CHAPTER 4

THEORETICAL ISSUES RELATED TO TERMS OF TRADE, SKILLED-UNSKILLED WAGE GAP AND FOREIGN CAPITAL INFLOW IN SMALL OPEN DEVELOPING ECONOMIES: A FOUR-SECTOR ANALYSIS
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4.1. Introduction:

In this chapter we want to examine the impact of a more liberalised investment regime and improvement in terms of trade on the skilled-unskilled wage gap in developing economies. We do this on the basis of a four-sector economy. It has been rightly pointed out by Acharyya and Marjit (2000) that a 2x2 HOS model fails to capture the impact of any change in factor endowment on factor prices and also the diverse trade pattern of the developing economies. So, we consider an extension of the Jones (1971) type specific factor model (in which the number of factors of production exceeds the number of goods) by introducing HT type of urban unemployment of unskilled workers and sector specific foreign capital. The use of foreign capital as a specific factor in a particular sector is meant for the production of exports only. Thus this sector may be described as what is known as Export Processing Zone (EPZ). Capital mobility between the EPZ and the rest of the world cannot be assumed away. The existence of an

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21 See the works of Young and Miyagiwa (1987), Young (1992), Dutta Chaudhuri & Adhikari (1993), Gupta (1994), Basu (1996), Gupta & Gupta (1998). These works are basically extensions of Harris-Todaro (1970) type of models. Also see the works of Hamada (1974), Hamilton & Svensson (1982), Young (1987), and Beladi & Marjit (1992) who use the Heckscher-Ohlin-Samuelson framework. The assumption that foreign capital is sector-specific (for the EPZ) and does not move to the other sectors is taken from the literature.
exogenously given foreign capital stock can be justified by assuming that the
Government directly regulates the entry of foreign capital. The host country Government
only sequentially and slowly opens up its investment regime to foreign multinational
corporations (MNCs). This is what is being done by the Government of many countries
in the process of liberalisation.24

The present chapter thus attempts to incorporate the existence of open
unemployment of unskilled workers in a trade model for the developing economies. We
consider a labour market allocation where unskilled workers migrate from the rural sector
to the urban formal sector on the basis of HT migration mechanism. Our analysis shows
that in the presence of urban unemployment composed of unskilled workers, more
investment liberalisation and improvement in terms of trade, whatever may be the source
of it, reduces the skilled-unskilled wage gap and also reduces urban unemployment.

This chapter is organised as follows. Section 4.2 describes the basic model. In
section 4.3 some comparative static effects are examined and the concluding remarks are
made in section 4.4.

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24 See the works of Marjit (1994) and Gupta and Gupta (1998) in this context. In fact, Marjit (1994) has
argued that, in India, the shift towards a more liberalised environment is a gradual one because drastic
policy changes may lead to socio-political tension in the country in the short run. He has considered a few
examples to establish his point. In the late 1990s, the experiences of some of the East Asian countries, like
Malaysia and Indonesia, support Marjit’s argument. We thus assume r_F > r_F^*, where r_F is the rate of return
on foreign capital within the economy and r_F^* is the world rate of return on foreign capital which is
exogenously given. In our model r_F is endogenously determined. As r_F > r_F^*, the foreign investors or MNCs
are interested to invest in the host country. Now, what prevents foreign capital to flow in till the rates are
equalised (i.e., equalisation of r_F and r_F^*) is the Government control in the host country over the inflow of
foreign capital stock. It implies that foreign capital stock is fixed at a particular point of time though
r_F > r_F^*.
4.2. The Model:

We consider a four sector small open economy, which is basically of the HT type. Sector x produces product X with the help of skilled labour and foreign capital; sector y produces product Y with the help of unskilled labour and domestic capital; sector m produces product M with skilled labour and domestic capital; sector z produces product Z with unskilled labour and land. The first three sectors produce manufacturing product in the urban sector of which sector x produces only for exports and the fourth one produces an agricultural product in the rural area using land as a specific factor along with unskilled labour.

Skilled workers are freely mobile between sectors x&m, while unskilled workers migrate from the rural sector, z, to the urban sector, y. This migration takes place according to HT principle. The urban wage rate of the unskilled workers is assumed to be institutionally fixed. The economy exports products X & Z and imports products Y & M. Production takes place under CRS and competitive market conditions. The product of sector y is considered as the numeraire and its price has been set equal to unity.

We denote the sectors by x, y, m & z and the products by X, Y, M & Z. The other notations used in this model are the following:

- \( P_j \) – world price for the product of the j-th sector, with \( j = x, y, m \) & z
- \( S \) - stock of skilled labour
- \( L \) - stock of unskilled labour
- \( K_D \) – stock of domestic capital
$K_F$ – stock of foreign capital

$T$ – stock of land

$a_{ij}$ – quantity of the $i$-th input required to produce one unit of the $j$-th sector’s product

$\lambda$ – urban unemployment rate of the unskilled labour

$W_S$ – wage rate of the skilled labour

$W_{LZ}$ – wage rate of the unskilled labour in the rural sector

$\bar{W}_{LY}$ – institutionally fixed wage rate of the unskilled labour in the urban sector

$r_F$ – rate of return on foreign capital

$r_D$ – rate of return on domestic capital

$R$ – rental on land

We now consider the equational structure of the model. The competitive equilibrium conditions are given by equations (4.1) to (4.4).

\[
\begin{align*}
  P_x &= W_s a_{sx} \left( \frac{W_s}{r_F} \right) + r_F a_{K_{Fx}} \left( \frac{W_s}{r_F} \right) \quad (4.1) \\
  1 &= \bar{W}_{LY} a_{LY} \left( \frac{\bar{W}_{LY}}{r_D} \right) + r_D a_{K_{Ly}} \left( \frac{\bar{W}_{LY}}{r_D} \right) \quad (4.2) \\
  P_m &= W_s a_{sm} \left( \frac{W_s}{r_D} \right) + r_D a_{K_{m}} \left( \frac{W_s}{r_D} \right) \quad (4.3) \\
  P_z &= W_{LZ} a_{LZ} \left( \frac{W_{LZ}}{R} \right) + R a_{TZ} \left( \frac{W_{LZ}}{R} \right) \quad (4.4)
\end{align*}
\]

HT migration equilibrium condition implies the equality between expected urban wage rate and actual rural wage rate of the unskilled workers. Thus we have:

\[
\bar{W}_{LY} = (1 + \lambda) W_{LZ} \quad (4.5)
\]

Factor market equilibrium conditions give us the following equations:

\[
\begin{align*}
  a_{sx} \left( \frac{W_s}{r_F} \right) X + a_{sm} \left( \frac{W_s}{r_D} \right) M &= S \quad (4.6) \\
  a_{K_{Fx}} \left( \frac{W_s}{r_F} \right) X &= K_F \quad (4.7) \\
  a_{K_{m}} \left( \frac{W_s}{r_D} \right) M + a_{K_{ly}} \left( \frac{\bar{W}_{LY}}{r_D} \right) Y &= K_D \quad (4.8)
\end{align*}
\]
Equations (4.6) to (4.10) ensure full employment of the factors of production, except for the unskilled workers. Our model consists of 10 equations with 10 endogenous variables: \( W_s, r_F, r_D, W_{LZ}, R, \lambda, X, Y, M, Z \).

The working of the model can be explained as follows. We can determine \( r_D \) and \( W_s \) from equation (4.3). So, \( r_F \) is known from equation (4.1). As we have already mentioned in a footnote (see footnote 24) that our implicit assumption is \( r_F > r_F^* \), where \( r_F^* \) is the exogenously given world rate of return on foreign capital. For this reason the foreign investors or MNCs are interested to invest in the host-country. Now, what prevents foreign capital to flow in till the rates are equalised is the Government control in the host-country over the inflow of foreign capital stock. It implies that the stock of foreign capital is fixed at particular point of time though \( r_F > r_F^* \).

Once the factor prices, i.e., \( W_s, r_F \) and \( r_D \), are known the input-output ratios, except \( a_{LZ} \) and \( a_{TZ} \), are known. Hence \( X \) is determined from equation (4.7); given \( X \), the level of \( M \) is determined from equation (4.6); and given \( M \), the level of \( Y \) is determined from equation (4.8). The rest of the variables are determined from equations (4.4), (4.5), (4.9) and (4.10). We express \( R \) & \( \lambda \) in terms of \( W_{LZ} \) from equations (4.4) & (4.5) respectively as \( P_z \) and \( \overline{W}_{LZ} \) are given.

Thus equation (4.9) can be written as

\[
(1 + \lambda) a_{LY} \left( \overline{W}_{LY} / r_D \right) Y + a_{LZ} \left( W_{LZ} / R \right) Z = L \tag{4.9}
\]

\[
a_{TZ} \left( W_{LZ} / R \right) Z = T \tag{4.10}
\]
or, \( H a_{ly} Y + a_{lz} Z = L \) \hspace{1cm} (4.9.1)

where, \( H = 1 + \lambda \left( W_{lz} \right) \) with \( H' = \lambda' < 0 \). Again equation (4.10) can be written as

\[ a_{TZ} \left\{ \frac{W_{lz}}{R(W_{lz})} \right\} Z = T \]

or, \( a_{TZ} \{W_{lz}\} Z = T \) \hspace{1cm} (4.10.1)

Given the equilibrium value of \( Y \), equations (4.9.1) and (4.10.1) solve the equilibrium values of \( W_{lz} \) and \( Z \). From equation (4.9.1), we find that as \( W_{lz} \) rises the level of unskilled unemployment \( \lambda (W_{lz}) a_{ly} Y \) falls. So the level of employment of sector \( Z \) must rise. But \( a_{lz} \) falls as \( W_{lz} \) rises. So, the output of \( Z \) rises.

The locus of \( W_{lz} \) and \( Z \), which maintains equilibrium in the market for unskilled labour, is given by the LL curve in Figure - 4.1. The slope of this curve as obtained from (4.9.1) is given by

\[ \left. \frac{d W_{lz}}{dZ} \right|_{LL} = - \{a_{lz} / (H' a_{ly} Y + a_{lz}' Z)\} \]

where \( a_{lz}' = (d a_{lz} / d W_{lz}) \). Now, given \( H' < 0 \) and \( a_{lz}' < 0 \), the LL curve is positively sloped, as shown in Figure - 4.1.

From equation (4.10.1) we find that as \( W_{lz} \) rises, the land-output ratio rises too. Hence \( Z \) must fall to maintain equilibrium in the land market. The locus of \( W_{lz} \) and \( Z \) that maintains equilibrium in the land market is given by the TT curve in figure- 4.1. The slope of the TT curve as obtained from (4.10.1) is:

\[ \left. \frac{d W_{lz}}{dZ} \right|_{TT} = - a_{TZ} / a_{TZ}' Z \]

with \( a_{TZ}' = (d a_{TZ} / d W_{lz}) > 0 \), the TT curve is negatively sloped.
Figure- 4.1

The intersection of LL and TT gives us the equilibrium values of $W_{LZ}$ and $Z$. Once $W_{LZ}$, is known, $R$ and $\lambda$ are determined from equations (4.4) and (4.5) respectively. This completes the working of the model.

4.3. Comparative Static Exercises:

We now want to examine some comparative static effects resulting from more liberalised investment regime and also due to changes in terms of trade.\(^{25}\) Firstly, we consider the consequences of a more liberalised investment regime resulting in an increase in the inflow of foreign capital. So long as the prices of products X and M remain unchanged there will be no change in $W_S$ and $r_F$ due to an increase in $K_F$. Hence

\(^{25}\) For the interpretation of international terms of trade, see chapter 3, page – 39.
factor proportions do not change in sectors x, m and y. So, inflow of foreign capital raises
the production of good X. For given endowment of skilled labour, the production of good
M falls. Again, for given endowment of domestic capital, the production of good Y rises.

The rise in the output of Y will have a definite effect upon the LL curve since it is
drawn on the basis of given value of Y. So, for given value of $W_{21Z}$, $(1+\lambda)a_{LY}Y$ rises.
Thus by relation (4.9.1), when $a_{21Z}$ remains the same, a fall in the production of
agricultural output is obvious. It shifts the LL curve in Figure- 4.1 to the left. But there
will be no change in the TT curve. The new equilibrium thus gives a higher value of $W_{21Z}$
and a lower value of Z. In fact, a rise in the flow of foreign capital increases employment
in sector y. It is ensured by drawing unskilled labour from the rural sector. Consequently,
the production of Z falls. Given land market equilibrium, per unit requirement of land
rises and it is guaranteed by rise in $W_{21Z}$.

The rise in $W_{21Z}$ leads to a fall in the rent of land and the rate of urban
unemployment. Indeed migration equilibrium requires a rise in expected urban wage rate
when wages in the rural sector increase. So, when $W_{21Z}$ rises, $\lambda$ must fall. The effect on
the level of urban unemployment, $\lambda a_{21Y}Y$, however, cannot be predicted as Y rises but $\lambda$
falls and $a_{21Y}$ remains unchanged. Since $W_{21Z}$ can be interpreted as the average wage rate
of the unskilled workers, rise in the foreign capital inflow leads to a reduction in
$W_S / W_{21Z}$, which is a measure of the wage-gap. The following proposition shows our
results [for mathematical derivations see the appendix].

26 See chapter 3, footnote 15 of page - 38.
Proposition 4.1: As a consequence of more liberalised investment regime, with given terms of trade, there is reduction in both the wage gap and the rate of urban unemployment of unskilled labour.

Our results are thus opposite to those obtained by Feenstra and Hanson (1995), in which it is shown that a rise in foreign investment in Mexico has widened the skilled-unskilled wage gap. Assume next a boost in the exports of the agricultural products due to a rise in the world demand. So, the world price and, therefore, the domestic price of the agricultural product rises. As \( P_Z \) rises, for given \( W_{LZ} \), there will be a rise in the rent of land. It reduces the relative price of unskilled labour. So, per unit requirement of labour rises and that of land falls in the \( z \)-th sector. Hence, by equation (4.9.1) the output of \( Z \) falls. It shifts the LL curve to the left. Again, a fall in \( a_{TZ} \) requires a rise in the production of \( Z \) to maintain equilibrium in the land market. So, the TT curve shifts to the right. The shift of TT and LL curve increases \( W_{LZ} \), but the impact on \( Z \) remains indeterminate. An increase in \( W_{LZ} \) with unchanged \( W_S \) reduces \( W_S / W_{LZ} \) and \( \lambda \). Hence the level of urban unemployment, \( \lambda a_{L} Y \), also falls. We summarise our results in the form of the following proposition [for mathematical derivations see the appendix].

Proposition 4.2: Improvement in terms of trade in the form of rise in the price of the agricultural product reduces the skilled-unskilled wage-gap and also leads to reduction in the rate of urban unemployment of unskilled labour.
A rise in the price of the skilled-intensive exportables in the international market does not alter our basic results. So long as the price of importables produced by skilled labour remains constant, wage rate for skilled labour remains the same. Thus $W_S$ is fixed by equation (4.3), when $r_D$ is fixed by equation (4.2). In other words, as $r_D$ is determined from equation (4.2) and $W_S$ is determined from equation (4.3), they are independent of changes in $P_X$. Thus rise in $P_X$ raises the return to foreign capital only. It induces substitution in favour of the skilled labour vis-à-vis the foreign capital. Reduction in the per unit use of foreign capital ($a_{K,x}$) raises the production of $X$ and reduces the production of $M$. Thus, when the endowment of domestic capital remains unchanged, the production of $Y$ rises. As soon as $Y$ rises, with $W_S$ unchanged as it is independent of change in $P_X$, the results of proposition 4.1 is imminent. It implies, for given value of $W_{LZ}$, $Z$ must fall. Thus, the LL curve of Figure – 4.1 shifts to the left. We also find that a rise in $P_X$ leads to no shift of TT locus. Hence, $W_{LZ}$ rises. Contrary to the results obtained in chapter 3, here we see that an improvement in terms of trade due to a rise in the world price of the skilled labour intensive exportable leads to a rise in the wage rate for the unskilled labour. The reason is that in this model the output of the urban manufacturing sector, $Y$, which uses unskilled labour, rises. Due to the free mobility of the skilled labour, a growth in output of the foreign enclave implies a shift of a part of the skilled labour force into sector $x$ from sector $m$. It leads to a reallocation of domestic capital from sector $m$ to sector $y$ and thereby raises output in this sector.

Liberalised trade regime might have the impact of reducing the prices of importables. If the price of the skilled intensive importables, $P_M$, falls, there will be a fall
in the wage rate of the skilled labour, $W_s$. So, $a_{sx}$ and $a_{sm}$ rise; and $a_{kX}$ and $a_{km}$ fall. A fall in $a_{kX}$ raises the level of $X$. Again, from equation (4.6) we find that as $a_{sx}$, $a_{sm}$ and $X$ rise, the level of production of $M$ falls. So, from equation (4.8), it follows that a fall in $M$ coupled with a fall in $a_{km}$ raises the production of good $Y$. Hence, our analysis leads to the results of proposition 4.1 when $W_s$ also decreases. Thus we can write the results of the impact of the improvement in terms of trade due to a rise in the price of the exportables or a fall in the price of the importables, which use skilled labour, in terms of proposition 4.3.

**Proposition 4.3**: *Improvement in terms of trade due to rise in the price of skilled-intensive exportables or reduction in the price of the skilled-intensive importables reduces the wage-gap and the rate of urban unemployment of unskilled labour.*

**4.4 Concluding Remarks:**

We have considered a four sector small open economy where we have both skilled and unskilled workers. The economy is characterised by a foreign enclave that uses sector specific foreign capital and there is migration of unskilled workers from the rural sector to the urban sector with urban unemployment of the unskilled. Our model is an extension of the works of Harjoit (1997, 1999). Our analysis has shown that more investment liberalisation and an improvement in the terms of trade, irrespective of its source, lead to reductions in both the skilled-unskilled wage gap and the urban unemployment rate of unskilled workers. The introduction of urban unemployment of unskilled labour gives us results that are similar to that of what has been empirically observed in the developing
countries of East Asia. In a three-sector model with sector-specific skilled labour there is an ambiguity about the impact of an improvement in terms of trade upon the wage gap. But in a four-sector model with perfectly mobile skilled labour and sector-specific foreign capital such ambiguity disappears.

We must note that in the present model the stock of foreign capital is exogenously given (as it is Government controlled) though the domestically determined rate of return of foreign capital is greater than its given world rate of return. We can think in terms of an alternative framework where the two rates are equal and the stock of foreign capital is endogenous. To model such a framework we can assume that one of the sectors produces a nontraded product and its price is determined by local conditions. This may be an interesting area of study. We, however, consider the behaviour of terms of trade in the presence of nontraded goods in the next chapter.
**APPENDIX 4**

From equation (4.3) of the text we get \( W_s = W_s(r_d, P_m) \)  \( (A.4.1) \)

with \( \partial W_s / \partial P_m > 0 \)

Again from equation (4.1) we have \( r_f = r_f(W_s, P_x) \)

\[ = r_f \{ W_s(r_d, P_m), P_x \} \]  \( (A.4.2) \)

with \( \partial r_f / \partial P_m < 0 \) and \( \partial r_f / \partial P_x > 0 \)

Substituting (A.4.1) & (A.4.2) into equation (4.7) yields

\[ a_{KF_X} [W_s(r_d, P_m) / r_f \{ W_s(r_d, P_m), P_x \}] X = K_F \]  \( (A.4.3) \)

From relation (A.4.3) we can express \( X \) in terms of \( P_X, P_m \) & \( K_F \), with \( \partial X / \partial P_X > 0, \) \( \partial X / \partial P_m < 0 \) & \( \partial X / \partial K_F > 0 \)

Thus equation (4.6) can be written as

\[ a_{S_X} [W_s(. , P_m) / r_f \{ (. , P_m), P_x \}] X( P_X, P_m, K_F ) + a_{S_m} [W_s(. , P_m) / r_f \{ (. , P_m), P_x \}] M = S \]  \( (A.4.4) \)

So, from (A.4.4) we get \( M = M( P_X, P_m, K_F ) \)  \( (A.4.4.1) \)

with \( \partial M / \partial P_m > 0, \partial M / \partial P_X < 0 \) & \( \partial M / \partial K_F > 0 \)

Now from equation (4.8) we have

\[ a_{KD_m} [W_s(. , P_m) / r_d) M( P_X, P_m, K_F ) + a_{K_d_Y} ( W_{LY} / r_d ) Y = K_D \]  \( (A.4.5) \)

\[ Y = Y( P_X, P_m, K_F ) \]  \( (A.4.5.1) \)

where \( \partial Y / \partial P_m < 0, \partial Y / \partial P_X > 0 \) & \( \partial Y / \partial K_F > 0 \)

Again, using equation (4.4) we can write

\[ R = R( W_{LZ} ; P_Z ) \]  \( (A.4.6) \)

Using relations (A.4.5.1) and (A.4.6) equation (4.9.1) can be written as

\[ \phi ( W_{LZ} ; P_X, P_m, K_F ) + a_{LZ} ( W_{LZ} ; P_Z ) Z = L \]  \( (A.4.7) \)
\[ \phi(W_{LZ}; P_X, P_M, K_F) = \{1 + \lambda(W_{LZ}) a_{LY}(W_{LY}/r_D)\} Y(P_X, P_M, K_F) \]

and \[ a_{LZ}(W_{LZ}; P_z) = a_{LZ}\{W_{LZ}/R(W_{LZ}; P_z)\} \]

with \( \phi_1 = \partial \phi / \partial W_{LZ} < 0, \phi_2 = \partial \phi / \partial P_X > 0, \phi_3 = \partial \phi / \partial P_M > 0 \)

& \( \phi_4 = \partial \phi / \partial K_F > 0 \)

Again, \( \partial a_{LZ} / \partial W_{LZ} < 0 \) and \( \partial a_{LZ} / \partial P_z > 0 \)

By using equation (A.4.6) we can write equation (4.10.1) as

\[ a_{TZ}(W_{LZ}; P_z) Z = T \]

(A.4.8)

with \( \partial a_{TZ} / \partial W_{LZ} > 0 \) and \( \partial a_{TZ} / \partial P_z > 0 \)

Total differential of (A.4.7) and (A.4.8) yields

\[ \phi_1 dW_{LZ} + \phi_2 dP_z + \phi_3 dP_M + \phi_4 dK_F + a'_{LZ} dW_{LZ} Z + \partial a_{LZ} / \partial P_z dP_z Z + a_{LZ} (.) dZ = 0 \]

or, \( (\phi_1 + a'_{LZ} Z) dW_{LZ} + \phi_2 dP_X + \phi_3 dP_M + \phi_4 dK_F + Z (\partial a_{LZ} / \partial P_z) dP_z + a_{LZ} (.) dZ = 0 \)

(A.4.7.1)

and \[ a'_{TZ} Z dW_{LZ} + Z (\partial a_{TZ} / \partial P_z) dP_z + a_{TZ} (.) dZ = 0 \]

(A.4.8.1)

**Proof of Proposition 4.1:**

Putting \( dP_X = dP_M = dP_z = 0 \) in (A.4.7.1) and (A.4.8.1) we solve for

\[ dW_{LZ} / dK_F = 1/ \Delta \{\phi_4 a_{TZ} (.)\} > 0 \]

(A.4.9)

\[ dZ / dK_F = 1/ \Delta (\phi_4 a'_{TZ} Z) < 0 \]

(A.4.10)

where \( \Delta = (\phi_1 + a'_{LZ} Z) a_{TZ} (.) - a'_{TZ} Z a_{LZ} (.) < 0 \)

The results of the proposition 4.1 follow from (A.4.9) and (A.4.10).

**Proof of Proposition 4.2:**

Putting \( dP_X = dP_M = dK_F = 0 \) in (A.4.7.1) and (A.4.8.1) we solve for

\[ dW_{LZ} / dP_z = (1/ \Delta) Z \{\partial a_{TZ} / \partial P_z a_{LZ} (.) - \partial a_{LZ} / \partial P_z a_{TZ} (.)\} \]

(A.4.11)

\[ dZ / dP_z = (1/ \Delta)[Z a'_{TZ} \partial a_{LZ} / \partial P_z - (\partial a_{TZ} / \partial P_z) (\phi_1 + a'_{LZ} Z)] \]

(A.4.12)
Here we find that \( \frac{d W_{LZ}}{d P_Z} > 0 \), but the sign of \( \frac{d Z}{d P_Z} \) is ambiguous. The results of the proposition 4.2 follows from (A.4.11) and (A.4.12).

**Proof of Proposition 4.3:**

Putting \( d K_F = d P_M = d P_Z = 0 \) in (A.4.7.1) and (A.4.8.1) we solve for

\[
\frac{d W_{LZ}}{d P_X} = \frac{1}{\Delta} \left\{ - \phi_2 a_{TZ} (.) \right\} > 0 \quad (A.4.13)
\]

\[
\frac{d Z}{d P_X} = \frac{1}{\Delta} (\phi_2 a'_{TZ} Z) < 0 \quad (A.4.14)
\]

Moreover, for \( d K_F = d P_X = d P_Z = 0 \), equations (A.4.7.1) and (A.4.8.1) give

\[
\frac{d W_{LZ}}{d P_M} = \frac{1}{\Delta} \left\{ - \phi_3 a_{TZ} (.) \right\} < 0 \quad (A.4.15)
\]

\[
\frac{d Z}{d P_M} = \frac{1}{\Delta} (\phi_3 a'_{TZ} Z) < 0 \quad (A.4.16)
\]

The results of the proposition 4.3 follow from (A.4.13) to (A.4.16).