) \right] \\ &= \text{sign} \frac{\rho L}{k_0} \left(\frac{\eta + 1}{2} \right) > 0.\end{aligned}$$

7.2 Proof of Proposition 3

Since consumers spend a fixed share of their income on differentiated goods, indirect utility is strictly decreasing in the price index for differentiated goods. The price indices in equilibrium and in the second best are given respectively by $\hat{P} = \hat{p} \left(\hat{R}\hat{M} \right)^{\frac{1}{1-\eta}}$ and $P^B = p^B \left(\hat{R}M^B \right)^{\frac{1}{1-\eta}}$. Given that the number of retailers is the same in equilibrium and in the second best, the respective price indices can be written as

$$\hat{P} = \hat{p} \left(\hat{R}\hat{M} \right)^{\frac{1}{1-\eta}} \quad \text{and} \quad P^B = p^B \left(\hat{R}M^B \right)^{\frac{1}{1-\eta}}. \quad (35)$$

We hence have

$$\hat{P} - P^B = \hat{R}^{\frac{1}{1-\eta}} \left[\hat{p}\hat{M}^{\frac{1}{1-\eta}} - p^B M^B \right]^{\frac{1}{1-\eta}} \quad (36)$$

$$= p^B \left(\hat{R}M^B \right)^{\frac{1}{1-\eta}} \left[\frac{1}{(1-\hat{s})} \left(\frac{\eta}{\eta(1-\hat{s}) + \hat{s}} \right)^{\frac{\eta}{1-\eta}} - 1 \right]. \quad (37)$$

$\hat{P} - P^B > 0$ provided that the expression in brackets is positive. This is the case if $f(\hat{s}, \eta) \equiv \hat{s} - \eta(1-\hat{s}) \left[(1-\hat{s})^{-\frac{1}{\eta}} - 1 \right] > 0$ for $\eta > 1$ and $\hat{s} \in (0, 1)$. Note that $f(0, \eta) = 0$. The proof proceeds by showing that $f(\hat{s}, \eta)$ reaches a minimum in \hat{s} at $\hat{s} = 0$:

$$\frac{\partial f(\hat{s}, \eta)}{\partial \hat{s}} = 1 + \eta \left[(1-\hat{s})^{-\frac{1}{\eta}} - 1 \right] - (1-\hat{s})^{-\frac{1}{\eta}} \stackrel{!}{=} 0 \quad \text{at } \hat{s} = 0,$$

and

$$\frac{\partial^2 f(\hat{s}, \eta)}{\partial \hat{s}^2} = \left(1 - \frac{1}{\eta} \right) (1-\hat{s})^{-\frac{1+\eta}{\eta}} > 0 \quad \forall \hat{s} \in [0, 1) \text{ and } \eta > 1.$$

7.3 Proof of Proposition 5

Note that

$$\frac{d\hat{R}}{dk_0} = - \left(\frac{(\eta-1)^2}{4} + \frac{\eta\rho L}{k_0} \right)^{-\frac{1}{2}} \frac{\rho L}{2k_0^2} < 0. \quad (38)$$

Using (23) and (27) after applying $\hat{s} = 1/\hat{R}$, we can decompose the effect on \hat{M} as follows:

$$\frac{d\hat{M}}{dk_0} = \left(\frac{\eta\hat{R}}{\eta(\hat{R}-1) + 1} \right) \frac{dM^B}{dk_0} - \left(\frac{(\eta-1)\eta M^B}{(\eta(\hat{R}-1) + 1)^2} \right) \frac{d\hat{R}}{dk_0}. \quad (39)$$

Since $d\hat{R}/dk_0 < 0$, it follows that $d\hat{M}/dk_0 > 0$ provided that $dM^B/dk_0 > 0$, where

$$\frac{dM^B}{dk_0} = \frac{\hat{R} - 1}{(k_1 + \alpha)} + \frac{k_0}{(k_1 + \alpha)} \frac{d\hat{R}}{dk_0} \quad (40)$$

$$= \frac{1}{(k_1 + \alpha)} \left(\hat{R} - 1 - \frac{\rho L}{k_0} \frac{1}{\eta(2\hat{R} - 1) + 1} \right). \quad (41)$$

Hence $dM^B/dk_0 > 0$ if and only if

$$\left(\hat{R} - 1 \right) \left[\eta(2\hat{R} - 1) + 1 \right] - \frac{\rho L}{k_0} > 0. \quad (42)$$

Rewriting the labor-market clearing condition as

$$\eta \hat{R}^2 - (\eta - 1) \hat{R} = \frac{\rho L}{k_0}, \quad (43)$$

and using (43) in (42) we obtain

$$R^2 - 2R + 1 > \frac{1}{\eta},$$

which holds as both R and η are greater than one.

7.4 Proof of Proposition 6

Given an increase in L : (i) The increase in \hat{R} (and decrease in \hat{s}) follows immediately from (22). (ii) The decrease in \hat{s} reduces \hat{p} and \hat{w} , as can be seen in (24) and (17), respectively. (iii) The fall in \hat{A} follows from (26), and (iv) the rise in \hat{y} from (25). (v) The effect on \hat{M} is given by:

$$\begin{aligned} \frac{d\hat{M}}{d\hat{s}} &= \frac{k_0(1 - \hat{s})}{(k_1 + \alpha) \hat{s} (\eta(1 - \hat{s}) + \hat{s})^2} \frac{\eta(\eta - 1)}{\eta(1 - \hat{s}) + \hat{s}} - \frac{k_0}{(k_1 + \alpha) \hat{s}^2} \frac{\eta}{\eta(1 - \hat{s}) + \hat{s}} \\ &= -\frac{k_0}{(k_1 + \alpha) \hat{s}^2} \frac{\eta}{(\eta(1 - \hat{s}) + \hat{s})^2} [(1 - s)(\eta(1 - s) + s) + s] < 0. \end{aligned}$$

(vi) Overall product variety, $\hat{R}\hat{M}$, rises, since both components increase. (vii) The rise in social welfare follows directly from the fall in the price index due

to the decrease in retail prices and the increase in $\hat{R}\hat{M}$. (viii) From (37), $(\hat{P} - P^B)$ is proportional to

$$Z(\hat{s}) \equiv \frac{1}{(1 - \hat{s})} \left(\frac{\eta}{\eta(1 - \hat{s}) + \hat{s}} \right)^{\frac{\eta}{1-\eta}}.$$

We have

$$\frac{dZ(\hat{s})}{d\hat{s}} \equiv \frac{1}{(1 - \hat{s})} \left(\frac{\eta}{\eta(1 - \hat{s}) + \hat{s}} \right)^{\frac{\eta}{1-\eta}} \left[\frac{\eta(1 - \hat{s})}{\eta(1 - \hat{s}) + \hat{s}} + \frac{1}{1 - \hat{s}} \right] > 0,$$

so that a fall in \hat{s} reduces $Z(\hat{s})$.

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