

DOES AGRICULTURAL TRADE LIBERALIZATION AND INFLOW OF FOREIGN CAPITAL INCREASE VULNERABILITY OF THE WEAKER SECTIONS OF SOCIETY? A THEORETICAL ANALYSIS

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ABSTRACT

In the present Paper we have constructed a general equilibrium model to focus on effects of FDI and agricultural trade liberalization in a developing country characterized by agricultural dualism. In the model we have constructed, capital is considered to be a binding constraint. Through the model we come to the conclusion that in case of increase in capital base of the economy and agricultural trade liberalization real wage decreases increasing the vulnerability of the marginalized. Possibility of immiseration is a reality in both the cases. Multiple cross effects embedded in a three sector general equilibrium model, factor intensity ranking and factor specificity play crucial roles in determining the results.

Index terms: Globalization, Real Wage, Agricultural Dualism, General Equilibrium, Factor Intensity

JEL CLASSIFICATION: F6,Q1,01

Section 1: Introduction

Globalization can generate enormous benefit. If properly reaped, it would improve social welfare. However, it also unleashes forces which can adversely affect the lives of families that survive at margins. In the paper we explore whether inflow of FDI and agricultural trade liberalization heightens the vulnerability and reduces welfare of people surviving with meager avenues by adversely affecting the real wage measured in unit of food. It is to be noted that a major aspect of vulnerability is food insecurity which can be linked to real income in general and the real wage measured in units of food items in particular.

First, we consider the importance of the real wage in context of vulnerability in general and food security in particular¹. Household-level food security is determined not only by physical access to food but also by

¹ The World Food Summit of 1996 conceptualized food security in terms of a situation where all people have access to sufficient, safe, nutritious food on a regular basis. According to UN's Food and Agriculture Organization (FAO), food security exists when all people, on a regular basis, have both physical and economic access to sufficient, safe and nutritious food. Their physical and economic access must be sufficient to fetch their dietary needs and food requirements for leading an active and healthy life. The United States Department of Agriculture (USDA), states that household food security implies regular accessibility of all members of the household to enough food for an active and healthy life. Apart from accessibility, ready availability of nutritionally safe

adequate purchasing power². Access to adequate food at the household level is also required for satisfying nutritional levels of all the members belonging to the household. It is to be noted that nutritional security also depends on non-food factors such as health, hygiene and also social practices. Thus, we can state that household food security is one of the primary conditions for achieving the overall nutritional well-being of individuals. FAO studies reveal that household food security would exist only when the capability to acquire food is present. A household access to food is generated through its own production. Access can also be generated through income-generating activities, ownership of assets and transfers of resources from government. What is to be noted is that even though the relative importance of various resources can be different for different households, the command over these resources must be adequate over time to enjoy enough food on a continual basis. According to FAO, household food security is said to exist when adequate effective demand for food exists. FAO studies conclude that an operational measure of short-term effective demand which effectively indicates household economic access to food is the real income.³ In this context reference may be made to the work by Lipton (1983), where a proxy indicator using wage rates and prices for measuring changes in the real income and thus accessibility of food at the household level was used. This approach was based on the notion that in poor households food expenditures usually absorb a large proportion of total expenditure. Based on the idea of Lipton (1983), in this paper, we explore the effect of capital mobility and agricultural trade liberalization on real wage to understand the effect of globalization on food accessibility of labour supplying households.

There is an extensive literature in the general equilibrium framework focusing on determinants of income inequality in developing countries. Mention may be made to the works of Feenstra and Hanson (1996), Marjit (2003), Marjit, Beladi and Chakrabarti (2004), Marjit and Kar (2005), Chaudhuri and Yabuuchi (2007), Chaudhuri (2007), Beladi, Chaudhuri and Yabuuchi (2008), Chaudhuri (2008) among others. What is missing in the literature is the determination of the real wage in presence of a non traded traditional agricultural sector. The objective of this paper is to address the issue of the real wage. In particular we will examine how agricultural trade liberalization and the inflow of capital affects the real wage measured in unit of food. The assumption of non tradedness made is based on available data. We now present certain stylized facts about the agricultural sector.

In this paper we incorporate the concept of agricultural dualism and usage of foreign capital in the agricultural sector. This assumption is based on available statistics on FDI. The process of economic reforms has led to a significant change in the organization of production in many emerging market economies. In the globalised world, dichotomy not only exists between urban and rural sector; it also exists within the agricultural and the manufacturing sector. The agricultural sector is no longer a monolithic entity but is divided into two sub sectors namely the traditional agriculture and the modern agriculture. The difference between the above two can be assessed in terms of nature and intensity of inputs used, as well as consumption pattern of these commodities. According to the World Development Report (WDR) 2008, the modern agricultural sector produces processed

food in adequate quantities is required for food security to exist. Both USDA and FAO agree on the fact that along with easy availability and accessibility, an assured means to acquire nutritious food in socially acceptable manners should also exist.

² Monitoring access to food and household food security, FAO Corporate Document Repository, www.fao.org.

³ Monitoring access to food and household food security, FAO Corporate Document Repository, www.fao.org

goods primarily for exports.⁴ It is to be noted that the World Trade Organisation (WTO) rules and regulations also provide some kind of incentive for the production of capital intensive, processed agricultural goods. High value agro food commodities are the fastest growing products in most developing countries expanding up to 6% to 7% a year, led by livestock product and horticulture as per World Development Report published in 2008. In the post WTO regime, the composition of international trade in agricultural products has changed significantly. In the early 1970s only six commodities which included coffee, tea, cotton, tobacco, sugar, rubber accounted for more than two thirds of total agricultural exports from developing countries. The picture has changed progressively. In 1970s and 1980s when the world was experiencing wide fluctuations in international agricultural commodity prices, most developing countries experienced accelerated growth in non traditional agricultural commodities. WDR (2008) pointed out that fresh and processed fruits and vegetables, fish and fish products, meat, nuts, spices and floriculture account for 43% of agro food exports from developing countries. The report also stated that there is room for further expansion of modern agricultural products especially in the agrarian based less developed countries. The report pointed out that India, Brazil, Philippines, Thailand, China, Ecuador, Costa Rica, Zimbabwe, Guatemala, Kenya, Thailand Mexico, Chile dominate the market for nontraditional agricultural products. The emerging pattern of trade is suggestive of the fact that the commodities produced in the traditional agricultural sector have lost their comparative advantage and have become either import competing or non-traded. The FAO statistics revealed that the net cereal imports of developing countries have increased from 39 million tonnes a year in the mid-1970s to 103 million tonnes in 1997-99. This dependence on imports is likely to increase in the years ahead. It has been estimated that by 2030 the developing countries could be importing 265 million tonnes of cereals, which means 14 percent of their consumption, would be imported annually⁵.

The paper is organized as follows. In section 2, we set up the basic model. In section 3 we carry out the comparative static exercises to explore the effect of greater inflow of FDI and agricultural trade liberalization. In section 4 we concentrate on welfare consequences. Section 5 concludes the paper.

Section 2: The Model

We consider a developing economy consisting of three sectors. One of the sectors is the industrial import competing sector, (X)⁶. The other two sectors belong to the broad category of agricultural sector. One is non traded traditional agricultural sector producing wage goods (Y) and the other one is export oriented modern agricultural sector (Z).

Next, we consider the input use in different sectors. X is produced with labour and capital. Y is produced with the help of labour and land, while land, labour and capital is used for the production of Z. Labour is mobile between all the sectors while capital is also mobile between the sectors X and Z. Labour and capital are

⁴ Modern agricultural sector produces high value agro food commodities such as processed fruits, vegetables, meat, fish products, nuts, spices, floriculture.

⁵ See World Agriculture: Towards 2015/2030. www.fao.org/docrep/004/v3557e/y3557e00.htm

⁶ In the modern day scenario the manufacturing sector of a developing country can also be export oriented in nature.

substitutes in the standard neo classical literature. On the other hand, land is not substitutable and is required in fixed proportions.⁷ Domestic capital and foreign capital are assumed to be substitutes.

The following symbols are used for the formal representation of the model:

a_{lx} = labour output ratio in the X sector

a_{ly} = labour output ratio in the Y sector

a_{lz} = labour output ratio in the Z sector

a_{kx} = capital output ratio in the X sector

a_{kz} = capital output ratio in the Z sector

a_{tz} = land output ratio in the Z sector

a_{ty} = land output ratio in the Y sector

w = wage of labour

R = rate of return on land

r = rate of return on capital

L = labour endowment in physical units

K = capital endowment in physical units

T = land endowment in physical units

P_x^*, P_y^*, P_z^* = prices of X, Y, Z respectively

θ_{lx} = distributive share of labour in the X sector

θ_{ly} = Distributive share of labour in the Y sector

θ_{lz} = distributive share of labour in the Z sector

θ_{kx} = Distributive share of capital in the X sector

θ_{kz} = Distributive share of capital in the Z sector

θ_{tz} = Distributive share of land in the Z sector

θ_{ty} = Distributive share of land in the Y sector

λ_{lx} = proportion of labour in the X sector

λ_{ly} = Proportion of labour in the Y sector

λ_{lz} = Proportion of labour in the Z sector

λ_{kx} = Proportion of capital in the X sector

λ_{kz} = Proportion of capital in the Z sector

λ_{tz} = Proportion of land in the Z sector

λ_{ty} = Proportion of land in the Y sector

⁷ A similar type of assumption, though in a separate context, has been made by Marjit (2009) in 'Two elementary propositions on Fragmentation and Outsourcing in Pure theory of International Trade' Presented at Bengal Economic Association 29th Conference, February 7-8, 2009

$\sigma_{l,k}^x$ = Elasticity of substitution between L,K in Sector X

$\sigma_{l,k}^z$ = Elasticity of substitution between L,K in Sector Z

U=Utility

The general equilibrium structure of the model is as follows.

Given the assumption of perfectly competitive markets, the usual price- unit cost equality conditions relating to the three sectors of the economy are given by the following three equations, respectively:

$$a_{lx} \cdot w + a_{kx} \cdot r = P_x^* \dots\dots (1)$$

$$a_{ly} \cdot w + a_{ly} \cdot R = P_y \dots\dots (2)$$

$$a_{lz} \cdot w + a_{kz} \cdot r + a_{tz} \cdot R = P_z^* \dots\dots (3)$$

Given the full employment condition, the endowment equations are given as follows.

$$a_{lx} \cdot X + a_{ly} \cdot Y + a_{lz} \cdot Z = L \dots\dots (4)$$

$$a_{kx} \cdot X + a_{kz} \cdot Z = K \dots\dots (5)$$

$$a_{ty} \cdot Y + a_{tz} \cdot Z = T \dots\dots (6)$$

Next, we consider equilibrium condition for non traded good. The demand for non traded sector is obtained by using Sheppard's Lemma.

Let $E(P_x^*, P_y^*, P_z^*, U)$ be the expenditure function with all its standard properties. According to Sheppards Lemma::

$$\frac{\delta E(P_x^*, P_y^*, P_z^*, U)}{\delta P_y} = \text{Demand for } Y = Y_d$$

Given concavity of the expenditure function we have $\frac{\delta Y_d}{\delta P_y} = \frac{\delta^2 E(P_x^*, P_y^*, P_z^*, U)}{\delta P_y^2} < 0 \dots(7)^8$

The demand supply equality for non traded sector is::

$$\frac{\delta E(P_x^*, P_y^*, P_z^*, U)}{\delta P_y} = Y_d = Y_s \dots\dots (7a),$$

Where U= Utility

Labour and capital are taken to be substitutable in sector X and sector Z. The elasticity of substitution between labour and capital in sector X and sector Z can be represented by the following equations respectively.

$$\frac{\hat{a}_{kx} - \hat{a}_{lx}}{\hat{w} - \hat{r}} = \sigma_{l,k}^x \dots\dots (8)$$

And $\frac{\hat{a}_{kz} - \hat{a}_{lz}}{\hat{w} - \hat{r}} = \sigma_{l,k}^z \dots\dots (9)$

For stability of the equilibrium, we require that excess demand of non traded item should fall with a rise in price of the non traded good. We note that, for stability

⁸ Since the expenditure function is concave in prices, Hicksian demand curve is downward sloping.

$$\frac{\delta}{\delta P_y} (ED) = \frac{\delta^2 E(P_x^*, P_y, P_z^*)}{\delta P_y^2} - \frac{\delta Y}{\delta P_y} < 0, \dots (10)$$

Where ED= Excess Demand

Since expenditure function is concave in prices we note that. $\frac{\delta^2 E(P_x^*, P_y, P_z^*)}{\delta P_y^2} < 0$. Hence, for stability of the

model we require that supply of non traded commodity should rise with a rise in prices of non traded commodity. We will show that the supply curve of the non traded good is positively sloped irrespective of factor intensity ranking. In other words, we have a stable equilibrium irrespective of factor intensity ranking. The explanation is as follows. We compare between Y and Z. First, we assume that the modern agricultural sector uses land intensively compared to the traditional agricultural sector. In such a setup, rise in price of the non traded commodity would lead to rise in wage of labour and fall in interest rate. Thus, usage of labour would fall and that of capital would rise. This can be thought of as a rise in labour endowment. As modern agricultural sector is land intensive compared to the traditional agricultural sector, production of the traditional agricultural sector would rise. Hence, the model is stable. On the other hand, if traditional agricultural sector is land intensive compared to modern agricultural sector, then along with an increase in price of non traded commodity, wage would fall and interest rate would rise. Thus, usage of labour would increase and that of capital would decrease. This can be thought of as a fall in labour endowment of the economy. Hence, modern agricultural sector would contract and following the Rybzyński argument, traditional agricultural sector rises. Again, the model is stable. We thus see that irrespective of factor intensity ranking, supply of traditional agricultural sector rises with rise in price.

Working of the Model

The model does not have the standard decomposition property. The variables of the model are determined simultaneously from equations (1)-(7). Equations (1)-(3) determine the factor prices. Equations (4)-(6) determine the levels of output. Equation (7a) solves for price of non traded agricultural sector.

Section 3: Comparative Static Exercise

In this section we would explore the consequences of an increase in capital base of the economy consequent upon an increase in foreign capital. We would then explore the effect of agricultural trade liberalization captured through an increase in price of modern agricultural sector produce.

First, we concentrate on the effect of an increase in capital base.

Differentiating the price system, endowment system and commodity market equilibrium with K, we have (See Mathematical Appendix for detailed derivation)

$$\hat{P}_y = \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{lx}}{\theta_{ly}}} \left(-\frac{1}{D_3} \frac{\lambda_{lz}}{\lambda_{ly}} \lambda_{lx} \hat{K} \right) \dots (11)$$

$$\left(\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} - \frac{\theta_{lx}}{D_3 C_3} \right)$$

$$\hat{R} = \frac{1}{\theta_{ty}} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) + \frac{\theta_{ly}}{\theta_{ty}} \frac{\theta_{kx}}{\theta_{lx}} \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \dots (12)$$

$$\hat{w} = -\frac{\theta_{kx}}{\theta_{lx}} \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \dots (13)$$

$$\hat{r} = \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \dots (14)$$

$$\hat{Y} = -\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \left[\lambda_{lx} \hat{K} + (\lambda_{lx}A_3 + \lambda_{kx}B_3) \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \right] \dots (15)$$

$$\hat{Z} = \frac{1}{D_3} \left[\lambda_{lx} \hat{K} + (\lambda_{lx}A_3 + \lambda_{kx}B_3) \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \right] \dots (16)$$

$$\hat{X} = -\frac{B_3}{\lambda_{lx}} \left[\left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) - \right.$$

$$\left. \left\{ -\frac{\theta_{kx}}{\theta_{lx}} \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \right\} - \right.$$

$$\left. \left[\frac{(\lambda_{ly} \lambda_{tz})}{\lambda_{lx}} \right] \frac{1}{D_3} \left[\lambda_{lx} \hat{K} + (\lambda_{lx}A_3 + \lambda_{kx}B_3) \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \right] \dots (17)$$

Where,

$$D_3 = \lambda_{kz} \lambda_{lx} - (\lambda_{tz} - \frac{\lambda_{ty} \lambda_{tz}}{\lambda_{ty}}) > 0^9$$

$$C_3 = \frac{[\theta_{kx} \{ \theta_{tz} \theta_{ly} - \theta_{tz} \theta_{ty} \} + \theta_{kz} \theta_{lx} \theta_{ty}]}{\theta_{lx} \theta_{ty}}$$

$$B_3 = (\lambda_{lx} \theta_{kx} \sigma_{l,k}^x + \lambda_{tz} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z)$$

$$A_3 = \lambda_{kx} \theta_{lx} \sigma_{l,k}^x + \lambda_{tz} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z$$

Proposition 1: The real wage would decrease consequent upon increase in capital base of the economy provided modern agricultural sector is capital intensive compared to the urban manufacturing sector

Comment: If modern agricultural sector uses land intensively compared to the traditional agricultural sector, then following an increase in capital base of the economy, price of the non traded sector would rise. Following the Stolper Samuelson argument, wage would rise. From equation (1) we can conclude that interest rate on capital would fall. What happens to rent is of importance. Manufacturing sector and modern agricultural sector forms a Hecksher Ohlin nugget in terms of labour and capital. If modern agricultural sector is capital intensive compared to the manufacturing sector, to maintain equality in equation (3), land owners' income would increase. The logic is this. From equation (3) we find that $\theta_{tz} \cdot \hat{w} + \theta_{kz} \cdot \hat{r} + \theta_{tz} \cdot \hat{R} = 0$. Since, the modern agricultural sector is capital intensive compared to the traditional manufacturing sector, $\theta_{tz} \cdot \hat{w} + \theta_{kz} \cdot \hat{r}$ falls. To maintain equilibrium in equation (3), rent rises.

From the above equations we see that:

$$\hat{w} - \hat{P}_y = [\theta_{ty} \theta_{kz} \theta_{lx} + \theta_{ty} (\theta_{kz} - \theta_{kx})] \left(-\frac{1}{\theta_{ty} \theta_{lx} C_3} \right) \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) < 0$$

$$\left(\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} - \frac{\theta_{kx}}{\theta_{lx}} \frac{\theta_{tz}}{\theta_{ty}} \right) \frac{1}{D_3 C_3}$$

We see that in this case real wage decreases. From the preceding analysis we find that both wages and price of non traded traditional agricultural sector increase. However, the increase in wage rate is less compared to the increase in price of non traded traditional agricultural product. Hence, real wage measured in terms of non traded good decreases.

Corollary A: Modern agricultural sector and manufacturing sector would expand and traditional agricultural sector would contract provided:

$$1 - \frac{\lambda_{tz}}{\lambda_{ty}} (A_3 \lambda_{lx} + B_3 \lambda_{kx})^2 > 0$$

Comment: If there is increase in capital base of the economy, wage interest ratio increases. This can be thought of as an increase in labour endowment and fall in capital base of the economy. However, capital base of the

⁹ Follows from stability condition.

economy tends to increase via an increase in FDI. In this setup, if: $1 - \frac{\lambda_{tz}}{\lambda_{ty}}(A_3\lambda_{lx} + B_3\lambda_{kx})^2 > 0$, increase in inflow of FDI helps in expansion of both manufacturing sector and modern agricultural sector. Following the Rybzyński argument, the traditional agricultural sector contracts.

We now concentrate on the effect of agricultural trade liberalization.

Differentiating the price system, endowment system and commodity market equilibrium with respect to price of the modern agricultural product, we have (Refer to mathematical appendix for detailed derivation)

$$\hat{P}_y = \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \dots (18)$$

$$\hat{R} = \frac{1}{\theta_{ty}} \frac{M_3}{C_3 \left\{ \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} + \frac{M_3 \theta_{tz}}{C_3 \theta_{ty}} \right\}} \hat{P}_z^* + \frac{\theta_{ly} \theta_{kx}}{\theta_{ty} \theta_{lx}} \left\{ \frac{1}{C_3} \hat{P}_z^* - \frac{\theta_{tz}}{C_3 \theta_{ty}} \frac{M_3}{C_3 \left\{ \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} + \frac{M_3 \theta_{tz}}{C_3 \theta_{ty}} \right\}} \hat{P}_z^* \right\} \dots (19)$$

$$\hat{W} = - \left\{ \frac{\theta_{kx}}{\theta_{lx}} \right\} \frac{1}{C_3} \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \\ \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \dots (20)$$

$$\hat{r} = \frac{1}{C_3} \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \dots (21)$$

$$\hat{Y} = - \frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \\ \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \dots (22)$$

$$\hat{Z} = - \frac{\lambda_{ty}}{\lambda_{tz}} \left[- \frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \right. \\ \left. \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \right] \dots (23)$$

$$\hat{X} = \frac{1}{\lambda_{lx}} \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) B_3 \left[\frac{1}{C_3} \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \right. \\ \left. \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \right]$$

$$\left\{ \lambda_{ly} - \frac{\lambda_{lz}\lambda_{ty}}{\lambda_{tz}} \right\} \left[-\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \right. \\ \left. \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \right] \dots (24)$$

Where,

$$C_3 = \frac{[\theta_{kx} \{\theta_{tz} \theta_{ly} - \theta_{lz} \theta_{ty}\} + \theta_{kz} \theta_{lx} \theta_{ty}]}{\theta_{lx} \theta_{ty}}$$

$$B_3 = (\lambda_{lx} \theta_{kx} \sigma_{l,k}^x + \lambda_{lz} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z)$$

$$A_3 = \lambda_{kxx} \theta_{lx} \sigma_{l,k}^x + \lambda_{lyz} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z$$

$$V = \lambda_{kx} \frac{1}{\lambda_{lx}} (\lambda_{ly} - \frac{\lambda_{lz}\lambda_{ty}}{\lambda_{tz}}) + \frac{\lambda_{kz}\lambda_{ty}}{\lambda_{tz}}$$

From the above equations we arrive at the following proposition.

Proposition 2: If the modern agricultural sector is land intensive to the traditional agricultural sector, the real wage would decrease consequent upon agricultural trade liberalization, provided:

$$\left\{ 1 - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} < 0$$

Comment: As soon as price of modern agricultural sector changes, rent increases since Modern agricultural sector is land intensive in nature. However, along with change in price of modern agricultural sector, price of non traded sector also increases. From equation (3.2.2) we come to the conclusion that even though price of non traded sector increases, wage may fall if:

$$\left\{ 1 - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} < 0$$

From equation (1) we find that interest rate increases. The change in interest rate affects equation (3). However, taking into account various cross effects we finally come to the conclusion that rent increases.

We see that wage falls but price of non traded good increases. Hence, the real wage measured in terms of non traded item falls.

Corollary B: The traditional agricultural sector increases, whereas the modern agricultural sector contracts after agricultural trade liberalization. The manufacturing sector contracts.

Comment: As price of the modern agricultural sector rises, demand of the traditional agricultural sector increases. This is because of the fact that the two goods are generally substitutes. Hence, there is a rightward shift of the demand curve. In figure (1) this can be shown through rightward shift of demand curve of Y from DD to D1D1. At initial equilibrium price P1, there is excess demand. To remove excess demand, supply of Y rises to Y2. However, it is also to be noted that price of traditional agricultural sector increases. This leads to a

fall in demand for Y. Thus, there is an upward movement along demand curve D1D1. The new equilibrium finally settles at B. Thus, output in the traditional agricultural sector expands from Y to Y1.. Following the Rybzynski argument, the modern agricultural sector contracts. Labour released from the modern agricultural sector is less compared to that required by the traditional agricultural sector. Hence, labour has to be released from the manufacturing sector. This leads to a fall in the production of the manufacturing sector.

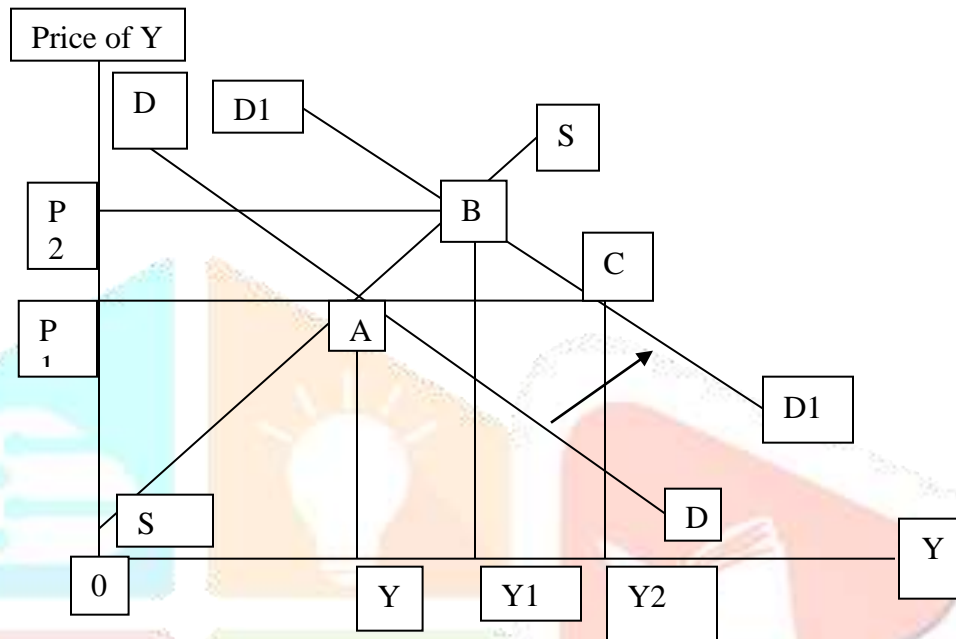


Figure 1

Section 4: Welfare Analysis

In this section we would be analyzing the welfare consequences of globalization policies. For analyzing the welfare of the society, we make use of “Expenditure Function”. First, we note that Total Expenditure on X, Y, Z at domestic prices must equal the value of production at domestic prices net of Foreign interest Income repatriated back¹⁰

$$E[P_x^*, P_y, P_z^*, U] = P_x^* X + P_y Y + P_z^* Z - r(K - K_d), \text{ where } K_d = \text{domestic capital}$$

From the price system and physical system we find that value of production at domestic prices net of foreign interest income repatriated back, equals factor income. Hence, value of expenditure equals factor income.

$$E[P_x^*, P_y, P_z^*, U] = wL + RT + rK_d \dots (25)$$

Where

$$E = E[P_x^*, P_y, P_z^*, U] = \text{expenditure function,}$$

U = Utility

$$\frac{\partial E}{\partial U} > 0, \frac{\partial E}{\partial P_y} > 0, \frac{\partial E}{\partial P_z^*} > 0, \frac{\partial E}{\partial P_x^*} > 0$$

We would first concentrate how welfare changes if capital base of the economy increases..

¹⁰ See Ethier (1988)

Differentiating equation (3.2.24) with respect to rate of interest we have,

$$\frac{\delta E}{\delta P_y} \frac{dP_y}{dK} + \frac{\delta E}{\delta U} \frac{dU}{dK} = L \frac{\delta w}{\delta K} + K_d \frac{\delta r}{\delta K} + T \frac{\delta R}{\delta K} \dots (26)$$

Manipulating the above equation we have:

$$\frac{\delta E}{\delta U} \frac{dU}{dK} = L \frac{\delta w}{\delta K} + K_d \frac{\delta r}{\delta K} + T \frac{\delta R}{\delta K} - \frac{\delta E}{\delta P_y} \frac{dP_y}{dK}$$

The R.H.S of the above expression is equivalent to:

$$\frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \right) \left[\frac{\delta E}{\delta P_y} P_y - TR \frac{1}{\theta_{ty}} \left(\left(1 - \frac{\theta_{ly}\theta_{kx}\theta_{tz}}{\theta_{ty}\theta_{lx}C_3} \right) + \frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} (K_d r - L \frac{\theta_{kx}}{\theta_{lx}} w) \right) \right]$$

$$\left(\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} - \frac{\theta_{lx}}{D_3 C_3} \right)$$

As capital base of the economy increases, wage and rent increase. This increases total factor income and thus leads to improvement in welfare. However, interest rate decreases. This reduces the welfare of the economy by decreasing factor income. We also see that an increase in price of traditional agricultural sector produce increases expenditure and hence welfare deteriorates. Thus, various cross effects are seen on welfare. If the positive effects are outweighed by the negative effects immiserisation becomes a reality. Sufficient condition for immiserisation is as follows:

$$\frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \right) \left[\frac{\delta E}{\delta P_y} P_y - TR \frac{1}{\theta_{ty}} \left(\left(1 - \frac{\theta_{ly}\theta_{kx}\theta_{tz}}{\theta_{ty}\theta_{lx}C_3} \right) + \frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} (K_d r - L \frac{\theta_{kx}}{\theta_{lx}} w) \right) \right] < 0$$

$$\left(\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} - \frac{\theta_{lx}}{D_3 C_3} \right)$$

We now focus on the effect of change in price of modern agricultural product. Differentiating the expenditure function with respect to price of modern agricultural sector produce we have:

$$\frac{\delta E}{\delta P_z^*} + \frac{\delta E}{\delta P_y} \frac{dP_y}{dP_z^*} + \frac{\delta E}{\delta U} \frac{dU}{dP_z^*} = L \frac{dw}{dP_z^*} + K_d \frac{dr}{dP_z^*} + T \frac{dR}{dP_z^*}$$

$$\frac{\delta E}{\delta U} \frac{\delta U}{\delta P_z^*} = L \frac{dw}{dP_z^*} + K_d \frac{dr}{dP_z^*} + T \frac{dR}{dP_z^*} - \frac{\delta E}{\delta P_y} \frac{dP_y}{dP_z^*} - \frac{\delta E}{\delta P_z^*}$$

Manipulating the above equation we find that the R.H.S of the equation is:

$$\left(-\frac{\delta E}{\delta P_y} + \frac{\theta_{tz}}{\theta_{ty}C_3} - \frac{1}{\theta_{ty}} \right) \frac{P_y}{P_z^*} \left\{ \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \right.$$

$$\left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} + (rK_d - \frac{\theta_{kx}}{\theta_{lx}} wL + \frac{RT\theta_{ly}\theta_{kx}}{\theta_{ty}\theta_{lx}}) \frac{P_y}{P_z^*} \frac{1}{C_3}$$

As agricultural trade liberalization takes place, wage decreases. This has a negative influence on welfare as total factor income decreases. However, increase in interest and rent increases factor income of the country. This has

positive effect on welfare. Increase in price of non- traded traditional agricultural produce and price of traded agricultural produce increase total expenditure and this leads to a decrease in welfare. Thus, there are various forces acting on welfare. If the negative forces outweigh the positive forces welfare falls. Sufficient condition for immiserisation is as follows:

$$\left(-\frac{\delta E}{\delta P_y} + \frac{\theta_{tz}}{\theta_{ty} C_3} - \frac{1}{\theta_{ty}}\right) \frac{P_y}{P_z^*} \left\{ \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \right. \\ \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} + (rK_d - \frac{\theta_{kx}}{\theta_{tlx}} wL + \frac{RT\theta_{ly}\theta_{kx}}{\theta_{ty}\theta_{lx}}) \frac{P_y}{P_z^*} \frac{1}{C_3} < 0$$

Proposition 3: A possibility of immiserisation exists in case of both inflow of FDI and agricultural trade liberalization.

Section 5: Conclusion

In the present Paper we have constructed a general equilibrium model to focus on effects of FDI and agricultural trade liberalization in a developing country characterized by agricultural dualism. In the model we have considered capital to be a binding constraint. We have constructed a three sector general equilibrium model incorporating agricultural dualism. We have kept in mind that foreign capital is being utilized by the agricultural sector also. Through the model we come to the conclusion that in case of increase in capital base of the economy and agricultural trade liberalization real wage decreases. However, what is also to be noted is that factor intensity rankings play important role in determining the nature of the results. Possibility of immiserisation is a reality in both the cases.

Increasing real wage is a disturbing global phenomenon in recent times. The broad policy message of the paper is that the policy makers while embarking upon policy of agricultural trade liberalization and policies encouraging FDI should judiciously look into the nature of the agricultural sector specially its factor usage, intensity with which it is used. We can also extend the paper by introducing different aspects of factor market segmentation such as division between the skilled-unskilled labourers to explore the effect of globalization on real wage of both skilled and unskilled labour.

Mathematical Appendix

Appendix for section 2

Effect of increase in capital stock:

From the price system we have:

$$\hat{w} = -\frac{\theta_{kx}}{\theta_{lx}} \hat{r} \dots (a)$$

$$\hat{r} = -\frac{\theta_{tz}}{\theta_{ty}} \left\{ \frac{1}{C_3} \hat{P}_y \right\} \dots (b)$$

$$\hat{R} = \hat{P}_y \left\{ \frac{1}{\theta_{ly}} \right\} + \frac{\theta_{ly}\theta_{kx}}{\theta_{ty}\theta_{lx}} \hat{r} \dots (c)$$

From market clearing equation we have:

$$\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \hat{P}_y = \hat{Y} \dots(d)$$

From the factor endowment equations we have:

$$\lambda_{ly} \hat{Y} + \lambda_{lx} \hat{X} + \lambda_{lz} \hat{Z} = -\lambda_{ly} \hat{a}_{ly} - \lambda_{lx} \hat{a}_{lx} - \lambda_{lz} \hat{a}_{lz} \dots(b5)$$

$$\lambda_{ty} \hat{Y} + \lambda_{tz} \hat{Z} = 0 \dots(3.2.b6)$$

$$\lambda_{ky} \hat{X} + \lambda_{kz} \hat{Z} = \hat{K} - \lambda_{ky} \hat{a}_{ky} - \lambda_{kz} \hat{a}_{kz} \dots(b71)$$

Using equations (a)-(b71) we have:

$$\hat{P}_y = \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \dots(11)$$

$$\hat{R} = \frac{1}{\theta_{ty}} \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) + \frac{\theta_{ly}}{\theta_{ty}} \frac{\theta_{kx}}{\theta_{lx}} \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \dots(12)$$

12)

$$\hat{w} = -\frac{\theta_{kx}}{\theta_{lx}} \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \dots(13)$$

$$\hat{r} = \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \dots(14)$$

$$\hat{Y} = -\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \left[\lambda_{lx} \hat{K} + (\lambda_{lx} A_3 + \lambda_{kx} B_3) \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \right] \dots(15)$$

$$\hat{Z} = \frac{1}{D_3} \left[\lambda_{lx} \hat{K} + (\lambda_{lx} A_3 + \lambda_{kx} B_3) \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx} A_3 + \lambda_{kx} B_3)}{(1 + \frac{\theta_{kx}}{\theta_{lx}}) \frac{\theta_{tz}}{\theta_{ty}}} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \right] \dots(16)$$

$$\hat{X} = -\frac{B_3}{\lambda_{lx}} \left[\left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{\left(\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} - \frac{\theta_{kx}}{\theta_{lx}} \frac{\theta_{tz}}{\theta_{ty}} \right)} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) - \left\{ -\frac{\theta_{kx}}{\theta_{lx}} \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{\left(\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} - \frac{\theta_{kx}}{\theta_{lx}} \frac{\theta_{tz}}{\theta_{ty}} \right)} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right) \right\} \right] - \left[\frac{(\lambda_{tz} - \frac{\lambda_{ly}\lambda_{tz}}{\lambda_{lx}})}{\lambda_{lx}} \right] \frac{1}{D_3} [\lambda_{lx} \hat{K} + (\lambda_{lx}A_3 + \lambda_{kx}B_3)(1 + \frac{\theta_{kx}}{\theta_{lx}}) \left\{ -\frac{1}{C_3} \frac{\theta_{tz}}{\theta_{ty}} \right\} \frac{(\lambda_{lx}A_3 + \lambda_{kx}B_3)}{\left(\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} - \frac{\theta_{kx}}{\theta_{lx}} \frac{\theta_{tz}}{\theta_{ty}} \right)} \left(-\frac{1}{D_3} \frac{\lambda_{tz}}{\lambda_{ty}} \lambda_{lx} \hat{K} \right)] \dots (17)$$

Where,

$$D_3 = \lambda_{kz} \lambda_{lx} - \left(\lambda_{tz} - \frac{\lambda_{ly}\lambda_{tz}}{\lambda_{ty}} \right) > 0^{11}$$

$$C_3 = \frac{[\theta_{kx} \{ \theta_{tz} \theta_{ly} - \theta_{lz} \theta_{ty} \} + \theta_{kz} \theta_{lx} \theta_{ty}]}{\theta_{lx} \theta_{ty}} > 0$$

$$B_3 = (\lambda_{lx} \theta_{kx} \sigma_{l,k}^x + \lambda_{ly} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z)$$

$$A_3 = \lambda_{kxx} \theta_{lx} \sigma_{l,k}^x + \lambda_{ly} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z$$

Effect of Agricultural Trade Liberalization

$$\hat{w} = -\frac{\theta_{kx}}{\theta_{lx}} \hat{r} \dots (a1)$$

$$\hat{R} = \frac{\theta_{ly}}{\theta_{ty}} \frac{\theta_{kx}}{\theta_{lx}} \hat{r} + \hat{P}_y \frac{1}{\theta_{ty}} \dots (b1)$$

$$\hat{r} = \{ \hat{P}_z^* - \hat{P}_y \frac{\theta_{tz}}{\theta_{ty}} \} \frac{1}{C_3} \dots (b3)$$

From market clearing equation we have:

$$\frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \hat{P}_y + P_z^* \frac{\delta^2 E}{\delta P_y \delta P_z^*} \hat{P}_z^* = \hat{Y} \dots (d)$$

From the factor endowment equations we have:

$$\lambda_{ly} \hat{Y} + \lambda_{lx} \hat{X} + \lambda_{lz} \hat{Z} = -\lambda_{ly} \hat{a}_{ly} - \lambda_{lx} \hat{a}_{lx} - \lambda_{lz} \hat{a}_{lz} \dots (b5)$$

¹¹ Follows from stability condition.

$$\lambda_{ty} \hat{Y} + \lambda_{tz} \hat{Z} = 0 \dots (b6)$$

$$\lambda_{kx} \hat{X} + \lambda_{lkz} \hat{Z} = -\lambda_{kx} \hat{a}_{kx} - \lambda_{lkz} \hat{a}_{kz} \dots (b7)$$

Using the above equations we have:

$$\hat{P}_y = \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \dots (18)$$

$$\hat{R} = \frac{1}{\theta_{ty}} \frac{M_3}{C_3 \left\{ \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} + \frac{M_3 \theta_{tz}}{C_3 \theta_{ty}} \right\}} \hat{P}_z^* + \frac{\theta_{ly} \theta_{kx}}{\theta_{ty} \theta_{lx}} \left\{ \frac{1}{C_3} \hat{P}_z^* - \frac{\theta_{tz}}{C_3 \theta_{ty}} \frac{M_3}{C_3 \left\{ \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} + \frac{M_3 \theta_{tz}}{C_3 \theta_{ty}} \right\}} \hat{P}_z^* \right\} \dots (19)$$

$$\hat{w} = - \left\{ \frac{\theta_{kx}}{\theta_{lx}} \right\} \frac{1}{C_3} \frac{1}{C_3} \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \\ \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \dots (20)$$

$$\hat{r} = \frac{1}{C_3} \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \dots (21)$$

$$\hat{Y} = - \frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \\ \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \dots (22)$$

$$\hat{Z} = - \frac{\lambda_{ty}}{\lambda_{tz}} \left[- \frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \right. \\ \left. \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \right] \dots (23)$$

$$\hat{X} = \frac{1}{\lambda_{lx}} \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) B_3 \left[\frac{1}{C_3} \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \right. \\ \left. \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \right] -$$

$$\left\{ \lambda_{ly} - \frac{\lambda_{lz} \lambda_{ty}}{\lambda_{tz}} \right\} \left[- \frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \left\{ \hat{P}_z^* - \frac{\theta_{tz}}{\theta_{ty}} \left[\frac{1}{C_3 V} \left(\frac{\theta_{lx}}{\theta_{kx}} + 1 \right) (\lambda_{kx} \frac{1}{\lambda_{lx}} B_3 + A_3) + \frac{P_z^*}{Y} \frac{\delta^2 E}{\delta P_y \delta P_z^*} \right] \hat{P}_z^* \right. \right. \\ \left. \left. \left[\frac{1}{VC_3} \left(\frac{\theta_{kx}}{\theta_{lx}} + 1 \right) \frac{\theta_{tz}}{\theta_{ty}} (\lambda_{kx} B_3 + A_3) - \frac{P_y}{Y} \frac{\delta^2 E}{\delta P_y^2} \right] \right\} \right] \dots (24)$$

Where,

$$C_3 = \frac{[\theta_{kx} \{\theta_{tz} \theta_{ly} - \theta_{lz} \theta_{ty}\}] + \theta_{kz} \theta_{lx} \theta_{ty}}{\theta_{lx} \theta_{ty}}$$

$$B_3 = (\lambda_{lx} \theta_{kx} \sigma_{l,k}^x + \lambda_{lz} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z)$$

$$A_3 = \lambda_{kxx} \theta_{lx} \sigma_{l,k}^x + \lambda_{lzx} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z$$

$$V = \lambda_{kx} \frac{1}{\lambda_{lx}} (\lambda_{ly} - \frac{\lambda_{ly} \lambda_{tz}}{\lambda_{tz}}) + \frac{\lambda_{kz} \lambda_{ty}}{\lambda_{tz}}$$

Stability Condition of the Model

We know, $\frac{\delta(ED)}{\delta P_y} < 0$ (for stability)

$$\frac{\delta}{\delta P_y} (ED) = \frac{\delta^2 E(P_x^*, P_y, P_z^*)}{\delta P_y^2} - \frac{\delta Y}{\delta P_y} < 0,$$

Where ED= Excess Demand

$$\frac{\delta^2 E(P_x^*, P_y, P_z^*)}{\delta P_y^2} < 0 \text{ (Since expenditure function is concave in prices.)}$$

Hence, for stability we require:

$$\frac{\delta Y}{\delta P_y} > 0$$

$$\frac{\hat{Y}}{\hat{P}_y} = \left\{ \frac{1}{D_3 C_3} \frac{\theta_{tz}}{\theta_{ty}} \left(1 + \frac{\theta_{kx}}{\theta_{lx}} \right) (\lambda_{lx} A_3 + \lambda_{kx} B_3) \right\}$$

$$D_3 = \lambda_{kzl} \lambda_{lx} - \left(\lambda_{ly} - \frac{\lambda_{ly} \lambda_{tz}}{\lambda_{tz}} \right)$$

$$C_3 = \frac{[\theta_{kx} \{\theta_{tz} \theta_{ly} - \theta_{lz} \theta_{ty}\}] + \theta_{kz} \theta_{lx} \theta_{ty}}{\theta_{lx} \theta_{ty}}$$

$$B_3 = (\lambda_{lx} \theta_{kx} \sigma_{l,k}^x + \lambda_{lz} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z)$$

$$A_3 = \lambda_{kxx} \theta_{lx} \sigma_{l,k}^x + \lambda_{lzx} \frac{\theta_{kz}}{1 - \theta_{tz}} \sigma_{l,k}^z$$

Manipulating the above equation we find that irrespective of the fact that Z is land intensive to Y or Z labour intensive to Y, the model is stable

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