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A Macroeconomic Two-Country Model with Price-Discriminating Monopolists

By

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1. Introduction

Monopolistic competition has gained a renewed interest in economic theory. In the macroeconomic field the question is asked whether monopolistic competition introduces Keynesian features into the model because firms face a demand constraint (e.g., Hart, 1982; Akerlof and Yellen, 1985; Blanchard and Kiyotaki, 1987; van de Klundert and Peters, 1988). In the theory of international trade imperfect competition is applied to explain intrasectoral trade along with intersectoral trade (e.g., Dixit and Norman, 1980; Helpman, 1984; Krugman, 1985; Venables, 1985). As such these models are helpful in understanding the consequences of world-wide competition in specific commodity markets.

The present paper introduces price-discriminating monopolists in a two-country macroeconomic model. The basic idea is considered in a seminal paper by Branson and Rotemberg (1980), but the microeconomic foundations of their model are not fully developed. As will be argued, this leads to some confusion with regard to the role of relative commodity prices and terms of trade. Price-discriminating monopolists drive a wedge between the real exchange rate (terms of trade) and relative consumers' prices. The consequences of such a divergence need to be carefully analysed.

The two-country macroeconomic model which serves here as a

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framework for the analysis of monopolistic competition is in the spirit of equilibrium models as studied among others by Lipton and Sachs (1983), Buiter (1984), van de Klundert (1986), Attanasio and van der Ploeg (1987). It may be of interest to compare the solutions of the model under different market structures. In addition, the more practical question may be asked in which way monopolistic competition determines the impact of shocks emanating from the demand side or the supply side of the economy. Import competition seems to a large extent price competition, which may have far reaching consequences. As stated by a group of economists in a Report for the EEC: "To think about the issue of import competition, one must relax the assumption of perfect competition in product markets. We can think of the problem most easily in terms of monopolistic competition, where each firm's demand depends on aggregate demand and the firm's price relative to the industry average. Import competition here simply takes the form of a reduction in the industry-wide price because the import segment of the industry price falls. All domestic firms face an inward shift of their demand curve. They react by contracting output and employment" (Blanchard et al., 1985, pp. 12—13). As this view may be influentially, it may be worthwhile to scrutinize these and associated ideas by applying a more formal mode of analysis.

The paper is organized as follows. In section 2 the microeconomic foundations of the model are given proper attention. Consumer behaviour is studied in section 2.1, while firm behaviour is examined in section 2.2. Applying these results a two-country macroeconomic equilibrium model is presented in section 3.1. Some differences between perfect and imperfect competition are reported in this section. Further results are obtained by a comparative static analysis. For this purpose a log-linear version of the model is presented in section 3.2. The impact of supply and demand shocks is analysed by solving this log-linear version in section 3.3. The paper closes with some conclusions.

2. Microfoundations of the Model

2.1 Consumer Behaviour

Consumers have to decide how much they will spend in the current period and how they will distribute that amount over the different commodities in the market. It will be assumed that both decisions are separable and that the first decision has already been made. The amount to be spend on different commodities (cp_c) is therefore known. The consumption menu consists of m domestic goods and m^* foreign goods. Domestic goods are produced under identical conditions implying that they can be aggregated. The domestic country specializes in the commodity indicated by the subscript 1. Total consumption of this commodity at home is denoted by c_1. The foreign country specializes in commodity two. All foreign goods are also produced under the same technological conditions. Total demand for this commodity at home (import) is denoted by c_2. The elasticity of substitution (η) between each pair of goods irrespective of their origin is the same, greater than one, and constant. The utility-index may then be written as:

$$\tilde{u} = \left[m\left(\frac{c_1}{m}\right)^{\frac{\eta-1}{\eta}} + m^*\left(\frac{c_2}{m^*}\right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

$$= \left[m^{\frac{1}{\eta}} c_1^{\frac{\eta-1}{\eta}} + m^{*\frac{1}{\eta}} c_2^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \quad \eta > 1. \tag{2.1.1}$$

Dividing through by $(m+m^*)^{\eta-1}$ the utility-index $\tilde{u}$ is transformed into:

$$u = \left[\alpha^{\frac{1}{\eta}} c_1^{\frac{\eta-1}{\eta}} + (1-\alpha)^{\frac{1}{\eta}} c_2^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{2.1.2}$$

where $\alpha = \dfrac{m}{m+m^*}$.

The representative consumer in the domestic country chooses c_1 and c_2 to maximize utility u subject to the budget constraint

$$cp_c = c_1 p_1 + c_2 p_2 , \tag{2.1.3}$$

where p_1 denotes the price of the domestic good and p_2 denotes the price of the foreign or imported good. The first order conditions for a maximum lead to the following solutions:

$$c_1 = \alpha c \left(\frac{p_1}{p_c}\right)^{-\eta} \tag{2.1.4}$$

$$c_2 = (1-\alpha) c \left(\frac{p_2}{p_c}\right)^{-\eta}, \quad \text{where} \tag{2.1.5}$$

$$p_c = [\alpha p_1^{1-\eta} + (1-\alpha) p_2^{1-\eta}]^{\frac{1}{1-\eta}} \tag{2.1.6}$$

is the ideal definition of the general price-index.

The corresponding equations in the foreign country, where we indicate variables with an asterisk, read

$$c_2^* = (1-\alpha)\, c^* \left(\frac{p_2^*}{p_c^*}\right)^{-\eta^*} \tag{2.1.7}$$

$$c_1^* = \alpha c^* \left(\frac{p_1^*}{p_c^*}\right)^{-\eta^*} \tag{2.1.8}$$

$$p_c^* = [(1-\alpha)\, p_2^{*\,1-\eta^*} + \alpha p_1^{*\,1-\eta^*}]^{\frac{1}{1-\eta^*}}. \tag{2.1.9}$$

It should be observed that there are m^* domestic goods and m imported goods in the foreign country assuming the same consumption menu in both regions.

2.2 Firm Behaviour

Following Dixit and Stiglitz (1977) each product is associated with a single firm, which sets the price of its specific commodity. The number of firms is sufficiently large and each firm ignores the effect of its actions on the general price level. There is a situation of monopolistic competition. However, the markets at home and abroad are separated which opens the possibility of price discrimination. As in Branson and Rotemberg (1980) we therefore postulate that the representative firm in each country behaves as a discriminating monopolist, charging different prices at home and abroad. The production function is $f(l)$, with $f_l(l) > 0$ and l denoting labour input. Profit maximization of domestic firms can then be formulated as

$$\max_{c_1, c_1^*}: \Pi = p_1 c_1 + p_1^* c_1^* - wl \tag{2.2.1}$$

$$\text{s.t. } c_1 + c_1^* = f(l), \tag{2.2.2}$$

where w denotes the nominal wage rate. Substitution of the inverted demand equations according to (2.1.4), (2.1.8) and equation (2.2.2) in the profit relationship gives:

$$\Pi = p_c(\alpha c)^{\frac{1}{\eta}} c_1^{1-\frac{1}{\eta}} + p_c^*(\alpha c^*)^{\frac{1}{\eta^*}} c_1^{*\,1-\frac{1}{\eta^*}} - wf^{-1}(c_1 + c_1^*). \tag{2.2.1a}$$

Maximization of equation (2.2.1 a) results after some manipulation in the following first order conditions:

$$\frac{\eta-1}{\eta} p_1 f_l(l) = w \tag{2.2.3}$$

$$\frac{\eta^*-1}{\eta^*} p_1^* f_l(l) = w. \tag{2.2.4}$$

The corresponding equations for the foreign discriminating monopolist can now be written as

$$\frac{\eta^*-1}{\eta^*} p_2^* f_l^* (l^*) = w^* \tag{2.2.5}$$

$$\frac{\eta-1}{\eta} p_2 f_l^* (l^*) = w^* . \tag{2.2.6}$$

Under perfect competition equations (2.2.3)—(2.2.6) come down to the familiar equality of the real wage rate and the marginal product of labour. Under monopolistic competition firms realize a profit margin, which differs on internationally segmented markets.[1] From equations (2.2.3)—(2.2.6) the following result can be obtained:

$$\frac{p_1}{p_1^*} = \frac{p_2}{p_2^*} = \frac{\dfrac{\eta^*-1}{\eta^*}}{\dfrac{\eta-1}{\eta}} = \frac{\zeta^*}{\zeta} . \tag{2.2.7}$$

Rewriting equation (2.2.7) as

$$\frac{p_1}{p_2} = \frac{p_1^*}{p_2^*} \tag{2.2.8}$$

it appears that the relative price consumers face is the same in both countries. The terms of trade of the domestic country (real exchange rate) are equal to $\frac{p_1^*}{p_2}$, whereas the reciprocal indicates the terms of trade of the foreign country. For $1 < \eta^* < \eta$ (and therefore $\zeta^* < \zeta$) we have

$$\frac{p_1^*}{p_2} > \frac{p_1}{p_2} = \frac{p_1^*}{p_2^*} > \frac{p_2}{p_1^*} . \tag{2.2.9}$$

This result leads to the following proposition.

Proposition 1. The terms of trade of the country where monopolistic competition is relatively weaker, because products are more homogeneous than in the other country, exceed

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[1] Branson and Rotemberg (1980) erroneously assume that under monopolistic competition the foreign price level enters the demand function for labour in the domestic country and *vice versa* for the other region.

the price ratio consumers are facing at home and abroad.

That is all to be said in a partial equilibrium setting. To determine the relative price of both goods we have to specify a general equilibrium model. This will be our task in the next section.

3. A Macroeconomic Two-Country Model

3.1 Specification of the Model

General equilibrium in a two-country model of the format presented in section 2 requires simultaneous equilibrium in four markets: two goods markets and two labour markets. However, there are only three relative prices to do the job, i.e. the real wage rate in both countries and the relative price of commodities one and two. In the theory of international trade it is usual to assume that all income accrueing from production is spent on commodities. For the domestic country this would mean: $c_1 p_1 + c_1^* p_1^* = c_1 p_1 + c_2 p_2$. The current account balances and one could invoke Walras' law to eliminate one of the equations requiring equilibrium in the goods market. The number of equations then corresponds to the number of unknown variables.

In macroeconomic theory one would allow for disequilibrium on the current account. Indeed, the notion of intertemporal choice refers to borrowing and lending, which could take the form of international capital movements. Assuming perfect capital mobility the real interest rate would be uniform across countries. If spending would depend on the interest rate there would be an additional variable to equilibrate both goods markets. In a number of macroeconomic two-country models the demand for investment goods is supposed to be a function of the real interest rate (e.g. Lipton and Sachs, 1983; Buiter, 1984; van de Klundert, 1986; Attanasio and van der Ploeg, 1987). Here, we shall assume that total consumption in both regions depends negatively on the real rate of interest.

$$c = c(r; \underset{\sim}{c}), \quad \frac{dc}{dr} < 0 \tag{3.1.1}$$

$$c^* = c^*(r; \underline{c}^*), \quad \frac{dc^*}{dr} < 0. \tag{3.1.2}$$

The symbols $\underline{c}$ and $\underline{c}^*$ indicate autonomous factors which may be conceived as multiplicative shift variables, which are equal to one in the initial equilibrium. Wealth effects (including gains and losses in the terms of trade) are omitted to make the analysis more tractable.

Equilibrium in the market for goods can be formulated as

$$f(l) = c_1 + c_1^* \tag{3.1.3}$$

$$f^*(l^*) = c_2^* + c_2. \tag{3.1.4}$$

The supply of labour may be positively related to the real wage rate, which can be written as

$$l_s = l_s\left(\frac{w}{p_c};\ \underline{l}_s\right), \quad \frac{dl_s}{d(w/p_c)} > 0 \tag{3.1.5}$$

$$l_s^* = l_s^*\left(\frac{w^*}{p_c^*},\ \underline{l}_s^*\right), \quad \frac{dl_s^*}{d(w^*/p_c^*)} > 0. \tag{3.1.6}$$

Here also, the symbols $\underline{l}_s$, $\underline{l}_s^*$ indicate multiplicative shift variables, which are equal to one in the initial situation. In equilibrium labour supply equals labour demand, which can be expressed formally as

$$l = l_s \tag{3.1.7}$$

$$l^* = l_s^*. \tag{3.1.8}$$

The complete model consists of 18 equations: (2.1.4)—(2.1.9), (2.2.3)—(2.2.6), and (3.1.1)—(3.1.8), which can be solved for the 18 endogenous variables, viz. $c_1, c_1^*, c_2, c_2^*, c, c^*, l, l^*, l_s, l_s^*, \frac{p_1}{p_c}, \frac{p_1^*}{p_c^*}, \frac{p_2}{p_c}, \frac{p_2^*}{p_c^*}, \frac{w}{p_c}, \frac{w^*}{p_c^*}, \frac{p_1^*}{p_2}$ and r. For suitable specifications of the consumption functions and labour supply functions, for instance assuming constant elasticities, existence of an equilibrium can be proved in a straightforward manner. However, general existence theorems are beyond the scope of the paper.

Real wage rigidity and labour market disequilibrium (Phillips-curve) can be introduced rather easily. Nominal wage rigidity would also be a possibility after the introduction of a monetary sector. However, unemployment problems are not our primary concern. We will therefore stick to the equilibrium version of the model and compare the situation of monopolistic competition with that of perfect competition.

It is easy to proof the following result.

Proposition 2. If labour supply is exogenous the country where monopolistic competition is relatively weaker realizes higher terms of trade than under perfect competition.

This proposition follows from proposition 1 and the fact that with exogenous labour supply the relative price consumers face is independent of the market structure. The relative price $\frac{p_1}{p_2}$ which is equal to the terms of trade under perfect competition, follows in this case from equations (2.1.4)—(2.1.9) and (3.1.3)—(3.1.4).

With endogenous labour supply this result does not hold. The solution of the model is then more complicated and linearization around an equilibrium solution will be helpful to obtain further results.

3.2 The Log-linear Version of the Model

The equations can be linearized around a particular solution by taking total differentials. Indicating percentage deviations by a dot above the variable the linearized system may be written as:

$$
\begin{array}{lll}
\textit{Home country} & \textit{Foreign country} & \\
\dot c_1 = \dot c - \eta(\dot p_1 - \dot p_2) & \dot c_2^* = \dot c^* - \eta^*(\dot p_2^* - \dot p_c^*) & (3.2.1) \\
\dot c_2 = \dot c - \eta(\dot p_2 - \dot p_c) & \dot c_1^* = \dot c^* - \eta^*(\dot p_1^* - \dot p_c^*) & (3.2.2) \\
\dot p_c = \Theta \dot p_1 + (1-\Theta)\dot p_2 & \dot p_c^* = \Theta^* \dot p_2^* + (1-\Theta^*)\dot p_1^* & (3.2.3) \\
\dot p_1 + \dot\zeta - \varepsilon \dot l = \dot w & \dot p_2^* + \dot\zeta^* - \varepsilon^* \dot l^* = \dot w^* & (3.2.4) \\
\dot p_1^* + \dot\zeta^* - \varepsilon \dot l = \dot w & \dot p_2^* + \dot\zeta^* - \varepsilon^* \dot l^* = \dot w^* & (3.2.5) \\
\dot c = -\xi \dot r + \underline{\dot c} & \dot c^* = -\xi^* \dot r + \underline{\dot c}^* & (3.2.6) \\
\dot l_s = \nu(\dot w - \dot p_c) + \underline{\dot l}_s & \dot l_s^* = \nu^*(\dot w^* - \dot p_c^*) + \underline{\dot l}_s^* & (3.2.7) \\
\beta \dot l = \mu \dot c_1 + (1-\mu)\dot c_1^* & \beta^* \dot l^* = \mu^* \dot c_2^* + (1-\mu^*)\dot c_2 & (3.2.8) \\
\dot l = \dot l_s & \dot l^* = \dot l_s^* . & (3.2.9)
\end{array}
$$

The elasticities evaluated at the equilibrium point have the following meaning:

$$\beta = \frac{lf_l}{f} < 1 \qquad \Theta = \frac{\alpha p_1^{1-\eta}}{\alpha p_1^{1-\eta} + (1-\alpha)\, p_2^{1-\eta}} < 1$$

$$\varepsilon = -\frac{lf_{ll}}{f_l} \qquad \xi = \frac{r}{c}\frac{dc}{dr}$$

$$\mu = \frac{c_1}{f} < 1 \qquad \nu = \frac{w/p_c}{l_s}\frac{dl_s}{d(w/p_c)}.$$

It should be noted that $\dot{\zeta}$ and $\dot{\zeta}^*$ relate to shocks of a particular kind. Under perfect competition we have $\zeta = \zeta^* = 1$. Monopolistic competition may then be seen as a perturbation of the system under perfect competition, implying ζ, $\zeta^* < 1$. This greatly facilitates a comparison of both market structures. The elasticities of substitution (η and η^*) are assumed invariant with respect to a change in market structure.

To make the model more tractable we assume that both regions have a number of structural characteristics in common in the steady state before the model is exposed to shocks, i.e. $\beta = \beta^*$, $\varepsilon = \varepsilon^*$, $\nu = \nu^*$ and $\xi = \xi^*$. Ignoring for the time being other multiplicative shocks ($\dot{\underline{c}} = \dot{\underline{c}}^* = \dot{\underline{l}}_s = \dot{\underline{l}}_s^* = 0$) the solution for the relative price is, as shown in the Appendix:

$$\dot{p}_1 - \dot{p}_2 = -\frac{1}{\Delta + \Delta^*}\frac{\beta\nu}{1+\varepsilon\nu}(\dot{\zeta} - \dot{\zeta}^*), \tag{3.2.10}$$

where

$$\Delta = \frac{\beta\nu(1-\Theta)}{1+\varepsilon\nu} + \mu\eta(1-\Theta) + (1-\mu)\,\eta^*\,\Theta^*$$

$$\Delta^* = \frac{\beta\nu(1-\Theta^*)}{1+\varepsilon\nu} + \mu^*\eta^*(1-\Theta^*) + (1-\mu^*)\,\eta\,\Theta.$$

From equations (3.2.4) and (3.2.5) it can be deduced that

$$\dot{p}_1^* - \dot{p}_2 = (p_1 - p_2) + (\dot{\zeta} - \dot{\zeta}^*). \tag{3.2.11}$$

What is at stake can easily be explained. The domestic country benefits from the higher profit margins abroad through trade. However, higher profit margins abroad induce a larger reduction in supply of the foreign good compared with the decline in supply at home. This leads to a rise of the relative price of the foreign good, counteracting the first mentioned effect. No general conclusion seems possible, but it can be argued that for parameter values within a reasonable range the second effect mentioned will be smaller than the first one. For $\nu \to \infty$ the reciprocal of the coefficient in the RHS of equation (3.2.10) reduces to

$$(2-\Theta-\Theta^*)+\frac{[\mu(1-\Theta)+(1-\mu^*)\Theta]\,\eta+[\mu^*(1-\Theta^*)+(1-\mu)\,\Theta^*]\,\eta^*}{\beta/\varepsilon}.$$

Noting that $\varepsilon=\frac{1-\beta}{\sigma}$, where σ denotes the elasticity of substitution between labour and capital (cf. Layard and Walters, 1978), η, $\eta^*>\beta/\varepsilon$ holds for parameter values within a wide range considered to be realistic. As a result the expression given above will be greater than one and the coefficient in equation (3.2.10) will be smaller than one. The observation that the elasticity of labour supply found in econometric studies is usually small (below unity) strongly reinforces the argument.

3.3 The Impact of Supply and Demand Shocks

It should be observed that under monopolistic competition $\zeta=\zeta^*=0$ unless the elasticities of demand η and η^* are a function of other variables, for instance the number of firms or total demand. However, as already discussed by Chamberlin (1933) there is no clear reason why these elasticities should vary in a systematic manner with the number of firms. As Chamberlin puts it: „*More* substitutes does not necessarily mean *better* substitutes in a sense which would increase elasticities" (Ibid., p. 286). Layard and Nickell (1985) hold a different view. In their opinion the elasticity η depends positively on aggregate demand, because oligopolistic firms reduce the mark-up over marginal cost in booms. We will not follow this argumentation, which seems typical *ad-hoc.*

For constant values of η and η^* the log-linear version of the model under monopolistic competition looks formally the same as the log-linear version under perfect competition. However, the original versions of the models lead to different solutions which is reflected in different values for a number of elasticity coefficients. Apart from this the market structure is important with respect to the transmission of shocks. The stories to be told are different. It is therefore instructive to analyse the impact of supply shocks and demand shocks in the present model.

Equilibrium in the goods market and the labour market in the domestic country implies a relation between the relative commodity price and the rate of interest. This relation is derived in the Appendix.

$$\Delta(\dot{p}_1-\dot{p}_2) = -\xi\dot{r}+\mu\dot{\underline{c}}+(1-\mu)\dot{\underline{c}}^* - \frac{\beta}{1+\varepsilon\nu}\dot{\underline{l}}_s. \tag{3.3.1}$$

There is a similar relation for market equilibrium abroad:

$$\Delta^*(\dot{p}_1-\dot{p}_2) = \xi\dot{r}-\mu^*\dot{\underline{c}}^*-(1-\mu^*)\dot{\underline{c}}^* + \frac{\beta}{1+\varepsilon\nu}\dot{\underline{l}}_s^* \tag{3.3.2}$$

Solving for the relative price gives:

$$\dot{p}_1-\dot{p}_2 = \frac{1}{\Delta+\Delta^*}\left[(\mu+\mu^*-1)(\dot{\underline{c}}-\dot{\underline{c}}^*) - \frac{\beta}{1+\varepsilon\nu}(\dot{\underline{l}}_s-\dot{\underline{l}}_s^*)\right]. \tag{3.3.3}$$

Turning to autonomous changes in labour supply first, the following proposition summarizes the result expressed in equation (3.3.3).

Proposition 3. A positive supply shock in the foreign country ($\dot{\underline{l}}_s^* > 0$) raises the terms of trade of the domestic country. The real rate of interest declines to eliminate excess supply of goods in both markets.

A graphical illustration of this proposition is presented in Fig. 1. A positive supply shock translates into a downward shift of the marginal cost curve of foreign (discriminating) monopolists.

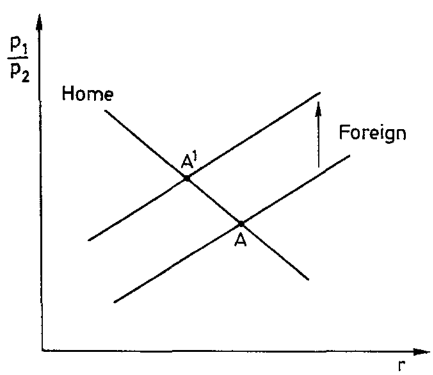

Fig. 1. Positive supply shock abroad

This may occur directly (in the case of a technological improvement) or indirectly as the wage rate falls in the case of excess supply in the labour market. Foreign firms lower their prices and sell more in both markets. Domestic firms lose ground because of a more severe import competition. Labour demand in the domestic economy declines which puts a downward pressure on wages. Labour supply increases simultaneously, because the real wage rate (w/p_c) rises as the price of imported goods declines. When domestic wages fall producers in the home country can fight back by lowering their prices and increasing output. Excess supply of goods is distributed internationally. A reduction in the real interest rate then becomes necessary to restore equilibrium in both markets.[2] The relative price of the foreign good decreases, as might be expected. Output increases in both regions.

A demand shock in one country leads to a shift of the market equilibrium curves of both countries as shown in Fig. 2a and 2b. The main implications of a demand shock are summarized in the following proposition.

Propostion 4. A positive demand shock in the foreign country ($\dot{c}^* > 0$) *leads to a deterioration of the terms of trade in the domestic country if there exists a "home market bias"* ($\mu > 1 - \mu^*$). *The real interest rate rises to choke off excess demand.*

The meaning of the condition $\mu > 1 - \mu^*$ is straightforward. The inequality states that there is a "home market bias" such that the share of domestic firms exceeds the share of foreign firms in the home market when the countries are equal in size. A demand pull will then have a stronger effect on the consumption of the domestic good than on the imported good in the country where the shock applies. A similar condition is reported in Venables (1985), where a Cournot model is applied to explain intrasector trade. Under the condition stated above output in the foreign country rises, while output in the domestic country falls. Branson and Rotemberg (1980) also note the possibility of an opposite outcome and call it the "Hong Kong" case. In their view it is related to the market structure of monopolistic competition. However, a demand pull in one country raises output in the other country when there is a "foreign market bias" whatever its cause. The outcomes for μ and μ^* depend on the relative size of countries and on the solution

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[2] In a model with capital accumulation a supply shock may affect the marginal efficiency of capital. Under these circumstances the interest rate may rise as shown for instance in van de Klundert (1986).

for relative prices. It is through the latter effect that the market structure will be of influence. The different possibilities are illustrated in Fig. 2a for the normal case and in Fig. 2b for the "Hong Kong" case.

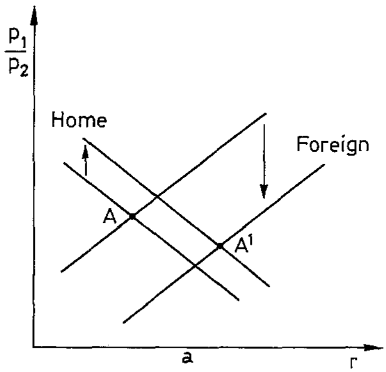

Fig. 2a. Positive demand shock abroad; normal case

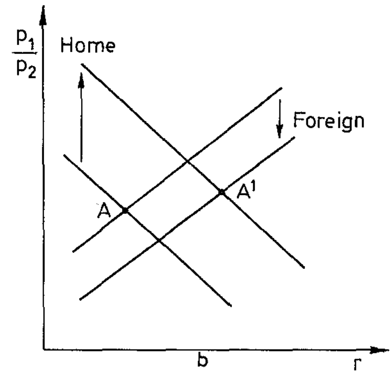

Fig. 2b. Positive demand shock abroad; "Hong Kong" case

The result of a demand pull can be explained as follows. On impact of a positive shock abroad firms operating in the foreign market raise their price and their output. There will be excess demand in all markets. The rate of interest rises to choke off demand for goods. Wages increase to restore equilibrium in the labour market. Prices in both countries rise. For $\mu > 1-\mu^*$ the terms of trade of the foreign country improve, implying an increase in the supply of labour and the volume of output. In the home country labour supply and output decrease.

4. Conclusions

Price discriminating monopolists may drive a wedge between the relative price of commodities and the terms of trade or real exchange rate in a macroeconomic two-country model. In the present analysis monopolistic competition relates to product differentiation. The higher the elasticity of substitution between goods the lower profit margins will be. In this sense competition is less severe. When the elasticity of substitution differs across countries the terms of trade of the region where monopolistic competition is less severe will be higher than under perfect competition.

If labour supply is endogenous output will be lower in both countries.

A positive supply shock in the foreign country raises the terms of trade of the domestic country (real exchange rate appreciation). A positive demand shock in the foreign country leads to a deterioration of the terms of trade at home (real exchange rate depreciation), if there is a "home market bias". Output in the domestic country declines. In the opposite case of a "foreign market bias" a demand pull abroad raises output in the domestic economy.

The model is kept rather simple and could be extended in several directions. Nominal wage rigidity as well as real wage rigidity could be introduced to study problems of unemployment. The microeconomic foundations of the model would gain by analysing intertemporal choice of consumers and producers. Fixed cost could be assumed to explain the number of firms on long term. However, this would not fundamentally change the conclusions of the present analysis.

Appendix

From equations (3.2.3) and (3.2.4) labour demand can be written as:

$$\dot{l} = -\frac{1}{\varepsilon}(\dot{w}-\dot{p}_1)+\frac{1}{\varepsilon}\dot{\zeta} = -\frac{1}{\varepsilon}(\dot{w}-\dot{p}_c-(1-\Theta)(\dot{p}_1-\dot{p}_2))+\frac{1}{\varepsilon}\dot{\zeta}. \qquad \text{(A.1)}$$

Equilibrium in the labour market in the domestic country implies

$$\dot{w}-\dot{p}_c = \frac{1-\Theta}{1+\varepsilon\nu}(\dot{p}_1-\dot{p}_2)+\frac{1}{1+\varepsilon\nu}\dot{\zeta}-\frac{\varepsilon}{1+\varepsilon\nu}\dot{\underline{l}}_s. \qquad \text{(A.2)}$$

Substitution of this result in (3.2.7) gives

$$\dot{l} = \frac{\nu(1-\Theta)}{1+\varepsilon\nu}(\dot{p}_1-\dot{p}_2)+\frac{\nu}{1+\varepsilon\nu}\dot{\zeta}+\frac{1}{1+\varepsilon\nu}\dot{\underline{l}}_s. \qquad \text{(A.3)}$$

Equations (3.2.1)—(3.2.6) may be used to give

$$\dot{c}_1 = -\xi\dot{r}-\eta(1-\Theta)(\dot{p}_1-\dot{p}_2)+\dot{\underline{c}} \qquad \text{(A.4)}$$

$$\dot{c}_1^* = -\xi^*\dot{r}-\eta^*\Theta^*(\dot{p}_1-\dot{p}_2)+\dot{\underline{c}}^*. \qquad \text{(A.5)}$$

Substitution of equations (A.3), (A.4) and (A.5) in the equilibrium relation for the goods market in the domestic country results in

$$\left[\frac{\beta\nu(1-\Theta)}{1+\varepsilon\nu}+\mu\eta(1-\Theta)+(1-\mu)\eta^*\Theta^*\right](\dot{p}_1-\dot{p}_2)=$$
$$-[\mu\xi+(1-\mu)\xi^*]\dot{r}$$
$$+\mu\dot{\underline{c}}+(1-\mu)\dot{\underline{c}}^*-\frac{\beta}{1+\varepsilon\nu}\dot{\underline{l}}_s-\frac{\beta\nu}{1+\varepsilon\nu}\dot{\zeta}. \tag{A.6}$$

A similar expression can be derived for equilibrium in the goods market in the foreign country:

$$\left[\frac{\beta^*\nu^*(1-\Theta)}{1+\varepsilon^*\nu^*}+\mu^*\eta^*(1-\Theta^*)+(1-\mu^*)\eta\Theta\right](\dot{p}_2-\dot{p}_1)=$$
$$-[\mu^*\xi^*+(1-\mu^*)\xi]\dot{r}$$
$$+\mu^*\dot{\underline{c}}^*+(1-\mu^*)\dot{\underline{c}}-\frac{\beta^*}{1+\varepsilon^*\nu^*}\dot{\underline{l}}_s^*-\frac{\beta^*\nu^*}{1+\varepsilon^*\nu^*}\dot{\zeta}^*. \tag{A.7}$$

The solution for the relative commodity price follows from equations (A.6) and (A.7). Assuming $\beta=\beta^*$, $\varepsilon=\varepsilon^*$, $\nu=\nu^*$ and $\xi=\xi^*$ the outcome can be simplified to

$$\dot{p}_1-\dot{p}_2=\frac{1}{\Delta+\Delta^*}[(\mu+\mu^*-1)(\dot{\underline{c}}-\dot{\underline{c}}^*)$$
$$-\frac{\beta}{1+\varepsilon\nu}(\dot{\underline{l}}_s-\dot{\underline{l}}_s^*)-\frac{\beta\nu}{1+\varepsilon\nu}(\dot{\zeta}-\dot{\zeta}^*)], \tag{A.8}$$

where

$$\Delta=\frac{\beta\nu(1-\Theta)}{1+\varepsilon\nu}+\mu\eta(1-\Theta)+(1-\mu)\eta^*\Theta^*$$

$$\Delta^*=\frac{\beta\nu(1-\Theta^*)}{1+\varepsilon\nu}+\mu^*\eta^*(1-\Theta^*)+(1-\mu^*)\eta\Theta.$$

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