CHAPTER 5

TERMS OF TRADE AND NONTRADED GOODS: A THEORETICAL ANALYSIS
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5.1 Introduction:

The theoretical literature associated with the behaviour of terms of trade in the presence of nontraded goods is not too extensive. In international trade theory, some attempts have been made to examine the basic propositions derived from the Heckscher-Ohlin-Samuelson (HOS) model, which includes nontradeables as the third good. Works by Komiya (1967) and Ethier (1973) are examples of this kind. These works assume that prices of the tradeables are given internationally and hence terms of trade is exogenous to their analysis. In a system with exogenous terms of trade, the presence of the nontradeables does not bear so much significance as they do in a system with endogenous terms of trade. Dornbusch (1980) has developed a trade model by including non-traded goods. He examines how terms of trade is endogenously determined. However, he makes no attempt to examine the propositions associated with the HOS model.

Without confining ourselves to a large country framework, we may, however, treat terms of trade to be endogenous in the context of developing economies also. Exogeneity tests conducted by Lutz and Singer (1994) does not contradict the hypothesis that terms of trade may be endogenous to the developing countries. They have argued that an individual country may be small in terms of aggregate economic weight, but if its exports are strongly concentrated on one or very few export commodities its share in global markets for these commodities may cease to be economically negligible. With sufficient
export/import concentration on a few highly specialised commodities, even a "small country" may no longer be "small" in the context of the specific global markets for specific commodities.\footnote{See Lutz and Singer (1994)}

As part of the development process of the LDCs, demand for nontradeable goods\footnote{We assume that the nontradeables consist of physical infrastructures, like roads, highways, ports, airports, electricity, etc. and social infrastructures, like primary education, basic health care facilities, supply of safe drinking waters, etc.} rises. With equality between income and expenditure, the growth in the demand for nontradeables will have some definite impact upon the trade balance condition when there is equilibrium in the market for exports. Terms of trade would adjust to restore balance in the trade balance condition. Again Dornbusch (1980) has shown that in the presence of nontradeables terms of trade will change if there is a rise in the foreign demand for home exports.

Komiya (1967) has analysed the impact of a rise in the stock of capital upon terms of trade. He has shown that a rise in the stock of capital would turn terms of trade in favour of the country owing to a fall in the demand for imports when importables are more capital intensive than exportables. But when the prices of internationally traded goods are endogenously determined, the factor prices and the price of the nontraded good also become endogenous. The market for the nontradeables would then play a major role in influencing the international terms of trade. So it might be interesting to examine the impact of rise in the stock of capital in a model with endogenous terms of trade. In this chapter, we would like to examine the impact of autonomous rise in the demand for
nontradeables of the home country, autonomous rise in foreign demand for home exports and a rise in the stock of capital on the terms of trade for the home country.

This chapter is organised in the following manner. Section 5.2 analyses the model and section 5.3 examines some comparative static exercises. We conclude the chapter in section 5.4.

5.2 The Model:

We consider a developing economy, which is capable of influencing the prices of the tradeable goods. There are three sectors in the economy. Sector $x$ produces exportables, $q_x$; sector $m$ produces importables, $q_m$; and sector $n$ produces nontradeable goods, $q_n$. Each good is produced with two factors, capital and labour. Factor endowments are exogenously given and there is full employment of the factors with perfect flexibility of factor prices. Since the economy produces more goods than factors, factor prices are determined by the prices of the traded goods. We assume that the production functions obey CRS with diminishing returns to factors and there is perfect competition in all markets.

We use the following notations in our model for all $i = x, m$ and $n$.

- $P_i$ – nominal price of the $i$-th good
- $p_i$ – relative price of the $i$-th traded good in terms of the non-traded good
- $w$ – wage rate

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29 See Acharyya and Marjit (2000).
$r$ – return on capital

$K$ – stock of capital

$L$ – supply of labour

$\Omega$ – all parameters, like factor endowments, of the model

$a_{ij}$ – quantity of the $i$-th factor required to produce one unit of the $j$-th product

$q_i$ – level of output of the $i$-th sector

$D_i$ – level of demand for the $i$-th good

$X$ – supply of exports

$M^*$ – foreign demand for home exports

$M$ – demand for imports

$\eta_n$ – supply elasticity for the nontradeables

$e_n$ – demand elasticity for the nontradeables

$E_{M^*}$ – elasticity of foreign demand for exports

$\sigma_X$ – supply elasticity of exports

$\alpha$ – proportion of the induced part out of the total demand for nontradeables

$(1-\alpha)$ – proportion of autonomous part out of the total demand for nontradeables

$\beta$ – proportion of the induced part out of the total foreign demand for home exports

$(1-\beta)$ – proportion of autonomous part out of the total foreign demand for home exports

$Y$ – national income in terms of nontradeables

Competitive equilibrium conditions give the following price-unit cost equations where the nominal prices are equal to their unit costs.\(^\text{30}\)

\(^\text{30}\) This formulation of the equational structure which includes nontradeables has been done on the basis of the works of Batra(1973).
raKx + waLx = Px (5.1)
raKm + waLm = Pm (5.2)
raKn + waLn = Pn (5.3)

Full employment conditions in the factor markets give equations (5.4) and (5.5).

\[ a_{Kx} q_x + a_{Kn} q_n = K \] (5.4)
\[ a_{Lx} q_x + a_{Ln} q_n = L \] (5.5)

Since, in this model, factor prices and thus the factor coefficients are functions of the prices of the traded goods the output levels\(^{31}\) of both tradeables and nontradeables are also functions of the prices of the tradeables.

Thus the supply of the nontraded goods is given by

\[ q_n = q_n (p_x, p_m; \Omega) \] (5.6)

where, \(\Omega\) represents all parameters, like \(K, L, etc.\)

Again, \(p_x = p_x / P_n\) (5.7)

and \(p_m = p_m / P_n\) (5.8)

The supply elasticities of the nontradeables (\(\eta_{lx}n\) and \(\eta_{lm}\m\)) with respect to the relative prices of the tradeables are negative since production of the nontradeables fall when the relative prices of the tradeables rise.\(^{32}\) Since the level of output of the nontradeables is determined by the supply-demand conditions in the local market, we introduce the demand function for the nontradeables as dependent on the relative prices of the tradeables and income, measured in terms of the nontradeables. Thus the demand function for nontradeables, by including an autonomous element \(D^0_n\), is expressed as

\[ D_n = D_n (p_x, p_m, Y) + D^0_n \] (5.9)

\(^{31}\) It is a standard result derived from the literature. See Komiya (1967).\(^{32}\) It implies that the supply elasticities of nontradeables with respect to relative prices of nontradeables are positive.
Assuming that the nontraded goods are substitutes to tradeables in consumption the demand elasticities \( (e_{nx} \text{ and } e_{nm}) \) for the nontraded goods with respect to the relative prices of the tradeables are taken to be positive. We represent the national income in terms of the nontradeables by equation (5.10) as

\[
Y = p_xq_x + p_mq_m + q_n \tag{5.10}
\]

So the equilibrium condition for the nontraded goods market is given by

\[
q_n (p_x, p_m; \Omega) = D_n (p_x, p_m, Y) + D_n^0 \tag{5.11}
\]

In order to make the terms of trade endogenous let us introduce the foreign demand function for home exports, \(^{33}\) which is split into two parts; one is a function of terms of trade and the other is an autonomous element \((M_0^*)\). Thus

\[
M^* = M^* (p_x / p_m) + M_0^* \tag{5.12}
\]

The foreigners will demand more of the home exports when terms of trade for the home country deteriorates. So the elasticity of foreign demand for exports \((E_{M^*})\) with respect to the terms of trade is negative.

The demand function for exportables in the home country is given as

\[
D_x = D_x (p_x, p_m, Y) \tag{5.13}
\]

The supply of exports of the home country is identical to the difference between the supply of exportables \((q_x)\) and the demand for exportables \((D_x)\). So supply of exports is a function of the relative prices and income. Hence we have

\[
X = q_x (.) - D_x (p_x, p_m, Y) = X (p_x, p_m, Y; \Omega) \tag{5.14}
\]

When the relative prices of the exportables rise, the supply of these goods also rise, but the demand for the exportables falls due to substitution effect and rises due to income

\(^{33}\) We ignore the impact of foreign country's income upon its own import demand as real income is a function of terms of trade. Thus foreign repercussion effects are ignored here.
effect arising out of improvement in terms of trade. Assuming stronger substitution
effect,\textsuperscript{34} we can say that demand for exportables falls. So the supply of exports rises when
its relative price rises. Thus the elasticity of supply of exports with respect to $p_x$ (i.e.,
$\sigma_{xp_x}$) is positive. Again when the relative prices of the importables rise, the supply of
exportables falls, but demand rises due to substitution effect and falls due to income
effect arising out of deterioration of terms of trade. With stronger substitution effect, the
supply of exports will fall. Hence the supply elasticity of exports with respect to $p_m$ (i.e.,
$\sigma_{xp_m}$) is negative. The equilibrium condition in the market for exports is given by
\begin{equation}
X(p_x, p_m, Y; \Omega) = M^* \left( \frac{p_x}{p_m} \right) + M_0^* \tag{5.15}
\end{equation}
Now the demand function for importables can be written as
\begin{equation}
D_m = D_m(p_x, p_m, Y) \tag{5.16}
\end{equation}
So the import demand function for the home country is obtained by the difference
between the demand for and supply of importables. Hence it is given by
\begin{equation}
M = D_m(p_x, p_m, Y) - q_m(\cdot) = M(p_x, p_m, Y; \Omega) \tag{5.17}
\end{equation}
The above system contains 17 equations with 17 unknowns: $w$, $r$, $p_x$, $p_m$, $p_n$, $q_x$, $q_m$,
$q_n$, $p_x$, $p_m$, $Y$, $D_x$, $D_m$, $D_n$, $M$, $X$, $M^*$. We can solve the system in the following way.
When the factor endowments are given, the output levels are functions of relative prices
of the tradeables. Thus, from equation (5.10) it can be said that the level of national
income depends only on $p_x$ and $p_m$, when $\Omega$ is given.\textsuperscript{35} Then equations (5.11) and (5.15)
jointly determine $p_x$ and $p_m$. Using equations (5.1), (5.2), (5.3), (5.7) and (5.8) we can
determine $w$, $r$, $p_x$, $p_m$, $p_n$. In fact, once the relative prices of the traded goods are

\textsuperscript{34} The assumption has been taken from the literature. See Dornbusch (1980) in this regard.
\textsuperscript{35} From equation (5.10), it follows that $Y = Y(p_x, p_m; \Omega)$
determined and the markets for exports and nontraded goods are in equilibrium, the terms of trade, defined as \((p_x / p_m)\), is also determined. We will see that there is no need to consider the trade balance condition separately to get the terms of trade when the markets for exports and nontraded goods are in equilibrium. When terms of trade is determined, the factor prices and the price of the nontraded good as well as the input requirements are determined.\(^\text{36}\) As \(p_x\) and \(p_m\) are determined, we can determine \(Y\). So, \(D_x, D_m, D_n, q_x, q_m, q_n, M\) and \(X\) are all determined. Again, as the terms of trade is already determined, we can determine \(M^*\) from equation (5.12).

We can now show that when the markets for nontradeables and exports are simultaneously in equilibrium, the trade balance condition is also satisfied.\(^\text{37}\) We get the trade balance condition as the equality between the value of demand for home imports and the value of demand for foreign imports. Any excess demand either in the market for exports or nontradeables implies a trade surplus. Similarly, any excess supply in the market for exports or nontradeables implies a deficit in the trade balance. The relation

\[ Y = p_x q_x + p_m q_m + q_n = p_x D_x + p_m D_m + D_n \quad (5.10') \]

From the relation (5.10) it follows that

\[ p_x (q_x - D_x) + (q_m - D_m) = p_m (D_m - q_m) \]

or, \(p_x X + (q_m - D_m) = p_m M\)

Subtracting \(p_x M^*\) from both sides we get

\[ p_x (X-M^*) + (q_m - D_m) = p_m M - p_x M^* \quad (A) \]

On the left hand side of the relation (A), the first term gives the condition for equilibrium in the market for exports and the second term gives the equilibrium condition for the nontraded goods market, while the right hand side shows the trade balance condition for the home country as the difference between the value of the demand for home imports (or, foreign exports) and the value of the demand for foreign imports (or, home exports). It follows, from relation (A), that when the exports and the nontraded goods markets are in equilibrium (as we have considered here), the trade balance condition is automatically satisfied. Hence there is no need to consider the trade balance condition as a separate relation.

\(^{36}\) See Komiya (1967).

\(^{37}\) We can rewrite equation (5.10) and interpret it in the form of a budget constraint or equality between income and expenditure of the home country. Thus, we have
shows that when the markets for exports and the nontraded goods are in equilibrium, trade is balanced.

5.3 Comparative Static Exercises:

In this section, we would like to examine the behaviour of terms of trade when accelerating development process in LDCs raises the demand for the nontradeables and the liberalisation process increases the foreign demand for home exports. We would also like to examine the impact of rise in the capital stock upon terms of trade.

Let us assume that the demand for nontradeables rises autonomously. So the autonomous part of the demand, \( D^0_n \), rises. Since \( Y \) is a function of \( p_x \) and \( p_m \), we can rewrite equations (5.11) and (5.15) as (5.11)' and (5.15)' respectively. Thus we have

\[
q_n (p_x, p_m; \Omega) = D_n (p_x, p_m) + D^0_n
\]

(5.11)'

\[
X (p_x, p_m; \Omega) = M^* (p_x / p_m) + M^*_0
\]

(5.15)'

Differentiation of equations (5.11)' and (5.15)' yields

\[
\hat{p}_x (\eta_{nx} - \alpha \ e_{nx}) + \hat{p}_m (\eta_{nm} - \alpha \ e_{nm}) = (1 - \alpha) \hat{D}_n^0
\]

(5.18)

\[
\hat{p}_x (\sigma_{xpx} - \beta E_{M^*}) + \hat{p}_m (\sigma_{xpm} + \beta E_{M^*}) = (1 - \beta) \hat{M}^* 0
\]

(5.19)

where \( \hat{p}_i = (dp_i / p_i) \), for \( i = x, m \)

Solving equations (5.18) and (5.19), for \( \hat{p}_x \) and \( \hat{p}_m \), with \( \hat{M}^* 0 = 0 \), we have

\[
\hat{p}_x = (1 - \alpha) \hat{D}_n^0 (\sigma_{xpx} + \beta E_{M^*}) / \Delta \; \text{and} \; \hat{p}_m = - (1 - \alpha) \hat{D}_n^0 (\sigma_{xpm} - \beta E_{M^*}) / \Delta
\]

Here, \( \Delta = (\eta_{nx} - \alpha \ e_{nx}) (\sigma_{xpm} + \beta E_{M^*}) - (\sigma_{xpx} - \beta E_{M^*}) (\eta_{nm} - \alpha \ e_{nm}) \).

\[38 \text{For detail derivations, see the appendix.}\]
where \( \eta_{nx} \) & \( \eta_{nm} \) are the supply elasticities and \( e_{nx} \) & \( e_{nm} \) are the demand elasticities for nontradeables. We have seen that \( \eta_{nx} < 0, \eta_{nm} < 0, e_{nx} > 0, e_{nm} > 0, E_{M} < 0, \sigma_{xpx} > 0 \) and \( \sigma_{xpni} < 0 \); thus, \( \Delta > 0 \).

So, \( \hat{p}_{x} / \hat{D}_{n}^{0} < 0 \) and \( \hat{p}_{m} / \hat{D}_{n}^{0} < 0 \)

In fact, any rise in the autonomous demand for nontradeables leads to excess demand for nontradeables. To clear the market the nominal price of nontradeables must rise. This leads to fall in the relative prices of the tradeables.

\[
(\hat{p}_{x} - \hat{p}_{m}) / \hat{D}_{n}^{0} = (1 - \alpha) (\sigma_{xp} + \sigma_{xpx}) / \Delta
\]

Again, \( (\hat{p}_{x} - \hat{p}_{m}) / \hat{D}_{n}^{0} > 0 \), if \( \sigma_{xpx} > \sigma_{xpni} \)

Thus any autonomous rise in the demand for nontradeables would improve the terms of trade for the home country, provided the supply elasticity of exports with respect to the price of exportables exceeds the same with respect to the price of the importables. From the equality relation between income and expenditure it is also seen that any excess demand in the market for nontradeables would imply a trade surplus. We assume that the Marshall-Lemer condition holds. So, terms of trade should improve to restore the trade balance. Our result can thus be summarised in terms of the following proposition.

**Proposition 5.1:** An autonomous increase in the demand for nontradeables improves terms of trade for the home country, if the supply elasticity of exports with respect to the price of exportables exceeds the same with respect to the price of importables.

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39 One should note that the supply elasticities for nontradeables are negative and the demand elasticities for nontradeables are positive.

40 The Marshall-Lemer condition states that if the sum of the elasticities of demand for imports of the home and the foreign countries exceed unity, trade balance would improve.
Let us now assume that the liberalisation process increases the foreign demand for home exports. This is reflected through an autonomous rise in the foreign demand for exports.

So, solving equations (5.18) and (5.19) for $\hat{p}_x$ and $\hat{p}_m$, with $\Delta_0 = 0$, we have

$$\hat{p}_x = -(1-\beta)\hat{M} \ast_0 (\eta_{xm} - \alpha e_{nm}) / \Delta > 0$$

and

$$\hat{p}_m = (1-\beta)\hat{M} \ast_0 (\eta_{mx} - \alpha e_{nx}) / \Delta < 0$$

So,

$$\hat{p}_x - \hat{p}_m = (1-\beta)\hat{M} \ast_0 (\eta_{xm} + \alpha e_{nm} - \eta_{mx} + \alpha e_{nx}) / \Delta > 0$$

Given the sign restrictions imposed upon the elasticities, we get $(\hat{p}_x - \hat{p}_m)\hat{M} \ast_0 > 0$.

Hence terms of trade would unambiguously improve when foreign demand for exports rises. In this sense, our result is similar to that obtained by Dornbusch (1980). But in this model, we have highlighted the importance of the market for the nontraded good, particularly the role played by elasticities of supply and demand for it, in determining the behaviour of terms of trade. The result also follows from the equality relation between income and expenditure stated above (see footnote 37). Any rise in demand for exports creates an excess demand for exports and this implies a trade surplus. Again, if the Marshall-Lerner condition holds, terms of trade should improve to restore trade balance. This leads us to proposition 5.2.

Proposition 5.2: When liberalisation process increases the demand for exports of the LDCs, reflected through an autonomous rise in the foreign demand for home exports, then their terms of trade improves.
We next assume that the stock of capital increases. At constant terms of trade and for given factor prices, there will be a rise in the level of national income when the stock of capital rises. Growth in the level of national income would obviously raise the demand for both tradeables and nontradeables. Assuming homothetic tastes, one can say that demand for all goods would increase by the same proportion. In order to match the growth in demand the production of nontradeables would also rise. Now, we are interested to find out its impact on the level of output of the tradeables. Let us assume that the importables are more capital intensive than the exportables. So, by Rybczynski theorem, the production of importables would rise but that of exportables would fall.

When the production of exportables fall and the demand for it rises, there would be a fall in the supply of exports in the world market. So the price of exports will rise. Since level of income rises as capital stock rises, we can say that the elasticity of supply of exports ($\sigma_{xy}$) with respect to income is negative. But nothing can be said a priori about the change in the demand for imports since both the production and the demand for importables increases. If we club exportables and importables and treat it as a composite tradeables then in a two-good framework the transformation schedule between nontradeable and a composite tradeable, as shown in Figure - 5.1 below, will not be

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41 The assumption can be justified in the context of a developing country like India. From the data published in Annual Survey of Industries in India, specially over the last few years, it is seen that the use of fixed capital per worker employed in the manufacture of machinery and equipments other than transport equipments industry (which is an importable item) is higher than the same in the manufacture of leather and leather products industry (which is an exportable item).

42 Batra (1973) has shown that the validity of the Rybczynski result in a model with both tradeables and nontradeables is based on the assumption that the marginal propensity to consume the nonfraded good lies between zero and unity.
strictly concave but it contains an interior flat plane or straight line segment. Samuelson (1953-54) has argued that when the number of goods (g) exceeds the number of factors (f) and the commodity prices are determined by international trading between countries then the domestic country is presumed to produce something of at least ‘f’ different goods. This leads to complete equalisation of factor prices between the countries. Since the differences in comparative advantage no longer exist then it opens up the possibility that the domestic country may produce something of every good. But nothing can be said about the final scales of production. There exists more than one way to produce any desired total of all goods. There will necessarily be an inessential indeterminacy of the production pattern. A linear segment in the transformation schedule can easily capture the problem of this indeterminacy and in a three-good two-factor model it can justify that there is a degree of freedom about the output combination to be produced at a given set of commodity prices. When the endowment of capital rises, the transformation schedule, along with its linear segment, will shift out in parallel fashion. Assuming that the new equilibrium remains on the flat section as in the original situation then, with homothetic taste, there will be a proportionate rise in both nontradeable and composite tradeable output. But the composition of tradeable output does change. With importables being more capital intensive than the exportables, fewer exportables will be produced but a greater than proportionate rise in importables will take place so that the composite tradeables rise in proportion. This ensures that production of importables increases more

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43 This point has been incorporated on the basis of the suggestions of an anonymous referee on a paper, related to this chapter, submitted by me to an international Journal. The paper is at present under revision. 44 See Samuelson (1953-54) and Komiya (1967) for more detail about the shape of the transformation schedule.
than the increase in the demand for it and hence on the basis of equation (5.17) we can conclude that there will be a fall in the demand for 

![Diagram](image)  

**Figure - 5.1**

imports. Hence there will be a fall in the price of imports. The rise in the price of exports and fall in the price of imports improve the terms of trade.

We can now examine the impact of rise in the stock of capital upon terms of trade from equations (5.11) and (5.15). By differentiating these equations with respect to $K$, we have

\[
\frac{\hat{p}_x}{K} (\eta_{nx} - \alpha e_{nx}) + \frac{\hat{p}_m}{K} (\eta_{nm} - \alpha e_{nm}) = \alpha e_{ny} \frac{\hat{y}}{K} - \frac{\hat{q}_n}{K} \tag{5.21}
\]

\[
\frac{\hat{p}_x}{K} (\sigma_{xp} - \beta E_{M^*}) + \frac{\hat{p}_m}{K} (\sigma_{xp} + \beta E_{M^*}) = - \sigma_{xy} \frac{\hat{y}}{K} + \frac{\hat{X}}{K} \tag{5.22}
\]

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45 Komiya (1967) has shown that the demand for imports falls provided neither good is inferior in consumption and the sum of the propensities to consume the tradeables and the nontradeables is equal to unity.

46 For detail derivations, see the appendix.
Solving for $\dot{p}_x / \dot{K}$ and $\dot{p}_m / \dot{K}$, we get

$$\dot{p}_x / \dot{K} = 1/\Delta \left( \hat{Y} / \hat{K} \alpha e_{ny} (\sigma_{xpm} + \beta E_{M^*}) - \hat{g}_n / \hat{K} (\sigma_{xpm} + \beta E_{M^*}) + \hat{y} / \hat{K} \sigma_{xy} (\eta_{nm} - \alpha e_{nm}) + \hat{X} / \hat{K} (\eta_{nm} - \alpha e_{nm}) \right)$$

$$= 1/\Delta \left( (\hat{y} / \hat{K} \sigma_{xy} (\eta_{nm} - \alpha e_{nm}) + \hat{X} / \hat{K} (\eta_{nm} - \alpha e_{nm})) + (\sigma_{xpm} + \beta E_{M^*})(\hat{y} / \hat{K} \alpha e_{ny} - \hat{g}_n / \hat{K}) \right)$$

$$= 1/\Delta \left[ \hat{Y} / \hat{K} \sigma_{xy} (\eta_{nm} - \alpha e_{nm}) + \hat{X} / \hat{K} (\eta_{nm} - \alpha e_{nm}) \right]$$

[from $(\hat{y} / \hat{K} \alpha e_{ny} - \hat{g}_n / \hat{K}) = 0$, when demand and supply of nontradeables increase by the same proportion.]

So, $\dot{p}_x / \dot{K} > 0$, when $\sigma_{xy} < 0$, $\eta_{nm} < 0$, $e_{nm} > 0$, $\Delta > 0$, $\hat{y} / \hat{K} > 0$ and $\hat{X} / \hat{K} < 0$.

Again, $\dot{p}_m / \dot{K} = 1/\Delta \left[ \hat{Y} / \hat{K} \{-\sigma_{xy} (\eta_{nx} - \alpha e_{nx})\} - \hat{X} / \hat{K} (\eta_{nx} - \alpha e_{nx}) - \hat{y} / \hat{K} \alpha e_{ny}(\sigma_{xpm} - \beta E_{M^*}) + \hat{g}_n / \hat{K} (\sigma_{xpm} - \beta E_{M^*}) \right]$

$$= 1/\Delta \left[ \hat{Y} / \hat{K} \{-\sigma_{xy} (\eta_{nx} - \alpha e_{nx})\} - \hat{X} / \hat{K} (\eta_{nx} - \alpha e_{nx}) \right], \text{ [since } (\hat{y} / \hat{K} \alpha e_{ny} - \hat{g}_n / \hat{K}) = 0]\]$$

So, we get $\dot{p}_m / \dot{K} < 0$, when $\eta_{nx} < 0$ and $e_{nx} > 0$

Hence, $(\dot{p}_x - \dot{p}_m) / \dot{K} = 1/\Delta \hat{y} / \hat{K} [\sigma_{xy} (\eta_{nm} - \alpha e_{nm}) + \sigma_{xy} (\eta_{nx} - \alpha e_{nx})] + \hat{X} / \hat{K} [(\eta_{nm} - \alpha e_{nm})$

$$+ (\eta_{nx} - \alpha e_{nx})]$$

Given the sign restrictions imposed upon the elasticities of demand (as we have already mentioned) and $\Delta > 0$, we get $(\dot{p}_x - \dot{p}_m) / \dot{K} > 0$. Thus a rise in the stock of capital leads to improvement in terms of trade when importables are more capital intensive than the exportables. Our study regarding the impact of rise in the stock of capital upon terms of trade corroborates Komiya’s (1967) result in this regard.
However, as the increase in capital endowment becomes larger by a finite amount, the country moves closer to autarky and it might then no longer engage itself in trade. A further increase in the capital stock may ultimately wipe out the production of exportables; and it may produce only nontradeables and the good that was previously imported by the country. If the home country does not produce any good which was previously exported but increases its consumption due to rise in income and homothetic taste, then it will begin to import the good which was previously exported. Again, if production of the good which was previously imported continues to rise and, as we have already seen, its demand rises by smaller proportion than the output, then a situation will come when there will be an exportable surplus of the previously imported good. In that case the home country will begin to export the good which was previously imported.\textsuperscript{47} Thus the pattern of trade of the country may change altogether. It will now import the previously exported good and will export the good which was earlier imported by it. We can summarise our result in terms of the following proposition.

**Proposition 5.3:** A rise in the stock of capital improves the terms of trade for the home country if its importables are more capital intensive. However, it may change the pattern of trade altogether when the stock of capital becomes larger by a finite amount and the home country produces only one tradeable good.

**5.4 Concluding Remarks:**

We have considered a developing economy, which produces three goods consisting of both tradeables and nontradeables using two factors of production. But the economy is

\textsuperscript{47} This point is also incorporated on the basis of comments of an anonymous referee.
capable of influencing the prices of the internationally traded goods and the terms of trade faced by it. Our analysis has shown the importance of the role played by the non-traded sector in determining the equilibrium value of the relative prices of the traded goods and the equilibrium value of terms of trade.

We have shown that any rise in the demand for nontradeables would not only create an excess demand in the market for nontraded goods but also generates a trade surplus. As a result, terms of trade moves in favour of the home country. Similarly, by using the same framework we have shown that when the liberalisation process raises the foreign demand for home exports, terms of trade facing the home country also improves. Finally we have demonstrated that rise in the stock of capital improves the terms of trade for the home country if its importables are more capital intensive. Using a product transformation schedule and making the assumption of homothetic taste, we have shown that any rise in the stock of capital reduces the supply of exports and demand for imports in the world market. The terms of trade improves not only because of the fall in the demand for imports, as shown in Komiya (1967), but also due to a fall in the supply of exports. Herein lies the worthiness of our study.
APPENDIX 5

Equations (5.18) and (5.19) of the text follow from the log differentiation of equations (5.11') and (5.15'). Differentiating equation (5.11)' we have

\[
\frac{dq_n}{q_n} = \frac{dD_n}{D_n} \cdot \{ D_n / (D_n + D_0^n) \} + \frac{dD_0^n}{D_0^n} \cdot \{ D_0^n / (D_n + D_0^n) \}
\]

or, \( \frac{dq_n}{q_n} = \alpha \frac{dD_n}{D_n} + (1- \alpha) \frac{dD_0^n}{D_0^n} \)

where \( \alpha = \frac{D_n}{D_n + D_0^n} \)

or, \( \{ (\partial q_n / \partial p_x)dp_x + (\partial q_n / \partial p_m)dp_m \} / q_n = \alpha \{ (\partial D_n / \partial p_x)dp_x + (\partial D_0^n / \partial p_x)dp_x \} \)

or, \( \{ (\partial q_n / \partial p_x)dp_x + (\partial q_n / \partial p_m)dp_m \} / D_n + (1- \alpha) \frac{dD_0^n}{D_0^n} \)

or, \( (\partial q_n / \partial p_x).(p_x / q_n). dp_x / p_x + (\partial q_n / \partial p_m).(p_m / q_n). dp_m / p_m \)

\( = \alpha (\partial D_n / \partial p_x).(p_x / D_n). dp_x / p_x + \alpha (\partial D_0^n / \partial p_m).(p_m / D_n). dp_m / p_m + (1- \alpha) \frac{dD_0^n}{D_0^n} \)

or, \( \eta_{nx} \hat{p}_x + \eta_{nm} \hat{p}_m = \alpha e_{nx} \hat{p}_x + \alpha e_{nm} \hat{p}_m + (1- \alpha) \hat{D}_0^n \)

or, \( \hat{p}_x (\eta_{nx} - \alpha e_{nx}) + \hat{p}_m (\eta_{nm} - \alpha e_{nm}) = (1- \alpha) \hat{D}_0^n \)

Again, differentiating equation (5.15)' we have

\[
\frac{dX}{X} = \frac{dM^*}{M^*} \cdot (M^* / (M^* + M^*o)) + \frac{dM^*o}{M^*o} \cdot (M^*o / (M^* + M^*o))
\]

or, \( \frac{dX}{X} = \beta \frac{dM^*}{M^*} + (1- \beta) \frac{dM^*o}{M^*o} \)

where \( \beta = (M^* / (M^* + M^*o)) \)

or, \( \{ (\partial X / \partial p_x)dp_x + (\partial X / \partial p_m)dp_m \} / X = \beta \{ (\partial M^* / \partial (p_x / p_m))d(p_x / p_m) / M^* + (1- \beta) \frac{dM^*o}{M^*o} \} \)

or, \( \{ (\partial X / \partial p_x)dp_x + (\partial X / \partial p_m)dp_m \} / (X / p_m)dp_m / p_m \)

\( = \beta \{ (\partial M^* / \partial (p_x / p_m)) \cdot (p_x / p_m) / M^* \} \cdot (p_x / p_m) / (p_x / p_m) + (1- \beta) \frac{dM^*o}{M^*o} \)

or, \( \sigma_{xpx} \hat{p}_x + \sigma_{xpm} \hat{p}_m = \beta E_{M^*} (\hat{p}_x - \hat{p}_m) + (1- \beta) \hat{M}^*o \)

or, \( \hat{p}_x (\sigma_{xpx} - \beta E_{M^*}) + \hat{p}_m (\sigma_{xpm} + \beta E_{M^*}) = (1- \beta) \hat{M}^*o \)
Equations (5.21) and (5.22) of the text are obtained by differentiating equations (5.11) and (5.15) with respect to K. We should note here that Ω includes K, L, etc.

Differentiating (5.11) we have

\[
(\frac{\partial q_n}{\partial p_x}) \frac{dp_x}{dK} + (\frac{\partial q_n}{\partial p_m}) \frac{dp_m}{dK} + \frac{dq_n}{dK} = (\frac{\partial D_n}{\partial p_x}) \frac{dp_x}{dK} + (\frac{\partial D_n}{\partial p_m}) \frac{dp_m}{dK} + (\frac{\partial D_n}{\partial Y}) \frac{dY}{dK}
\]

Dividing both sides by \( q_n \) and manipulating we have

\[
\eta_{nx} (\hat{p}_x / \hat{K}) + \eta_{nm} (\hat{p}_m / \hat{K}) + (\hat{q}_n / \hat{K}) = \alpha \ e_{nx} (\hat{p}_x / \hat{K}) + \alpha \ e_{nm} (\hat{p}_m / \hat{K}) + \alpha \ e_{ny} (\hat{Y} / \hat{K})
\]

or, \( (\hat{p}_x / \hat{K}) (\eta_{nx} - \alpha \ e_{nx}) + (\hat{p}_m / \hat{K}) (\eta_{nm} - \alpha \ e_{nm}) = \alpha \ e_{ny} (\hat{Y} / \hat{K}) - (\hat{q}_n / \hat{K}) \)

Now differentiating (5.15) we have

\[
(\frac{\partial X}{\partial p_x}) \frac{dp_x}{dK} + (\frac{\partial X}{\partial p_m}) \frac{dp_m}{dK} + (\frac{\partial X}{\partial Y}) \frac{dY}{dK} + \frac{dX}{dK} = \frac{\partial M^*}{\partial (p_x/p_m)} \frac{dp_x}{dK} + \frac{dp_m}{dK}
\]

Dividing both sides by X and manipulating we have

\[
\sigma_{xpx} (\hat{p}_x / \hat{K}) + \sigma_{xpm} (\hat{p}_m / \hat{K}) + \sigma_{xy} (\hat{Y} / \hat{K}) + (\hat{X} / \hat{K}) = \beta \ E_{M^*} (\hat{p}_x - \hat{p}_m) / \hat{K}
\]

or, \( (\hat{p}_x / \hat{K}) (\sigma_{xpx} - \beta \ E_{M^*}) + (\hat{p}_m / \hat{K}) (\sigma_{xpm} + \beta \ E_{M^*}) = - \sigma_{xy} (\hat{Y} / \hat{K}) - (\hat{X} / \hat{K}) \)