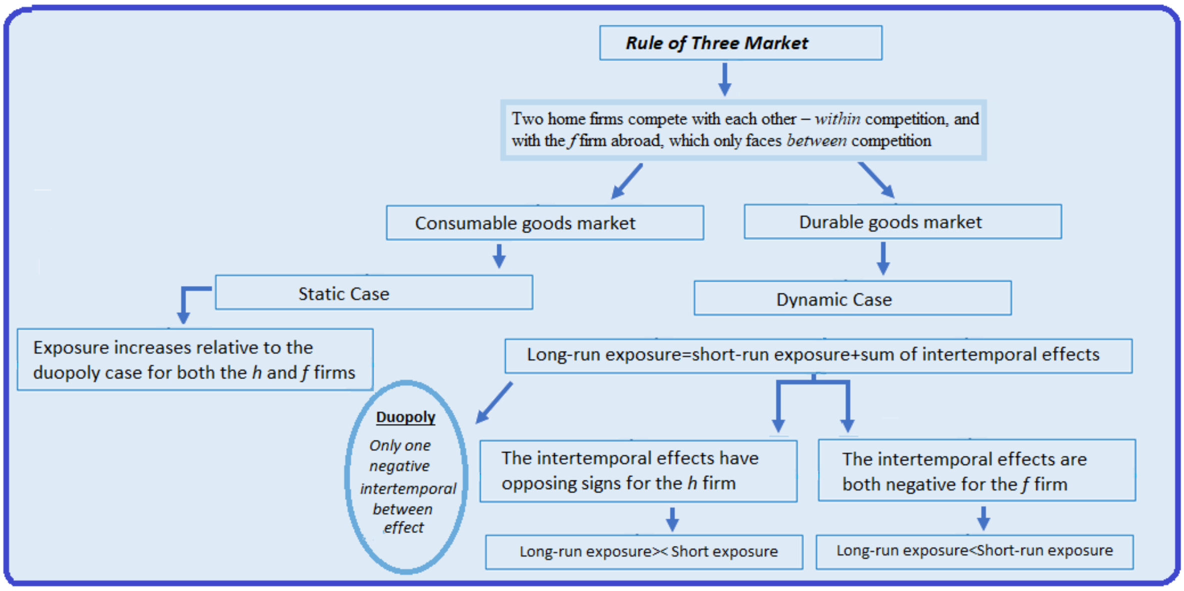
Graphical abstract



Highlights

- We examine exchange rate exposure in an international triopoly
- We calculate the intertemporal effects on long-run exposure
- Gap increases between long-run and short-run exposure after including home rival
- Long-run exposure for triopoly firm with home rival higher or lower than short-run
- Long-run exposure of firm with two foreign rivals lower than short-run

Is “Three” a lucky number?

Exchange-rate exposure in a “Rule of Three” model

Abstract

We examine exchange-rate exposure in an international model of differentiated goods using the frequently encountered in international markets “*Rule of Three*” (*RoT*) market structure that allows both *within* and *between* countries competition. In a static setting the addition of a domestic competitor increases the exposure of both internationally competing firms relative to duopoly unless the exchange-rate pass-through of one of its rivals is elastic. Using a dynamic model, we study the intertemporal effects on the firms’ long-run exposure. The exposure gap between the *RoT* market and the international duopoly increases in the long run for the firm facing domestic competition. The long-run exposure of that firm can be higher or lower than its short-run exposure, while the foreign monopolist has a smaller long-run exposure.

Keywords: *Rule of Three* Market; Exchange-rate Exposure; Switching costs; Short run;

Long run

JEL Classification Numbers: F23, L13, D21

Abbreviations: *Rule of Three* (*RoT*), Froot and Klemperer (1989) (FK), Gross and Schmitt (2000) (GS), Multinational corporations (MNCs), Procter and Gamble (P&G), Unilever (UN), General Motors (GM), Sports Utility Vehicles (SUV), Original Automobile Equipment Manufacturers (OEMs), Mahindra & Mahindra (M&M), Advanced Micro Devices (AMD), Taiwan Semiconductor Manufacturing Company (TSMC), with respect to (*wrt*), first order conditions (F.O.C.s).

1. Introduction

Marketing literature refers to markets with three competitors as a "*Rule of Three*". This market structure is "optimal" for firm stability and profitability (Sheth and Sisodia, 2002; Uslay et al., 2010). The economics literature also looks at triopolies (Bouis *et al.*, 2009; Shibata, 2016), exploring their stability in a closed economy. Adding a "third" firm (a domestic competitor) to a duopoly between a domestic and foreign based firm is not a trivial exercise but a project designed to better understand many real-world international markets as explained in section 2.

The previous studies differ from our work as they focus on the convergence to a *RoT* market structure, while we look at international markets that are already *RoT* and study the impact of exchange rates on prices (exchange-rate pass-through) and profits (exchange-rate exposure). We study a static and a dynamic version of the model to explore short-run and long-run exposure. For the latter we use the switching costs literature (see, Rhodes, 2014 and below).

While this study is connected to the exposure literature, to our knowledge no other study examines exchange-rate exposure (exposure) and exchange-rate pass-through (pass-through) in an international triopoly. Marston (2001) and Floden *et al.* (2008) emphasize the importance of market structure on the firms' pass-through and exposure. However, they study only duopolies, while we look at *RoT* markets.

Bodnar *et al*. (2002) also look at pass-through and exposure in a model where the exporting firm cannot sell in its own market and the local firm cannot produce abroad. Bartram *et al.,* (2010) expand the Bodnar *et al.* model by deriving pass-through in competitive industries where firms produce and compete in both foreign and local markets. They show that exposure depends on market share, product substitutability, and pass-through.

The dynamic version of the *RoT* model relates to the Froot and Klemperer (1989) (FK) and Gross and Schmitt (2000) (GS) models. In FK's two-period dynamic game, the expected exchange rates affect current market shares in an international duopoly of homogenous goods.

Both Gross and Schmitt and Bénassy-Quéré *et al*. (2011) note that there is an intertemporal trade-off as far as switching costs are concerned. Arie and Grieco (2014) show that firms with small market shares might be harmed by small switching costs, and respond by cutting their prices. Both Rhodes and Cabral (2017) study how old customers lock into the products of a firm. Consequently, they are less sensitive to price changes by that firm and its competitors. On the other hand, new customers will be offered lower prices as a "firm's incentive to lock people in will outweigh the customer's incentive to avoid being locked in" (Rhodes, p. 172). How the firm responds to an exchange-rate change will depend on how it values its future profits as measured by the size of the firm's discount factor.

We note that the current paper differs from the GS paper, as they study two foreign producers of a homogenous good serving a market with no home production under Bertrand competition, looking only at exchange-rate passthrough and not foreign exchange exposure. This model looks at foreign exchange exposure in a *RoT* setting where there are two home firms and one foreign firm competing in a Bertrand differentiated goods framework. We study how the intertemporal effects of exchange rates on the optimal prices of a firm's domestic and international rivals will, in turn, change the magnitude of long-run as compared to short-run exposure. Modelling this will allow us to understand the determinants of foreign exchange exposure in consumable goods as compared to durable goods (as the demand for the latter will have intertemporal characteristics) and form expectations about the difference in the responsiveness of these two types of goods in foreign exchange fluctuations.

Table 1 summarizes the relevant literature in different strands to facilitate reading.

[Insert Table 1]

2. Motivation - Real World Markets and International Market Structure

There are many consumable and durable goods produced by multinational corporations (MNCs). In the consumable goods category, the market for Apparel, Sports clothing, and Accessories is in the form of an international triopoly, followed by a fringe of firms: Nike is the global leader, followed by Adidas and Puma.

Similarly, in food processing, there are three leading food processing firms: two US firms, PepsiCo and Kraft Foods, and one Swiss firm, Nestlé. Together they produce a large fraction of global processed food sales and control the world market for food (Market Watch, 2014). Nestlé is the largest food firm in the world, while PepsiCo is the second largest food and beverage business in the world (Food Processing's Top 100, 2014).

In the Pet Food market, 80% of global pet food is controlled by Procter and Gamble (P&G), Nestlé and Colgate. The direct competition for P&G in this market is the segment Snacks and Pet, and for Nestlé it is the segment Pet Care. Colgate's revenue comes from Oral, Personal and Home Care and Pet Nutrition. In the Cognac market, the big three producers of Cognac are LVMH, Courvoisier, Martell, and Rémy Martin-Rémy Cointreau (Steinberger, 2008).

The Cosmetics market is dominated by three MNCs: L'Oréal, P&G and Unilever (UN). The Bottled water market comprises the Non-sparkling Segment and the Sparkling segments. Nestlé, Danone and Coca-Cola lead the global market. (Research and Markets, 2015). Finally, the Toy market (more of a semi durable good) is dominated by Mattel Inc., Hasbro Inc., and Bandai Co., Ltd., (Economist, 2013).

There are also numerous durable good *RoT* markets. For example, in the Smartphones market, formed in 2007 when Apple's iPhone was launched, Apple (US) is the global leader, followed by two South Korean firms Samsung and LG. Samsung controls just over a quarter of the global market today. In the case of mobile phones during the period 1992-2007, Finish Nokia was the largest seller of mobile phones in the world. The second firm in this market was

Motorola, followed by Samsung (Hessedahl, 2004). In the case of the Automobile Manufacturing market, the global automobile market as a whole has been a *RoT* example for many years, including General Motors (GM) (US), Toyota (Japan) and Ford (US).

Global automakers also dominate in their own country and generate most of their revenue from their home markets. In the USA one *RoT* market is again GM (US), Toyota (Japan) and Ford (US); another *RoT* has been Toyota (Japan), GM (US) and Honda (Japan) since the third semester of 2008 (The Age, 2008). In Europe the *RoT* is Volkswagen (Germany), Fiat Chrysler (US) and Daimler (Germany). In Asia the *RoT* comprises Toyota (Japan), Hyundai (South Korea) and Nissan.

Finally, if we define the automobile market using vehicle types, we still get *RoT* formations. Specifically, in the Trucks segment there is a *RoT* including GM (US), Fiat (US) and Toyota (Japan). Also, in the Sports Utility Vehicles (SUV) segment the *RoT* includes BMW (Germany) and the US automakers Fiat and Ford. This market is important as since the late 1990s over half of their profits for car companies have come from SUVs, while often these same companies could not break even on compact cars. SUV sales peaked in 1999 and then declined due to high gas prices.

Looking at the Original Automobile Equipment Manufacturers (OEMs), the market is perceived to be made mainly of automakers, but auto parts make up another profitable sector of the market. The top global automotive suppliers, based on revenue, are two German firms Bosch and Continental and the Japanese firm Denso. Bosch (a privately held firm), is an engineering and electronics MNC founded in 1886.

The airliner engine market is a typical *RoT* market with two US firms, GE and Pratt & Whitney, and one British firm, Rolls-Royce plc. These firms own more than 50% of the airliner engine market. Pratt & Whitney is a private company and a subsidiary of Raytheon Technologies.

In Consumer Electronics, the top three companies are the Japanese firms Sony and Panasonic and the South Korean company Samsung. In the Video Game Industry-Video game platforms, the leading companies are (US) Microsoft, (Japanese) Sony and (Japanese) Nintendo.

For the Video game industry-Manufacturers, the world's largest electronics manufacturers by revenue are: (Taiwan) Foxconn, (Taiwan) Pegatron (Singapore/US) Flextronics, while for Crane companies, there are Caterpillar (US), Komatsu (Japan) and Hitachi (Japan). In the global market for agricultural machinery and equipment the top three producers are the (US) Deere, (Italy/Netherlands) CNH and (US) AGCO; together they account for one third of the global market. Indian Mahindra & Mahindra (M&M) became the largest manufacturer of agricultural tractors in the world by taking on Deere in 2013.

There are also cases of international duopolies: for example, the Consumer Desktop Computer Microprocessor market can be perceived as a duopoly dominated by two American firms, Intel and Advanced Micro Devices (AMD). However, it can be argued that a third competitor is either the Taiwan Semiconductor Manufacturing Company (TSMC), or Chinese Lenovo, a technology MNC with headquarters in China and US, listed in the Hong-Kong Stock Exchange. The Detergent market is also dominated by two MNCs, UN and P&G, and it is an example of an international duopoly. Finally, the large jet airliner market has been dominated by two the MNCs Airbus and Boeing since the 1990s.

3. Duopoly

For comparison purposes, we first study the impact of the exchange rate, S, on prices and profits of firms with differentiated goods and linear demands in a static Bertrand duopoly; for example, the Detergent market, which is dominated by UN and P&G. Pass-through refers to the firm’s price elasticity with respect to (henceforth *wrt*) S, and exposure refers to the impact of S on profits.

The home, h and the foreign firm, f, set prices P_h^{DU} and P_f^{DU} respectively. Their demand functions are:

$$\begin{bmatrix} q_h(P_h^{DU}\ P_f^{DU}; S) \\ q_f(P_h^{DU},\ P_f^{DU}; S) \end{bmatrix} = \begin{bmatrix} \theta_o \\ \lambda_o \end{bmatrix} + \begin{bmatrix} \theta_h & \theta_f S \\ \lambda_h \frac{1}{S} & \lambda_f^{DU} \end{bmatrix} \begin{bmatrix} P_h^{DU} \\ P_f^{DU} \end{bmatrix}$$

where $\theta_f, \lambda_h > 0, \theta_h,\ \lambda_f^{DU} < 0$. Marginal costs c_h and c_f are constant, while $0 < c_h < \theta_o, 0 < c_f < \lambda_o$ and $4\lambda_f^{DU}\theta_h - \theta_f\lambda_h > 0$. As the currency appreciates (S increases), the optimal price of home (foreign) goods increases (decreases):

$$\frac{\partial P_h^{*DU}}{\partial S} = \frac{\theta_f(\lambda_o - \lambda_f c_f)}{(4\lambda_f^{DU}\theta_h - \theta_f\lambda_h)} > 0 \text{ and } \frac{\partial P_f^{*\mathrm{DU}}}{\partial S} = \frac{\lambda_h(\theta_h c_h - \theta_o)}{(4\lambda_f^{DU}\theta_h - \theta_f\lambda_h)S^2} < 0.$$

The positive (negative) derivative of the home (foreign) equilibrium price *wrt S* is the result of the fact that as this is an international duopoly, there is only *between* (countries) competition.

Using the above and solving for the optimal profits, exposure is: $\frac{\partial \Pi_h^{*\mathrm{DU}}}{\partial S} = \theta_f\left(m_h^{*\mathrm{DU}}\right)P_h^{*\mathrm{DU}}P_f^{*\mathrm{DU}}\left[1 + \varepsilon_{P_f^{*\mathrm{DU}},S}\right]$[1]. $\varepsilon_{P_f^{*\mathrm{DU}},S} = \frac{\partial P_f^{*\mathrm{DU}}}{\partial S}\frac{S}{P_f^{*\mathrm{DU}}} < 0$, is the foreign firm's pass-through on the equilibrium foreign price *wrt S* in an international duopoly, $m_h^{*\mathrm{DU}} = \frac{(P_h^{*\mathrm{DU}} - c_h)}{P_h^{*\mathrm{D}}}$ is the equilibrium price-cost margin of h, and θ_f the price sensitivity of its rival to S. $\frac{\partial \Pi_h^{*\mathrm{DU}}}{\partial S}$ is positive unless f reduces its optimal price, $P_f^{*\mathrm{DU}}$ so that it more than offsets the increase in S to restore its competitiveness. Hence, the sign and size of firm h's exposure in equilibrium, $\frac{\partial \Pi_h^{*\mathrm{DU}}}{\partial S}$, depends on the size of h's price-cost margin in equilibrium, its cross-price substitution parameter θ_f, and its international rival's equilibrium price sensitivity on foreign exchange fluctuations.

[1] Or alternatively, $\frac{\partial \Pi_h^{*\mathrm{DU}}}{\partial S} = \theta_f\left(P_h^{*\mathrm{DU}} - c_h\right)\left[P_f^{*\mathrm{DU}} + \frac{\partial P_f^{*\mathrm{DU}}}{\partial S}S\right]$

Similarly, $\frac{\partial \Pi_f^{*\mathrm{DU}}}{\partial S} = \frac{1}{S^2}\lambda_h\left(m_f^{*\mathrm{DU}}\right)P_h^{*\mathrm{DU}}P_f^{*\mathrm{DU}}\left[\varepsilon_{P_h^{*\mathrm{DU}},S} - 1\right]$.[2] The value of this is negative unless the home firm's pass-through is elastic, in which case the increase in $P_h^{*\mathrm{DU}}$ *wrt S* more than offsets its competitiveness gains. Hence, the sign and size of *f*'s exposure on equilibrium, $\frac{\partial \Pi_f^{*\mathrm{DU}}}{\partial S}$, depends on the exchange rate, its equilibrium price cost margin $m_f^{*\mathrm{DU}}$, the cross-price substitution parameter, λ_h, and its international rival's pass through.

To conclude, the above results cover the case of an international duopoly and illustrate the link between the ability of each firm to pass on the exchange-rate change in its price and the direction and degree of the impact on the profits of the other firm because of a change in *S*.

4. The *RoT* Model

In this section, we study exchange-rate exposure in a *RoT* market structure. We start with the static case, although the focus of our analysis is primarily on the dynamic case. The static case is closer to consumable goods markets as opposed to durable goods markets, where switching costs give rise to intertemporal effects affecting the size of exposure in the long run.

4.1 Static Case

Two home firms compete with each other, *within* competition, and with the *f* firm abroad, which only faces *between* competition, choosing prices P_{1h}, P_{2h}, and P_f^T respectively. Take, for example, the *Sports market*, where Adidas competes with Puma (*within competition*) and with Nike (*between competition*). Their demand functions are:

$$\begin{bmatrix} q_{1h}\left(P_{1h}, P_{2h}, P_f^T; S\right) \\ q_{2h}\left(P_{1h}, P_{2h}, P_f^T; S\right) \\ q_f\left(P_{1h}, P_{2h}, P_f^T; S\right) \end{bmatrix} = \begin{bmatrix} \theta_{1,o} \\ \theta_{2,o} \\ \lambda_o \end{bmatrix} + \begin{bmatrix} \theta_{11h} & \theta_{12h} & \theta_{1f}S \\ \theta_{21h} & \theta_{22h} & \theta_{2f}S \\ \lambda_{1h}\frac{1}{S} & \lambda_{2h}\frac{1}{S} & \lambda_f^T \end{bmatrix} \begin{bmatrix} P_{1h} \\ P_{2h} \\ P_f^T \end{bmatrix}$$

[2] Or alternatively, $\frac{\partial \Pi_f^{*\mathrm{DU}}}{\partial S} = \frac{1}{S^2}\lambda_h\left(P_f^{*\mathrm{DU}} - c_f\right)\left[\frac{\partial P_h^{*\mathrm{DU}}}{\partial S}\mathrm{S} - P_h^{*\mathrm{D}}\right]$

where $\theta_{11h}, \theta_{22h}, \lambda_f^T < 0$. $\theta_{12h}, \theta_{21h}$ are the *within* countries cross-price effects, while θ_{1f}, θ_{2f} and $\lambda_{1h}, \lambda_{2h}$ are the *between* countries cross-price effects. Moreover, $|\theta_{11h}| > \theta_{12h}, \theta_{1f}$, $|\theta_{22h}| > \theta_{21h}, \theta_{2\mathrm{f}}$, $|\lambda_f^T| > \lambda_{1h}, \lambda_{2h}$. Marginal costs are constant, while $c_{1h} < \theta_{1o}, c_{2h} < \theta_{2o}, c_f < \lambda_o$.

Proposition 1

The optimal prices of the home (foreign) goods (good) are (is) an increasing (decreasing) function of *S*, i.e. $\frac{\partial P_{1h}^*}{\partial S}, \frac{\partial P_{2h}^*}{\partial S} > 0$ and $\frac{\partial P_f^{T*}}{\partial S} < 0$.

Proof.

Please refer to Appendix. [3]

Between competition results in a positive (negative) derivative *wrt S* of the optimal price of the firm in the depreciating (appreciating) country. The domestic rival, which introduces *within* competition in the home market alone, does not affect the sign of the results relative to duopoly.

Since the optimal domestic prices increase as a result of an increase in *S,* this will ameliorate, or even reverse, the decrease in the optimal prices from the increase in competition through the introduction of one additional competitor. For the case of the *f* firm, the negative impact of *S* on its optimal price will further reinforce the reducing effect from an increase in competition.

Using the first order conditions (F.O.C.s) and replacing the outputs with the demand functions, the addition of a domestic competitor changes both firms' exposures as follows:

[3] We have also studied the quadropoly case including two home and two foreign firms. Unlike the duopoly and the triopoly cases, the effect on profits of the home and the foreign firms is ambiguous as the impact of *S* on the optimal prices of all four competitors can be either negative or positive because of the existence of *within* and *between* competition in both countries. As Proposition 1 no longer applies, the impact on the exchange-rate exposure of each firm is ambiguous as it depends on the sign and size of the pass-throughs *wrt S*. The proofs of these results are available upon request.

$$\frac{\partial \Pi_{ih}^*}{\partial S} = P_{ih}^*\, m_{ih}^* \left[\theta_{ijh} P_{jh}^* \frac{\varepsilon_{P_{jh}^*,S}}{S} + \theta_{if} P_f^{*T} \left(1 + \varepsilon_{P_f^*,S}\right)\right]$$

$$\frac{\partial \Pi_f^*}{\partial S} = \frac{1}{S^2} P_f^{*T}\, m_f^{*T} \left[\lambda_{ih} P_{ih}^* \left(\varepsilon_{P_{ih}^*,S} - 1\right) + \lambda_{jh} P_{jh}^* \left(\varepsilon_{P_{jh}^*,S} - 1\right)\right]$$

for $i = 1,2, j = 1,2, j \neq i$ where $\varepsilon_{P_{jh}^*,S} = \frac{\partial P_{jh}^*}{\partial S} \frac{S}{P_{jh}^*} > 0$ and $\varepsilon_{P_f^*,S} = \frac{\partial P_f^{*\mathrm{T}}}{\partial S} \frac{S}{P_f^{*\mathrm{T}}} < 0$ are the pass-through of firm i's domestic and foreign competitors respectively. For the h firm the introduction of a domestic competitor in the home market has introduced one additional positive term, so exposure will unambiguously increase relative to the duopoly case unless $-1 > \varepsilon_{P_f^*,S}$. Even if the latter is the case, the second negative term will now be smaller in absolute terms given the decrease in the optimal price of the *f* firm mentioned above. For the foreign firm, the addition of an *h* firm will also increase, in absolute terms, the exposure of the *f* firm unless one of its two rivals' pass-through is elastic and the other inelastic.

We want to emphasize here that the focus of our paper is to establish the theoretical underpinnings of the *RoT* model, which is also a very frequently encountered market structure in real life international markets.

4.2 Dynamic Case

In this section we set a dynamic model that describes the behavior of three firms. We can take as an example the Smartphones market; two South Korean firms Samsung and LG compete with each other (*within competition*) and with Apple abroad (*between competition*). The value of each firm V_t at time *t* is the present value of its future profits at the one-period discount factor $\delta_{1h}, \delta_{2h}, \delta_f$. The firms choose prices $P_{t1h}, P_{t2h},$ and P_{tf} for $t = 1,2$:

$$\max_{\{p_{11h},p_{21h}\}} \mathrm{V}_{1h} = \max_{\{p_{11h},p_{21h}\}} \big[\Pi_{11h}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right) + \delta_{1,h}\Pi_{21h}\{\left(P_{21h}, P_{22h}, P_{2f}; S_2\right), q_{11h}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right)\}\big]$$

$$\max_{\{p_{12h},p_{22h}\}} \mathrm{V}_{2,h} = \max_{\{p_{12h},p_{22h}\}} \big[\Pi_{12h}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right) + \delta_{2h}\Pi_{22h}\{\left(P_{21h}, P_{22h}, P_{2f}; S_2\right), q_{12h}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right)\}\big]$$

$$\max_{\{p_{1f},p_{2f}\}} \mathrm{V}_f = \max_{\{p_{1f},p_{2f}\}} \left[\Pi_{1f}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right) + \delta_f \Pi^*_{2f}\{\left(P_{21h}, P_{22h}, P_{2f}; S_2\right), q_{1f}\left(P_{11,h}, P_{12h}, P_{1f}; S_1\right)\}\right]$$

where $q_{11h}, q_{12h,}$and q_{1f} are the first-period outputs, and S_1, S_2 the exchange rates in the first and second period respectively.

We look for a subgame perfect equilibrium. We use backward induction; starting at $t = 2$, firms solve:

$$\max_{p_{21h}} \Pi_{2,1,h}\left(P_{21h}, P_{22h}, P_{2f}; S_2\right) = \max_{P_{1h}}\left[\theta_{21o}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right) + \theta_{11h}P_{21h} + \theta_{12h}P_{22h} + \theta_{1f}S_2P_{2f}\right][P_{21h} - c_{21h}]$$

$$\max_{p_{22h}} \Pi_{2,2,h}\left(P_{21h}, P_{22h}, P_{2f}; S_2\right) = \max_{P_{2h}}\left[\theta_{22o}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right) + \theta_{21h}P_{21h} + \theta_{22h}P_{22h} + \theta_{2f}S_2P_{2f}\right][P_{22h} - c_{22h}]$$

$$\max_{P_{2f}} \Pi_{2,f}\left(P_{21h}, P_{22h}, P_{2f}; S_2\right) = \max_{P_{1,f}}\left[\lambda_{2o}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right) + \lambda_f P_{2f} + \lambda_{1h}\frac{1}{S_2}P_{21h} + \lambda_{2h}\frac{1}{S_2}P_{22h}\right][P_{2f} - c_{2f}]$$

As there are switching costs, a higher consumer base in the first period implies that consumers are "locked in" and buy from the same firm in the second period. Hence, we first maximize the profits of each firm in the second period, bearing in mind that the prices set in the first period determine the position of the demand in the second period. This means that all the second-period demand intercepts θ_{21o}, θ_{22o} and λ_{2o} are no longer exogenously determined and fixed, but are instead a function of the prices as set by the firms in the first period, i.e. for firm 1, $\theta_{21o}\left(P_{11h}, P_{12h}, P_{1f}; S_1\right)$, where $\frac{\partial\theta_{21o}}{\partial P_{11h}} < 0, \frac{\partial\theta_{21o}}{\partial P_{12h}} > 0$, $\frac{\partial\theta_{21o}}{\partial P_{1f}} > 0$. Similar results hold for the other two intercepts, and with a negative own-price impact and positive cross-price impacts.

Without loss of generality and in order to retain the tractability of our results, we argue that this shift will only affect the intercept terms. This is a realistic assumption as unless the relative prices of the goods change substantially between the two subsequent periods, we do not expect that the own- and cross-price effects parameters will change. The consumers will alter the degree that they substitute among different goods only when relative prices change substantially.[4]

We derive the second-period optimal prices $P_{21h}^{M}, P_{22h}^{M}, P_{2f}^{M}$, which depend on the prices and exchange rates of the first period. The second-period optimal profits are:

$$\pi_{2,1,h}^{M}\left(P_{11h}, P_{12h}, P_{1f}; S_2\right), \pi_{2,2,h}^{M}\left(P_{11h}, P_{12h}, P_{1f}; S_2\right), \pi_{2,f}^{M}\left(P_{11h}, P_{12h}, P_{1f}; S_2\right).$$

The firms solve:

$$\begin{bmatrix} \frac{\partial \mathrm{V}_{1,h}}{\partial P_{11h}} \\ \frac{\partial \mathrm{V}_{2,h}}{\partial P_{12h}} \\ \frac{\partial \mathrm{V}_{f}}{\partial P_{1f}} \end{bmatrix} = \begin{bmatrix} \frac{\partial[\Pi_{1,1,h}(P_{11h},P_{12h},P_{1f};S_1)]}{\partial P_{11h}} \\ \frac{\partial[\Pi_{1,2,h}(P_{1,1,h},P_{1,2,h},P_{1,f};S_1)]}{\partial P_{12h}} \\ \frac{\partial[\Pi_{1,f}(P_{11h},P_{12h},P_{1f};S_1)]}{\partial P_{1f}} \end{bmatrix} + \begin{bmatrix} \delta_{1h}\frac{\partial[\pi_{2,1,h}^{M}(P_{1,1,h},P_{12,h},P_{1f};S_2)]}{\partial P_{11h}} \\ \delta_{2h}\frac{\partial[\pi_{2,1,h}^{M}(P_{11h},P_{12h},P_{1f};S_2)]}{\partial P_{12h}} \\ \delta_{f}\frac{\partial[\pi_{2,f}^{M}(P_{11h},P_{12h},P_{1f};S_2)]}{\partial P_{1f}} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \tag{1}$$

and derive the first-period optimal dynamic prices, $P_{11h}^{*D}, P_{12h}^{*D}, P_{1f}^{*D}$, which depend on S_1, S_2 c_{1h}, c_{2h} and c_f. Current pricing decisions affect future prices (and profits) by securing a larger customer base.

Since $\frac{\partial P_{21h}^{M}}{\partial P_{11h}}, \frac{\partial P_{22h}^{M}}{\partial P_{12h}}, \frac{\partial P_{2f}^{M}}{\partial P_{1f}}$ are negative, this implies that $\frac{\partial \pi_{2,1,h}^{M}(P_{11h},P_{12h},P_{1f};S_2)}{\partial P_{11h}}, \frac{\partial \pi_{2,2,h}^{M}(P_{11h},P_{12h},P_{1f};S_2)}{\partial P_{12h}}, \frac{\partial \pi_{2,f}^{M}(P_{11h},P_{12h},P_{1f};S_2)}{\partial P_{1f}}$ are negative too. Consequently, (1) becomes zero at a point where the:

$$\frac{\partial(\Pi_{1,1,h}(P_{11h},P_{12h},P_{1f};S_1))}{\partial P_{11h}}, \frac{\partial(\Pi_{1,2,h}(P_{11h},P_{12h},P_{1f};S_1))}{\partial P_{12h}}, \frac{\partial(\Pi_{1,f}(P_{11h},P_{12h},P_{1f};S_1))}{\partial P_{1f}}$$

are positive (instead of zero as in the static case). Therefore, $P_{11h}^{*D}, P_{12h}^{*D}, P_{1f}^{*D}$ are less than they would have been in the static case due to the intertemporal effect.

[4] As an example of the latter case, an episode of very deep price cuts by The Times in 1993 (from 45p to 30p), severely affected the market share of Daily Express (typically classified as belonging in the mid-market range) rather than the upper range “quality” newspapers (The Times, Guardian, Telegraph and The Independent), thus altering the definition of the market.

Since $\frac{\partial P_{2ih}^{M}}{\partial P_{1jh}}, \frac{\partial P_{2ih}^{M}}{\partial P_{1,f}}, \frac{\partial P_{2f}^{M}}{\partial P_{1ih}}$ are positive for $t = 1{,}2, i = 1{,}2, j = 1{,}2$ and i $\neq j$, this implies a dynamic interdependence among firms, examined in Proposition 2.

Proposition 2

The exposure for the first-period value of firm *i*=1,2 (from the currency depreciating country):

$$\frac{\partial V_{ih}^{*}}{\partial S_1} = m_{1ih}^{*D} P_{1ih}^{*D} [\theta_{ijh} P_{1jh}^{*D} \frac{\varepsilon_{P_{1jh,S_1}^{*D}}}{S_1} + \theta_{if} P_{1f}^{*D} (1 + \varepsilon_{P_f^{*D},S_1})] + \delta_{ih} \left(\frac{\partial \pi_{2ih}^{M}}{\partial P_{1jh}^{*D}} \frac{\partial P_{1jh}^{*D}}{\partial S_1} + \frac{\partial \pi_{2ih}^{M}}{\partial P_{1f}^{*D}} \frac{\partial P_{1f}^{*D}}{\partial S_1} \right), \quad (2a)$$

depends on:

a) The first-period profit exposure: $\frac{\partial \Pi_{1i,h}^{*D}}{\partial S_1} = m_{1ih}^{*D} P_{1i,h}^{*D} [\theta_{ijh} P_{1jh}^{*D} \frac{\varepsilon_{P_{1jh,S_1}^{*D}}}{S_1} + \theta_{if} P_{1f}^{*D} (1 + \varepsilon_{P_f^{*D},S_1})]$.

b) The positive intertemporal effect of S_1 on the second-period profit of the *h* rival firm: $\frac{\partial \pi_{2i,h}^{M}}{\partial P_{1jh}^{*D}} \frac{\partial P_{1jh}^{*D}}{\partial S_1}$, reinforcing its gains from a home currency depreciation.

c) The negative intertemporal effect of S_1 on the second-period profit of the *f* firm: $\frac{\partial \pi_{2ih}^{M}}{\partial P_{1f}^{*D}} \frac{\partial P_{1f}^{*D}}{\partial S_1}$, offsetting its gains from a home currency depreciation.

The exposure for the first-period value of firm *f* (from the currency appreciating country):

$$\frac{\partial V_f^{*}}{\partial S_1} = \frac{1}{(S_1)^2} m_{1f}^{*D} P_{1f}^{*D} [\lambda_{1h} P_{11h}^{*D} (\frac{\varepsilon_{P_{11h,S_1}^{*D}}}{S_1} - 1) + \lambda_{2h} P_{12h}^{*D} (\frac{\varepsilon_{P_{12h,S_1}^{*D}}}{S_1} - 1)] + \delta_f (\frac{\partial (\pi_{2f}^{M})}{\partial P_{1ih}^{*D}} \frac{\partial P_{1ih}^{*D}}{\partial S_1} + \frac{\partial (\pi_{2f}^{M})}{\partial P_{1jh}^{*D}} \frac{\partial P_{1jh}^{*D}}{\partial S_1}) \quad (2b)$$

depends on:

a) The first-period profit exposure: $\frac{\partial \Pi_{1f}^{*D}}{\partial S_1} = \frac{1}{(S_1)^2} m_{1f}^{*D} P_{1f}^{*D} \left\{ \lambda_{1h} P_{11h}^{*D} \left(\frac{\varepsilon_{P_{11h,S_1}^{*D}}}{S_1} - 1 \right) + \lambda_{2h} P_{12h}^{*D} \left(\frac{\varepsilon_{P_{12,h,S_1}^{*D}}}{S_1} - 1 \right) \right\}$.

b) The sum of the positive intertemporal effects of S_1 on the second-period profits of the two overseas rivals: $\frac{\partial \pi^M_{2f}}{\partial P^{*D}_{1ih}} \frac{\partial P^{*D}_{1ih}}{\partial S_1} + \frac{\partial \pi^M_{2f}}{\partial P^{*D}_{1jh}} \frac{\partial P^{*D}_{1jh}}{\partial S_1}$, ameliorating its losses from a home currency depreciation.

Proof.

We differentiate the *V* functions *wrt* S_1:

Home firm 1:

Using the envelope theorem:

$$\frac{\partial V^*_{1.h}}{\partial S_1} = \underset{(+)}{\frac{\partial P^{*D}_{12h}}{\partial S_1}} \theta_{12h}(P^{*D}_{11h} - c_{1h}) + \underset{(?)}{\theta_{1f} P^{*D}_{1f}(1 + \frac{\partial P^{*D}_{1f}}{\partial S_1} \frac{S_1}{P^{*D}_{1f}})}(P^{*D}_{11h} - c_{1h}) + \underset{(+)}{\delta_{1h} \frac{\partial \pi^M_{21,h}}{\partial P^{*D}_{12h}} \frac{\partial P^{*D}_{12h}}{\partial S_1}} + \underset{(-)}{\delta_{1h} \frac{\partial \pi^M_{21,h}}{\partial P^{*D}_{1f}} \frac{\partial P^{*D}_{1f}}{\partial S_1}}$$

where, $\frac{\partial P^{*D}_{12h}}{\partial S_1} > 0, \frac{\partial P^{*D}_{1f}}{\partial S_1} < 0,\ \frac{\partial \pi^M_{21,h}}{\partial P^{*D}_{12h}} > 0, \frac{\partial \pi^M_{21,h}}{\partial P^{*D}_{1f}} > 0\ \left(\text{since } \frac{\partial \theta_{21o}}{\partial P^{*D}_{12h}} > 0, \frac{\partial \theta_{21o}}{\partial P^{*D}_{1f}} > 0\right)$. The sign of the second term depends on $\varepsilon_{P^*_f, S_1}$. Written differently:

$$\frac{\partial V^*_{1.h}}{\partial S_1} = m^{*D}_{11h} P^{*D}_{11h} [\theta_{12h} P^{*D}_{12,h} \frac{\varepsilon_{P^{*D}_{12,h,S_1}}}{S_1} + \theta_{1,f} P^{*D}_{1f}(1 + \varepsilon_{P^{*D}_f, S_1})]$$
$$+ \delta_{1h} \left(\frac{\partial \pi^M_{21,h}}{\partial P^{*D}_{12h}} \frac{\partial P^{*D}_{12h}}{\partial S_1} + \frac{\partial \pi^M_{21,h}}{\partial P^{*D}_{1f}} \frac{\partial P^{*D}_{1f}}{\partial S_1} \right),$$

Home firm 2:

$$\frac{\partial V^*_{2.h}}{\partial S_1} = m^{*D}_{12h} P^{*D}_{12h} [\theta_{21h} P^{*D}_{11h} \frac{\varepsilon_{P^{*D}_{11h,S_1}}}{S_1} + \theta_{2f} P^{*D}_{1f}(1 + \varepsilon_{P^{*D}_f, S_1})] + \delta_{2h} \left(\frac{\partial \pi^M_{22,h}}{\partial P^{*D}_{11h}} \frac{\partial P^{*D}_{11h}}{\partial S_1} + \frac{\partial \pi^M_{22,h}}{\partial P^{*D}_{1f}} \frac{\partial P^{*D}_{1f}}{\partial S_1} \right),$$

where $\frac{\partial P^{*D}_{11h}}{\partial S_1} > 0,\ \frac{\partial P^{*D}_{1f}}{\partial S_1} < 0,\ \frac{\partial \pi^M_{22h}}{\partial P^{*D}_{11h}} > 0, \frac{\partial \pi^M_{21,h}}{\partial P^{*D}_{1f}} > 0\ \ \left(\text{since } \frac{\partial \theta_{22o}}{\partial P^{*D}_{12h}} > 0 \frac{\partial \theta_{22o}}{\partial P^{*D}_{1f}} > 0\right)$.

Foreign firm:

$$\frac{\partial V^*_f}{\partial S_1} = \frac{1}{(S_1)^2} m^{*D}_{1f} P^{*D}_{1f} [\lambda_{1h} P^{*D}_{11h} (\frac{\varepsilon_{P^{*D}_{11h,S_1}}}{S_1} - 1) + \lambda_{2h} P^{*D}_{12h} (\frac{\varepsilon_{P^{*D}_{12h,S_1}}}{S_1} - 1)] + \delta_f (\frac{\partial (\pi^M_{2,f})}{\partial P^{*D}_{11h}} \frac{\partial P^{*D}_{11h}}{\partial S_1} + \frac{\partial (\pi^M_{2,f})}{\partial P^{*D}_{12h}} \frac{\partial P^{*D}_{12h}}{\partial S_1}),$$

where $\frac{\partial P^{*D}_{11h}}{\partial S_1} > 0,\ \frac{\partial P^{*D}_{12h}}{\partial S_1} > 0,\ \frac{\partial \pi^M_{2,f}}{\partial P^{*D}_{11h}} > 0, \frac{\partial \pi^M_{2,f}}{\partial P^{*D}_{12h}} > 0\ \ \left(\text{since } \frac{\partial \lambda_{2o}}{\partial P^{*D}_{12h}} > 0, \frac{\partial \lambda_{2o}}{\partial P^{*D}_{1h}} > 0\right)$.

Q.E.D.

Re-writing (2a) and (2b):

$$\frac{\partial V_{ih}^{*}}{\partial S_1}=\frac{\partial \Pi_{i1,h}^{*D}}{\partial S_1}+\delta_{i,h}\left(\frac{\partial \pi_{2i,h}^{M}}{\partial P_{1jh}^{*D}}\frac{\partial P_{1j,h}^{*D}}{\partial S_1}+\frac{\partial \pi_{2i,h}^{M}}{\partial P_{1f}^{*D}}\frac{\partial P_{1f}^{*D}}{\partial S_1}\right),\text{ for },i=1,2,j=1,2,\mathrm{i}\neq j$$

$$\frac{\partial V_{f}^{*}}{\partial S_1}=\frac{\partial \Pi_{1,f}^{*D}}{\partial S_1}+\delta_{f}\left(\frac{\partial \pi_{2,f}^{M}}{\partial P_{11h}^{*D}}\frac{\partial P_{11h}^{*D}}{\partial S_1}+\frac{\partial \pi_{2,f}^{M}}{\partial P_{12h}^{*D}}\frac{\partial P_{12h}^{*D}}{\partial S_1}\right).$$

For the *h* firms (2a) reads as long-run exposure = short-run exposure + sum of intertemporal effects of S_1 on the first-period price of the *f* and the rival *h* firm. Analogously for the *f* firm: long-run exposure = short-run exposure + sum of intertemporal effects of S_1 on the first-period price of the *f* firm's two overseas rivals. Hence, both rivals of the firm affect its value both directly and indirectly via the intertemporal effects.

Corollaries:

1. The gap between long-run and short-run exposure increases after the addition of the home rival. In an international duopoly, (b) does not exist. There is only a *between* intertemporal effect, which is negative, hence the long-run is lower than the short-run exposure, i.e. firm values are less sensitive to exchange rates than the profits.
2. The two intertemporal effects ((b), (c)) with opposing signs imply that the home firm's long-run exposure can be higher or lower than its short-run exposure.
3. The long-run exposure of the *f* firm is lower than its short-run exposure. Namely, V_f^* ,the first period value of the *f* firm, is less sensitive to exchange rates than the profits, $\Pi_{1,f}^{*D}$, of the same period.

4.3 Discussion

According to the Occam's razor problem-solving principle, the simplest way to model both *between* and *within* countries competition is with a *RoT* market with two firms in one country and one firm in another. This market structure is also a very frequently encountered real-world case.

For the *f* firm, as the number of home competitors increases - say two instead of one and then three instead of two - the negative impact of an increase in *S* of the additional competitors will further reinforce the reducing effect from an increase in competition on its equilibrium price. On the other hand, the positive impact of *S* on the equilibrium price of the home companies will partially offset or even reverse the price decreasing effect of the increase in competition in the home market.

In the case of three *h* firms and one *f* firm, the sign of the exchange-rate exposure of the *f* firm depends on the values of the pass-through of its now three international competitors from the home market which may either be reinforcing or offsetting depending on whether this is elastic or inelastic, while the exchange-rate exposure of the *h* firm will further increase.

Moreover, there will be an extra positive *between* intertemporal effect for the *f* firm, from the additional overseas rival. This additional effect will further ameliorate the losses of the *f* firm from its home currency appreciation and the increase in competition. As a consequence, the long-run exposure of the *f* firm will be lower than its short-run exposure. As for an *h* firm, the addition of a third home rival will further increase the gap between long-run and short-run exposure. This is the result of the addition of a positive intertemporal effect from the new domestic rival. [5]

Another case of a *RoT* market is the market structure with three firms from three different countries. One example of a consumable goods market is the Bottled water market; Nestlé (Switzerland) Danone (France) and Coca-Cola (US) lead the global market. An example of a durable goods market is the Laundry equipment market; the top three firms are (US) Whirlpool, Swedish Electrolux and Chinese Midea Group. However, an international triopoly model with three firms from three different countries does not allow both *within* and *between* countries

[5] We wish to thank an anonymous reviewer for mentioning this latter case of three or more firms.

competition. In such a model we only have *between* markets competition which can be studied in an international duopoly and it has already been discussed in the literature. While this model is also interesting since there are three different countries and requires to consider two exchange rates, *S1* and *S2*, it is beyond the scope of the current paper and left for future research.

5. Conclusions

International triopolies are a reality in most industries. Hence, our theoretical analysis offers a framework that can be used for the study of the implications of both *within* and *between* markets competition involving exchange-rate exposure in international triopoly markets with multinational companies offering consumable or durable goods under fluctuating exchange rates.

We show how profits are impacted under such conditions in order to explain the shaping of international competition in the form of triopolies. More specifically, each firm should expect that there is a link between its ability to pass on the exchange-rate change in the price it charges its customers and the direction and degree of the impact on the profits of its domestic and international competitors.

Moreover, durable goods firms and consumable goods firms should have different expectations regarding their exposure to exchange rates and the competition they face. In a consumable goods market, which is closer to the static case of the model, a local monopolist should expect that the addition of a domestic competitor increases (in absolute terms) its exposure, while the foreign monopolist should also expect an increase, in absolute terms, unless one (but not both) of its two rivals' pass though is elastic.

In addition, in a durable goods market, which is closer to the dynamic case, the gap in exposure between an international triopoly and an international duopoly is larger in the long run than in the short run for the company that now faces a domestic rival. On the other hand, the two intertemporal effects (domestic and foreign) have opposing signs. This means that the exposure for the home firm can be either smaller or larger in the long run relative to the short run. Finally, the firm that remains a monopolist in its domestic market finds that its exposure is smaller in the long run than in the short run.

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Appendix

Proof of Proposition 1.

The firms solve:

$$\max_{p_{1h}} \Pi_{1,h}\left(P_{1h}, P_{2h}, P_f^T; S\right) = \max_{P_{1h}}\left[\theta_{1o} + \theta_{11h}P_{1h} + \theta_{12h}P_{2h} + \theta_{1f}SP_f^T\right][P_{1h} - c_{1h}]$$

$$\max_{p_{2h}} \Pi_{2,h}\left(P_{1h}, P_{2h}, P_f^T; S\right) = \max_{P_{2h}}\left[\theta_{2o} + \theta_{21h}P_{1,h} + \theta_{22h}P_{2,h} + \theta_{2f}SP_f^T\right][P_{2h} - c_{2h}]$$

$$\max_{P_{1f}} \Pi_f\left(P_{1h}, P_{2h}, P_f^T; S\right) = \max_{P_{1f}}\left[\lambda_o + \lambda_f^T P_f^T + \lambda_{1h}\frac{1}{S}P_{1h} + \lambda_{2h}\frac{1}{S}P_{2h}\right][P_f - c_f]$$

Differentiating the equilibrium prices *wrt S*:

$$\Delta\frac{\partial P_{1h}^*}{\partial S} = \frac{\partial\begin{vmatrix}\theta_{1o}-\theta_{11h}c_{1,h} & \theta_{12h} & \theta_{1f}S\\ \theta_{2o}-\theta_{22h}c_{2,h} & 2\theta_{22h} & \theta_{2f}S\\ \lambda_o-\lambda_f^T c_f & \lambda_{2h}\frac{1}{S} & 2\lambda_f^T\end{vmatrix}}{\partial S} = \left[\left(\lambda_o - \lambda_f^T c_f\right)(\theta_{12h}\theta_{2f} - 2\theta_{22h}\theta_{1f}\right] > 0,$$

$$\Delta\frac{\partial P_{2h}^*}{\partial S} = \frac{\partial\begin{vmatrix}2\theta_{11h} & \theta_{1o}-\theta_{11h}c_{1h} & \theta_{1f}S\\ \theta_{21h} & \theta_{2o}-\theta_{22h}c_{2h} & \theta_{2f}S\\ \lambda_{1h}\frac{1}{S} & \lambda_o-\lambda_f^T c_f & 2\lambda_f^T\end{vmatrix}}{\partial S} = -\left(\lambda_o - \lambda_f^T c_f\right)(2\theta_{11h}\theta_{2f} - \theta_{21h}\theta_{1f}) > 0,$$

and

$$\Delta\frac{\partial P_f^{T*}}{\partial S} = \frac{\partial\begin{vmatrix}2\theta_{11h} & \theta_{12h} & \theta_{1o}-\theta_{11h}c_{1,h}\\ \theta_{21h} & 2\theta_{22h} & \theta_{2,o}-\theta_{22,h}c_{2,h}\\ \lambda_{1h}\frac{1}{S} & \lambda_{2h}\frac{1}{S} & \lambda_o-\lambda_f^T c_f\end{vmatrix}}{\partial S} =$$

$$-\frac{1}{S^2}(\theta_{1o} - \theta_{11h}c_{1h})(\theta_{21h}\lambda_{2,h} - 2\theta_{22h}\lambda_{1,h}) + \frac{1}{S^2}(\theta_{2o} - \theta_{22h}c_{2h})(2\theta_{11h}\lambda_{2h} - 2\theta_{12h}\lambda_{1h}) < 0$$

where $\Delta = \begin{vmatrix}2\theta_{11h} & \theta_{12h} & \theta_{1f}S\\ \theta_{21h} & 2\theta_{22h} & \theta_{2f}S\\ \lambda_{1h}\frac{1}{S} & \lambda_{2h}\frac{1}{S} & 2\lambda_f^T\end{vmatrix}$. Hence, $\frac{\partial P_{1h}^*}{\partial S}, \frac{\partial P_{2h}^*}{\partial S} > 0$ and $\frac{\partial P_f^{T*}}{\partial S} < 0$.

Q.E.D.

Table 1. Relevant Literature.

Literature overview in strands.

Literature Strand	<u>Marketing literature</u>	<u>Economics literature</u>	<u>Exposure literature</u>		<u>Switching costs literature</u>
Study	“*Rule of Three*” literature.	Triopoly literature.	Perfect Competition	Imperfect Competition	
			Focus and relation to our study		
Sheth and Sisodia, (2002).	Argue that an industry structure with three large generalists and numerous smaller specialists generates a competitive environment that is “optimal” for firm stability and profitability.				
Uslay et al., (2010)	Show that industries with three firms financially outperform every other market structure.				
Bouis *et al.*, (2009) Shibata, (2016)		Study stability of triopolies in a closed economy.			
Marston (2001) Floden *et al.* (2008)				Emphasize the importance of market structure on the firms’ pass-through and exposure in duopolies.	
Bodnar *et al*. (2002) Bartram *et al.*, (2010)			Look at pass-through and exposure in competitive industries where firms produce and compete in both foreign and local markets.		

Froot and Klemperer (1989) (FK)	The dynamic version of the RoT model relates to the (FK) and (GS) models. In FK’s two-period dynamic game, the expected exchange rates affect current market shares in an international duopoly of homogenous goods.	FK’s model only includes one foreign and one domestic producer and the goods are homogenous.
Gross and Schmitt (2000) (GS)	GS study two foreign producers of a homogenous good serving a market with no home production under Bertrand competition, looking only at exchange-rate passthrough.	Both Gross and Schmitt and Bénassy-Quéré et al., note that there is an intertemporal trade-off as far as switching costs are concerned. Customers face switching costs when they move from one supplier to the other. Sacrificing current profits allows a firm to maintain its market share, while attracting new customers. In the next period, the firm will enjoy higher demand (thanks to new customers being locked in).
Bénassy-Quéré *et al*. (2011)	Study the implications of changes in the exchange rate in a duopoly case, using a model of optimal pricing in the Airbus–Boeing duopoly of the aircraft industry.	
Arie and Grieco (2014)		Show that firms with small market shares might be harmed by small switching costs, and respond by cutting their prices.
Cabral (2017) Rhodes, A. (2014)		Study how old customers lock into the goods of a firm and they are less sensitive to price changes by that firm and its competitors. On the other hand, new customers will be offered lower prices as a “firm’s

				incentive to lock people in will outweigh the customer's incentive to avoid being locked in" (Rhodes, p. 172).

Notes: This study is related to the triopoly or "*Rule of Three*" literature, as it is known in marketing, to the exposure literature under perfect and imperfect competition and to the switching costs literature.