TARIFF STRUCTURE IN A SMALL OPEN ECONOMY: A THEORETICAL ANALYSIS

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Abstract: Developing countries have been facing substantial adjustment costs in their endeavor in implementing trade reform. To lessen the adjustment costs of trade reform and to diffuse political support for protection a uniform tariff policy has often been recommended. The present paper examines the efficacy of this policy in terms of a 3×4 specific factor full-employment structure reasonable for a developing economy. It shows that whether a symmetric tariff structure would be able to protect all the import-competing sectors crucially depends on the economy's trade pattern. The paper is then extended to include Harris-Todaro type unemployment of unskilled labour. In this framework also the implications of the uniform tariffs and then welfare effects of tariffs on one sector have been studied. Finally, the consequences of tariffs on urban unemployment of unskilled labour have been examined.

Keywords: Full-employment, specific factor, uniform tariffs, Hechscher-Ohlin subsystem, skilled labour, unskilled labour, urban unemployment.

JEL classification: F2, O10, O41.

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1. Introduction:

Economic liberalization means a closer international integration of production and markets. The increasing interdependence of economies around the world is the result of growing trade and capital flows and rising inter-firm technology cooperation. These trends reflect the liberalization of trade initiated by successive GATT rounds, and especially in the 1980s, the worldwide deregulation of financial markets and other business services such as banking and insurance. The multilateral agreement and the formation of the World Trade Organization (WTO), resultant of the Uruguay round of discussions, have brought about revolutionary changes in liberalizing international trade across countries whether developed or developing. Radical measures for reducing tariff barriers and completely doing away with non-tariff barriers to ensure freer global trade have already been undertaken in manufacturing commodities[1] that are intensive in the use of capital or skilled labour. Liberalization involves both inflow of foreign capital as well as reduction of protection of domestic industries, structural reforms like deregulating the labour market and integrating the domestic market with the world market.

However, a wide variety of potentially disadvantageous short-run outcomes would invariably result from trade liberalization. These outcomes include a reduction in employment and output, the loss of industry-specific and firm-specific human capital, and macroeconomic instability resulting from balance of payments difficulties or reductions in government revenue. These adjustment costs are positively correlated with the extent of structural rigidities prevalent in the liberalizing countries.

Available empirical evidence strongly suggests that the adjustment costs associated with trade reform have been alarmingly high in many developing economies. Although, many of the Sub-Saharan African countries have been subjected to IMF-imposed reforms for a decade or more, yet the overall performance of these economies remains remarkably poor, despite considerable progress on liberalization and deregulation. The average annual growth of real GDP in these countries fell from 2.5 per cent between 1985-89 to 1.9 per cent between 1990-97. During the 1990s, per capita income has also declined in most of Africa's less developed countries (UNCTAD 2000). In South Africa and in many of the Latin American countries, trade liberalization during 1990s was associated with falling employment and hence economic insecurity for the formal sector labour force. Liberalizing low income countries have experienced

[1] However, the attempt to subject agricultural commodities to disciplines similar to those that govern trade in manufactures has not so far been successful. Moreover, in agriculture, exports from developing countries remain severely hampered by massive domestic support and export subsidy programs in developed countries, by peak tariffs and difficulties in the implementation of the tariff quota system (UNCTAD 1999).

significant volatility in terms of the population of firms and that this has almost certainly had a disproportionate impact on labour (Kaplinsky 2001). Moreover, wage inequality between skilled and unskilled labour has increased significantly in Latin American Countries (Wood 1997). In spite of high growth rates in many regions of the world, there has been little dent in the number of people living in absolute poverty. Some regions, notably sub-Saharan-Africa, South Asia and Central Asia have experienced sharp rises in the number of the absolutely poor, just as their participation in the global economy was deepening. Relative poverty during this period has also increased (Kaplinsky 2001). United Nations development Program (UNDP) Human development report suggests a striking increase in inter-country inequality as globalization advanced rapidly. Most seriously, as noted by Kaplinsky (2001), trade reform measures have made the developing economies increasingly reliant on external economic events. In recent decades, this external environment has become increasingly volatile. The volatility of both capital flows and GDP growth was much greater in developing countries than in the industrial countries (Hausmann and Gavin 1996). Besides, the costs of this volatility were greater for developing than industrialized countries. More developing countries experienced currency crises than industrial countries, and with a greater negative impact on output (IMF 1998).

On the other hand, it has been observed that some developing countries, notably the non-OECD countries, are relatively slow in carrying out tariff reforms compared to other countries, although they have opted for the policy of free trade as their development strategy. Also there have a few cases where some countries, which initially implemented tariff reform vigorously, had to increase the tariff rates at least for the time being.[2] There are both economic and political reasons behind the sluggishness of tariff reforms. One such explanation is provided by the *tariff-jumping* theory[3] that suggests a positive correlation between the amount of FDI in a country and tariff rate imposed by it. There is no doubt that the major driving force behind FDI by the multinational corporations (MNCs) in the developing countries are the higher rates of return on their capital in these countries vis-à-vis in the international market. Countries with protected domestic markets are likely to attract foreign investment, but only for the purpose of jumping the tariff walls and reaping a good harvest by serving their markets directly. On the contrary, reductions of import tariffs imply larger volumes of imports, lower rates of return to capital and smaller amounts of FDI in these countries. So, the countries in quest of foreign capital may be reluctant in implementing tariff reform seriously. Another strong argument in favour of keeping up with tariff is related to its employment generating and preserving effects, which is especially important for the developing countries with a significant proportion of unemployment in its total labour force. It is usually argued that a tariff reduction would immediately lead to an increase in unemployment since displaced workers cannot readily be absorbed in other sectors of the economy. This view is quite popular and acceptable to many political

[2] For example, Pakistan, in October 1995, implemented a series of major economic measures, including imposition of additional import duties designed to improve the trade balance, which had deteriorated sharply following implementation of trade liberalization programs in the initial phase of reforms.
[3] See for example, Massimo (1992) and Yanagawa (1990) for details.

parties in these countries. Most importantly, a few recent theoretical works like Chaudhuri and Mukherjee (2002a) and Chaudhuri and Mukhopadhyay (2002b) have shown that some countries may endeavor tariff reforms slowly because tariff reductions may directly lead to deterioration of the welfare of these economies. Chaudhuri and Mukherjee (2002a) show that in a production structure appropriate for a developing economy there may be cases where reduction in import tariff directly leads to deterioration in welfare in the presence of labour market distortion. They have developed a three-sector general equilibrium model with two informal sectors where there is complete mobility of labour between these two sectors and assumed a positive relationship between wage income and labour's efficiency. In this scenario, the paper shows that tariff reform may not be desirable due to its adverse impact on welfare. Chaudhuri and Mukhopadhyay (2002b) have also reached the same broad conclusion in terms of a two-sector general equilibrium model with an informal sector. Besides, in Chaudhuri and Mukhopadhyay (2002b) it is shown that the welfare impact of removal of protectionist policy crucially depends on the trade pattern of the relevant country and that the Wage efficiency hypothesis is neither necessary nor sufficient for deriving the counterintuitive result relating to tariff reform. On the contrary, for tariff reform to be welfare deteriorating the presence of the labour market distortion is a necessity. These theoretical results suggest the view that owing to the presence of labour market distortion, adjustment costs of trade reform have been higher in developing countries vis-à-vis developed countries.

From the above discussions, it is clear that many of the developing countries have been encountering serious problems in their task of adjusting to an environment of internal and external competition stimulated by trade liberalization measures like deregulation, the opening up of the overall economy, and reduction of tariffs. Several industrial units have had difficulties in adjusting to more competitive market conditions due to influx of commodities from other countries at cheaper rates. As a consequence, numerous of these units had to be shut down, leading to a substantial increase in unemployment level. It, therefore, appears that longer timeframes for implementation of tariff reduction commitments should be granted to these countries and some degree of protection in some key industries is necessary until the domestic industries can successfully withstand foreign competition. To lessen the adjustment costs of trade reform a uniform tariff policy, long favored by the IMF and the World Bank as a means of diffusing political support for protection has often been recommended. Panagariya and Rodrik (1993) have formalized the argument. They note that a key advantage of a uniform tariff structure is that it would minimize lobbying by special interests for protection because it diffuses the benefits of protection. If the only way protection can be increased is by increasing protection for all industries, lobbying for protection then yields only dispersed benefits as well as costs. Then a uniform tariff creates a free-rider problem for the interests seeking protection. However, this view is acceptable only if a uniform tariff structure can protect all the import-competing sectors of a developing economy.

The present paper examines the validity and generality of the above view in terms of a 3×4 specific factors-full-employment model reasonable for a developing economy. It is closely related to Marjit (1993) paper. Marjit (1993) in a 3×3 specific factors-full-employment framework has shown that a symmetric tariff structure may fail to protect all the import-competing sectors. The model that Marjit (1993) has considered contains a Heckscher-Ohlin sub-system (HOSS), which uses the same two factors of production. The result of Marjit (1993) crucially hinges on the assumption that the specific factor (SF) model contains one subset of the economy displaying HO properties. However, we shall study the same aspect in a SF full-employment model, which does not contain a HOSS. We focus on one of the typical industrial structure with an intermediate good sector of a developing economy. This industrial structure cannot be captured by Marjit's model. We consider a 3×4 specific factors-full-employment model consisting of an intermediate good-producing sector (sector 1) which is used in another sector (sector 3) along with unskilled labour to produce a final commodity. There is another sector-specific input – skilled labour, which is used in another sector (sector 2) along with capital to produce another final commodity. Finally, the intermediate good is produced using capital and unskilled labour. The prices of the two final commodities and the intermediate good are given internationally. We will show that if commodities 1 and 2 (or 2 and 3) are the two importables of the economy the imposition of tariffs at a uniform rate will lead to a contraction of the sector that uses the specific input and thus fails to protect both of the import-competing sectors of the economy. So the result of Marjit (1993) can be proved in a SF model even when it does not contain a HOSS. However, if both of the final commodities (i.e. commodities 1 and 3) are the two importables of the economy, then uniform tariffs leads to an expansion of both the import competing sectors at the cost of a contraction of the intermediate good-producing sector. Then we have proceeded to analyze the welfare effect of tariffs on one sector. The model has then been extended into the Harris-Todaro (HT) framework and the same procedure (first, the uniform tariffs, and then tariffs on one sector) has been followed. Finally, we have explained as to why some of the results differ between the competitive and the HT economies.

2. The Model:

We consider a small open economy consisting of three sectors. Sector 2 produces a crucial input (say, fertilizer) for sector 3 with the help of unskilled labour and capital. Sector 1 is the specialized manufacturing sector, which produces its output using skilled labour and capital. Finally sector 3 produces its product using unskilled labour and the intermediate input (fertilizer) produced by sector 2. So capital is mobile between sectors 1 and 2 and unskilled labour is mobile between sectors 2 and 3. But skilled labour is specific to sector 1. Owing to our small open economy assumption we consider all the three product prices to be given internationally. The economy described above roughly resembles a developing country. The markets are perfectly competitive. Production functions exhibit constant returns to scale (CRS) with diminishing marginal productivity to each factor. We, however, at this moment do not assume anything

about the trade pattern of the economy. We shall only assume that two of the three goods are importables[4] and the remaining one is an exportable.

The following symbols will be used in the equations.

a_{Ki} = capital-output ratio in the *i*th sector, $i = 1,2$;

a_{Li} = unskilled labour-output ratio in the *i*th sector, $i = 2,3$;

a_{S1} = skilled labour-output ratio in sector 1;

a_{F3} = fertilizer-output ratio in sector 3;

P_i = world price of the *i*th good, $i = 1,2,3$;

W_S = wage rate of skilled labour;

W = wage rate of unskilled labour;

r = return to capital;

L* = endowment of unskilled labour;

S* = endowment of skilled labour;

K* = capital stock of the economy;

Y = national income at world prices;

dt_i = a small ad-valorem tariff imposed on the i^{th} commodity, $i = 1,2,3$;

$M = a_{F3}.X_3 - X_2$ = the volume of import of the traded intermediary (commodity 2).

A general equilibrium of the system is represented by the following set of equations:

$$W_S.a_{S1} + r.a_{K1} = P_1 \quad (1)$$

$$W.a_{L2} + r.a_{K2} = P_2 \quad (2)$$

$$W.a_{L3} + P_2.a_{F3} = P_3 \quad (3)$$

$$a_{S1}.X_1 = S^* \quad (4)$$

$$a_{K1}.X_1 + a_{K2}.X_2 = K^* \quad (5)$$

$$a_{L2}.X_2 + a_{L3}.X_3 = L^* \quad (6)$$

We have six equations (1 – 6) to solve for six unknowns – W_S, W, r, X_1, X_2 and X_3. The three factor prices are determined from equations (1–3), independent of factor endowments. Once the factor prices are known factor coefficients are also known. X_1, X_2 and X_3 are then found from equations (4–6).

[4] Since the production technology exhibits CRS, the domestic supply curves of importables are horizontal. If the corresponding world prices are below (above) it, the domestic production (import) will be zero. Thus it is implicitly assumed that in the initial equilibrium the domestic production sectors supply the whole amount of importables domestically demanded under the world prices equal to the height of the domestic supply curves. In other words, the economy does not import these commodities in the initial equilibrium.

2.1 ***The effects of a uniform tariff structure:***

We are now interested to study the effects of imposition of tariffs on different import-competing sectors. At the very outset we do not consider any specific trade pattern for the economy. We shall study the effects of a uniform tariff under all the three possible trade patterns of the economy. Suppose that initially we do not have any tariff. So world prices and domestic prices are equal. Now a small *ad valorem* tariff $dt_i > 0$ is imposed on the *i*th commodity, $i = 1,2,3$, starting from an initial $t_i = 0$.

Differentiating equations (1-3) and using the envelope conditions we get

$$\theta_{S1}.\hat{W}_S + \theta_{K1}.\hat{r} = dt_1 \quad (7)$$

$$\theta_{L2}.\hat{W} + .\theta_{K2}.\hat{r} = dt_2 \quad (8)$$

$$\theta_{L3}.\hat{W} + \theta_{F3}.dt_2 = dt_3 \quad (9)$$

where, the circum flex denotes proportional change and θ_{ji} is the share of the j^{th} input in the total value of production of the i^{th} commodity for j = L, S, K and i = 1, 2, 3. Arranging equations (7 - 9) in a matrix notation and solving by Cramer's rule we get

$$\hat{W} = (1/\Delta).\theta_{S1}.\theta_{K2}.(dt_3 - \theta_{F3}.dt_2) \quad (10)$$

$$\hat{W}_S = (1/\Delta).[\theta_{L3}.(dt_1.\theta_{K2} - dt_2.\theta_{K1}) + (dt_3 - \theta_{F3}.dt_2).\theta_{K1}.\theta_{L2}] \quad (11)$$

$$\hat{r} = (1/\Delta).[\theta_{L3}.\theta_{S1}.dt_2 - (dt_3 - \theta_{F3}.dt_2).\theta_{S1}.\theta_{L2}] \quad (12)$$

where, $\Delta = \theta_{L3}.\theta_{S1}.\theta_{K2} > 0$.

Let us first consider the case where the intermediary is the export commodity and the two final commodities are the importables of the economy. In this case, a small uniform tariff in the ad valorem fashion on the two importables implies that $dt_1 = dt_3 = dt$ and $dt_2 = 0$. From (10 – 12) we get

$$\hat{W} = (1/\Delta).\theta_{S1}.\theta_{K2}.dt > 0;$$

$$\hat{W}_S = (1/\Delta).[\theta_{L3}.\theta_{K2} + \theta_{K1}.\theta_{L2}].dt > 0;$$

$$\hat{r} = -(1/\Delta).\theta_{S1}.\theta_{L2}.dt < 0.$$

So if commodities 1 and 3 are the two importables of the economy, uniform tariffs raise the two wage rates and lower the rental to capital. As a consequence, a_{S1} will fall and a_{K1} will rise since the producers in industry 1 will be willing to adopt more capital-intensive technique of production relative to the skilled labour. X_1 rises since a_{S1} falls and there is full-employment of skilled labour. This requires more capital for

sector 1. As a_{K2} also rises as (W/r) has gone up, for sector 1 to get more capital sector 2 must contract. This also releases more unskilled labour to sector 3 as a_{L2} has gone down. Sector 3 also expands as unskilled labour is also fully employed. So we have the following proposition.

PROPOSITION 1: In the given production structure, if the two final commodities are the importables of the economy the imposition of a uniform tariff, $dt > 0$, starting from an initial $t_i = 0$ is able to protect both the sectors.

The clue behind proposition 1 is that sectors 1 and 3 do not have any common mobile factor between themselves. So both of them can expand following the imposition of uniform tariffs at the cost of the intermediate good sector without hurting each other.

Now suppose that good 1 and 2 are the importables of the economy. So for a uniform tariff on commodities 1 and 2 we have $dt_1 = dt_2 = dt$ and $dt_3 = 0$. From (10-12) we have

$$\hat{W} = -(1/\Delta).(\theta_{S1}.\theta_{K2}.\theta_{F3}).dt < 0$$

$$\hat{W}_S = (1/\Delta).[\theta_{L3}.(\theta_{K2} - \theta_{K1}) - \theta_{F3}.\theta_{K1}.\theta_{L2}].dt$$

$$\hat{r} = (1/\Delta).[\theta_{L3} + \theta_{F3}.\theta_{L2}].\theta_{S1}.dt > 0$$

$$(\hat{W}_S - \hat{r}) = (1/\Delta).[\theta_{L3}.\theta_{K2} - \theta_{L3} - \theta_{F3}.\theta_{L2}].dt < 0.$$

Since $(\hat{W}_S - \hat{r}) < 0$, (W_S / r) decreases due to the imposition of a uniform on commodities 1 and 2. So a_{S1} goes up implying a decrease in the production of commodity 1 since the size of the skilled labour force is given. Also a_{K1} goes down. So capital will be released from sector 1 to sector 2. As (W/r) has gone down the production technique will be more unskilled labour-intensive in sector 2. So a_{K2} decreases and a_{L2} increases. As a consequence, the output in sector 2 increases but that in sector 3 goes down as more labour is pulled out from sector 3 to sector 2. Hence sector 2 expands while sector 1 contracts as a sequel of the imposition of a uniform tariff on commodities 1 and 2.

It is easy to check that in this production structure, even if commodities 2 and 3 are the two importables of the economy we obtain the same result The clue behind this result is that both sectors 1 (3) and 2 use a common mobile input – capital (unskilled labour). So one sector can expand only at the cost of the other. This establishes the following proposition.

PROPOSITION 2: If commodities 1 (3) and 2 are the two importables of the economy, then due to imposition of uniform tariffs the intermediate good producing sector (2) expands at the cost of the final good sector, 1 (3).

It should be noted that in proving the proposition that the symmetric tariff structure may fail to protect all the import competing sectors, unlike Marjit (1993), we do not require a production structure containing a HOSS.

2.2 Effects of tariffs on one commodity:

From the analysis of section 2.1 we find that the uniform tariffs are effective in protecting final goods sectors (commodities 1 and 3). But if one of the two final goods (1 and 3) and the intermediary (Commodity 2) are the importables of the economy, the uniform tariffs fail to protect both sectors. A pertinent question in this context is on which of these sectors a tariff should be imposed if protection of both import-competing sectors is not feasible[5] for some reasons. Let us now study the welfare consequences of tariff imposition on any of the three sectors of the economy. The criterion of judgment on the choice of tariff-imposed sector is the national income at international prices. National income will be able to be used as a criterion if we assume a homothetic utility function. This is because the demand functions of the final commodities and hence the economy's welfare will be a function of the aggregate income, independent of the income distribution. The national income at world prices is given by

$$Y = W.L^* + r.K^* + W_S.S^* - \sum_{i=1,3} t_i.P_i.X_i + t_2.P_2.M \qquad (13)$$

where $M (= a_{F3}.X_3 - X_2)$ is the volume of import of commodity 2 at the international price, P_2. Here $(W.L^* + r.K^* + W_S.S^*)$ is the aggregate factor income, $t_i.P_i.X_i$ denotes the cost of protection of the i^{th} sector for i = 1,3. Finally, $t_2.P_2.M$ is the revenue of the government from imposition of a tariff on the import of the traded intermediary (sector 2).

Depending on the different trade patterns of a developing economy the following three cases should be considered.

Case I: $dt_1 > 0$; $dt_2 = dt_3 = 0$. From equations (10) – (12) it follows that

$\hat{W}$, $\hat{r} = 0$ and $\hat{W}_S = dt_1/\theta_{S1}$.

Now differentiating (13) with respect to t_1, we get

$(dY/dt_1) = (dW_S/dt_1).S^* - P_1.X_1$

Inserting the value of (dW_S/dt_1) and after simplification one gets

$(dY/dt_1) = 0$.

Case II: $dt_2 > 0$; $dt_1 = dt_3 = 0$. In this case from (10) – (12) we find that

$\hat{W} = -\theta_{S1}.\theta_{K2}.\theta_{F3}.(dt_2/\Delta)$, $\hat{r} = (\theta_{S1}/\Delta).(\theta_{L3} + \theta_{F3}.\theta_{L2}).dt_2$ and $\hat{W}_S = -(\theta_{K1}/\Delta).(\theta_{L3} + \theta_{L2}.\theta_{F3}).dt_2$

[5] It may not be feasible due to multilateral trade agreements.

Differentiation of (13) with respect to t_2, substitution of the expressions for (dW/dt_2), (dW_S/dt_2) and (dr/dt_2) and after simplification it is easy to show[6] that
$(dY/dt_2) = 0$.

Case III: $dt_3 > 0$; $dt_1 = dt_2 = 0$.
In this case also it can be verified[7] that
$(dY/dt_3) = 0$.

PROPOSITION 3: If a small tariff $dt_i > 0$ is imposed on the i^{th} commodity, $i = 1,2,3$ starting from an initial $t_i = 0$, it succeeds in protecting that sector. However, welfare measured by national income at world prices does not change due to imposition of the tariff.

We explain proposition 3 as follows. The imposition of tariff on any of the three sectors of the economy affects incomes of different factors of production. For example, a small tariff on sector 1 (specialized manufacturing sector) raises only the skilled wage but does not affect the unskilled wage and the rental to capital. Again a small tariff on sector 3 raises the two wage rates but lowers the rental to capital. Aggregate factor income rises in these cases. But the imposition of tariff leads to misallocation of resources and hence imposes a cost on the society. However, in both the above cases, two opposite forces on welfare arise and these completely cancel out each other, thereby producing no net effect on welfare. On the other hand, a small tariff on sector 2 (intermediate good producing sector) lowers both skilled and unskilled wages but raises the rental to capital. Aggregate factor income declines. Bur tariff revenue increases as the volume of import of the traded intermediary rises. Again two opposite effects on national income are generated, which completely cancel out each other.

Thus we find that under the above full-employment production structure if the economy decides to protect only one of its import-competing sectors, from the viewpoint of national welfare all the three cases are equivalent. So the economy can protect any one of its import-competing sectors without hurting national welfare.

3. Rural-Urban Migration and Protection:

In this section of the paper we shall proceed to extend the model into the Harris-Todaro (HT) economy. In an HT economy there are two broad sectors: rural and urban. While the urban sector faces a unionized labour market, the rural sector faces a competitive labour market. Due to the existence of rural-urban wage differential, rural workers migrate to the urban sector with the hope of getting jobs in the higher wage-paying sector. In the migration equilibrium, there exists a positive level of urban unemployment because

[6, 7] See appendix I for mathematical proof of these results.

the number of migrants exceeds the number of jobs in the urban sector. The equilibrium in the HT economy is sub-optimal because of the persistence of wage differential between the sectors and presence of unemployment in the migration equilibrium. It would be interesting to analyze the effects of tariff imposition in such an economy owing to the presence of labour market distortion and urban unemployment of unskilled labour.

We shall assume that sector 3 is the rural or unskilled labour supplying sector and sectors 1and 2 constitute the two urban sectors of the economy. The urban unskilled labour earns the unionized wage $W^* > W$, where W is the rural wage rate. We shall stick to the same procedure that has been followed in the full-employment case. First the effects uniform tariffs and then tariffs on one sector will be analyzed. The general equilibrium of the extended model is represented by equations (1), (3-5) of section 2 and the following three equations.

$$W^*.a_{L2} + r.a_{K2} = P_2 \qquad (2.1)$$

$$a_{L2}.X_2 + a_{L3}.X_3 + L_U = L^* \qquad (6.1)$$

$$(W^*/W).a_{L2}.X_2 + a_{L3}.X_3 = L^* \qquad (14)$$

Here equation (14) is the rural-urban migration equilibrium condition, which has been simplified by using the labour endowment equation given by (6.1). In (6.1) L_U is the level of urban unemployment of unskilled labour.

In this extended model also the three input prices – W, W_S and r are determined independent of factor endowments by solving equations (1), (2.1) and (3). Once the factor prices are known the factor coefficients are also known. X_1, X_2 and X_3 are then found from equations (4), (5) and (14). Finally, L_U is obtained from equation (6.1) since a_{L2}, a_{L3}, X_2 and X_3 have already been determined.

We should note that our measure of welfare in this small open economy, national income at international prices remains the same as before. However, W is now the rural sector wage rate and from the envelope property of HT framework it follows that WL^* is the aggregate wage income of the unskilled labour force.

3.1 *Effects of uniform tariffs:*

Suppose that initially we do not have any tariff. Now a small tariff $dt_i > 0$ is imposed on the *i*th commodity, $i = 1,2,3$ starting from an initial $t_i = 0$. Differentiating equations (1), (2.1) and (3), using the envelope conditions and solving we get

$$\hat{W} = [(dt_3/\theta_{L3}) - (\theta_{F3}/\theta_{L3}).dt_2] \qquad (15)$$

$$\hat{W}_S = (1/\theta_{S1})[dt_1 - (\theta_{K1}/\theta_{K2}).dt_2]. \quad (16)$$

$$\hat{r} = (dt_2/\theta_{K2}) \quad (17)$$

Totally differentiating equations (4), (5) and (6.1) and after simplification we can obtain the following expressions.[8]

$$\hat{X}_1 = (\theta_{K1}.\sigma_1/\theta_{S1}).dt_1 - (\theta_{K1}.\sigma_1/\theta_{K2}.\theta_{S1}).dt_2 \quad (18)$$

$$\hat{X}_2 = (1/\lambda_{K2}).[-(\lambda_{K1}.\sigma_1/\theta_{S1}).dt_1 + \{(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2)/\theta_{K2}.\theta_{S1}\}.dt_2] \quad (19)$$

$$\begin{aligned}\hat{X}_3 = (1/\lambda_{L3}).[&\{W^*.\lambda_{L2}.\lambda_{K1}.\sigma_1/W.\lambda_{K2}.\theta_{S1}\}.dt_1 - dt_2.\{(W^*.\lambda_{L2}.\theta_{F3}/W.\theta_{L3}) + (W^*.\lambda_{L2}.\sigma_2/W) \\ &+ (\lambda_{L3}.\theta_{F3}.\sigma_3/\theta_{L3}) + (W^*.\lambda_{L2}/W.\lambda_{K2}).(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2/\theta_{K2}.\theta_{S1})\} \\ &+ dt_3.\{(W^*.\lambda_{L2}/W.\theta_{L3}) + (\lambda_{L3}.\theta_{F3}.\sigma_3.\theta_{L3})\}]\end{aligned} \quad (20)$$

Now subtraction of (7) from (6) yields

$L_U = ((W^*/W) - 1).a_{L2}.X_2$

Totally differentiating this equation and using (15), (17) and (19) one can easily derive the following expression.[9]

$$\begin{aligned}L_U.\hat{L}_U = &-(W^*/W).(a_{L2}.X_2/\theta_{L3}).dt_3 - \{((W^*/W) - 1).a_{L2}.X_2.\lambda_{K1}.\sigma_1.dt_1/\lambda_{K2}.\theta_{S1}\} \\ &+ dt_2.[(W^*.a_{L2}.X_2.\theta_{F3}/W.\theta_{L3}) + ((W^*/W) - 1).a_{L2}.X_2.\sigma_2) \\ &+ \{((W^*/W) - 1).a_{L2}.X_2.(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_1\} / \lambda_{K2}.\theta_{K2}.\theta_{S1}]\end{aligned} \quad (21)$$

Let us study the effects of the uniform tariffs in this framework. Depending on different trade patterns we consider the following three cases.

Case I: $dt_1 = dt_3 = dt > 0$. So, $\hat{W}$, $\hat{W}_S > 0$; and, $\hat{r} = 0$. From equations (18)–(20) one can easily check that $\hat{X}_1 > 0$; $\hat{X}_2 < 0$; and $\hat{X}_3 > 0$. We explain these results as follows. As (W_S/r) rises a_{S1} decreases. As a consequence, X_1 increases as the skilled labour is fully utilized. The capital-output ratio in sector 1, a_{K1}, increases. So the usage of capital in sector 1 rises. Sector 2 now gets less capital than before which leads to a decrease in X_2. As W rises, the rural-urban wage differential falls. Also a decrease in X_2 lowers the expected urban wage rate. The consequence will be a reverse migration of workers from the urban to the rural sector. The rural sector (sector 3) expands, as it now gets more labour than before. So if commodities 1 and 3 (both final commodities) are the importables of the economy, the uniform tariffs are able to protect both the sectors.

[8] ,[9] These expressions have been derived in appendix II.

Case II: $dt_1 = dt_2 = dt > 0$; and, $dt_3 = 0$. Here $\hat{W} = -(\theta_{F3}/\theta_{L3}).dt < 0$; $\hat{r} = (dt/\theta_{K2}) > 0$; and, $\hat{W}_S = ((\theta_{K2}-\theta_{K1})/\theta_{K2}.\theta_{S1}).dt$. From (18)–(20) we find that $\hat{X}_1 < 0$; $\hat{X}_2 > 0$; $\hat{X}_3 < 0$. The symmetric tariffs imposed on commodities 1 (final commodity) and 2 (intermediary) lowers (W_S/r), (W/r) and (W^*/P_2) ratios. More labour intensive techniques will be used in production of all the three sectors. As a consequence, a_{S1}, a_{L2} and a_{L3} rise and a_{K1} and a_{K2} fall. As skilled labour is a specific input in the production of commodity 1, X_1 falls following an increase in a_{S1}. A contraction of sector 1 releases capital to sector 2, leading to its expansion. Sector 2 now employs more unskilled than before. On the other hand, a reduction in the rural sector wage rate, W, and an increase in the number of jobs in the urban manufacturing sector, will lead to more migration of unskilled labour to the urban sector. The rural sector (sector 3) contracts following a shortage of unskilled labour.

Case III: $dt_2 = dt_3 = dt > 0$; and, $dt_1 = 0$. In this case $\hat{W} = dt > 0$; $\hat{r} = (dt/\theta_{K2}) > 0$; and, $\hat{W}_S = -(\theta_{K1}.dt/\theta_{K2}.\theta_{S1}) < 0$; $(\hat{W} - \hat{r}) = -(\theta_{L2}/\theta_{K2}).dt$; $(\hat{W}_S - \hat{r}) = -(dt/\theta_{K2}.\theta_{S1})$ and, $(\hat{W} - dt_2) = 0$. From (18)–(20) we find that $\hat{X}_1 = -dt.(\theta_{K1}.\sigma_1.\theta_{L2}/\theta_{K2}.\theta_{S1}) < 0$; $\hat{X}_2 = dt.\{(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2)/(\theta_{K2}.\theta_{S1}\lambda_{K2})\} > 0$; and,

$\hat{X}_3 = dt.(W^*.\lambda_{L2}/W.\theta_{L3}.\lambda_{L3}).[(1 - \theta_{F3} - \sigma_2) - \{(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2).\theta_{L3}.\lambda_{L3}/(\lambda_{K2}.\theta_{K2}.\theta_{S1})\}]$.

So, $\hat{X}_3 < 0$ if $(\theta_{F3} + \sigma_2) \geq 1$.

The following proposition follows immediately.

PROPOSITION 4: In a Harris-Todaro type economy, the uniform tariffs can protect both the import-competing sectors if the two final commodities are the importables of the economy. However, if specialized manufacturing sector and the intermediary are the two importables, the specialized manufacturing sector contracts due to uniform tariffs. On the other hand, if the intermediary and the agricultural commodity are the importables of the economy, uniform tariffs fail to protect both sectors if $(\theta_{F3} + \sigma_2) \geq 1$.

Thus we find that the uniform tariffs can protect both import-competing final goods sectors but fail to do so when one of the sectors is an intermediary. So this result is found to be valid irrespective of the framework of analysis, whether full-employment or Harris-Todaro framework.

3.2 Tariffs on one sector

Let us now analyze the effects of tariff on any one of the sectors in an HT economy. Depending on different trade patterns of a developing economy the following three cases are to be considered.

Case I: $dt_1 > 0$; $dt_2 = dt_3 = 0$. From equations (15) – (17) it follows that

$\hat{W}$, $\hat{r}$ = 0 and $\hat{W}_S = (dt_1/\theta_{S1}) > 0$. Then from (18) – (20) we have, $\hat{X}_1 > 0; \hat{X}_2 < 0$;and, $\hat{X}_3 > 0$. Also from (21) it follows that $\hat{L}_U < 0$. Now differentiating (13) with respect to t_1, we get

$(dY/dt_1) = (dW_S/dt_1).S^* - P_1.X_1$

Inserting the value of (dW_S/dt_1) and after simplification one gets

$(dY/dt_1) = 0$.

We can explain these results as follows. As W_S rises with W and r remaining unchanged, the (W_S/r) ratio increases. So producers in this sector now use more capital-intensive technique than before. As a_{S1} falls, and skilled labour is a specific input in this sector, the output of this sector increases. An expansion of sector 1 means that less capital will now be available to sector 2. Sector 2 contracts as a consequence and there would be a reverse migration of labour from the urban to the rural sector. The rural sector expands both in terms of employment and output. The level of urban unemployment of unskilled labour decreases as the number of workers returning to the rural sector and getting absorbed in this sector is greater than the magnitude of fall in urban employment. Besides, the imposition of a small tariff on the specialized manufacturing product (commodity 1) creates another distortion (apart from the existing labour market distortion) in the economy. This raises the skilled wage rate and leaves the other factor prices unaltered. The increase in domestic factor income is exactly neutralized by the protectionary cost of tariff. Hence, the national income measured at international prices remains unaffected.

Case II: $dt_2 > 0$; $dt_1 = dt_3 = 0$. In this case from (15) – (17) we find that

$\hat{W} = -(\theta_{F3}/\theta_{L3}).dt_2 < 0$; $\hat{r} = (dt_2/\theta_{K2}) > 0$;and, $\hat{W}_S = -(\theta_{K1}/\theta_{K2}.\theta_{S1}).dt_2 < 0$. Using (18)–(20) we can write $\hat{X}_1 < 0$; $\hat{X}_2 > 0$; and, $\hat{X}_3 < 0$. Besides, from (21) we get $\hat{L}_U > 0$. Differentiating (13) with respect to t_2 one can show[9] that $(dY/dt_2) < 0$. These results can intuitively be explained in the following way. As r increases and W_S decreases, $a_{S1}$and a_{K1} take higher and lower values, respectively than before. Since there is full employment of skilled labour, the level of production in sector 1, X_1 falls. Thus, capital will be released for sector 2. X_2 rises as a_{K2} has fallen and the capital stock of the economy is fully utilized. As X_2 increases the level of employment of unskilled labour in that sector also rises. As the urban sector employment level increases and the rural sector wage decreases, there will be an increase in migration of labour from the rural to the urban sector. So, the rural sector gets less labour than before and as a consequence, the rural sector output, X_1, falls. Also the new migrants will outnumber the magnitude of new jobs created in the urban sector. So, the level of urban unemployment of unskilled labour rises. When a small tariff is imposed on commodity 2 only, both the skilled and unskilled wage rates go down and the rental rate on capital goes up. In this case, the tariff on the intermediate good producing sector also enables the government to earn certain amount of tariff revenue. The sum of increase in the rental income and the

[9] See appendix II for mathematical derivation of this result.

tariff revenue is outweighed by the sum of decrease in the skilled and unskilled wages. As a consequence, the economy's welfare measured by national income at international prices falls.

Case III: $dt_3 > 0$; $dt_1 = dt_2 = 0$. In this case, $\hat{W} = (dt_3/\theta_{L3}) > 0$; $\hat{r}$, $\hat{W}_S = 0$. From (18) – (21) it then follows that $\hat{X}_1 = 0$; $\hat{X}_2 = 0$; $\hat{X}_3 > 0$; and $\hat{L}_U < 0$. Differentiation of equation (13) with respect to t_3 yields: $(dY/dt_3) > 0$. In this case only the rural sector wage rises. As the skilled wage and rental to capital do not change, a_{S1}, a_{K1}, a_{K2} do not change. So the output levels of sectors 1 and 2 do not change. However, as the rural sector unskilled wage, W, rises, there will be an increase in supply of labour in this sector, thereby, leading to an expansion of this sector both in terms of output and employment. Urban unemployment of unskilled labour falls as some of the previously unemployed workers now move to the rural sector due to an increase in the rural sector wage rate. There will be two opposite effects on welfare. As W rises, total wage income of unskilled labour (and hence aggregate factor income) rises. But the expansion of sector 3 means an increase in the cost of tariff protection of this sector. However, it can be easily shown[10] that the first effect dominates over the second effect. The net result will be an increase in welfare of the economy. Thus we have the following proposition.

PROPOSITION 5: Let $dt_i > 0$ be the small tariff imposed on the i^{th} import competing sector, starting from an initial $t_i = 0$, $i = 1,2,3$. Then (a) urban unemployment of unskilled labour falls while the welfare of the economy remains unaffected if $i = 1$, i.e. if the tariff is imposed on sector 1; (b) urban unemployment level increases and the economy's welfare decreases if $i = 2$, i.e. if the tariff is imposed on sector 2; (c) urban unemployment decreases and welfare improves if the tariff is imposed on sector 3.

So if national welfare is the sole criterion of judgment on the choice of tariff-imposed sector, if the rural sector produces an importable and a tariff is imposed on this sector, welfare of the economy improves unequivocally. Besides, a tariff on sector 3 also lowers the magnitude of the urban unemployment, which is also one of the important goals for policy discussions in developing economies.

A close inspection of the results presented in the form of different propositions reveals that some of the results hold irrespective of the framework of analysis. More specifically, results relating to uniform tariffs are valid both in the full-employment and Harris-Todaro (HT) frameworks. On the contrary, welfare effects of tariffs on single commodities differ significantly between the two frameworks. A competitive model is Pareto optimal and free trade is the best policy for a small open economy. On the other hand, the HT framework is sub-optimal because in the migration equilibrium there exists a positive amount of unemployment in the urban sector and the urban-rural wage gap continues to persist. The root cause behind the sub-optimality of the HT equilibrium is the presence urban labour market distortion in the form of unionized wage. Imposition of a small tariff on any sector in a competitive model creates two effects. First,

[10] This has shown in appendix II.

aggregate factor income changes, secondly, the cost of tariff protection affects welfare. In a competitive model imposition of any distortion in the form of a small tariff on any sector of the economy cannot affect welfare measured by national income at world prices because the above two opposite effects completely cancel out each other. So the net effect of a small tariff imposition starting from $t_i = 0$, leaves welfare unchanged. On the contrary, welfare effect of imposition of tariff on any sector in an HT economy crucially hinges on the extent of wage differential between the urban and rural sectors in the two equilibrium situations. If the wage differential increases, as in case of tariff imposition on sector 2 (intermediary), the greater will be the cost of distortion and the lesser will be the economy's welfare. When a small tariff is imposed on sector 1, the competitive unskilled wage in the rural sector does not change and so would be the urban-rural wage differential. Again, if a small tariff is imposed on sector 2 welfare decreases. Finally, a small tariff on sector 3 starting from a zero level, leads to an increase in the competitive unskilled wage rate, thereby lowering the unskilled wage gap between the sectors. Hence, welfare unambiguously improves.

4. Concluding Remarks:

Implementation of trade reform at a fast pace has not so far been proved to be an unmixed blessing for many developing countries. Available empirical evidence suggests that the adjustment costs associated with trade reform have been alarmingly high in many developing economies. Reductions in tariff rates indiscriminately and vehemently have led to serious disconcerting effects like closure of several industrial units and substantial increases in unemployment levels in many developing countries. So tariff reform should be implemented in a phased manner and some degree of protection in some key industries is necessary until the hitherto protected domestic industries can successfully withstand foreign competition. To lessen the adjustment costs of trade reform a uniform tariff policy, long favored by the IMF and the World Bank as a means of diffusing political support for protection has often been recommended. However, this view is acceptable only if a uniform tariff structure can protect all the import-competing sectors of a developing economy.

The present paper examines the validity and generality of the above view in terms of a 3×4 specific factors-model reasonable for a developing economy. The production structure of the economy is as follows. There is an intermediate good-producing sector (sector 2), which is used in another sector (sector 3) along with unskilled labour to produce a final commodity. There is another sector-specific input - skilled labour, which is used in another sector (sector 1) along with capital to produce another final commodity. Finally, the intermediate good is produced using capital and unskilled labour. We have first studied the effects of uniform tariffs and then tariffs on one sector. The effects of tariffs have been analyzed in both competitive and Harris-Todaro frameworks.

In this set-up it has been found that uniform tariffs are effective for protecting the two final goods sector (1 and 3). However, when commodity 1 (commodity 3) and the intermediate good (2) are importables, the uniform tariffs fail to protect both of the sectors. We have then proceeded to find out the sector on which a tariff should be imposed from the viewpoint of national welfare. We have then extended the model into the Harris-Todaro economy, and followed the same procedure.

The analysis of the paper has found that under this production structure which resembles a less developed economy. If commodities 1 and 2 (or 1 and 3) are the importables of the economy, the uniform tariffs will lead to a contraction of the sector that uses the specific input and thus fails to protect both the import-competing sectors of the economy. Besides, the present paper has shown that if both the final commodities (i.e. commodities 1 and 3) are the two importables of the economy, then a uniform tariff structure leads to an expansion of both the import competing sectors at the cost of a contraction of the intermediate good-producing sector. Thus, whether a uniform tariff structure is appropriate for protecting the import-competing sectors crucially depends on the trade pattern of the country. Then we have tried to find out on which of these sectors a tariff should be imposed from the viewpoint of national welfare. We have then extended our model by introducing Harris-Todaro type unemployment of unskilled labour and tried to follow the same procedure. In the HT economy too it has been found that the uniform tariffs are able to protect both sectors if the two final commodities are the importables of the economy. But if the government cannot protect both the import-competing sectors due to some reasons, then tariff must be imposed on the agricultural commodity. In that case national income increases and the urban unemployment decreases. Our analysis also suggests that in the given production structure if a small tariff is imposed on the sector which uses a specific factor and does not use unskilled labour (e.g. sector 1), the urban unemployment of unskilled labour will fall while the welfare remains unaltered. On the contrary, if a small tariff is imposed on the intermediate-input producing sector, the economy's welfare deteriorates and the urban unemployment problem aggravates. Free trade is the optimal policy for a small open economy. However, if a minimum dose of protection has to be imposed, in the given production structure of this paper, it must be on the agricultural sector which uses the traded intermediary.

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APPENDIX I: ***Full-employment framework: Effect of tariff imposition on welfare***

Case I: $dt_1 > 0$; $dt_2 = dt_3 = 0 \Rightarrow \hat{W}$, $\hat{r} = 0$;and, $\hat{W}_S = (dt_1/\theta_{S1})$ } (A.1)

$(dY/dt_1) = (dW_S/dt_1).S^* - P_1.X_1 = (W_S.S^*/\theta_{S1}) - P_1X_1 = (W_S.a_{S1}.X_1.P_1/W_S.a_{S1}) - P_1.X_1 = 0$ (A.2)

Case II: $dt_2 > 0$; $dt_1 = dt_3 = 0$. So from (10) – (12) it follows that

$\hat{W} = -\theta_{S1}.\theta_{K2}.\theta_{F3}.(dt_2/\Delta)$, $\hat{r} = (\theta_{S1}/\Delta).[\theta_{L3} + \theta_{F3}.\theta_{L2}].dt_2$; and

$\hat{W}_S = -(\theta_{K1}/\Delta).[\theta_{L3} + \theta_{L2}.\theta_{F3}].dt_2$ (A.3)

Note that $\Delta = \theta_{S1}.\theta_{K2}.\theta_{L3} > 0$.

Differentiating (14) one gets

$(dY/dt_2) = (dW_S/dt_2).S^* + (dW/dt_2).L^* + (dr/dt_2).K^* + P_2.M$

After substituting the values of (dW_S/dt_2), (dW/dt_2) and (dr/dt_2) from (A.3) we get

$(dY/dt_2) = -(W_S/\Delta).S^*.(\theta_{L3} + \theta_{L2}.\theta_{F3}).\theta_{K1} - (W/\Delta).L^*.\theta_{S1}.\theta_{K2}.\theta_{F3} + (r/\Delta).K^*.(\theta_{L3} + \theta_{F3}.\theta_{L2}).\theta_{S1} + P_2.M$

$= (1/\Delta).(\theta_{L3} + \theta_{F3}.\theta_{L2}).[r.K^*.(a_{S1}.W_S/P_1) - W_S.S^*.(a_{K1}.r/P_1)] - (W/\Delta).L^*.\theta_{S1}.\theta_{K2}.\theta_{F3} + P_2.M$

$= (1/\Delta).(\theta_{L3} + \theta_{F3}.\theta_{L2}).r.\theta_{S1}.a_{K2}.X_2 - (W/\Delta).L^*.\theta_{S1}.\theta_{K2}.\theta_{F3} + P_2.M$

$= (\theta_{S1}.\theta_{K2}/\Delta).[P_2X_2\theta_{F3}.\theta_{L2} - WL^*.\theta_{F3} + P_2.X_2.\theta_{L3}] + P_2.M$

$= (\theta_{S1}.\theta_{K2}/\Delta).[W.\theta_{F3}.(a_{L2}.X_2 - a_{L2}.X_2 - a_{L3}.X_3) + P_2.X_2.\theta_{L3}] + P_2.M$

$= (\theta_{S1}.\theta_{K2}/\Delta).[(P_2X_2.W.a_{L3}/P_3) - (W.a_{L3}.X_3.P_2.a_{F3}/P_3)] + P_2.M$

$= (\theta_{S1}.\theta_{K2}.\theta_{L3}/\Delta).P_2.(X_2 - a_{F3}.X_3) + P_2.(a_{F3}.X_3 - X_2)$

$= 0.$

So, $(dY/dt_2) = 0.$ (A.4)

Case III: $dt_3 > 0$; $dt_1 = dt_2 = 0$.

From (10) – (12) we get

$$\left.\begin{aligned} \hat{W} &= (\theta_{S1}.\theta_{K2}/\Delta).dt_3 \ , \ \hat{r} = -(\theta_{S1}.\theta_{L2}/\Delta).dt_3; \text{ and} \\ \hat{W}_S &= -(\theta_{K1}/\theta_{L2}/\Delta).dt_3 \end{aligned}\right\} \quad \text{(A.5)}$$

$(dY/dt_3) = (dW_S/dt_3).S^* + (dW/dt_3).L^* + (dr/dt_3).K^* - P_3.X_3$

After putting the expressions for (dW_S/dt_3),. (dW/dt_3), (dr/dt_3) from (A.5) we get

$(dY/dt_3) = (W_S.\theta_{K1}.\theta_{L2}.S^*/\Delta) + (W.L^*.\theta_{S1}.\theta_{K2}/\Delta) - (r.K^*.\theta_{S1}.\theta_{L2}/\Delta) - P_3X_3$

$= (\theta_{S1}.\theta_{L2}/\Delta).\{(P_1X_1.r.a_{K1}/P_1) - r.K^*\} + (WL^*.\theta_{S1}.\theta_{K2}/\Delta) - P_3.X_3$

$= -(\theta_{S1}.\theta_{L2}/\Delta).r.a_{K2}.X_2 + WL^*.(\theta_{S1}.\theta_{K2}/\Delta) - P_3X_3$

$= (\theta_{S1}.\theta_{K2}/\Delta).(\{WL^* - P_2X_2.(W.a_{L2}/P_2)\} - P_3X_3$

$= (\theta_{S1}.\theta_{K2}/\Delta).W.a_{L3}.X_3 - P_3.X_3$

$= (\theta_{S1}.\theta_{K2}.\theta_{L3}/\theta_{L3}.\theta_{S1}.\theta_{K2}).P_3.X_3 - P_3X_3 = 0.$

Thus, $(dY/dt_3) = 0.$ (A.6)

APPENDIX II: ***Harris-Todaro Framework***

Uniform Tariffs:

Differentiating equations (1), (2.1) and (3) and solving we get the following expressions.

$\hat{r} = (dt_2/\theta_{K2})$; $\hat{W} = [(dt_3/\theta_{L3}) - (\theta_{F3}/\theta_{L3}).dt_2]$;and,

$\hat{W}_S = (dt_1/\theta_{S1}) - (\theta_{K1}/\theta_{K2}.\theta_{S1}).dt_2.$ (A.7)

Now from (A.7) it is easy to derive the following expressions.

$(\hat{W} - \hat{r}) = (dt_3/\theta_{L3}) - \{(\theta_{F3}.\theta_{K2} + \theta_{L3})/\theta_{L3}.\theta_{K2}).dt_2$

$(\hat{W}_S - \hat{r}) = \{(dt_1/\theta_{S1}) - (dt_2/\theta_{K2}.\theta_{S1})\}$

$(\hat{W} - dt_2) = (dt_3/\theta_{L3}) - (\theta_{F3}/\theta_{L3}).dt_2 - dt_2 = (dt_3/\theta_{S1}) - (dt_2/\theta_{L3})$

Differentiating equation (4) one can derive

$$\hat{X}_1 = (\theta_{K1}.\sigma_1/\theta_{S1}).dt_1 - (\theta_{K1}.\sigma_1/\theta_{K2}.\theta_{S1}).dt_2 \quad (18)$$

Now differentiating equation (5) and using (A.8) the following result can be easily derived.

$$\hat{X}_2 = (1/\lambda_{K2}).[-(\lambda_{K1}.\sigma_1/\theta_{S1}).dt_1 + \{(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2)/\theta_{K2}.\theta_{S1}\}.dt_2] \quad (19)$$

Again differentiating equation (6.1) we get

$$\lambda_{L3}.\hat{X}_3 = (W^*/W).(\lambda_{L2}.\hat{W} - \lambda_{L2}.\hat{a}_{L2} - \lambda_{L2}.\hat{X}_2) - \lambda_{L3}.\hat{a}_{L3}$$

$$= (W^*.\lambda_{L2}/W).\{(dt_3/\theta_{L3}) - (\theta_{F3}.dt_2/\theta_{L2}) + (W^*.\lambda_{L2}.\theta_{K2}.\sigma_2/W).(\hat{W} - \hat{r}) + \lambda_{L3}.\theta_{F3}.\sigma_3.(\hat{W} - dt_2)$$

$$- (W^*.\lambda_{L2}/W.\lambda_{K2}).[-(\lambda_{K1}.\sigma_1.dt_1/\theta_{S1}) + \{(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2).dt_2/\theta_{K2}.\theta_{S1}\}]$$

Using (A.7) and (A.9) the following expression can be obtained.

$$\hat{X}_3 = (1/\lambda_{L3}).[\{W^*.\lambda_{L2}.\lambda_{K1}.\sigma_1/W.\lambda_{K2}.\theta_{S1}\}.dt_1 - dt_2.\{(W^*.\lambda_{L2}.\theta_{F3}/W.\theta_{L3}) + (W^*.\lambda_{L2}.\sigma_2/W)$$

$$+ (\lambda_{L3}.\theta_{F3}.\sigma_3/\theta_{L3}) + (W^*.\lambda_{L2}/W.\lambda_{K2}).(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2/\theta_{K2}.\theta_{S1})\}$$

$$+ dt_3.\{(W^*.\lambda_{L2}/W.\theta_{L3}) + (\lambda_{L3}.\theta_{F3}.\sigma_3/\theta_{L3})\}] \quad (20)$$

From (6) and (7) one gets the following expression.

$$L_U = ((W^*/W) - 1).a_{L2}.X_2 \quad (A.8)$$

Differentiation of (A.8) yields

$$dL_U = -(W^*/W^2).a_{L2}.X_2.dW + ((W^*/W) - 1).(da_{L2}.X_2 + a_{L2}.X_2)$$

or, $L_U.\hat{L}_U = -(W^*/W).a_{L2}.X_2.\hat{W} + ((W^*/W) - 1).a_{L2}.X_2.(\hat{a}_{L2} + \hat{X}_2)$

Using (A.7) and (19) the above expression may be rewritten as

$$L_U.\hat{L}_U = -(W^*/W).(a_{L2}.X_2).\{(dt_3/\theta_{L3}) - (\theta_{F3}/\theta_{L3}).dt_2\}$$

$$+ ((W^*/W) - 1).a_{L2}.X_2.[\sigma_2.dt_2 - (\lambda_{K1}.\sigma_1.dt_1/\lambda_{K2}.\theta_{S1})\ \{(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2)/\lambda_{K2}.\theta_{K2}.\theta_{S1}\}.dt_2]$$

$$L_U.\hat{L}_U = -(W^*/W).(a_{L2}.X_2/\theta_{L3}).dt_3 - ((W^*/W) - 1).(a_{L2}.X_2.\lambda_{K1}.\sigma_1/\lambda_{K2}.\theta_{S1}).dt_1$$

$$+ dt_2.[(W^*/W).a_{L2}.X_2.(\theta_{F3}/\theta_{L3}) + ((W^*/W) - 1).a_{L2}.X_2.\sigma_2$$

$$+ ((W^*/W) - 1).a_{L2}.X_2.\{(\lambda_{K1}.\sigma_1 + \lambda_{K2}.\theta_{L2}.\theta_{S1}.\sigma_2)/\lambda_{K2}.\theta_{K2}.\theta_{S1}\}] \quad (21)$$

Effects of tariff imposition on one commodity

Welfare implication of tariff imposition on one commodity is to be considered here. Depending on different trade situations we consider three cases.

Case I: $dt_1 > 0$; $dt_2 = dt_3 = 0$.

From (A.7) it follows that $\hat{W}$, $\hat{r} = 0$; and, $\hat{W}_S = (dt_1/\theta_{S1}) > 0$.

Differentiating (13) with respect to t_1 we get

$(dY/dt_1) = (dW_S/dt_1).S^* - P_1.X_1 = (W_S.a_{S1}.X_1/W_S.a_{S1}).P_1 - P_1.X_1 = 0$

From (21) it follows that

$\hat{L}_U < 0$ i.e urban unemployment level decreases when $dt_1 > 0$; $dt_2 = dt_3 = 0$.

Case II: $dt_2 > 0$; $dt_1 = dt_3 = 0$.

From (A.7) it follows that $\hat{r} = (dt_2/\theta_{K2}) > 0$; $\hat{W}_S = -(\theta_{K1}.dt_2).(\theta_{K2}.\theta_{S1}) < 0$; $\hat{W} = -(\theta_{F3}/\theta_{L3}).dt_2$.

From (21) it follows that $\hat{L}_U > 0$.

Differentiating (13) with respect to t_2 one gets

$(dY/dt_2) = (dW/dt_2).L^* + (dr/dt_2).K^* + (dW_S/dt_2).S^* + P_2.M$

Insertion of the values of (dW/dt_2), (dr/dt_2), (dW_S/dt_2) and M yields

$(dY/dt_2) = -WL^*.(\theta_{F3}/\theta_{L3}) + (rK^*/\theta_{K2}) - (W_S.\theta_{K1}.S^*/\theta_{K2}.\theta_{S1}) +, P_2.(a_{F3}.X_3 - X_2)$

$= (P_2.a_{F3}/a_{L3}).(a_{L3}.X_3 - L^*) + (P_2/a_{K2}).(K^* - a_{K2}.X_2 - a_{K1}.X_1)$

$= -(P_2.a_{F3}/a_{L3}).(W^*.a_{L2}.X_2/W) < 0$

Case III: $dt_3 > 0$; $dt_1 = dt_2 = 0$.

From (A.7) we have $\hat{W} = (dt_3/\theta_{L3})$; and, $\hat{r}$, $\hat{W}_S = 0$.

From (21) one gets $\hat{L}_U < 0$.

Now differentiation of Y with respect to t_3 yields

$(dY/dt_3) = (dW/dt_3).L^* + (dr/dt_3).K^* + (dW_S/dt_3) - P_3.X_3 = (WL^*/\theta_{L3}) - P_3.X_3 = (P_3/a_{L3}).(L^* - a_{L3}.X_3)$

$= (P_3/a_{L3}).(W^*/W).a_{L2}.X_2 > 0.$