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GROWTH AND WELFARE EFFECTS OF EXPORT SUBSIDIES IN AN ENDOGENOUS GROWTH MODEL

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Abstract

The aim of this paper is to examine the welfare impacts of a simultaneous multilateral increase in export subsidies, considering the influence of changes in the growth rate. Firstly, this paper shows that a multilateral increase in export subsidies results in an enhanced world growth rate under some conditions. Subsequently, we show that the welfare effects of export subsidies are contingent upon world growth, transport costs, international relocation of firms and the terms of trade. This paper shows that the economic welfare of each country is enhanced by a simultaneous increase in multilateral export subsidies, under some conditions.

Keywords: *Export Subsidy, Growth, Welfare, Location, Transport Costs*

1. Introduction

So far, the international trade theory has been largely successful in accounting for the effects of export subsidies on welfare, as evidenced by numerous standard textbooks (Feenstra, 2004; Pugel, 2004; McLaren, 2012; Krugman, Obstfeld and Melitz, 2018). However, to date, the welfare effect of export subsidies via alterations in world growth rate has been almost overlooked in both the textbook and research papers in the international economics literature. If the ultimate motivation for studying international trade is its implication on welfare, then it is worth while studying the relationship between growth and export subsidies, taken into account that export subsidies have direct and indirect welfare effects through economic growth. In the real world economy, where globalization is progressing and economic growth rates are increasing worldwide, it is also important to note that the omission of growth would have serious implications for the predictions of effects of export subsidies by policy makers. Despite this context, there has been little work done to analyze export subsidies in the endogenous growth literature.

Of course, in parallel with the standard perfect competitive international trade theory, a substantial corpus of literature has emerged which analyses the linkages between welfare and export subsidies using imperfect competitive model. This literature can be found within the oligopoly theory literature, for example in the works of Brander and Spencer (1985), de Meza (1986), Eaton and Grossman (1986) and Helpman and Krugman (1992). However, these models are subject to at least three limitations. Firstly, the relationship between trade policy and innovation activities that contribute to economic growth, such as research and development, is not considered. Secondly, the location of firms between the two countries is fixed in all models. Thirdly, the analysis of the welfare implications of export subsidies fails to take into account the impact of fluctuations in growth and transportation costs. From the above, it is therefore necessary to address these current theoretical limitations in the international economics literature in order to gain a more comprehensive understanding of the linkages between innovations, trade, economic growth and export subsidies. In other words, there is a need for a framework that integrates the theory of endogenous economic growth, the theory of international trade, and the new economic geography model. Such a framework should enable us to answer questions such as the following: does the implementation of an export subsidy result in a deceleration or acceleration of economic growth in the context of international firm relocation? Does the introduction of an export subsidy lead to an increase in the overall welfare of a country, even in the presence of economic growth?

This paper seeks to establish a model that demonstrates the relationship between export subsidies, the location of firms, transport costs, economic growth and overall welfare. In order to address the aforementioned questions, we employ a two-country endogenous growth model. The model is based on the theoretical framework of the new economic geography, particularly the recent contributions of Martin and Ottaviano (1999). The model possesses the following characteristics. The model depicts a two-country world economy. The model comprises two types of traded goods (differentiated goods and a numeraire good), with firms able to relocate internationally and labor remaining fixed in place of residence. Secondly, transportation costs are incurred for differentiated goods. Thirdly, research and development activities lead to an expansion in the number of differentiated goods endogenously. Fourthly, international technological knowledge spillovers facilitate the invention of new blueprints for producing differentiated goods worldwide. Finally, the model incorporates the welfare effects of export subsidies and their relationship with growth.

In particular, the presence of a tax burden as a source of export subsidies has a significant impact on the growth results that emerge from standard endogenous growth models. Ultimately, in our model, the impact of export subsidies on growth depends upon the magnitude of certain parameters.

Our principal findings are that a simultaneous multilateral increase in export subsidies has the effect of raising the world growth rate, which in turn leads to an increase in labor in the R&D sector. Furthermore, we demonstrate that the welfare impact of a simultaneous multilateral subsidy on home and foreign welfare through changes in growth can be positive under certain conditions. In particular, regarding the growth effect of export subsidy, it is opposite to the endogenous growth model without firm relocation and transport costs.

The remainder of the paper is structured as follows. Section 2 outlines the features of the model. Section 3 describes the equilibrium location and firm size, and Section 4 details the R&D sector. Section 5 examines the impact of a simultaneous multilateral increase in export subsidies on the world growth rate. Section 6 examines the impact of a simultaneous multilateral increase in export subsidies on the welfare of each country. The final section concludes the paper.

2. Model

The following section focuses on the description of the home country. Variables for the foreign country are denoted with an asterisk. The objective of a representative household in the home country is to maximize the following lifetime utility function:

$$U = \int_0^{\infty} \log(Q(t)^{\alpha} A(t)^{1-\alpha}) e^{-\rho t} dt. \tag{1}$$

In this context, $A(t)$ represents the numeraire good in period t, whereas $Q(t)$ denotes the consumption index of differentiated goods, as defined by the following equation:

$$Q(t) = \left(\int_{i=0}^{N(t)} Q_i(t)^{1-1/\sigma} di \right)^{1/(1-1/\sigma)}, \sigma > 1. \tag{2}$$

In this model, $Q_i(t)$ represents the consumption of differentiated good i, while $N(t)$ denotes the total number of differentiated goods produced in both home and foreign countries. In this model, the government in each country levies a lump-sum tax on households to finance export subsidies on all imported differentiated goods. Each household provides one unit of labor in order to earn $w(t)$. Therefore, the intertemporal budget constraint can be expressed as follows:

$$\dot{B}(t) = r(t)B(t) + w(t) - E(t) - T(t),$$

where the variables $B(t)$, $r(t)$, $E(t)$, $T(t)$ are used to denote, respectively, per capita asset holdings, the interest rate, per capita expenditure, and per capita lump-sum tax. Furthermore, we assume iceberg transport costs in transporting the differentiated goods between countries: τ ($\tau \geq 1$). Consequently, the per capita expenditure of a typical household, E, is

$$\int_{i \in n} p_i Q_i di + \int_{j \in n^*} (1 - s_f) \tau p_j^* Q_j dj + A = E. \tag{3}$$

In this model, the producer price of a typical variety (i) in the home country is represented by p_i, while the export subsidy rate of the foreign (home) country is represented by s_f (s_h). As illustrated in equation (3), the home country is comprised of n firms, while the remaining n^* firms are situated in the foreign country. The total number of firms in both countries is therefore N, with $n + n^* = N$. The consumption price indices for the differentiated products are then given by

$$P^Q = \left(\int_{i \in n} p_i^{1-\sigma} di + \int_{j \in n^*} \left((1 - s_f)\tau p_j^*\right)^{1-\sigma} dj\right)^{1/(1-\sigma)}, \tag{4}$$

$$P^{Q*} = \left(\int_{i \in n} \left((1 - s_h)\tau p_i\right)^{1-\sigma} di + \int_{j \in n^*} p_j^{*1-\sigma} dj\right)^{1/(1-\sigma)}. \tag{5}$$

In this context, P^Q (P^{Q^*}) represents the price index in the home (foreign) country. In the differentiated goods sector, each good requires β units of labor. The optimal profit-maximizing strategy for a firm in this sector is to choose p_i, which gives $p_i = w\beta\sigma/(\sigma - 1)$, where w is the wage rate. The profit flow of each firm ($= \pi_i$) is then

$$\pi_i = p_i x_i(p_i) - w\beta x_i(p_i) = \frac{w\beta x_i(p_i)}{\sigma - 1}, \tag{6}$$

where the variable x is the quantity of output.

It is assumed that the homogeneous good A is produced by a linear technology that requires labor as an input. Therefore, factor prices are equalized between countries ($w = w^*$) due to the free trade of the homogeneous good. Given that the numeraire is the homogeneous good, it follows that the wage rate in each location is $w = w^* = 1$. Therefore, we can conclude that $p = p^* = \beta\sigma/(\sigma - 1)$. In this context, we define $\delta \equiv \tau^{1-\sigma}$ as a variable that belongs to the set {0, 1}. By optimizing the utility function, given the choice of Q_i, Q_j and A, we can derive the following expressions:

$$Q_i = \frac{\sigma - 1}{\beta\sigma}\left(\frac{\alpha E}{n + n^*(1 - s_f)^{1-\sigma}\delta}\right),\ Q_j = \frac{\sigma - 1}{\beta\sigma}\left(\frac{\alpha E(1 - s_f)^{-\sigma}\tau^{-\sigma}}{n + n^*(1 - s_f)^{1-\sigma}\delta}\right),\ A = (1 - \alpha)E. \tag{7}$$

Let z be the equity value of a firm and r be the return on a riskless bond. Thus, by considering (6), we obtain a no-arbitrage condition in the world's capital markets:

$$\frac{\beta x}{\sigma - 1} + \dot{z} = rz. \tag{8}$$

Maximizing (1) subject to the intertemporal budget constraint and the assumption of free capital mobility between countries necessitates that nominal spending grows at a rate equal to $r - \rho$:

$$\frac{\dot{E}}{E} = \frac{\dot{E}^*}{E^*} = r - \rho. \tag{9}$$

3. International Distribution of Firms

The market-clearing condition for any differentiated product x can be derived by aggregating the demand in (7) across all households worldwide:

$$x_i = LQ_i + L\tau Q_i^* = \frac{\alpha L(\sigma-1)}{\beta\sigma}\left(\frac{E}{n+n^*(1-s_f)^{1-\sigma}\delta} + \frac{E^*(1-s_h)^{-\sigma}\delta}{n^*+n(1-s_h)^{1-\sigma}\delta}\right) = x. \quad (10)$$

In the above equations, in both countries, the labor endowment, represented by the variable L, is equal. Similarly, for any product x^*, we obtain

$$x_j^* = L\tau Q_j + LQ_j^* = \frac{\alpha L(\sigma-1)}{\beta\sigma}\left(\frac{E(1-s_f)^{-\sigma}\delta}{n+n^*(1-s_f)^{1-\sigma}\delta} + \frac{E^*}{n^*+n(1-s_h)^{1-\sigma}\delta}\right) = x^*. \quad (11)$$

In order for a firm to be indifferent between its home and foreign locations following location arbitrage, it is necessary that the operating profits of the two locations be equal:

$$\pi = \pi^*. \quad (12)$$

Thus, from equations (6), (12) and $w = w^* = 1$, we obtain $x = x^*$. In this model, we define K and K^* to represent the capital stocks in the home and foreign countries, respectively. Furthermore, the total stock of capital owned by agents determines the total number of firms, such that:

$$n + n^* = K + K^* = N. \quad (13)$$

Solving (10)-(13) allows us to determine the proportion of firms based in the home country as follows:

$$\gamma = \frac{n}{N} = \frac{((1-s_h)^{-\sigma}\delta-1)(1-s_f)^{1-\sigma}\delta E^* - \left((1-s_f)^{-\sigma}\delta-1\right)E}{\left((1-s_f)^{-\sigma}\delta-1\right)((1-s_h)^{1-\sigma}\delta-1)E + ((1-s_h)^{-\sigma}\delta-1)\left((1-s_f)^{1-\sigma}\delta-1\right)E^*}. \quad (14)$$

The level of output of each firm is as follows:

$$x = x^* = \alpha L\left(\frac{\sigma-1}{\beta\sigma}\right)\frac{\bar{E}}{N}\left\{\frac{(1-s_h)^{-\sigma}\delta(1-s_f)^{-\sigma}\delta-1}{\left((1-s_h)^{1-\sigma}\delta(1-s_f)^{1-\sigma}\delta-1\right)((1-s_h)^{-\sigma}\delta-1)\left((1-s_f)^{-\sigma}\delta-1\right)}\right\}, \quad (15)$$

where $\bar{E} = \left((1-s_f)^{-\sigma}\delta-1\right)((1-s_h)^{1-\sigma}\delta-1)E + ((1-s_h)^{-\sigma}\delta-1)\left((1-s_f)^{1-\sigma}\delta-1\right)E^*$.

4. Research and Development Sector

It is assumed that the technology developed through research and development (R&D) follows a linear technology. The value of a blueprint developed through R&D is represented by the variable z. In line with the argument put forth by Martin and Ottaviano (1999), the knowledge base surrounding new products is considered an international public good. Therefore, a researcher engaged in R&D activities will require η/N units of labor due to that R&D costs are identical in both locations due to global spillovers. Consequently, the existence of free entry into the R&D sector results in the equation $z = \eta/N$.

In this section, we derive the solution for a steady state where $\gamma = n/N$ and $g = \dot{N}/N$ are both constants. Therefore, if there is a balanced growth path, this implies that z decreases at the rate $g = \dot{N}/N = \dot{n}/n$. Then, the world labor market clearing condition is as follows:

$$\eta g + (1-\alpha)L(E+E^*) + \alpha L\left(\frac{\sigma-1}{\sigma}\right)\bar{E}\bar{T} = 2L, \tag{16}$$

where

$$\bar{T} = \frac{(1-s_h)^{-\sigma}\delta(1-s_f)^{-\sigma}\delta-1}{\left((1-s_h)^{1-\sigma}\delta(1-s_f)^{1-\sigma}\delta-1\right)((1-s_h)^{-\sigma}\delta-1)\left((1-s_f)^{-\sigma}\delta-1\right)}.$$

Assuming that g remains constant in the steady state, equation (16) implies that expenditure must be consistent. This leads to the conclusion that $r = \rho$, as derived from equation (9). Substituting equation (15), along with $z = \eta/N$ and $r = \rho$, into equation (8) while considering equation (16), yields the equilibrium growth rate of K, K^* and N:

$$g = \frac{2L}{\eta\sigma} - \frac{(1-\alpha)L(E+E^*)}{\eta\sigma} - \left(\frac{\sigma-1}{\sigma}\right)\rho. \tag{17}$$

The respective levels of per capita expenditure in a steady state for each country are as follows:

$$E = 1 + \frac{\rho\eta k}{L} - \frac{s_h\tau n p_h Q_h^*}{L},\ E^* = 1 + \frac{\rho\eta(1-k)}{L} - \frac{s_f\tau n^* p_f^* Q_f}{L}, \tag{18}$$

In the steady state, the share of firms owned in the home country k ($\equiv K/N$) and the foreign country ($1-k$) are constant. The first term in the above equations denotes labor income per capita, the second denotes capital income per capita and the third denotes the per capita tax burden on households imposed by the government to finance export subsidies.

5. Effects of Export Subsidies

In order to analyze the effects of a simultaneous multilateral increase in export subsidies on growth and welfare, it is assumed that $s_h = s_f = s_c$. However, it remains challenging to obtain analytical outcomes regarding the impact of export subsidies. Therefore, two assumptions, $\varepsilon_h \equiv \alpha s_h(1-s_h)^{-\sigma}(1-s_f)^{1-\sigma}\delta^2 \approx 0$ and $\varepsilon_f \equiv \alpha s_f(1-s_f)^{-\sigma}(1-s_h)^{1-\sigma}\delta^2 \approx 0$, are made in order to facilitate analysis. The impact of export subsidies becomes apparent when considering these assumptions.

Firstly, equation (17) is used to analyze the effect of a simultaneous multilateral increase in the export subsidy rate on the world growth rate through the effect on world consumption expenditure. It is evident that the world growth rate depends negatively on world consumption expenditure; therefore, the following steady-state world consumption expenditure can be obtained from equation (18):

$$E + E^* = \left(\frac{1}{A_hA_f - B_hB_f}\right)\left[(A_f - B_f)(L+\rho\eta k) + (A_h - B_h)\left(L + \rho\eta(1-k)\right)\right]. \tag{19}$$

where

$$A_h = A_f = A = L - \frac{\alpha s_c(1-s_c)^{-\sigma}\delta}{(1-s_c)^{2(1-\sigma)}\delta^2 - 1}$$

$$B_h = B_f = B = \frac{\alpha s_c (1 - s_c)^{1-2\sigma} \delta^2}{(1 - s_c)^{2(1-\sigma)} \delta^2 - 1}$$

By differentiating equation (19) with respect to the common export subsidy, we obtain

$$\left.\frac{\partial (E + E^*)}{\partial s_c}\right|_{s_c \approx 0} = -\frac{\alpha\delta(2L + \rho\eta)}{L^2(1+\delta)} < 0. \tag{20}$$

Equation (20) shows that a simultaneous increase in the export subsidy on a multilateral basis will result in a reduction in global consumption expenditure. By differentiating equation (17) with respect to the common export subsidy and considering equation (20), we can obtain the following result:

$$\left.\frac{\partial g}{\partial s_c}\right|_{s_c \approx 0} > 0. \tag{21}$$

As previously stated, the world growth rate, as defined in equation (17), is inversely proportional to the world consumption expenditure, as outlined in equation (19). Consequently, equation (21) shows that a simultaneous multilateral increase in the export subsidy will result in an increase in the world growth rate through a reduction in world consumption expenditure.

What is the mechanism through which a simultaneous multilateral increase in export subsidies leads to enhanced global growth? In our model, a simultaneous multilateral increase in export subsidies has three effects that affect growth: the real income effect, the subsidy effect, and the tax burden effect. Firstly, a simultaneous multilateral increase in export subsidies results in a reduction of the price index of composite industrial goods in both countries, as illustrated in equation (4). This subsequently gives rise to an increase in the real demand for differentiated goods in both countries and global consumption expenditure. In light of the inverse relationship between the consumption price index and the export subsidy, a simultaneous multilateral increase in the export subsidy has the effect of increasing purchasing power, prompting consumers to purchase larger quantities of both differentiated and homogeneous goods. An increase in global consumption expenditure results in a greater utilization of labor to produce global consumption goods. Consequently, from the perspective of labor market equilibrium, there is a reduction in the availability of labor for the R&D sector. This effect, which we term the 'real income effect', has a detrimental impact on the world growth rate. Secondly, a simultaneous multilateral increase in export subsidies results in a reduction in the consumption price index in both countries. Consequently, the total cost of consumption expenditures in both countries is also reduced, which in turn leads to a reduction in the global consumption expenditure. Consequently, in contrast to the real income effect, the utilization of labor in the production of global consumption goods is reduced, while the equilibrium condition for the labor market induces an increase in the availability of labor for the R&D sector. This second effect, which we term the 'subsidy effect', has a positive impact on the world growth rate. Thirdly, a simultaneous multilateral increase in export subsidies results in an increase in the tax burden in both countries, which subsequently reduces consumption spending in both countries and global spending. As with the subsidy effect, a reduction in global consumption expenditure results in a decrease in the labor required for the production of goods and services to satisfy global consumption expenditure. Consequently, from the labor market equilibrium condition, there is an increase in the availability of labor for the R&D sector. Therefore, this third effect, the "tax burden effect", has a positive impact on the world growth rate.

Thus, a simultaneous multilateral increase in export subsidies has a positive effect on the world growth rate due to two effects: the subsidy effect and the tax burden effect. Conversely, a negative effect on the world growth rate is due to the real income effect. Therefore, when considering the world growth impact of a simultaneous multilateral increase in export subsidies, it is necessary to assess the relative strength of the above opposite effects in order to determine the net growth effect.

In our model, the initial two positive effects are greater than the negative real income effect when $\varepsilon_h \approx 0$ and $\varepsilon_f \approx 0$. This results in the outcomes reflected in equation (21). In other words, under the assumption of $\varepsilon_h \approx 0$ and $\varepsilon_f \approx 0$, if the elasticity of substitution between any two differentiated goods is high, the iceberg In the event that transport costs are high, the proportion of expenditure allocated to differentiated goods is relatively low, and the export subsidy rate in the home (foreign) location is also low, a simultaneous multilateral increase in the export subsidy will result in an increase in the world growth rate.

To illustrate, when the level of transport costs is sufficiently high (and therefore $\varepsilon_h \approx 0$ and $\varepsilon_f \approx 0$), the positive subsidy effect on the world growth rate is considerable, as demonstrated in equation (3). This is due to the fact that when the level of transport costs is high (or a low level of δ), the price level of imported goods prior to the export subsidy increase is already high. In this case, the subsidy effect is consequently larger due to the greater extent of the price reduction resulting from the export subsidy increase. It can thus be concluded that, should the conditions of $\varepsilon_h \approx 0$ and $\varepsilon_f \approx 0$ be met, the positive effects of the subsidy and tax burden on world growth will outweigh the negative impact on real income. Consequently, a simultaneous multilateral increase in the export subsidy will result in an increase in the world growth rate.

6. Welfare

This section considers the impact of a simultaneous multilateral increase in the export subsidy on the welfare of each country, as measured by the utility of the representative household. The indirect utilities in the home and foreign countries are as follows:

$$U(0) = \frac{1}{\rho}\log\left\{\alpha^{\alpha}(1-\alpha)^{1-\alpha}E\left(\frac{\sigma-1}{\beta\sigma}\right)^{\alpha}N(0)^{\frac{\alpha}{\sigma-1}}\left[[1-(1-s_c)^{1-\sigma}\delta]\gamma+(1-s_c)^{1-\sigma}\delta\right]^{\frac{\alpha}{\sigma-1}}e^{\frac{\alpha g}{\rho(\sigma-1)}}\right\}, \quad (22)$$

$$U^{*}(0)=\frac{1}{\rho}\log\left\{\alpha^{\alpha}(1-\alpha)^{1-\alpha}E^{*}\left(\frac{\sigma-1}{\beta\sigma}\right)^{\alpha}N(0)^{\frac{\alpha}{\sigma-1}}[1-[1-(1-s_c)^{1-\sigma}\delta]\gamma]^{\frac{\alpha}{\sigma-1}}e^{\frac{\alpha g}{\rho(\sigma-1)}}\right\}. \quad (23)$$

Firstly, we consider the impact of a simultaneous multilateral subsidy on the international relocation of firms. From equation (14), it can be seen that an increase in a simultaneous multilateral subsidy will affect the equilibrium share of home firms:

$$\left.\frac{\partial\gamma}{\partial s_c}\right|_{s_c=0}=\left[(\delta-1)\left(2+\frac{\rho\eta}{L}\right)\right]^{-2}Z, \quad (24)$$

where

$$Z=-\frac{1}{L^2}\left(\frac{\alpha\delta}{1-\delta^2}\right)\left[\delta\left(L+\rho\eta(1-k)\right)-(L+\rho\eta k)\right](\delta-1)\left(2+\frac{\rho\eta}{L}\right)-(\sigma-1)\delta\left(1+\frac{\rho\eta(1-k)}{L}\right)(1-\delta)\left(2+\frac{\rho\eta}{L}\right)+\frac{\delta}{L^2}\left(\frac{\alpha\delta}{1-\delta^2}\right)\left[\delta(L+\rho\eta k)-\left(L+\rho\eta(1-k)\right)\right](\delta-1)\left(2+\frac{\rho\eta}{L}\right)-\left[\delta\left(1+\frac{\rho\eta(1-k)}{L}\right)-\left(1+\frac{\rho\eta k}{L}\right)\right]\left[(\sigma-1)\delta\left(2+\frac{\rho\eta}{L}\right)-(\delta-1)\frac{\alpha\delta(2L+\rho\eta)}{L^2(1+\delta)}\right], \quad (25)$$

It is not evident from equations (24) and (25) what effect a multilateral increase in export subsidies would have on the international relocation of firms. However, when L is sufficiently large, equation (25) can be written as follows:

$$Z=(\sigma-1)\delta\left(2+\frac{\rho\eta}{L}\right)\left(\frac{\rho\eta k}{L}-\frac{\rho\eta(1-k)}{L}\right)>0, \quad (26)$$

As illustrated by equations (24) and (26), when L is sufficiently large, an increase in the simultaneous multilateral subsidy results in an elevated equilibrium share of home firms:

$$\left.\frac{\partial\gamma}{\partial s_c}\right|_{s_c=0}>0, \quad (27)$$

Equation (27) illustrates that when L is sufficiently large, an increase in export subsidies concurrently leads to a heightened concentration of firms in the home country, where capital stocks are plentiful.

We proceed to examine the effect of a simultaneous multilateral subsidy on domestic welfare through the agglomeration of firms in the home country. By differentiating equation (22) with respect to s_c, we find that

$$\left.\frac{\partial U(0)}{\partial s_c}\right|_{s_c\approx 0}=\frac{1}{\rho(L+\rho\eta k)}\left(\frac{\alpha\delta}{1-\delta^2}\right)\left[\delta\left(1+\frac{\rho\eta(1-k)}{L}\right)-\left(1+\frac{\rho\eta k}{L}\right)\right]+\left(\frac{\alpha(1-\delta)}{\rho(\sigma-1)}\right)\left(\frac{1}{(1-\delta)\gamma+\delta}\right)\frac{\partial\gamma}{\partial s_c}+\frac{\alpha\delta(1-\gamma)}{\rho}\left(\frac{1}{(1-\delta)\gamma+\delta}\right)+\left(\frac{\alpha^2(1-\alpha)}{\rho^2\eta\sigma(\sigma-1)}\right)\left(\frac{\delta}{1+\delta}\right)\left(2+\frac{\rho\eta}{L}\right) \quad (28)$$

The initial term on the right-hand side of equation (28) signifies the adverse effect of an increase in s_c on the welfare of the home country due to the tax burden incurred to finance the export subsidy. This effect is referred to in this paper as the tax burden effect. The second term represents the improvement in welfare resulting from the reduction in transport costs for consumers in the home country when γ is increased by an increase in sc. This is attributable to an increase in the number of firms in the home country, which enables households in the home country to reduce the volume of foreign imports, thereby avoiding unnecessary transportation costs. This effect is referred to in this paper as the relocation effect. The third term represents the positive effect of joint subsidy increases, which is a consequence of an increase in terms of trade. This effect is referred to in this paper as the terms of trade effect. The terms of trade effect is contingent on the number of firms in the home country (γ). For instance, an increase in the number of firms in the home country (γ) will result in a reduction of the terms of trade effect in the home country. This can be explained as follows: the higher the number of firms located in a country (γ), the lower the country's dependence on imports, which reduces the degree of improvement in terms of trade caused by imports. The fourth term represents the growth effect of an increase in s_c on the world growth rate, which increases the wealth of the home country and, consequently, the welfare of the home country. In conclusion, the tax burden effect exerts a negative influence on welfare, whereas the relocation effect, the terms of trade effect and the growth effect exert a positive influence on welfare. Consequently, the net welfare effect of a multilateral subsidy on the home country is contingent upon the relative strength of these countervailing effects. However, if L is sufficiently large, the tax burden effect becomes sufficiently small. Therefore, in this case, we obtain the following result:

$$\left.\frac{\partial U(0)}{\partial s_c}\right|_{s_c\approx 0} > 0 \tag{29}$$

Subsequently, differentiating equation (23) with respect to s_c yields the following result for the welfare impact of the foreign country:

$$\left.\frac{\partial U^{*}(0)}{\partial s_c}\right|_{s_c\approx 0} = \frac{1}{\rho\left(L+\rho\eta(1-k)\right)}\left(\frac{\alpha\delta}{1-\delta^2}\right)\left[\delta\left(1+\frac{\rho\eta k}{L}\right)-\left(1+\frac{\rho\eta(1-k)}{L}\right)\right]-\left(\frac{\alpha(1-\delta)}{\rho(\sigma-1)}\right)\left(\frac{1}{1-(1-\delta)\gamma}\right)\frac{\partial\gamma}{\partial s_c}+$$

$$\frac{\alpha\delta\gamma}{\rho}\left(\frac{1}{1-(1-\delta)\gamma}\right)+\left(\frac{\alpha^2(1-\alpha)}{\rho^2\eta\sigma(\sigma-1)}\right)\left(\frac{\delta}{1+\delta}\right)\left(2+\frac{\rho\eta}{L}\right). \tag{30}$$

The initial term on the right-hand side of equation (30) represents the impact of an increase in s_c on the welfare of the foreign country through an increase in the tax burden. The second term represents the negative effect on welfare resulting from the increase in the transport cost burden on consumers in the foreign country when γ is increased by an increase in s_c. The third term represents the effect of changes in the terms of trade. It is important to note that the terms of trade effect also occurs in the non-agglomerated foreign country and is dependent on the number of firms located in the home country (γ). Consequently, the greater the number of firms located in the home country (γ), the more pronounced the terms of trade effect in the foreign country, which is the inverse of that observed in the home country. This is due to the fact that the greater the number of firms in the home country (γ), the greater the foreign country's dependence on imports from the home country. Consequently, as the number of firms in the home country (γ) increases, the positive terms of trade effect in the foreign country is more pronounced, as import costs in the foreign country are reduced. The fourth term represents the growth effect that an increase in s_c has on the world growth rate, which thereby increases the wealth of the foreign country and, consequently, the welfare of the foreign country. In conclusion, the foreign country's welfare effect of a multilateral increase in the common subsidy rate is characterised by a complex interplay of negative and positive welfare effects. On the one hand, there are negative welfare effects associated with the tax burden and relocation effects. On the other hand, positive welfare effects emerge from the terms of trade and growth effects. It follows that the net welfare effect of a multilateral subsidy on the welfare of the foreign country is contingent upon the relative strength of these countervailing effects. However, if L is sufficiently large, the negative tax burden effect becomes sufficiently small. Furthermore, if ρ and η are sufficiently small, the positive growth effect becomes large. Consequently, in this case, we obtain the following result:

$$\left.\frac{\partial U^*(0)}{\partial s_c}\right|_{s_c \approx 0} > 0 \tag{31}$$

7. Conclusion

This paper used a two-country endogenous growth model to consider the growth and welfare implications of a simultaneous multilateral increase in an export subsidy, taking into account the international relocation of firms and transport costs. Firstly, it was showed that a simultaneous multilateral increase in export subsidies consequently leads to an elevation in global growth through an increase in labour within the R&D sector. Secondly, it was shown that the welfare impact of a simultaneous multilateral subsidy on both the home and foreign country's welfare is positive under certain conditions.

Disclosure Statement

No potential conflict of interest was reported by the author.

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