LDCs versus DCs

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LDCs versus DCs: Trade and Growth

by Theo van de Klundert and Ad Kolnaar

Introduction

Our aim is to analyse patterns of international trade and economic growth in connection with the North-South income gap. The analysis is based on the familiar two-factor, two-sector, two-country model adapted to the specific situation in question. Less developed countries, LDCs, are characterised by a low level of capital per head and a low productivity level compared with developed countries, DCs. Massive hidden or overt unemployment is supposed to be another feature of poor countries. The full employment equilibrium wage rate lies then below the subsistence level, which is characteristic of a labour-surplus economy. By introducing a distortion in the form of a fixed real wage level in LDCs we can make use of the results obtained by Brecher (1974) with regard to the pure theory of international trade. The main difference from Brecher's analysis, apart from our specific interpretation, is the emphasis we put on economic growth. For that reason we have to consider a number of specialisation patterns which may emerge in the course of time. These and other links between trade and growth are dealt with in a number of papers in the economic literature. As Takayama (1972) shows, the main concern of the authors in this field is uniqueness and stability of equilibrium growth. Although we have something to say on the long-term properties of our model, stability analysis will not be the central issue.

Economic theory is used here as a vehicle for examination of the fascinating problem of changes in the international division of labour and the possible resulting convergence of LDCs and DCs. Specific but common functions for production and expenditure are applied to illustrate these processes by means of graphs and numerical examples. Convergence could lead to LDCs accumulating enough capital to employ the existing labour force at the prevailing wage rate after some time. From then on, the wage rate in LDCs could rise and the traditional symmetrical model would apply. In the present study we shall not deal with this more remote possibility.

The organisation of the article is as follows. The complete model and the numerical values of the parameters used in the exercises will be introduced in the next section. Various situations with regard to trade are considered in the third section, where use is made of well-known graphs. Time paths with changing patterns of international specialisation based on numerical examples are studied in the fourth section. The results are compared with the development in a situation of autarchy for which we adopt a path of steady growth. The main conclusions are summarised in the last section.

The Model

It is assumed that in both countries neo-classical conditions prevail. Entrepreneurs maximise profits under conditions of full competition. Households maximise utility,

but the supply of labour is fixed at the outset. Markets function smoothly, so that factors and products have the same prices everywhere. Production functions are of the Cobb-Douglas type, whereas technical change is conceived as labour-augmenting. The initial levels of productivity as well as the rate of technical change are the same in both sectors. The macro-economic savings rate is constant. For ease of presentation most parameters are set equal in both countries. Exceptions to this rule are the general level of technology in the initial period and the rate of technical change.

The consumption goods sector will be indicated by the suffix c and the investment goods sector by the suffix i. The superscripts 1 and 2 relate respectively to DCs and LDCs. The equations common to both regions read as follows.

(1) *Production Functions*

$$y_c = \{h\,(1 + \varphi)^t\,l_c\}^{\lambda_c}\,k_c^{1-\lambda_c}$$

$$y_i = \{h\,(1 + \varphi)^t\,l_i\}^{\lambda_i}\,k_i^{1-\lambda_i}$$

where

y = production
l = labour
k = capital
h = productivity level
φ = rate of labour-augmenting technical change
λ = production elasticity of labour.

(2) *Choice of Techniques*

$$\frac{l_c}{k_c} = \frac{\lambda_c}{1-\lambda_c}\,\frac{p_r}{p_l}$$

$$\frac{l_i}{k_i} = \frac{\lambda_i}{1-\lambda_i}\,\frac{p_r}{p_l}$$

where

p_l = nominal wage rate
p_r = rental price of capital.

(3) *Availability of Factors*

$$l_c + l_i = l$$

$$k_c + k_i = k$$

(4) *Costs of Production*

$$p_c = \frac{l_c}{y_c}p_l + \frac{k_c}{y_c}p_r$$

$$p_i = \frac{l_i}{y_i}p_l + \frac{k_i}{y_i}p_r$$

where

p = price of output.

(5) *Definition of Real Income (in terms of consumer goods)*

$$Y = y_c + \frac{y_i p_i}{p_c}$$

(6) *Expenditure Relations*

$$c = \gamma Y$$

$$i = (1 - \gamma)Y\frac{p_c}{p_i}$$

where

c = consumption

i = investment

γ = propensity to consume.

The equations under (1) — (6) can be applied to obtain short-term solutions (for a given stock of capital) in both countries. In the case of DCs there is assumed to be full employment. In the autarchic situation, production equals expenditure ($y_c = c$ and $y_i = i$). The consumption good is considered as the numéraire, so p_c can be set equal to one. The 10 endogenous variables are:

y_c, l_c, k_c, y_i, l_i, k_i, p_i, p_l, p_r and Y.

There are 11 equations employed, but one of the expenditure relations is of course redundant.

   In LDCs capital is scarce and the level of productivity (h) is low. Under these circumstances the real wage rate at the full-employment level may fall short of the minimum wage, determined by the cost of living. As said in the introduction, it will be assumed throughout the paper that such a situation is typical for LDCs. As a consequence, the real wage rate p_l/p_c (and therefore, given the *numéraire* also the nominal wage rate p_l) becomes an exogenous variable, whereas the level of employment (l) becomes endogenous. The stock of capital changes over time, due to investment and the physical deterioration of the already existing stock. For this reason the model should be extended with:

(7) *Accumulation Equation*

$$k_{+1} = k + i - \delta k$$

where

δ = rate of deterioration.

Time subscript t is (again) omitted for ease of presentation. The accumulation equation can be used to generate time paths of the endogenous variables in both regions.

When international trade takes place, production no longer equals expenditure. Therefore, the following definitions are introduced:

(8) *Excess Supply*

$$e_c = y_c - c$$

$$e_i = y_i - i.$$

If savings equal investments the balance of payments is in equilibrium. This would not be the case if development aid is given or received. However, aid scenarios are not taken into consideration for lack of space. Therefore, we write:

(9) *Balance of payments equilibrium*

$$e_c = -e_i \frac{p_i}{p_c}$$

The model is closed by two equations, expressing goods market equilibrium, showing that an excess supply in one of the countries should be matched by an excess demand in the other region.

(10) *Goods Market Equilibrium*

$$e_c^1 = -e_c^2$$

$$e_i^1 = -e_i^2$$

Counting unknowns and equations for the short-run solution we can proceed as follows. In the autarchic situation there are 10 endogenous variables and the same number of equations in both regions. In the trading model we have four additional dependent variables in both countries, i.e., c, i, e_c, e_i. The total number of endogenous variables is therefore 28. There are eight additional equations under (8)-(10), which give us also a total of 28. The numéraires of both countries are supposed to be the same, so there is no need to introduce a rate of exchange.

Numerical exercises and graphs will be based on the numerical values of parameters and exogenous variables presented below.

Parameters

$$\lambda_c = 0.75 \quad \lambda_i = 0.5 \quad \gamma = 0.8 \quad d = 0.16$$
$$h^1 = 1 \qquad \varphi^1 = 0.04$$
$$\varphi^2 = 0$$

Exogenous variables

$$l^1 = 84 \qquad k_0^1 = 100 \quad p_c^1 = 1$$
$$p_I^2 = 0.368 \quad k_0^2 = 60 \quad p_c^2 = 1$$

The strategic parameter is h^2, which will be given different values smaller than one to analyse the impact of international competition from low wage countries. The figures chosen for region 1 (DCs) generate a path of neoclassical equilibrium growth in the autarchic situation. The rate of growth amounts to 4 per cent. If $h^2 = 0.5$ prices are equal in both regions, and thus there will be no trade [1]. The growth rate in region 2 (LDCs) is then constant and also equal to 4 per cent, because of the numerical choices made above. It is, of course, possible to assume a constant rate of labour-augmenting technical progress in region 2, along with a rise in the real wage rate of the same magnitude. Employment then decreases at the same rate. This is in contrast with the neoclassical model of region 1, where an increase in technical change leads to a rise in production volumes. However, because nothing further is gained by such an extension, we have not proceeded in this direction.

Patterns of International Trade

International trade emerges in the model for values of h^2 unequal to 0.5. If $0.5 < h^2 < 1$ the productivity level is low in comparison with DCs but high with respect to the prevailing real wage rate in LDCs. This means that labour is relatively cheap and LDCs specialise in the labour-intensive commodity, irrespective of this being the consumption or the investment good. On the other hand, if $h^2 < 0.5$ region 2 has high effective labour costs compared with region 1. In that case LDCs (region 2) specialise in the production of the capital-intensive commodity.

Both possibilities can be illustrated by applying the well-known concept of offer curves. Trade in the consumption good is measured along the vertical axis. It should be recalled that in our example this is the labour-intensive commodity. Along the horizontal axis we measure export and import of the capital-intensive investment good. For the time being, we assume that both countries specialise incompletely. The offer curve of region 1 has the usual curvilinear shape as is shown in Figure 1. The slope of the dotted line, which is tangent to the offer curve in the origin 0, gives the price ratio $(p_i/p_c = 0.883)$ in the autarchic situation. For higher values of this ratio country 1 specialises in the production of good i. Capital goods are then exchanged for consumption goods on the international market $(e_i^1 > 0, e_c^1 < 0)$. For lower values of the price ratio, region 1 specialises in the production of good c, which is then the export commodity $(e_c^1 > 0, e_i^1 < 0)$. The first mentioned possibility

relates to quadrant I, whereas the other case is shown in quadrant III of the figure.

Figure 1.
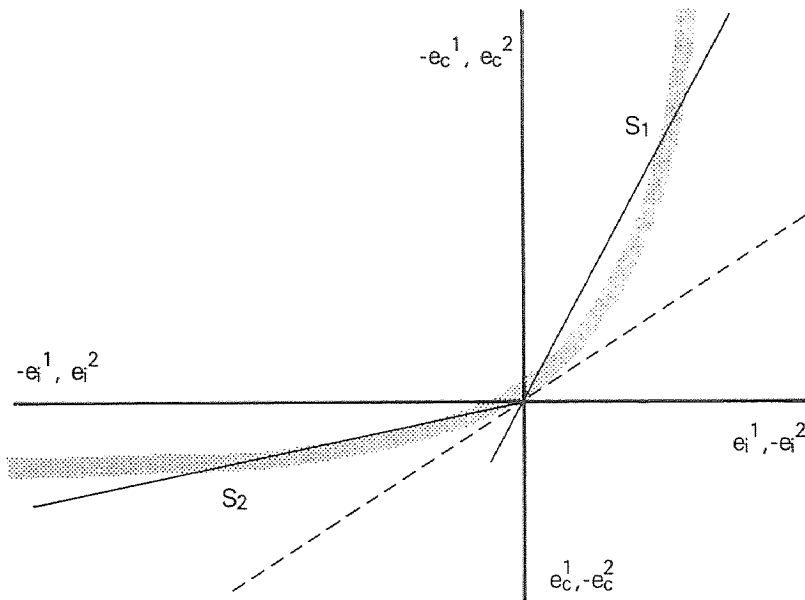
In region 2 the relative price level is determined by the exogenous real wage. As a result of this the offer curve appears as a straight line. In the case of relatively low effective labour costs, LDCs have a comparative advantage with respect to good c and the offer curves of both regions intersect in point S_1 ($e_c^2 > 0$, $e_i^2 < 0$). In the case of $h^2 < 0.5$, the point of intersection is S_2, and LDCs export the capital-intensive i-good ($e_i^2 > 0$, $e_c^2 < 0$). It should be observed that the international terms of trade in case of incomplete specialisation in region 2 are determined by the autarchic price ratio in this region.

As illustrated by Brecher [1] a distortion in the form of an inflexible real wage rate could imply that international trade is disadvantageous for the country in which the wage rate is fixed. Specialisation in capital-intensive goods in the case of unemployment worsens the income and the employment situation. In our case this means that LDCs with a very low level of productivity ($h^2 < 0.5$) suffer from their participation in trade.

The different possibilities mentioned above are shown in Figure 2a (superior specialisation) and Figure 2b (inferior specialisation). The production possibility curve in region 2 is the straight downward sloping line AB, because capital is the only scarce production factor. The slope of the line is determined by the quotient of the capital coefficients or capital output ratios in both sectors (x_i/x_c). These capital coefficients x_i and x_c depend on the productivity level, which characterises the

different situations [2].

With a constant savings rate the expansion path of c and i is also a straight line, OC in Figure 2. The slope of this line is determined by exogenous consumers' preferences γ and by the price ratio p_i/p_c. The terms of trade in case of incomplete specialisation are equal to the price ratio in region 2, as shown earlier. From marginal productivity theory we have:

$$\frac{x_i}{x_c} = \frac{1-\lambda_i}{1-\lambda_c}\frac{p_i}{p_c} = 2\frac{p_i}{p_c}.$$ Therefore, the trade triangles in both cases should be drawn as illustrated by the shaded areas. Inspection of the figures makes clear that international trade leads to higher welfare in case of specialisation on the labour-intensive c-good and to lower welfare in the opposite case, where LDCs specialise on capital-intensive i-goods. Should the consumption good be the capital-intensive commodity we have $\frac{x_i}{x_c} < \frac{p_i}{p_c}$. Specialisation in this good by region 2 would then be disadvantageous. The reader can easily verify this statement by drawing graphs similar to Figures 2a and 2b.
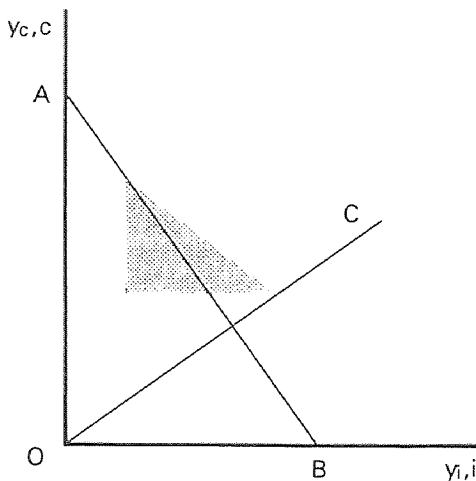
Figure 2a   Figure 2b
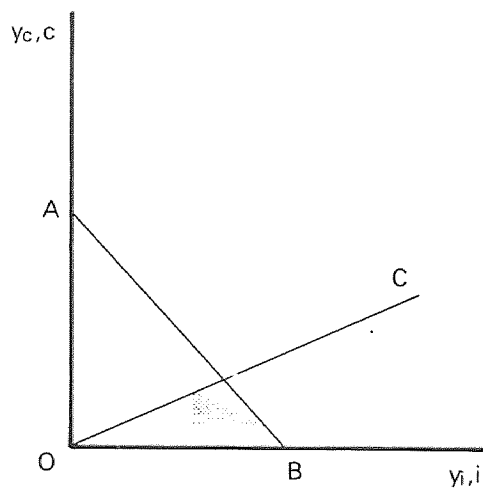
The gain or loss because of international trade is associated with changes in employment. Specialisation in the labour-intensive good implies a higher rate of employment. Movements along the production possibility frontiers in the Figures 2a and 2b from point B in the direction of point A lead to an increase in l^2. Opposite movements, resulting in case of specialisation in capital-intensive goods, create diminishing employment figures. It may be concluded that very poor countries with a low productivity level ($h^2 < 0.5$) should not engage in international trade with DCs. These countries should impose prohibitive tariffs (in the meanwhile trying to improve their productivity levels).

Whether incomplete specialisation is possible depends among other things on the *relative size* of the countries involved. The size of region 2 is a function of the available amount of capital (k_0^2) and the productivity of capital in both sectors. Capital coefficients depend upon the productivity level (h^2) [3]. A higher value of h^2 or lower effective labour costs lead to production techniques which are more labour-intensive. As a consequence capital coefficients will be lower. With the same amount of capital the absolute size in terms of capacity will then be greater. However, lower effective labour costs of LDCs increase the scope for international trade on the basis of comparative advantage. The autarchic price ratio in region 2 (p_i^2/p_c^2) increases, whereas the autarchic price ratio in region 1 remains the same. This could imply that, despite the increase in absolute size, the relative size of region 2 would prevent the full exploitation of comparative advantages. In our examples this appears to be the case. So, starting from a position with incomplete (superior) specialisation (S_1 in Figure 1) an increase in h^2 could lead to a change in the pattern of specialisation with region 2 producing only the labour-intensive consumption good. This situation is illustrated in Figures 3a and 3b.

Figure 3a.   **Figure 3b.**
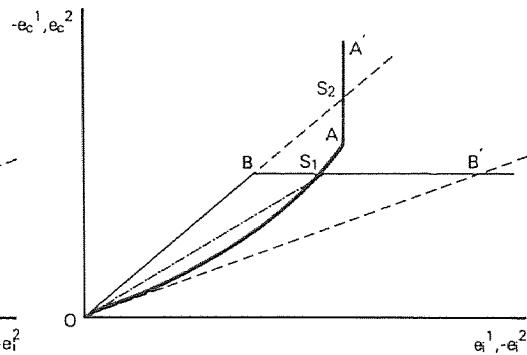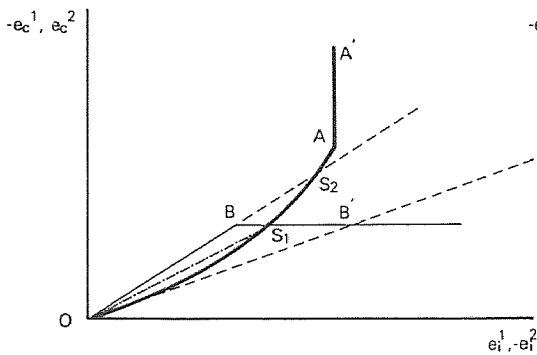
The offer curve of DCs is depicted by the broken line OAA'. The dotted line OB' indicates again the price ratio in the situation of autarchy. At point A, region 1 specialises completely in the production of the *i*-good. Higher values of p_i/p_c leave e_i^1 unchanged, which means that the offer curve beyond point A can be represented by a vertical line as shown in both figures [4]. The offer curve of LDCs is denoted by OBB'. At point B, region 2 specialises completely in the production of the *c*-good. Lower values of p_i/p_c leave e_c^2 unchanged, which means that the offer curve beyond point B can be drawn as a horizontal line [5].

The relatively small size of region 2 leads to the pattern marked by point S_1 in both figures. In this situation LDCs produce labour-intensive consumption goods only, whereas DCs produce both goods. For that reason international terms of trade, as indicated by the line OS_1, are determined by conditions of demand and supply in both regions. Should region 2 command a greater amount of capital, line BB_1 would settle on a higher level, perhaps beyond point S_2 on the line OS_2. Then we would be back to the situation of incomplete specialisation, as depicted in Figure 1.

The difference between Figures 3a and 3b relates also to the *relative* size of region 2, which is smaller in the latter case. The reason is a higher productivity level h^2. That is, effective labour costs are lower in Figure 3b compared to the position in Figure 3a. However, the terms of trade in equilibrium (p_i/p_c) are higher in Figure 3b. Thus, the scope for further improvements in the terms of trade of DCs is enlarged. This illustrates the remarks made above with regard to the relative size of LDCs.

If LDCs grow faster than DCs, the latter group profits from an increase in their terms of trade—up to the point of incomplete specialisation in region 2. This can be easily deducted from the figures 3a and 3b if one assumes that the growth rate in region 1 is zero. Then if region 2 expands, the equilibrium point moves along the curve OAA' until point S_2 is reached. If so, region 2 produces both goods, while the final pattern of specialisation in region 1 depends upon the initial situation. In Figure 3a we have incomplete specialisation of both countries in S_2, but in the situation of figure 3b DCs specialise completely in the production of investment goods. In this example there is an intermediate situation along the line AS_2, where both countries specialise completely.

From Figures 3a and 3b we can derive that there are four possibilities with regard to specialisation in case of low effective labour costs in LDCs. The same number of possibilities emerges in the situation of high effective labour costs $(h^2 < 0.5)$, but the case of incomplete specialisation in both countries is common to both situations. The total number of variations therefore amounts to seven [6].

Paths of Growth and Trade
International trade induces changes in expenditure including a change in the investment levels in both countries. This leads to differences with regard to the accumulation of capital, which in turn has implications for trade. These interconnections between trade and growth are studied in this section. For this purpose we shall present some simulation runs of the model presented in section 2 [7]. The runs chosen correspond to the cases dealt with in the previous section.

For $h^2 = 0.51$ the initial situation $(t = 1)$ is shown in the first quadrant of Figure 1. The terms of trade are determined by the autarchic price ratio in region 2 $(p_i^2 = 0.8994)$. This means that region 1 benefits from exporting the i-goods in exchange for the c-goods. The autarchic price ratio in this area amounts to $p_i^1 = 0.883$. LDCs are better off because they realise a higher level of employment and income. The main results for this period and subsequent ones are given in Table I. Variables with a ^ relate to percentage deviations of the steady growth path in case of autarchy. It is recalled that in the autarchic situation region 1 follows a neo-classical path of equilibrium growth at a rate of 4 per cent. Region 2 exhibits Harrod-Domar

characteristics. There the constant rate of growth in case of autarchy depends upon h^2. In our example with $h^2 = 0.51$ the growth rate is equal to 4.78 per cent.

Table I. Relatively Low Effective Wages in LDCs ($h^2 = 0.51$)

variable	period	1	2	3	4	5	...	30		
Country 1										
$\hat{y}_c$		− 7.5	− 7.28	− 7.1	− 6.94	− 6.79		− 5.9	(	0)
$\hat{y}_i$		29.72	28.45	27.35	26.40	25.57		20.27	(−	.02)
$\hat{c}$		.43	.34	.27	1.20	.15		− .21	(	0)
$\hat{i}$		− 1.41	− 1.5	− 1.57	− 1.64	− 1.69		− 2.04	(	0)
$\hat{k}$		0	− .27	− .51	− .71	− .89		− 2.02	(	0)
$\hat{p}_l$		− 1.84	− 1.84	− 1.84	− 1.84	− 1.84		− 1.84	(	0)
Country 2										
$\hat{y}_c$		20.84	21.55	22.31	23.10	23.92		47.25	(	.86)
$\hat{y}_i$		−41.68	−38.15	−34.93	−31.97	−29.25		11.19	(	1.15)
$\hat{c}$		8.33	9.61	10.86	12.08	13.28		40.04	(	.92)
$\hat{i}$		8.33	9.61	10.86	12.08	13.28		40.04	(	.92)
$\hat{k}$		0	1.65	3.23	4.74	6.20		35.23	(	.96)
$\hat{l}$		11.91	13.02	14.13	15.23	16.32		42.10	(	.9)

With regard to region 1 (DCs) the following can be observed. In period 1 the extra income from trade is outweighed by the price increase of capital goods. As a result investment expenditure declines and accumulation slows down. In the case of Table I the terms of trade are determined by the fixed price-ratios of region 2. Because prices are fixed the Rybczynski theorem applies. The change in the availability of capital is reflected in the mutation of the output mix. International trade leads to specialisation in the capital-intensive i-goods. The subsequent development induces a partial reversion of this pattern as can be seen in Table I. If the composition of output changes in favour of the labour-intensive sector, the macro-economic capital coefficient falls and the slow-down of capital accumulation will be checked over time. The path of accumulation follows from the difference equation: $k^1_{+1} = 0.9024 k^1 + 13.473 (1.04)^t$.

In period $t = 30$, the final result is nearly reached. This can be deduced from the figures between parenthesis, which relate to the incremental rate of growth caused by international trade in that period [8]. Trade with LDCs having low effective wage costs is advantageous for DCs in the short term, but disadvantageous in long-term situations, at least in this example. Long-term results with regard to the level of consumption depend on opposite tendencies. In the present case, the gain in the terms of trade is dominated by the accumulation loss. This can be different, as will be shown below. The favourable effects on a short-term basis accrue to the factor capital. Real wages are negatively influenced as is shown in the table [9].

Turning to the consequences for LDCs, we see a substantial increase in employment compared to the autarchic situation, which would prevail if a prohibitive tariff should be imposed. More employment means more income, which is proportionally spent on both commodities because prices do not change. Accumulation accelerates, which leads to even further improvements with regard to employment. Output of both commodities rises, but the increase in the capital-intensive *i*-goods has to be higher than the increase in the labour-intensive *c*-goods ($\Delta \hat{y}_i > \Delta \hat{y}_c$). The reason for this is that the initial pattern of specialisation cannot be fully maintained, as observed earlier. The relative scarcity of factors in region 1 changes in favour of labour and region 2 must respond to this development with adequate changes in the output mix. These changes imply a continuous rise of the macro-economic capital coefficient starting in period 2. Thus, eventually the extra growth due to trade vanishes, however, at that point the level of economic development will be substantially higher. The last column of Table I gives an illustration of this point. After 30 periods the level of expenditure has increased with 40 per cent and the incremental rate of growth still amounts to nearly 1 per cent. Obviously, the adjustment process in region 2 takes a rather long time in the case of incomplete specialisation in both regions.

It should be borne in mind that region 2 grows much faster than region 1. The relative significance of trade in LDCs therefore declines in time. This explains why stability in region 2 requires much more time. Ultimately, the growth rate will approach the autarchic rate, as follows from the relevant difference equation:

$$k^2_{+1} = 1.0478 \ k^2 + 0.185 \ e^2_c, \text{ with } e^2_c > 0.$$

Table II. Relatively High Effective Wages in LDCs ($h^2 = 0.49$)

variable	period	1	2	3	4	5	. . .	30		
Country 1										
$\hat{y}_c$		7.61	7.39	7.20	7.03	6.89		6.02	(	0)
$\hat{y}_i$		—30.72	—29.37	—28.21	—27.21	—26.35		—21.01	(	0.02)
$\hat{c}$		— .32	— .23	— .16	— .04	0		— .31	(	0)
$\hat{i}$		1.61	1.70	1.78	1.85	1.90		2.26	(	0)
$\hat{k}$		0	.31	.58	.81	1.01		2.24	(	0)
$\hat{p}_i$		1.94	1.94	1.94	1.94	1.94		1.94	(	0)
Country 2										
$\hat{y}_c$		—23.33	—24.33	—25.39	—26.50	—27.65		—66.27	(—1.69)	
$\hat{y}_i$		46.67	43.44	40.51	37.81	35.33		— 3.56	(—1.27)	
$\hat{c}$		— 9.33	—10.78	—12.21	—13.64	—15.06		—53.73	(—1.61)	
$\hat{i}$		— 9.33	—10.78	—12.21	—13.64	—15.06		—53.73	(—1.61)	
$\hat{k}$		0	— 1.74	— 3.42	— 5.06	— 6.66		—45.37	(—1.55)	
$\hat{l}$		—13.33	—14.65	—15.98	—17.31	—18.66		—57.31	(—1.63)	

Accumulation and trade in the opposite case, with a relatively high effective real wage rate in LDCs caused by a low productivity level ($h^2 = 0.49$) is summarised in Table II. The initial position corresponds to the situation in the third quadrant of Figure 1. The terms of trade are again determined by region 2 ($p_i^2 = 0.866$). Region 1 benefits from the opportunity to buy investment goods at a lower cost than in the autarchic case. As a result, capital accumulation accelerates and production has to be shifted towards the capital-intensive i-goods sector. The accompanying rise in the macro-economic capital coefficient leads to a slow-down of the incremental growth of capital. Finally, a new and higher level is reached, as is shown in the last column of Table II. In this case the difference equation for region 1 reads as follows:

$$k_{+1}^1 = 0.8977\,k^1 + 14.549\,(1.04)^t$$

For region 2 the inferior specialisation induces a loss of welfare in the first period. The resulting decline in capital accumulation is reinforced, because the specialisation structure has to be adapted to the needs of DCs. Developed countries import relatively fewer i-goods as more capital is accumulated. The adjustment of the output mix in region 2 implies a declining macro-economic capital coefficient. Therefore, the slow-down of accumulation in this area is checked. A new equilibrium level could be attained eventually; however, this is not the whole story [10]. The impact of region 1 on region 2 increases over time because the growth rate in DCs is much higher than that in LDCs. (The autarchic rate is 3.25 per cent. In addition, the incremental growth rate as a result of trade is negative.) After some time the negative influence of the inferior specialisation pattern becomes dominant again. From then on the incremental rate of growth of capital decreases gradually. The difference equation for this case is:

$$k_{+1}^2 = 1.0325\,k^2 + 0.163\,e_c^2,\ \text{with}\ e_c^2 < 0.$$

The variable e_c^2 is negative and increases over time. It can be concluded that the system is unstable in the case of an inferior specialisation in developing countries [11].

The case where region 2 is relatively small in the sense defined in the third section is dealt with in Table III. The effective wage rate in LDCs is very low ($h^2 = 0.736$). Consequently, there is a wide margin between the autarchic price ratios. In the first period, region 2 specialises completely in the production of the labour-intensive c-goods. The terms of trade are determined by both countries ($p_i = 0.9954$). The situation corresponds to point S_1 in Figure 3b.

Region 2 grows very fast, which leads to a deterioration of its terms of trade. In the second period, the price of the i-goods on the international market rises to $p_i = 1.046$. Region 1 responds by a further shift in the output mix in favour of the capital-intensive i-goods. The relatively moderate redirection in capital accumulation cannot reverse this movement. The gain in terms of trade also leads to an increase in consumption in DCs. It is interesting to note the difference with the case presented in Table I.

The same tendencies can be observed in the third period. The price of investment goods reaches the value $p_i = 1.1675$. At this price level region 1 specialises com-

Table III. Relatively Small Size of LDCs ($h^2 = 0.736$)

variable	period	1	2	3	4	5	. . .	30	
Country 1									
$\hat{y}_c$		− 52.26	− 75.38	−100.	−100	−100		−100	(0)
$\hat{y}_i$		196.65	274.03	352.02	348.93	346.14		321.88	(− .2)
$\hat{c}$		5.08	8.32	19.55	32.11	31.29		24.15	(− .06)
$\hat{i}$		− 6.80	− 8.57	− 9.60	− 10.21	− 10.77		− 15.62	(− .04)
$\hat{k}$		0	− 1.31	− 2.70	− 4.03	− 5.22		− 15.25	(− .08)
$\hat{p}_i$		− 11.30	− 15.59	− 14.61	− 5.63	− 6.22		− 11.32	(− .04)
Country 2									
$\hat{y}_c$		50	78.88	108.72	117.82	114.55		100.86	(− .02)
$\hat{y}_i$		−100	−100	−100	− 70.61	− 38.43		100.11	(.16)
$\hat{c}$		20	43.11	66.97	80.14	83.96		100.71	(.02)
$\hat{i}$		56.61	77.73	85.79	80.14	83.96		100.71	(.02)
$\hat{k}$		0	19.26	39.14	55.01	63.56		100.61	(.04)
$\hat{i}$		28.57	53.33	78.90	90.90	92.70		100.75	(.01)

pletely in the production of the capital-intensive *i*-goods. Thus, in this period both countries produce only one commodity. The situation now corresponds to a point somewhere between A and S_2 in Figure 3b.

At the point of complete specialisation in region 1 the negative accumulation effect must become dominant. This is shown by comparing the production results in the periods 3 and 4. There is no production of consumption goods, whereas the production of investment goods decreases to a relative degree as a result of decreasing capital accumulation. The gap in the market is filled by region 2. LDCs begin production of investment goods in period 4. In comparison with period 1, the specialisation pattern is reversed. The situation corresponds to point S_2 in Figure 3b. It can be said that at this point region 1 has a relatively small size. Prices on the world market are then equal to the autarchic values of region 2. From period 4 we have $p_i = 1.299$.

The process of capital accumulation induces negative feedbacks, which guarantee a stable development after the third period. In period $t = 30$ the system is close to its final results. In region 1 production of *i*-goods becomes more labour-intensive. The capital coefficient decreases and the negative growth effects are checked. In region 2 production shifts towards the capital-intensive *i*-goods sector. So, in this case, the macro-economic capital coefficient increases and the incremental growth rate approaches zero. It should be observed that compared with the results in Table I, adjustment in region 2 is rather fast. This can be explained in the following way. In the initial phase of the growth process, region 2 is relatively small. The impact of region 1 on region 2 is therefore quite substantial. This forces LDCs into complete specialisation in consumption goods. The *c*-sector then expands very fast and the relative deviation ($\hat{y}_c$) even surpasses the final equilibrium outcome. Significant

changes in output-mix are now required to obtain the long-term composition. For this reason the effect on the macro-economic capital coefficient will be more pronounced than in the case of Table I where production in both sectors increases, although at a different rate.

With regard to long-term results there is an important qualitative difference when one compares the figures in Tables I and III. Consumption in DCs increases in Table III, whereas the opposite holds true in Table I. In the situation where LDCs are relatively small, DCs realise important gains in their terms of trade. The negative effect of a slow-down of capital accumulation leads to a fall in consumption after $t = 4$, but the impact is not strong enough to wipe out the terms of trade effect on the long run.

Conclusions
Naturally, conclusions always depend on the hypotheses made. In the present article we made a number of specific assumptions in tackling the problems of trade and growth in the North-South development context. More specifically, we introduced Cobb-Douglas production functions and constant macro-economic savings ratios for both countries. Moreover, the consumption goods sector was chosen as the relative labour-intensive sector. Because of these restrictions, some results may not be as general as one would like. It is against this background that we summarise our findings.

LDCs exhibiting classical unemployment, combined with a relatively high productivity level, can benefit from international trade. These countries specialise in the production of labour-intensive commodities, which induces an increase in employment. However, if the technological capabilities are not very developed, the effective real wage rate will be relatively high. Then free trade leads to an inferior pattern of specialisation and a loss of employment opportunities [12]. DCs always benefit from trade in the usual static sense. These conclusions are in agreement with the results derived by Brecher (1974) in the case of a real wage distortion in one of the trading countries.

Simulation runs with the model show that in the case of low effective real wages in LDCs, capital accumulation accelerates. However, accumulation in DCs slows down. If LDCs are small in size in the initial phase of the growth process, DCs could realise further gains through improvements of their terms of trade. The effect of these gains on the level of consumption could be larger than the negative influence of decreasing capital accumulation, as in our example. If this proves true, both regions are better off, not only on a short-term, but also on a long-term basis.

In the case of a superior specialisation pattern, the dynamic process is stable in the sense that for $t \rightarrow \sim$, the autarchic growth rate will be realised in both regions. It should be observed that these growth rates are constant but different. We initialised the model in such a way that growth rates are equal in case of equal effective real wages rates. If the effective wage in LDCs is low, then the autarchic growth rate will be higher. This means that the relative position of trade becomes insignificant for LDCs on a long-term basis. This is illustrated very clearly in the last column of Table III.

Stability is not assured in the case of inferior specialisation. The autarchic growth rate of LDCs is then smaller than that of the DCs. As a result of this, destabilising trade effects will sooner or later dominate the process of economic expansion in poor countries.

The model can easily be adapted to study other aspects of the development process. In this connection, policy measures such as import tariffs and financial aid seem to be of particular interest. However, priority should perhaps be given to the testing of alternative assumptions with regard to production and expenditure.

References.

1. In the situation of autarchy we get for $t = 0$: $\dfrac{p_i^1}{p_c^1} = 0.883$ and $\dfrac{p_i^2}{p_c^2} = 1.765\ h^2$.

2. The following expressions for the capital coefficients in region 2 hold in our model:

    $\kappa_c = 2.37\ (\dfrac{p_i}{h})\quad \kappa_i = 3.081\ \dfrac{(p_i)^2}{h}$.

3. See [2].

4. In case of complete specialisation we get: $e_i = y_i - i = \gamma\, y_i = \gamma l^{\lambda_i}\, k^{1-\lambda_i}$.

5. In this case we can write: $e_c = y_c - c = (1 - \gamma) y_c = (1 - \gamma)\dfrac{k}{\kappa_c}$.

6. Takayama (1972) distinguishes 9 specialisation patterns; however, the position with both regions specialising in the same product is not attainable in our model.

7. We are indebted to Mr Paul de Heus, who wrote the computer programme of the main model and its variants.

8. Incremental rates of growth are approximately equal to differences between percentage deviations in subsequent periods.

9. If the propensity to save out of wages is less than the propensity to save out of capital income the rate of accumulation could accelerate. For lack of space this alternative will not be analysed here.

10. In the meantime, region 2 specialises completely in the production of *i*-goods. In our example this occurs in period $t = 49$.

11. This result has nothing to do with traditional stability problems in two-sector models. These problems are avoided by our assumptions with regard to factor substitutability and savings. See Burmeister and Dobell (1970).

12. In the case of complete specialisation in capital-intensive goods, the terms of trade of LDCs improve. Whether this leads to a different result with regard to employment remains to be seen.

Bibliography

Brecher, R. A., "Minimum Wage Rates and the Pure Theory of International Trade", *Quarterly Journal of Economics,* February 1974.

Burmeister, E., and Dobell, A. R., *Mathematical Theories of Economic Growth,* London, 1970, Ch. 4.

Takayama, A., *International Trade,* New York, 1972.