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Working Paper

Manufacturers and retailers in the global economy

CESifo Working Paper, No. 3508

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Suggested Citation: Raff, Horst; Schmitt, Nicolas (2011) : Manufacturers and retailers in the global economy, CESifo Working Paper, No. 3508, Center for Economic Studies and ifo Institute (CESifo), Munich

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Manufacturers and Retailers in the Global Economy

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CESIFO WORKING PAPER NO. 3508
CATEGORY 8: TRADE POLICY
JUNE 2011

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CESifo *Working Paper No. 3508*

Manufacturers and Retailers in the Global Economy

Abstract

We develop a general-equilibrium model to capture key features of the retailing and of the manufacturing industry in order to understand how these two industries interact and how labor is allocated between them. We show that the observed shift in employment from manufacturing to retailing, the rise in retailer product assortment and the emergence of slotting allowances in many retail markets are consistent with the global integration of product markets, while higher retail market concentration is best explained by technological change in retailing. We also identify a novel benefit from market integration consisting of efficiency gains in the vertical distribution chain.

JEL-Code: F120, F150, L130.

Keywords: international trade, product variety, retailing, slotting allowance, multi-product firms.

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June 2011
We would like to thank participants at various workshops and conferences for helpful comments and the Social Sciences and Humanities Research Council of Canada for financial support.

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 simple model capturing key features of the retailing and of the manufacturing industry in order to understand how these two industries interact 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 and technological change. By doing so we shed light on the circumstances under which retailers increase their assortment, slotting allowances rise, retail market concentration increases, labor is reallocated from manufacturing to retailing, as well as the welfare impact of these changes. In the process we also identify a novel benefit from market integration 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] In 2008 retailing alone was 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 accounted for $3.9 trillion in annual sales.[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

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

[2] Not including food services and drinking places (Table 1017: Retail Trade and Food Services, 2010 Statistical Abstract, US Bureau of the Census). The US wholesale market represented another $4.5 trillion in sales in 2008, 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, resulting in a steady increase in the ratio of square footage to sales (see Klein and Wright, 2006, Figure 1).[4]

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 Sudhir 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, retailers play an important role in international trade, not only because they carry many imported goods but also because they directly intermediate a lot of trade. Bernard and al. (2010) document the international trade activities of US retailers and wholesalers and find that 13% of im-

[3] In 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.

[4] In 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).

[5] 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.

[6] Note that slotting allowances should not be 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.

porting 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 (2008) find that over the period 1997 to 2002 US 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, 2010). 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 foreign exporters and the importers they deal with. In particular, they find that large multi-product retailers facilitate trade for small exporters because they provide an efficient way of reaching consumers who otherwise would be difficult to find.

In this paper 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 an increasing-returns-to-scale technology. 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]

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

[7] For instance, in 2003, the share of imports in Canada was 55% for clothing, 82% for clothing accessories, 86% for footwear, 100% for audio, video, small electrical appliances, as well as for toys and games (Jacobson, 2006, Table 33).

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

is efficient in the sense that the wholesale price maximizes the surplus of each retailer-manufacturer pair, the wholesale price nevertheless exceeds the marginal cost of production and thus creates an inefficiency in the vertical distribution chain. This is because the retailer-manufacturer pair takes into account the cannibalization effect that selling the respective variety generates for the retailer. The rent generated by this wholesale margin is dissipated in equilibrium through slotting allowances.

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 to retailing, the rise in retailer product assortment and the increase in slotting allowances are consistent with product-market integration, but that the increase in retail market concentration 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 inefficiency in the vertical distribution chain.

Our paper is linked to several strands of the literature. There is a large literature that examines the causes and consequences of slotting allowances. A seminal contribution is Shaffer (1991) who shows that these allowances may be used by retailers to soften price competition 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.

Our paper is also related to the growing literature on the role of intermediaries in international trade and their welfare impact. It includes Akerman (2010), Antras and Costinot (2011), Blum et al. (2009), and Bardhan et al. (2009).

Papers specifically examining the interaction between trade and retailing include Richardson (2004) who studies market access to retail distribution, Raff and Schmitt (2005, 2006, 2009) who examine the effects of trade liberalization on markets where either manufacturers or retailers have power over the other group of firms, and Francois and Wooton (2010) who show that market structure in distribution becomes increasingly important for trade as

tariffs fall. They also include Basker and Van (2008) who investigate the effects of trade liberalization on competition between a chain retailer and small single-market retailers, concluding that trade liberalization raises the size of the chain retailer, and that the growth of the chain gives an additional boost to imports.

Finally, papers using a monopolistic competition approach with retailers include Eckel (2009) who develops a general equilibrium model to examine the effects of trade on retail market structure, especially on product variety and accessibility of retailers, and Raff and Schmitt (2011) who 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 heterogenous.

The value-added of our paper is to provide a theoretical framework rooted in the monopolistic-competition tradition to shed light on the stylized facts discussed above and on the welfare consequences of product- and retail-market integration.

The paper continues as follows. In Section 2, we present a simple general equilibrium model with manufacturers and retailers. Section 3 characterizes the equilibrium of the closed economy, and Section 4 examines the effects of product market integration and technological change in retailing. Section 5 deals with retail market integration and the associated welfare effects. Section 6 concludes, and the Appendix contains proofs.

2 The Model

In this section, we develop a simple general equilibrium model of manufacturing and retailing. 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 closed 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

$$U = y_0 + \rho \ln(Y_d), \qquad \rho < 1, \tag{1}$$

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

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

where $\eta > 1$ is the elasticity of substitution between varieties and Ω is the endogenous set of 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:

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

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, in addition, the

[9] Exclusive dealing is common in many industries. Even in grocery retailing, there is very little overlap between the products sold by different stores when one considers barcode

number or retailers is endogenously determined by free entry, the total mass of varieties is also endogenous.

Our modelling of retailers as multi-product firms follows Feenstra and Ma (2008) who develop this approach to study producers. There are R retailers and 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

$$Y_d = \left(\int_0^{M_1} y_d(i)^{\frac{\eta-1}{\eta}} di + \int_{M_1}^{M_1+M_2} y_d(i)^{\frac{\eta-1}{\eta}} di + \cdots + \int_{\bar{M}-M_R}^{\bar{M}} y_d(i)^{\frac{\eta-1}{\eta}} di \right)^{\frac{\eta}{\eta-1}}. \tag{4}$$

Similarly, the CES price index is given by

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

The assumption that a retailer carries a whole mass of varieties implies that any adjustment he makes to his assortment or to prices across his assortment has an effect on the price index. It is both realistic and useful to assume that retailers take this into account when choosing their assortment and setting prices. Consider first the implications for the retailer's pricing decision. Note that manufacturers in our model are symmetric so that a retailer faces identical wholesale prices across all the varieties he sells. The retailer thus sets the same retail price for all varieties in his assortment and responds to a change in these wholesale prices by adjusting his retail prices across the board. Denoting the price retailer r charges for each of the varieties he sells

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.

by p_r, the CES price index (5) simplifies to:

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

Taking into account that the price index P is increasing in p_r for $M_r > 0$ means that demand for each variety reacts less to price changes than in the usual CES framework. More precisely, the price elasticity of demand is not constant but rather decreasing in r's market share, s_r:

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

with

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

Next consider how a multi-product retailer's effect on the price index affects the assortment choice. From (6) we see that an increase in M_r reduces P. Using this in (3), we observe that demand for each variety falls. In other words, the retailer acknowledges that adding a product to his assortment lowers the demand for the other products he carries. As we will see below, this 'cannibalization' effect becomes bigger as the retailer adds products, thus putting a limit on his product assortment.

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 includes the usual headquarter costs such as 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 however 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

$$l^r = k_0 + k_1 M. \tag{9}$$

Manufacturers are single-product firms and enter the industry as long as profits are positive. We follow Krugman (1980) in assuming that their technology exhibits increasing returns to scale; specifically, 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

$$l^m = \alpha + \beta y, \qquad \alpha, \beta > 0. \tag{10}$$

2.3 The Wholesale Market

The manufacturing and the retailing side of the economy are linked through the wholesale market. Contracts between manufacturers and retailers take the form of two-part tariffs, consisting of a wholesale price, w, and a payment or transfer, T, from a manufacturer to a retailer (where T can be negative). The reason for considering two-part tariffs is that we want to examine whether the market equilibrium exhibits slotting allowances, which we define as positive payments from manufacturers to retailers.

In equilibrium the two-part tariffs are determined by two forces, namely by bargaining between retailers and manufacturers over the wholesale price, and by free entry into manufacturing, which assures that the transfers between retailers and manufacturers are consistent with zero profits. 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.

[10] 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).

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:

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

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

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

We observe that the higher is a retailer's market share, s, the higher is his mark-up. To derive the first-order condition with respect to M, recall that we have to take into account that y is a function of M through the effect each retailer has on the price index. The first-order condition then reads:

$$(p-w)\,y - s\,(p-w)\,y = k_1 - T. \tag{13}$$

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

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

The surplus that is generated when a retailer adds the manufacturer's product to his assortment is equal to the sum of Π^m and the incremental profit of the retailer, which we have already encountered in (13):

$$(w-\beta)y + (1-s)\,(p-w)\,y - k_1 - \alpha. \tag{15}$$

Substituting for $(p - w)$ from (12), the wholesale price maximizing this surplus is given by the following first-order condition:

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

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

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

The wholesale price thus exceeds the manufacturer's marginal cost by a margin that is increasing in the retailer's market share, s. 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 sold by the retailer. 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.[11]

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 quasi-rents earned by the manufacturer, $(w - \beta)y$, net of the fixed cost of production, α:

$$T = (w - \beta)y - \alpha. \tag{18}$$

This transfer, if 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.[12]

[11] The 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 profit from 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.

[12] The cannibalization effect is a sufficient but not a necessary condition for the distortion in the wholesale price and the associated slotting allowance. Shaffer (1991) shows that in a setting, in which each good is distributed by more than one retailer, slotting allowances with wholesale prices exceeding marginal cost 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 the assumption of exclusive dealing.

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

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

This output is decreasing in s due to the fact that the wholesale price is increasing in s as explained above.

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:

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

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-good industry (i.e., manufacturing and retailing), this condition can be written as:

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

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

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

and the mass of varieties carried by each retailer:

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

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:

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

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

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

and the equilibrium transfer from a manufacturer to a retailer is

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

If $\hat{T}$ is positive, we observe a slotting allowance. A slotting allowance has the following properties:

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.

Clearly the higher is k_1 and the greater is η, the less attractive it is for a retailer to take on an additional variety. The slotting allowance hence has to be higher to induce the retailer to do so. The same is true for a higher k_0 and a lower ρL which both reduce the number of retailers, thus making them bigger and strengthening the cannibalization effect.

The market equilibrium is inefficient since it involves double marginalization in the vertical distribution chain. Before moving on to examine the positive and normative aspects of market integration it is useful to characterize this inefficiency by comparing the market allocation to a second-best allocation in which the double marginalization is ruled out by imposing a wholesale price equal to the marginal production cost, i.e., $w^B = \beta$, where the superscript B denotes the second-best allocation. In this second best, the transfer that guarantees manufacturers zero profit is $T^B = -\alpha$. The second best thus amounts to maximizing the sum of a retailer's profit and the profits of all the manufacturers he deals with.[13]

[13] One way to implement this second-best allocation is to give the retailers the power to set w and T. This corresponds to the case of *buyer power* examined in a different context by Raff and Schmitt (2009).

The opposite of buyer power is *seller power*, i.e. a situation in which the manufacturers have all the bargaining power and make take-it-or-leave-it-offers to the retailers. As already discussed, the allocation under seller power is identical to the one obtained in the equilibrium of our model.

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

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

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

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

Hence not only is the retail price in the market equilibrium too high compared with the second best, but each retailer carries too many varieties and sells too little of each variety. 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 welfare and the allocation of resources between manufacturing and retailing. It is immediate from (27) and (23) that in equilibrium too much labor is devoted to distributing the mass of varieties compared to the second best, $\hat{R}(k_0 + k_1\hat{M}) > \hat{R}(k_0 + k_1 M^B)$. With a fixed amount of labor devoted to the differentiated good industry (ρL), this implies that too little labor is left over for the production of each variety.

A similar reasoning applies to social welfare. Despite the fact that the mass of varieties is bigger in equilibrium than in the second best, equilibrium welfare turns out to be lower precisely because there is too little consumption of each variety. We hence may state:

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.

4 Product-Market Integration vs. Technological Change in Retailing

The question we want to investigate in this section is whether the model can shed light on the stylized facts about retailing discussed in the introduction,

namely the reallocation of labor from manufacturing to retailing, the rise in slotting allowances, the growth of retailers' assortment, and increased market concentration in retailing. We focus on two plausible drivers of these changes: product-market integration and technological change in retailing. We consider the case of retail-market integration in the next section.

By product-market integration, we mean a scenario in which goods become tradable across countries but retail services remain non-tradable. 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.

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).[14]

4.1 Product-Market Integration

We may examine the effects of product-market integration by considering a world consisting of identical countries indexed by $c = 1, ..., C$ and studying 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 spread his fixed cost over C markets. In effect, the fixed cost of manufacturing per country becomes α/C.

Since product-market integration only 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

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

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 $RMy_c\beta$ units of labor are needed to cover the variable labor requirement in production. The fixed labor requirement in production absorbs $RM_c\alpha = RM\alpha/C$ units of labor, and the remaining labor is allocated to retailing. The new labor market clearing condition in a country is then

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

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 by replacing α with α/C in (23) and (25):

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

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

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 not entirely surprising,[15] a novel result is the 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

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

$(\hat{R}\tilde{M}\tilde{y}_c\beta)$ 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:

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

Product-market integration obviously erodes the quasi-rent earned by the manufacturer, the first term in (33). But the fixed cost falls by even more so that, on balance, the slotting allowance paid by a manufacturer to each retailer rises as C goes up. In addition, even if there were no slotting allowance in autarky ($\hat{T} \leq 0$ in (26)), it has to be the case that in free trade $\tilde{T}_c > 0$ if C is sufficiently big. 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 three stylized facts listed in the introduction, namely the shift in employment from manufacturing to retailing, the rise in slotting allowances, and the increase in retailer product assortment. 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.

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 cannibalization effect 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 then 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 Retail-Market Integration and Welfare

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. 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 to 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 (23) as

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

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. To understand better some of the forces that might drive these changes, this paper proposes a simple general equilibrium model that not only includes retailing but also the relationship between retailers and manufacturers through the wholesale market. Cast in a monopolistic-competition framework with multi-product retailers, the model allows us to consider several possible shocks that might contribute to explain why some key stylized facts are observed. One is market integration which in the present approach may take two separate forms, namely product-market and retail-service market integration. The other is technological change especially at the retailing level.

We have argued that product-market integration goes a long way to explaining several important stylized facts regarding retailing and manufacturing. Indeed it helps understand the shift in employment from manufacturing to retailing, the more prevalent use of slotting allowances as well as the larger product assortment carried by retailers. The only important stylized fact that product-market integration fails to account for in our model is the rise in market concentration in retailing. It requires adding technological changes, such as the increased use of information and communication technology that raises the fixed cost of retailing.

It is important to understand why some of these results occur. First, we are able to generate slotting allowances because each multi-product retailer understands that selling one more variety reduces the demand for the other varieties he sells. This cannibalization effect implies that when a retailer enters into a competitive relationship with manufacturers and bargains bilaterally with each manufacturer whose product he considers selling, the bargaining pair agrees to a wholesale price in excess of the marginal cost combined with a fixed payment which, when it is paid by a manufacturer to a retailer, represents a slotting allowance. This allowance and the inefficiency it is associated with are thus directly linked to the fact that retailers are multi-product firms; they do not depend, however, on our simple modeling of manufacturers producing a single good. The same inefficiency 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.

Second, the fact that, in the present model, product-market integration shifts employment from manufacturing to retailing comes from a standard

general-equilibrium effect. The integration of product markets allows manufacturers to realize economies of scale by selling to more customers, and the mass of manufacturers in each country falls. For consumers, the drop in the mass of domestic varieties is more than compensated by their access to imported varieties. But since consumers buy the larger mass of varieties from retailers, retailing must use more labor and this is possible precisely because labor saved in manufacturing is reallocated to retailing. In the case of product-market integration, the number of retailers remains the same and thus retailing uses more labor only because retailers sell a larger assortment of products. Incidentally, the fact that retail concentration does not change with product-market integration is in part due to the structure of the model, particularly the fact that retailers 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 (2011) show that product-market integration may indeed lead to higher concentration at the retail level when there is heterogeneity among retailers. In the present paper with identical retailers, the number of retailers does change too but with retail-market integration. In this case, a similar general-equilibrium effect occurs than in the case of product-market integration, leading to an increase in retailers' assortment and a shift in employment from manufacturing to retailing. But the allocation of labor is less skewed toward retailing than with product-market integration because the number of retailers in each country falls.

Third, retail-market integration brings higher welfare gains than product-market integration because retail-market integration results in an efficiency gain in the vertical distribution chain. Indeed retail-market integration, but not product-market integration, reduces the gap between the market equilibrium wholesale price and the marginal cost of production. It is also the presence of this same inefficiency 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.

In this paper, we have assumed that retailers and manufacturers are independent 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 inefficiency 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 a central point of

this paper is linked to the inefficiency that manufacturers and multi-product retailers generate when they must bargain.

More broadly, this paper suggests that, in order to understand economic integration or the policies associated with it in today's world, our attention should not be restricted exclusively to freer trade in goods or services separately. Indeed when services such as retailing are closely associated with the products themselves because there is a complementarity between production, sales and distribution, then not only may market integration take different forms but its impact may differ as well depending on the specific form of the integration. It is then crucial to understand in detail how the production and distribution of goods interact. This is what this paper has started to do in light of the facts that have unfolded over the last few decades.

7 Appendix

7.1 Proof of Proposition 1

Given (22) and (26), 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

$$\frac{\partial\hat{T}}{\partial\eta}=\frac{1}{D^2}\left[(k_1+\alpha)D-(\eta-1)(k_1+\alpha)\left\{\frac{1}{2}+\frac{1}{2}\frac{\left(\frac{(\eta-1)}{2}+\frac{\rho L}{k_0}\right)}{\sqrt{\frac{(\eta-1)^2}{4}+\frac{\eta\rho L}{k_0}}}\right\}\right].$$

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

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

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

We hence have

$$
\begin{aligned}
\hat{P}-P^B &= \hat{R}^{\frac{1}{1-\eta}}\left[\hat{p}\hat{M}^{\frac{1}{1-\eta}}-p^B M^{B\frac{1}{1-\eta}}\right] && (36)\\
&= p^B\left(\hat{R}M^B\right)^{\frac{1}{1-\eta}}\left[\frac{1}{(1-\hat{s})}\left(\frac{\eta}{\eta(1-\hat{s})+\hat{s}}\right)^{\frac{\eta}{1-\eta}}-1\right]. && (37)
\end{aligned}
$$

$\hat{P}-P^B>0$ provided that the expression in brackets is positive. This is the case if

$$
f(\hat{s},\eta)\equiv\hat{s}-\eta\left(1-\hat{s}\right)\left[\left(1-\hat{s}\right)^{-\frac{1}{\eta}}-1\right]>0 \tag{38}
$$

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 $\hat{s}=0$, which is guaranteed by

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

and

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

7.3 Proof of Proposition 5

Note that

$$\frac{d\widehat{R}}{dk_0} = -\left(\frac{(\eta-1)^2}{4} + \frac{\eta\rho L}{k_0}\right)^{-\frac{1}{2}} \frac{\rho L}{2k_0^2} < 0. \tag{39}$$

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

$$\frac{d\hat{M}}{dk_0} = \left(\frac{\eta\hat{R}}{\eta(\hat{R}-1)+1}\right)\frac{dM^B}{dk_0} - \left(\frac{(\eta-1)\,\eta M^B}{(\eta(\hat{R}-1)+1)^2}\right)\frac{d\hat{R}}{dk_0}. \tag{40}$$

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

$$\frac{dM^B}{dk_0} = \frac{\hat{R}-1}{(k_1+\alpha)} + \frac{k_0}{(k_1+\alpha)}\frac{d\hat{R}}{dk_0} \tag{41}$$

$$= \frac{1}{(k_1+\alpha)}\left(\widehat{R} - 1 - \frac{\rho L}{k_0}\frac{1}{\eta\left(2\widehat{R}-1\right)+1}\right). \tag{42}$$

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

$$\left(\widehat{R}-1\right)\left[\eta\left(2\widehat{R}-1\right)+1\right] - \frac{\rho L}{k_0} > 0. \tag{43}$$

Rewriting the labor-market clearing condition as

$$\eta\widehat{R}^2 - (\eta-1)\,\widehat{R} = \frac{\rho L}{k_0}, \tag{44}$$

and using (44) in (43) we obtain $R^2 - 2R + 1 > 1/\eta$, which holds as both R and η are greater than one.

7.4 Proof of Proposition 6

Given an increase in L, the increase in $\hat{R}$ (and decrease in $\hat{s}$) follows immediately from (22). The decrease in $\hat{s}$ reduces $\hat{p}$ and $\hat{w}$, as can be seen in (24) and (17), respectively. The effect on $\hat{M}$ is given by:

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

Overall product variety, $\hat{R}\hat{M}$, rises, since both components increase.

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 $\hat{R}\hat{M}$. To see why equilibrium welfare approaches the second best, note from the proof of Proposition 3 that $\left(\hat{P} - P^B\right)$ is proportional to $f(\hat{s},\eta)$, as defined in (38); but $f(\hat{s},\eta)$ approaches zero as $\hat{s}$ falls.

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