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Trade, Luxury Goods and a Growth Enhancing Tariff

Leonid V. Azarnert

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Abstract

This article presents a Ricardian model of trade with learning-by-doing to study the effect of barriers to trade in products with low growth potential on the long-run economic growth. The model shows that, when elasticity of demand for the product with a lower learning potential is greater than unity, a tariff imposed on this product can shift the demand toward the product with a higher learning potential, thus enhancing growth in the exporter economy. Therefore, although with some possible negative effect on the welfare in the short run, barriers for the export of natural luxury goods may be beneficial for developing economies in the long run, since they increase their incentive to develop sectors with higher growth potential.

Leonid V. Azarnert
Department of Economics and Business Administration
Ariel University
Israel – Ariel, 40700
Leonid.Azarnert@ariel.ac.il

1. Introduction

One of the channels through which international trade can affect economic growth is its influence on sectoral composition: trade alters the relative price and the resulting supply and demand of goods, and the sectoral composition of production determines the overall rate of growth if different goods have different rates of technological progress. These compositional changes in the structure of production due to trade may not necessarily be growth enhancing for all trading countries. Thus, for example, it has been broadly argued that, if trading economies are at different levels of economic development, the more developed countries, rich in skilled labor or with superior technology, will specialize in the production of skill-intensive goods with more potential for further technological progress, while the less developed countries will specialize in the goods with lower growth potential.[1]

This paper focusses on trade in high value natural resources with higher than unitary elasticity of demand, such as several highly valuable hard minerals, especially, diamonds and other gems, exotic tropical products, rare plants and animal species, that represent a considerable fraction of the export in many poor slow developing countries, in particular, in Africa.[2] Building on Spilimbergo (2000), I use a three-good and two-country Ricardian model of trade to show that, if the product with a lower learning potential is characterized by a higher than unitary elasticity of demand, a tariff imposed on such product can increase the demand for the product with a higher learning potential. The present analysis thus suggests that, although with some possible negative effect on the welfare in the short run, barriers for the export of natural luxury goods may be beneficial for developing countries in the long run, since they increase their incentive to develop sectors with higher growth potential.

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[1] Yanikkaya (2003), where some references to theoretical literature can be found, demonstrated that, in contrast to the developed world, in many presently developing countries trade liberalization was not growth enhancing. Bond et al. (2013) show that, if the labor-intensive good is inferior, trade can pull an initially rich country into poverty.

[2] For a discussion of a negative association between diamond production and development see, for example, Olsson (2006), where further references and a survey of the more general literature on the "natural resources curse" can be found. Even in the "developmental state" of Botswana fast growth of the mining sector has been associated with the failure of the manufacturing sector that amounted to roughly 3% of the country's GDP (e.g. Hillbom, 2012 and references therein). For a detailed description of the lucrative transnational wildlife trade in Africa see Warchol et al. (2003).

The intuition behind this result is as follows. Suppose the world that consists of two entities: a developing home country and the rest of the world consolidated as a "foreign country". Suppose there is one factor of production and three different goods, all produced with a constant return to scale technology. One good represents the aforementioned natural luxury goods that are exported by many developing countries, especially, in the Sub Sahara. Another good is manufacture, which is still an advanced product for many developing countries. The third good represents all other products, where the rest of the world has its comparative advantage. The "foreign" good can, for example, be the high-tech products, where the advanced developed countries have the biggest comparative advantages. Similarly, it can also represent many other more traditional high-quality goods, such as exclusive cars, designers' clothes, or simply, foie gras, or a quality whisky, which are exported by the developed countries.

Suppose for simplicity that in the more advanced foreign economy all gains from learning have already been achieved and no further learning is possible. Similarly, in the home country there is no possibility for learning in the luxury, as well as in the "foreign", sectors, but further learning is still possible in the manufacturing sector. Suppose the comparative advantages are such that, when trade is allowed, the home country will produce and export the natural luxury goods and manufacture, while the foreign country will specialize in its own "foreign" good.[3]

With technological progress modeled as learning-by-doing, it is straightforward that trade will increase the worldwide demand for the manufactured good, produced in the home country, thus stimulating technological progress in the home country and improving welfare in both countries. It is similarly clear that with unitary elasticity of demand an import tariff imposed in the foreign country on the natural luxury good will proportionally decrease the demand for that good in the foreign country and reduce welfare, but it will have no effect on the demand for the manufactured good and then on the process of learning in the home country.

Proceeding now to the main insight of the present paper, let us recall that elasticity of demand for the natural luxury good is greater than unity. Now, with the non-constant

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[3] With such pattern of comparative advantage, allowing for learning in the "foreign" sector in the home economy will not generate additional insights.

shares of income allocated to different goods, an import tariff imposed in the foreign country on the natural luxury good will decrease the foreign country's demand for that product more than proportionally, thereby causing a reallocation of resources toward the manufactured product. This will generate an additional stimulus for a further increase in the worldwide demand for the product with a potential for further learning. This in turn will intensify the learning process and technological progress in the manufacturing sector in the home country.

To fully concentrate on the pure effect of trade barriers per se, it is assumed in this paper that tariff revenues are fully appropriated by the absentee government and are not redistributed to the population in the foreign economy. As long as the revenues are collected on the natural luxury good, adding redistribution will strengthen the paper's result, because the net effect will be to reduce the demand for this good and further increase the demand for the good with learning, relative to the case presented in the next section[4]

While unambiguously beneficial for technological progress, the tariff has an ambiguous effect on welfare. Thus, on the one hand, it predictably reduces the static gains from trade. But, on the other hand, it also enhances the process of learning, which yields the dynamic gains. The net effect on the welfare is thus uncertain. But, as long as the dynamic gains associated with an increase in technological progress are strong enough to outweigh the static losses, the trading economies can be better off with the tariff, relative to free trade. In this work, I derive the exact conditions for the tariff to increase or decrease welfare in the home and foreign countries and the world as a whole.

2. The Model

In this section, I present and analyze the basic model with two countries: Home and Foreign. The population size of Home is normalized to one, while the population size of Foreign is f.[5] I suppose that there is no international mobility of labor, while there is

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[4] Some references to the large literature on tariffs can be found, for instance, in Opp (2010). For an analysis of the welfare implications of the distribution of tariff revenues see, for example, Galor (1994).

[5] When population growth is allowed, international trade can generate an incentive in less developed countries to specialize in the production of the unskilled labor-intensive goods, thus leading to the

perfect mobility of labor across sectors.[6] First, I introduce a demand function and specify the production side. Second, I consider the equilibrium in autarky and with international trade. Next, I proceed to the effect of the import tariff imposed in Foreign on the product without learning on technological progress in the exporter Home. Finally, I compare welfare with tariff and under free trade.

2.1. Demand side

In both countries the agents share the same endowments and the same preferences. In every period each agent is endowed with one unit of labor, which is supplied to the labor market at the price of 1. The utility of an agent in country j (= Home or Foreign) at time 0 is given by:

$$W_0^j = \int_0^\infty U_t^j e^{-\rho t} dt \,, \tag{1}$$

where U_t^j is an instantaneous utility function in country j at time t, and ρ is the discount rate. The instantaneous utility function is a variation on a Stone-Geary-type utility function, and it has three arguments (the goods x, y, and z):[7]

$$U_t^j = \alpha \ln(x_t^j + X) + \beta \ln(y_t^j) + \gamma \ln(z_t^j), \tag{2}$$

where j specifies the country ($j = H, F$), X is a nonnegative constant and $\alpha, \beta, \gamma, \in (0,1)$, $\alpha + \beta + \gamma = 1$.

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expansion of population and delaying the process of development, as shown by Galor and Mountford (2006, 2008) and Azarnert (2016). Close in spirit to this line of research, it has also been shown that foreign aid may similarly lead to the expansion and further impoverishment of the poor recipient populations (Azarnert, 2008). Strulik and Weisdorf (2014) show how child costs and survival shaped the industrial revolution and the demographic transition, while Ferreira et al. (2016) argue that trade specialization played an indispensable role in supporting the industrial revolution. Sasaki (2015) examines the relationship between international trade and industrialization, when population growth is negative.

[6] In Azarnert (2004) I consider the effect of the opportunities abroad for the high-skilled taxpayers on taxation and then economic growth. In Azarnert (2012a, b) I consider the effect of temporary guest-worker-type migration on economic growth in the source countries. In Azarnert (2010) I show how the influences of unskilled immigration, differential fertility between immigrants and the local indigenous population, and the incentives for investment in human capital combine to predict the decline of the West.

[7] Although following Spilimbergo (2000) I adopt a Stone-Geary-type utility function, the same result could be obtained using any utility function with elasticity of substitution greater than one. Note however that this is not a standard Stone-Geary utility function with minimum consumption requirements. A similar formulation of the demand for high income elasticity goods along with the underlying justification and some further references can be found, for instance, in Markusen (2013). Cf. also Caron et al. (2014).

All goods are perishable, they cannot be accumulated, and saving is not possible, so that consumers maximize their instantaneous utility each period.

Standard maximization problem ($\max U_t^j$ s. t. $P_{xt}^j x_t^j + P_{yt}^j y_t^j + P_{zt}^j z_t^j = 1$), where P_{it}^j is the price for a good i ($= x, y, z$) in country j at time t gives the demands for x_t^j, y_t^j, z_t^j:

$$x_t^j = \frac{\alpha}{P_{xt}^j}\left(1 - \frac{1-\alpha}{\alpha} P_{xt}^j X\right), \tag{3}$$

$$y_t^j = \frac{\beta}{P_{yt}^j}\left(1 + P_{xt}^j X\right), \tag{4}$$

$$z_t^j = \frac{\gamma}{P_{zt}^j}\left(1 + P_{xt}^j X\right). \tag{5}$$

An assumption that $\frac{1-\alpha}{\alpha} P_{xt}^j X < 1$ ensures that the demand for x is always strictly positive. Given that population size of Home and the wage rate are normalized to 1, Eqs. (3) to (5) represent both individual and total demand in Home. Individual demand in Foreign is obtained by multiplying these equations by the relative wage in that country, ω, as specified below in Section 2.4. The total demand in Foreign is obtained by multiplying these equations by f.

Finally, we obtain the indirect utility function by plugging the demand for goods x, y, and z (Eqs. (3) to (5)) into the instantaneous utility function (Eq. (2)):

$$U_t^j = \ln(1 + P_{xt}^j X) - \alpha \ln P_{xt}^j - \beta \ln P_{yt}^j - \gamma \ln P_{zt}^j + J, \tag{6}$$

where $J \equiv \alpha \ln \alpha + \beta \ln \beta + \gamma \ln \gamma$.

2.2. Supply side

In both countries all the goods are produced using labor as the only input with a constant return to scale technology:

$$i_t^j = \frac{1}{a_{it}^j} L_{it}^j, \quad i = x, y, z, \tag{7}$$

where L_{it}^{j} is the number of workers employed in the production of good $i (= x, y, z)$ in country j at time t and a_{it}^{j} is a coefficient that is time-, country- and good-specific.

In the terminology of the example given in the introduction, suppose that good x represents the natural luxury goods, such as precious stones, several other highly valuable minerals, exotic tropical products, rear plants and animal species that are exported by many developing countries, in particular, in Africa. Good y is manufacture, which is an advanced product for many developing countries. Lastly, good z represents all other products, where the rest of the world, consolidated as the foreign country, has a comparative advantage.

For simplicity, suppose that in the foreign country all gains from learning have already been achieved and no further learning is possible. Similarly, in the home country no learning is possible in the natural luxury sector x, as well as in the "foreign" sector z, but further learning is still possible in the manufacturing sector y. Therefore, in Foreign, the unit labor requirement (a_{i}^{j}) is constant for all three goods. In Home, the unit labor requirement is constant for goods x and z, whereas for good y it can change over time, because in sector y technological progress is possible in this country as specified below. Suppose also that this technological progress is limited by a constant a_{y}^{H}; $\lim_{t \to \infty} a_{yt}^{H} = a_{y}^{H}$.

Technological progress, which is limited to manufactured good y in the home country, is country specific and operates through a learning-by-doing as, for example, in Krugman (1987), Lucas (1988), Redding (1999), Matsuyama (1992), Spilimbergo (2000), and Azarnert (2014). The percentage reduction in the production cost is proportional to the number of workers employed in the production and to a constant ξ:

$$\frac{\dot{a}_{yt}^{H}}{a_{yt}^{H}} = -\xi L_{yt}^{H}, \tag{8}$$

where L_{yt}^{H} represents the number of workers who are employed in the production of the good y in the home country at time t.

The two countries have different technologies. The comparative advantages are assumed to be as follows:

$$\frac{a_z^H}{a_z^F} > \frac{a_{yt}^H}{a_y^F} > \frac{a_x^H}{a_x^F}, \qquad a_{yt}^H \geq a_y^H. \tag{9}$$

Suppose that if, when trade is allowed, an import tariff at the rate τ is imposed in the foreign country on good x imported from the home country, this does not affect the comparative advantages, so that:[8]

$$\frac{a_z^H}{a_z^F} > \frac{a_{yt}^H}{a_y^F} > \frac{a_x^H(1+\tau)}{a_x^F}. \tag{9a}$$

Except for the tariff, I assume a competitive environment in both countries, so that in a closed economy $P_{xt}^j = a_x^j$; $P_{zt}^j = a_z^j$; $P_{yt}^F = a_y^F$; $P_{yt}^H = a_{yt}^H$. To concentrate on the pure effect of the trade barriers per se, suppose that tariff revenues are fully appropriated by the absentee government and are not redistributed to the population in Foreign.

2.3. Equilibrium in autarky

In this section, I determine the relative prices faced by consumers, the relative demands, and the dynamics of the autarkic economy. I first present the home economy. Next, I proceed to the foreign country.

Note that in Home, the demand for y changes over time, because it depends on a_{yt}^H, which decreases over time owing to technological progress. The time path of a_{yt}^H depends, through the formula for the learning-by-doing (Eq. (8)), on the number of workers employed in sector y (L_{yt}^H) and on the demand for y (Eq. (4)). Using equations (4), (7) and (8), and noting that $P_{xt}^H = a_x^H$ and $P_{zt}^H = a_z^H$, we can obtain the rate of growth of a_{yt}^H:

$$\frac{\dot{a}_{yt}^H}{a_{yt}^H} = -\xi L_{yt}^H = -\xi\beta(1+a_x^H X), \tag{10}$$

or

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[8] Formally, this condition implies that technological progress in sector y in the home country sets the upper bound for the tariffs imposed on the good produced in sector z. Models with an endogenous emergence of comparative advantages can be found, for instance, in Redding (1999), Fajgelbaum, Grossman and Helpman (2011) and Jaimovich and Merella (2015).

$$a_{yt}^{H} = a_{y0}^{H} e^{-\xi D^{H,a} t}, \quad \text{where} \quad D^{H,a} \equiv \beta(1 + a_x^{H} X). \tag{11}$$

Plugging a_x^{H}, a_{yt}^{H} and a_z^{H} for P_{zt}^{H}, P_{yt}^{H} and P_{yt}^{H} into Eq. (6), we can obtain the utility in Home in autarky at time t:

$$U_t^{H} = \ln(1 + a_x^{H} X) - \alpha \ln a_x^{H} - \beta \ln a_{y0}^{H} - \gamma \ln a_z^{H} + \xi \beta D^{H,a} t + J \tag{12}$$

Therefore, the welfare in Home in autarky at time 0 is:

$$W_0^{H} = \int_0^{\infty} U_t^{H} e^{-\rho t} dt = \int_0^{\infty} S^{H,a} e^{-\rho t} dt + \xi \int_0^{\infty} D^{H,a} t e^{-\rho t} dt = \frac{S^{H,a}}{\rho} + \frac{\xi D^{H,a}}{\rho^2}, \tag{13}$$

where $S^{H,a} \equiv \ln(1 + a_x^{H} X) - \alpha \ln a_x^{H} - \beta \ln a_{y0}^{H} - \gamma \ln a_z^{H} + J$.

As in Spilimbergo (2000), the utility in Home is thus decomposed into two components: a static component ($S^{H,a}/\rho$), which depends on the present state of the technology ($a_x^{H}, a_{y0}^{H}, a_z^{H}$), and a dynamic component ($\xi D^{H,a}/\rho^2$), which depends on the accumulation rate of technological progress and on the amount of labor employed in the production of y.

In contrast to Home, in Foreign in autarky the demands for all three goods are constant over time. Therefore, plugging a_x^{F}, a_y^{F} and a_z^{F} for P_{xt}^{F}, P_{zt}^{F} and P_{yt}^{F} into Eq. (6), the utility in Foreign in autarky at time t is:

$$U_t^{F} = \ln(1 + a_x^{F} X) - \alpha \ln a_x^{F} - \beta \ln a_y^{F} - \gamma \ln a_z^{F} + J \tag{14}$$

and the welfare in Foreign in autarky at time 0 is:

$$W_0^{F} = \int_0^{\infty} U_t^{F} e^{-\rho t} dt = \int_0^{\infty} S^{F,a} e^{-\rho t} dt = \frac{S^{F,a}}{\rho}, \tag{15}$$

where $S^{F,a} \equiv \ln(1 + a_x^{F} X) - \alpha \ln a_x^{F} - \beta \ln a_y^{F} - \gamma \ln a_z^{F} + J$.

Since, by assumption, further learning is not possible in the developed foreign economy, in contrast to Home, there is no dynamic component in the utility in Foreign.

2.4. International trade

In this section international trade is allowed. The equilibrium with trade between Home and Foreign is supposed to satisfy two conditions: first, production must be split

according to comparative advantages; second, trade must be balanced. These two conditions determine the range of goods produced in Home and in Foreign and the relative wage between Home and Foreign. Using the wage in Home as numeraire, we define ω as the wage in the foreign country in terms of the wage in the home country.

2.4.1. Comparative advantages

The first condition states that the location of the production of the goods is split according to comparative advantages. Home has a comparative advantage in the production of the natural luxury good x and manufacture y, while Foreign has a comparative advantage in the production of the "foreign" good z (Eq. (9a)). Further, I suppose that, when trade is allowed, Home will produce and export the goods x and y, while Foreign will produce and export the good z.[9]

2.4.2. Balanced trade

The second condition states that trade must be balanced. To find the level of ω, which solves this condition, we have to determine the relative prices in both countries. Given the specialization pattern and the tariff at the rate τ imposed in Foreign on the natural luxury good x imported from Home, the relative prices are:

$$\text{in Home} = \begin{cases} P_{xt}^H = a_x^H \\ P_{yt}^H = a_{yt}^H \\ P_{zt}^H = a_z^F \omega \end{cases} \quad \text{and in Foreign} = \begin{cases} P_{xt}^F = a_x^H (1+\tau)/\omega \\ P_{yt}^F = a_{yt}^H/\omega \\ P_{zt}^F = a_z^F \end{cases} \tag{16}$$

The balanced trade condition requires that the value of the import of Home should equal the value of the import of Foreign:

$$z_t^H P_{zt}^H = (x_t^F P_{xt}^F + y_t^F P_{yt}^F) f\omega. \tag{17}$$

Therefore,

$$z_t^H P_{zt}^H = (1 - z_t^F P_{zt}^F) f\omega. \tag{18}$$

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[9] With the equilibrium level of ω, as computed below in (19), the specialization follows this pattern.

Substituting the demand for z in Home and Foreign in Eq. (18) yields the equilibrium level of ω:[10]

$$\omega = \frac{\gamma(1 + a_x^H X(1 + (1+\tau)f))}{(1-\gamma)f}.$$ (19)

Equation (19) immediately yields the following lemma.

Lemma 1: *An import tariff τ imposed on the natural luxury good x imported from the home country increases the relative wage in the foreign country ω.*

Note also that ω depends only on parameters that are constant over time and the tariff (τ), which is given exogenously.

2.5. *Growth with free trade and with tariff*

Recall that, as follows from comparative advantages, once trade starts, Foreign stops producing manufactured good y. Hence, with trade, the total amount of y worldwide is supplied by Home, where, in contrast to Foreign, further learning in sector y is still possible.

With ω as given in equation (19), the prices of the imported goods x and y in Foreign are:

$$P_x^F = \frac{(1-\gamma)f}{\gamma(((1/a_x^H) + X)(1+\tau)^{-1} + fX)}.$$ (20)

and

$$P_{yt}^F = \frac{(1-\gamma)a_{yt}^H f}{\gamma(1 + a_x^H X(1 + (1+\tau)f))}.$$ (21)

The following lemma summarizes this result.

Lemma 2: *An import tariff τ imposed on the natural luxury good x imported from the home country increases the price of this good in the foreign country, while, at the same time, reducing the price of the imported manufactured good y.*

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[10] The steps to compute ω are:

$$\gamma(1 + P_{xt}^H X) = [1 - \gamma(1 + P_{xt}^F X)]f\omega \quad \Rightarrow \quad \gamma(1 + a_x^H X) = \left[1 - \gamma\left(1 + \frac{a_x^H(1+\tau)}{\omega}X\right)\right]f\omega.$$

Solving this equality for ω gives equation (19).

Clearly, the change in the prices, relative to the free trade, is likely to reduce the demand for the imported good x, while increasing the demand for the imported good y in Foreign. This allows us to hypothesize that the change in the worldwide demand pattern is likely to increase the total worldwide demand for the manufactured product y, thus encouraging the learning-by-doing process in sector y in Home.

To verify this hypothesis, compute first the total worldwide demand for good y_t:[11]

$$y_t^{H,tr} + y_t^{F,tr} = \frac{1}{a_{yt}^H} D^{tr},$$ (22)

where $D^{tr} \equiv \beta\left((1 + a_x^H X(1+(1+\tau)f))/(1-\gamma)\right)$.

Note however that with a unitary elasticity of demand, when $X = 0$, the price of the manufactured good y in Foreign (P_{yt}^F), as shown in equation (21) is not affected by the tariff imposed on x and therefore the worldwide demand for good with learnig y (Eq. 22) is also not affected by τ.

Given the production function, as specified in equation (7), the total amount of labor in sector y is $L_{yt}^H = D^{tr}$. From equation (22), it is clear that with any $\tau > 0$ the total amount of labor employed in sector y in Home is higher than with $\tau = 0$. Namely, any tariff $\tau \geq 0$ is associated with an increase in the amount of labor producing the product y by:

$$\Delta L_{yt}^{tr}(\tau \geq 0) \equiv L_{yt}^{tr}(\tau > 0) - L_{yt}^{tr}(\tau = 0) = \tau \frac{\beta a_x^H X f}{1-\gamma}.$$ (23)

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[11] The total demand for y_t is the sum of the demands in Home and in Foreign. The total demand for y_t is thus:

$$y_t^{H,tr} + y_t^{F,tr} = \frac{\beta}{P_{yt}^H}\left(1 + P_{xt}^H X\right) + \frac{\beta}{P_{yt}^F}\left(1 + P_{xt}^F X\right)f$$

$$= \frac{\beta}{a_{yt}^H}\left(1 + a_x^H X\right) + \frac{\beta\omega}{a_{yt}^H}\left(1 + \frac{a_x^H(1+\tau)}{\omega} X\right)f = \frac{\beta}{a_{yt}^H}\left(1 + a_x^H X(1+(1+\tau)f) + \omega f\right).$$

Plugging in the equation for ω (19) and simplifying gives equation (23).

The labor force in sector y determines the temporal path of the coefficient a_{yt}^H according to the learning-by-doing process ($\frac{\dot{a}_{yt}^H}{a_{yt}^H} = -\xi L_{yt}^H = -\xi D^{tr}$): $a_{yt}^H = a_{y0}^H e^{-\xi D_0^{tr} t}$.

Therefore, any tariff imposed on the natural luxury good x leads to the one-period percentage reduction in the production cost of the manufactured good y by: $\tau \xi \frac{\beta a_x^H X f}{1-\gamma}$.

This implies that any tariff on x changes the whole temporal path of the coefficient a_{yt}^H and thus any $\tau \geq 0$ yields the following gains in the learning-by-doing process in sector y:

$$\Delta a_{yt}^H \equiv a_{yt}^H(\tau \geq 0) - a_{yt}^H(\tau = 0) = a_{y0}^H[e^{-\xi D_{\tau \geq 0}^{tr} t} - e^{-\xi D_{\tau = 0}^{tr} t}]. \tag{24}$$

This allows us to establish the following result.

Proposition 1: *An import tariff τ imposed on the natural luxury good with elasticity of demand greater than unity x imported from the home country shifts the worldwide pattern of demand toward the manufactured good y, where further learning is possible, thus encouraging technological progress in the manufacturing sector in the home country.*

2.6. Welfare with free trade and with tariff

Welfare depends on the present state of the technology and on the dynamics of the prices of y, as determined by the temporal path of the unit labor requirement in sector y in Home (a_{yt}^H). Now, once we have the temporal path followed by the price of y ($P_{yt}^H = a_{yt}^H$ and P_{yt}^F as shown in Eq. (21)), the utility in Home and in Foreign in the case of trade at time 0 can be calculated:

$$W_0^{j,tr} = \int_0^\infty U_t^{j,tr} e^{-\rho t} dt = \frac{S^{j,tr}}{\rho} + \frac{\xi D^{tr}}{\rho^2}, \tag{25}$$

where

$$S^{H,tr} \equiv \ln(1 + a_x^H X) - \alpha \ln a_x^H - \beta \ln a_{y0}^H - \gamma \ln a_z^F \omega + J,$$

$$S^{F,tr} \equiv \ln(1+(a_x^H(1+\tau)/\omega)X)-\alpha\ln(a_x^H(1+\tau)/\omega)-\beta\ln(a_{y0}^H/\omega)-\gamma\ln a_z^F+J,$$

and $D^{tr} \equiv \beta\big((1+a_x^H X(1+(1+\tau)f))/(1-\gamma)\big).$

As in the case of autarky, the utility is decomposed into two components: a static component ($S^{j,tr}/\rho$), which depends on the present state of the technology (a_x^H, a_{y0}^H, a_z^F), and a dynamic component ($\xi D^{tr}/\rho^2$), which depends on the accumulation rate of technological progress and on the amount of labor employed in the production of y in Home. Note that with trade the dynamic component exists also in the utility of Foreign, because technological progress, associated with learning in Home, reduces the price of the product y in Foreign as well. Note also that with trade the dynamic component is the same in Home and in Foreign, because it depends on the total demand for good y, produced in Home, worldwide.

Proceeding now to the analysis of the effect of the tariff on welfare, recall that the condition for welfare in country j to be higher with tariff than under free trade is

$$W_0^{j,\tau>0} > W_0^{j,\tau=0} \quad\Rightarrow\quad \frac{\xi}{\rho}\big(D_{\tau>0}^{tr}-D_{\tau=0}^{tr}\big) > S_{\tau=0}^{j,tr}-S_{\tau>0}^{j,tr}. \tag{26}$$

The interpretation of the inequality (26) is as follows. Tariff leads to a higher level of utility than free trade only if the gains in the dynamic component are positive enough to compensate for the decrease in the static component, which is always lower with tariff, than under free trade, as follows from the new price structure in presence of the tariff.

Thus, given equation (25), Home gains from the tariff as long as the following inequality holds:

$$\tau\frac{\xi\beta a_x^H Xf}{\rho(1-\gamma)} > \gamma\ln\left(\frac{1+a_x^H X(1+(1+\tau)f)}{1+a_x^H X(1+f)}\right). \tag{27}$$

Although in this model tariff revenues are not redistributed to the population in Foreign, the same intuition implies that, if the dynamic gains are strong enough, the tariff can also be beneficial for Foreign as well. The formal condition for Foreign to gain from the tariff is:

$$\tau\frac{\xi\beta a_x^H Xf}{\rho(1-\gamma)} > \ln\left(\frac{(1+a_x^H X(1+(f/\gamma)))(1+a_x^H X(1+(1+\tau)f))}{(1+a_x^H X(1+f))(1+a_x^H X(1+(1+\tau)(f/\gamma)))}\right)+$$

$$\alpha \ln\left(\frac{(1+\tau)(1+a_x^H X(1+f))}{1+a_x^H X(1+(1+\tau)f)}\right)+\beta \ln\left(\frac{1+a_x^H X(1+f)}{1+a_x^H X(1+(1+\tau)f)}\right). \quad (28)$$

With the population size in Home normalized to one, while the population in Foreign is f, the condition for the welfare in the whole world to be higher with tariff than under free trade is

$$W_0^{H,\tau>0}+fW_0^{F,\tau>0}>W_0^{H,\tau=0}+fW_0^{F,\tau=0} \quad \Rightarrow$$

$$\frac{\xi}{\rho}(1+f)\left(D_{\tau>0}^{tr}-D_{\tau=0}^{tr}\right)>S_{\tau=0}^{H,tr}-S_{\tau>0}^{H,tr}+f(S_{\tau=0}^{F,tr}-S_{\tau>0}^{F,tr}). \quad (29)$$

Therefore, the world that consist of Home and Foreign can gain from the tariff imposed on the natural luxury good with the elasticity of demand greater than unity x if

$$\tau\frac{\xi\beta a_x^H Xf}{\rho(1-\gamma)}(1+f)>f\ln\left(\frac{(1+a_x^H X(1+(f/\gamma))(1+a_x^H X(1+(1+\tau)f)}{(1+a_x^H X(1+f))(1+a_x^H X(1+(1+\tau)(f/\gamma))}\right)+ \quad (30)$$

$$f\alpha\ln\left(\frac{(1+\tau)(1+a_x^H X(1+f))}{1+a_x^H X(1+(1+\tau)f)}\right)+f\beta\ln\left(\frac{1+a_x^H X(1+f)}{1+a_x^H X(1+(1+\tau)f)}\right)+\gamma\ln\left(\frac{1+a_x^H X(1+(1+\tau)f)}{1+a_x^H X(1+f)}\right)$$

3. Conclusion

This article presents a three-good and two-country Ricardian model of trade with technological progress, modelled as learning-by-doing, to study the effect of barriers to trade in products with low growth potential on the long-run economic growth. The model shows that, when elasticity of demand for the product with a lower learning potential is greater than unity, a tariff imposed on this product can shift the demand toward the product with a higher learning potential, thus enhancing growth in the exporter economy. Therefore, the current analysis suggests that, although with some possible negative effect on the welfare in the short run, barriers for the export of natural luxury goods may be beneficial for developing economies in the long run, since they increase their incentive to develop sectors with higher growth potential.

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