

INTERSECTORAL TERMS OF TRADE, INDUSTRIAL LABOR SUPPLY, AND THE CLASSICAL MODEL: EARLY JAPANESE EXPERIENCE

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ONE of the most important models developed to explain growth in labor surplus poor countries is the classical two-sector model. The main outline of the theory was developed by Arthur Lewis [2] in the 1950s and further elaborated by Ranis and Fei [4]. Recently there has been a critical reevaluation of this model by both Harry Oshima [3] and Yhi-Min Ho [1]. This short paper will draw upon the work of these individuals in order to critically analyze the classical view of the relationship between the supply of labor to the modern industrial sector and the terms of trade between agriculture and industry (the price of agricultural goods divided by the price of industrial goods).¹

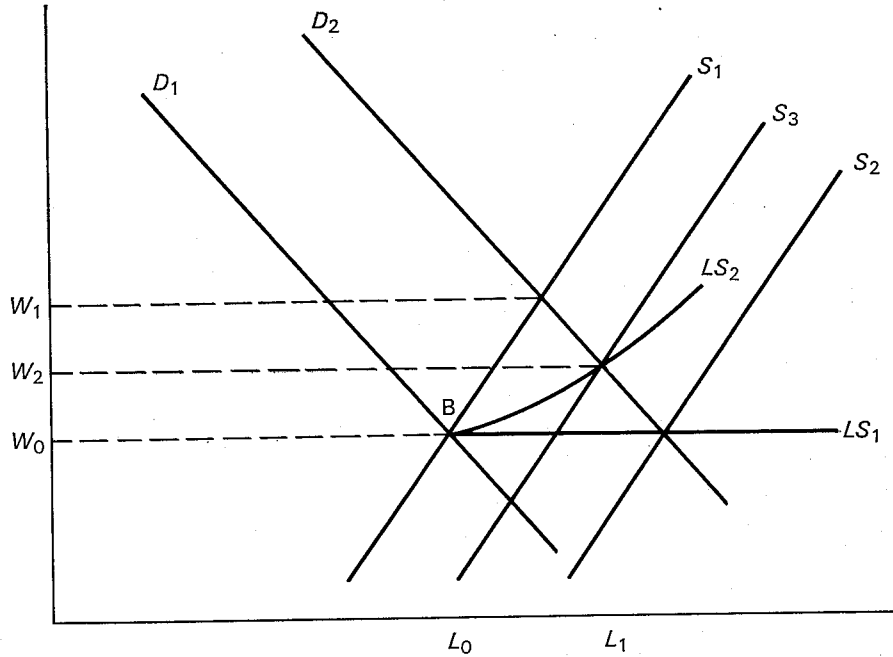
The Section I of the paper will briefly discuss the classical model of the development process, with special emphasis being placed on the impact of a rise in the price of agricultural relative to industrial goods on the supply of labor to the industrial sector. It will be seen that this model hypothesizes that as the terms of trade turn against industry, the supply of labor to the modern sector decreases and the real wage in this sector must, *ceteris paribus*, rise.

In Section II, the criticisms of the classical model developed by Oshima and Ho will be briefly discussed. These ideas will be further developed into an alternative hypothesis concerning the relationship between the intersectoral terms of trade and the supply of labor to the industrial sector. More specifically, it will be hypothesized that in the early stages of industrialization when living standards are close to subsistence, an initial deterioration of the terms of trade for industry will result in an increase in the supply of labor to the modern sector. As the terms of trade continue to turn against industry, eventually the supply of labor to the modern sector will decline and, *ceteris paribus*, the real wage in this sector will rise.

In Section III the above hypothesis will be tested using data from Japan for the period 1887 to 1915. Finally, Section IV will summarize the paper.

¹ Lewis divided the economy of a typical less developed country into a modern and a traditional sector. He emphasizes that the traditional sector is not necessarily agriculture and the modern sector is not to be identified with industry. Ranis and Fei however identify the modern sector with industry and the traditional sector with agriculture and we will follow this classification scheme throughout this paper.

Fig. 1



I

In the classical model of development the growth of the modern industrial sector results from the savings and capital accumulation of the capitalist class in this sector. As capital accumulates the marginal productivity of labor in this sector increases and hence the demand curve for labor shifts from D_1 to D_2 in Figure 1. If S_1 represents the short-run supply of labor, the increase in demand results in a higher equilibrium wage W_1 , which is the money wage divided by the price index for goods produced in the modern industrial sector (real wage in terms of industrial goods). This higher wage will induce laborers in the agricultural sector to seek employment in industry and if the marginal product of labor in agriculture is initially zero, then the output of this sector will not decline and the intersectoral terms of trade will remain unchanged. Thus labor will flow into the modern sector until the wage is reduced to W_0 which is assumed to be equal to that in the agricultural sector.² In other words, the short-run labor supply curve shifts to S_2 . Thus according to classical theory the long-run supply of labor in the early stage of the development process is completely elastic (LS_1) and the wage in the long run is W_0 , which equals the subsistence level in the traditional sector.

² Actually, Lewis argued that wages in the modern industrial sector would have to be higher than that in the traditional sector. However, in this paper we will ignore this wage differential.

Eventually, the second stage of the development process occurs when the marginal product of labor in agriculture becomes positive. Thus as labor moves to the industrial sector, the production of agricultural goods will fall and the terms of trade will turn against industry. Thus the purchasing power, in terms of agricultural goods, of the modern sector wage (the money wage in industry divided by the price index for agricultural goods) will decline. Thus labor's incentive to move to the industrial sector will be reduced and thus the supply curve of labor would shift only to S_3 and the long-run supply curve of labor would be upward sloping, indicated by LS_2 in Figure 1. Thus a deterioration in the terms of trade for the industrial sector shifts the short-run supply curve to the left from S_2 to S_3 .

The resulting rise in the industrial wage rate would tend to reduce the surplus available to the capitalist for new capital formation. Thus the growth process may be significantly slowed or even brought to a halt. The key to successful development is thus balanced growth, i.e., the simultaneous growth of agriculture and industry such that the terms of trade between the two sectors remains stable. Eventually, if balanced growth can be attained, so much labor will be drawn out of the agricultural sector that the marginal product of agricultural labor will be equal to the wage and the economy enters the neoclassical or commercialized stage.

The authors of this paper realize that much of this analysis is familiar to most members of the profession. However it was felt to be necessary to spend some time reviewing the model in order to highlight the impact on labor supply of a deterioration in the terms of trade for industry. As this deterioration occurs, the classical model hypothesizes that the long-run supply of labor to the industrial sector will turn up. Or, in other words, the short-run supply of labor will shift only to S_3 rather than S_2 . Thus the impact of a deterioration in the terms of trade is to shift the short-run supply of labor curve from S_2 to S_3 . This occurs as the result of the fact that such a deterioration reduces the purchasing power of the industrial wage in terms of agricultural goods. Thus the incentive to agricultural workers to move to the industrial sector is reduced,³ and many of them decide to return to and remain at work in the agricultural sector.

II

Yhi-Min Ho has criticized the relevance of the classical model for labor surplus countries such as Taiwan. First of all, the main process by which development occurs in the classical model is the absorption of agricultural labor of low productivity into the highly productive modern industrial sector. However, he finds that in the case of Taiwan the growth of nonfarm employment is relatively unimpressive, only slightly higher than the growth in nonfarm population for the period 1951 to 1965 [1, p. 218].

³ It must be remembered that in the classical model there are two "real" wage rates to be concerned with. The money wage divided by the price index for the industrial sector, i.e., the real wage in terms of industrial goods, and the money wage divided by the price index for agricultural goods, i.e., the real wage in terms of agricultural goods.

Ho's second major criticism involves the impact of changes in the terms of trade on the expansion of the modern sector [1, pp. 227-28]. Beginning in 1958 the terms of trade turned against the industrial sector in Taiwan and it was also at this point that the rate of growth of the industrial sector began to rise rapidly relative to that in the agricultural sector. Thus the worsening of the terms of trade did not prevent the industrial sector in Taiwan from growing rapidly during the period 1951 to 1965.

Oshima has also raised serious questions concerning the relevancy of the classical model. He feels that the cornerstone of the classical model lies in the assumption that as long as there is an unlimited (unskilled) labor supply, wages paid by the capitalist would remain constant over time as production is expanded. Thus profits would rise, investment would grow, and finally all surplus labor would be absorbed into the industrial sector. He accepts the conclusion that the more elastic the supply of labor the easier the expansion process will be. However, the question he asks is whether or not constant wages are a necessary condition for rapid expansion or is it merely a favorable experience neither necessary nor sufficient?

Examining the growth experience of several Asian countries Oshima finds that those countries which grew rapidly were those countries where real wages also grew rapidly, even during those years when surplus labor was still plentiful. In addition, for this same group of rapidly growing countries the decline and/or disappearance of unlimited labor supply did not substantially reduce their rate of industrialization and in some countries growth actually accelerated. Thus Oshima concludes that low, fixed wages have not been an important factor in explaining postwar Asian growth and thus the classical model would seem to be irrelevant [3, pp. 2-9].

One of the major reasons that the model is irrelevant, according to Oshima, is that it was originally constructed to explain the growth experience of England in the eighteenth and nineteenth century. At this time English agriculture was undergoing a significant transformation. Technical innovation, the spread of capitalistic agriculture, and the enclosure movement had freed the peasant from feudalistic obligations and, in many cases, forced them from the land. Thus a large pool of surplus labor had been created from which the newly established industries could draw their labor [3, pp. 10-11].

Alternatively, Asian agriculture today is characterized, for the most part, by high population densities and thus small farm sizes. As a result crop intensification, multiple cropping, and irrigation are necessary to expand production and for the most part, there are not sufficient economies of scale to wipe out the small rice farms. The intensity of farming operations varies with the seasons, during planting and harvesting times labor is actually in short supply while in the dry parts of the year there is little farm work to do and much time is spent in handcraft production and off-farm jobs. Thus labor in monsoon agriculture is surplus only in a seasonal sense, i.e., during the slack season. However, during the peak season, all available labor is needed.

If one accepts Oshima's characterization of monsoon Asian agriculture as being basically correct, then new light can be shed on the likely input of changes

in the terms of trade on the supply of labor to the modern sector. If the reader will remember, the classical hypothesis is that as the terms of trade turn against the industrial sector, the real wage in this sector in terms of agricultural goods will decline, the supply of labor to this sector declines (people return to agricultural work), and the real wage in terms of industrial goods goes up. In other words, the agricultural sector is assumed to be able to absorb workers returning from the industrial sector anytime the terms of trade turn against the latter sector. Obviously, if agricultural labor demand is highly seasonal, then only at certain times will there be a demand for additional labor, mainly at planting and harvesting time. The conclusion is then that for much of the year a deterioration of the terms of trade will not lead to a reallocation of workers from industry to agriculture, there are no additional jobs available in agriculture.

Furthermore, it is likely that in the early stages of industrialization that the income level of the workers in the industrial sector is close to subsistence. Then a deterioration in the terms of trade occasioned by a rise in agricultural prices, in particular food prices, will force them to increase their short-run labor supply to industry in an attempt to maintain their already low standard of living. This increase in labor supply may occur through individual workers working longer hours or as the result of secondary workers in their families deciding to join the labor force. However, there are limits to a family's ability to work additional hours and thus if the deterioration in the terms of trade reaches a critical level, the supply of labor to the industrial sector will begin to decline. This latter effect is the result of the fact that as agricultural goods, in particular food, become very scarce, the ability of individuals to continue working will decline.

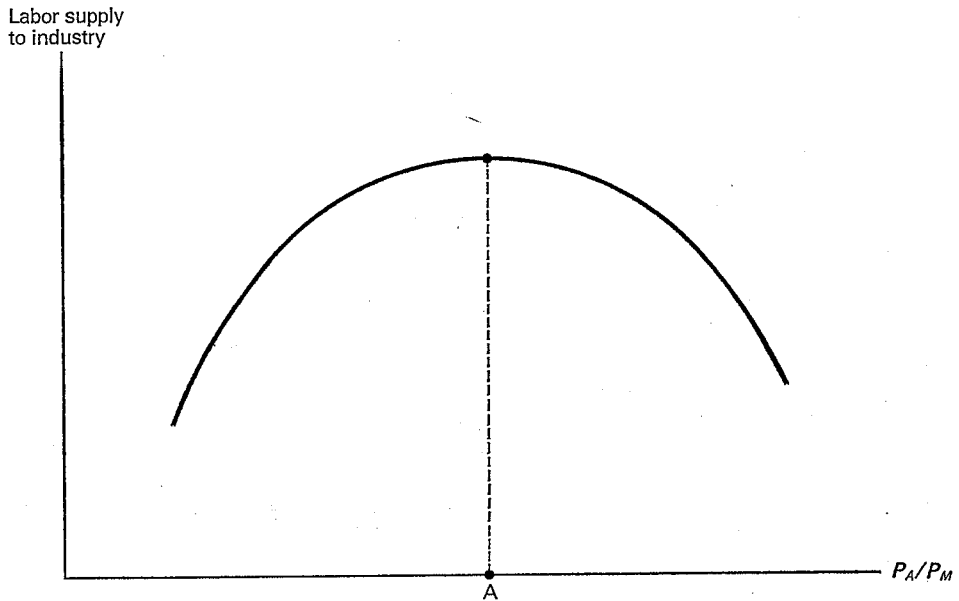
Let us summarize the hypothesis. Initially, as the terms of trade turn against the industrial sector the workers in the sector would like to return to work in agriculture. However, given the seasonal nature of the demand for labor in this latter sector, the opportunities for finding work are likely to be limited. If the deterioration involves a rise in the price of food, the laborers in the industrial sector are likely to try and maintain their standard of living by seeking additional employment, i.e., the short-run supply of labor to the industrial sector would increase. However, if the shortage of agricultural goods, in particular food, becomes acute, the ability of individuals to continue to work will be impaired and the short-run supply of labor to industry will decline. Ho's observation that a deterioration in the terms of trade for the industrial sector in Taiwan did not slow the growth of that sector now becomes understandable. Unless the deterioration reaches some critical level, the supply of labor to the modern industrial sector will not be impaired.

III

The hypothesis developed in the previous section can be formalized by introducing a system of supply and demand for labor equations for the modern industrial sector. Labor demand can be written as:

$$W_M/P_M = \alpha_0 + \alpha_1 L_M + \alpha_2 K_M + \alpha_3 \text{Year} + u_1, \quad (1)$$

Fig. 2



and labor supply as

$$L_S = \beta_0 + \beta_1(W_M/P_M) + \beta_2(P_A/P_M) + \beta_3(P_A/P_M)^2 + \beta_4Y + \beta_5 Pop + u_2, \quad (2)$$

with equilibrium written as

$$L_S = L_D = L_M. \quad (3)$$

The variables are defined as follows: P_A represent the price index for agricultural goods; W_M is the wage rate in manufacturing; Y is GNP in constant prices; Pop is population; L_M is the labor force in manufacturing; K_M is the capital stock in manufacturing; P_M is the price index for manufacturing.

Examining equation (2) one can see that the relationship between the terms of trade and labor supply is assumed to be quadratic in nature. In addition, it is hypothesized that $\beta_2 > 0$ and $\beta_3 < 0$. Thus the hypothesized relationship can be represented as in Figure 2.

In other words, it is hypothesized that initially as the terms of trade pass the critical level A the supply will begin to decline. This is in effect the hypothesis developed in the previous section.

The two-stage least squares regression technique was applied to estimate the industrial labor supply equation using data from Japan for the period 1887 to 1915. The data, specific variable definitions, and summary statistics are listed in Tables I and II. It was decided to apply the model to early Japanese experience for two basic reasons. First, both Ranis and Fei and Lewis use Japan as

TABLE I

Year	P_A	W_M/P_M	L_M	K_M	P_A/P_M	Population	P_M	Y
1887	22.0	0.59	2,909.00	2,673.0	0.61972	38,289	35.5	4,408
1888	21.1	0.59	3,035.75	2,817.8	0.60807	38,627	34.7	4,529
1889	24.5	0.55	3,162.50	2,962.5	0.65333	39,082	37.5	4,786
1890	32.9	0.50	3,289.25	3,107.3	0.86579	39,516	38.0	4,639
1891	28.7	0.62	3,416.00	3,252.0	0.80618	39,869	35.6	5,105
1892	29.4	0.65	3,505.75	3,456.3	0.83286	40,135	35.3	5,016
1893	30.1	0.63	3,632.50	3,660.5	0.82920	40,500	36.3	5,323
1894	34.3	0.60	3,759.25	3,864.8	0.88402	40,792	38.8	5,554
1895	34.4	0.58	3,775.00	4,069.0	0.87089	41,212	39.5	5,897
1896	37.0	0.61	3,847.00	4,326.8	0.87886	41,650	42.1	5,878
1897	44.7	0.63	3,919.00	4,584.5	0.97386	42,067	45.9	5,750
1898	52.7	0.64	3,991.00	4,842.3	1.12128	42,560	47.0	6,027
1899	45.3	0.68	4,063.00	5,100.0	0.89349	43,076	50.7	6,391
1900	47.4	0.66	4,123.25	5,357.8	0.79000	43,521	60.0	6,267
1901	44.8	0.70	4,183.50	5,615.5	0.76190	44,056	58.8	6,505
1902	48.8	0.74	4,243.75	5,873.3	0.86219	44,663	56.6	6,419
1903	55.4	0.70	4,304.00	6,131.0	0.97364	45,246	56.9	6,485
1904	53.6	0.68	4,345.00	6,383.8	0.86731	45,856	61.8	7,140
1905	54.4	0.63	4,386.00	6,646.5	0.88196	46,343	61.7	6,868
1906	57.7	0.65	4,427.00	6,904.3	0.92616	46,747	62.3	6,814
1907	63.8	0.69	4,468.00	7,618.0	0.96229	47,131	66.3	7,166
1908	60.9	0.76	4,533.00	7,875.8	0.95755	47,654	63.6	7,301
1909	54.3	0.80	4,598.00	8,133.5	0.89604	48,225	60.6	7,547
1910	55.3	0.80	4,663.00	8,391.3	0.80145	48,851	69.0	7,961
1911	68.0	0.79	4,728.00	9,865.0	1.07256	49,489	63.4	8,171
1912	79.3	0.77	4,899.50	10,526.0	1.11848	50,178	70.9	7,908
1913	78.8	0.81	5,071.00	11,187.0	1.12571	50,925	70.0	8,111
1914	56.5	0.85	5,242.50	11,848.0	0.78911	51,672	71.6	8,206
1915	53.3	0.79	5,414.00	12,509.0	0.84069	52,389	63.4	8,735

Sources: Allan Kelly and Jeffrey Williamson, *Lessons from Japanese Development* (Chicago: University of Chicago Press, 1974), pp. 221–30, and Kazushi Ohkawa and Miyoei Shinohara, eds., *Patterns of Japanese Economic Development: A Quantitative Appraisal* (New Haven, Conn.: Yale University Press, 1979).

Note: P_A represents an annual all-commodity index of agricultural products, which is set at 100 in the period 1934–36. W_M is the male wage rate in manufacturing (yen), in current prices. Y is GNP in 1934–36 prices. Population is in thousands. L_M is the labor force in manufacturing in thousands. K_M is the capital stock in manufacturing measured in yen in 1934–36 prices. P_M is an annual price index for manufacturing, 1934–36=100. The figures for K_M and L_M are given only for 1887, 1891, 1895, 1899, 1903, 1907, 1911, and 1915. The figures for the intervening years were interpolated.

an example of the classical model of growth. Secondly, reliable data for the variables listed above is available.

The results of the estimation of equation (2) are as follows:⁴

⁴ The figures inside the parentheses indicate t -ratios. * indicates significance using a 0.10 significance level, ** significance using a 0.025 level of significance.

TABLE II
SUMMARY STATISTICS OF SELECTED VARIABLES

Variable	N	Mean	Standard Deviation	Minimum Value	Maximum Value
L_M	29	4,135.6724138	644.6617334	2,909.000000	5,414.000000
W_M/P_M	29	0.6789655	0.0885355	0.500000	0.850000
K_M	29	6,129.4827586	2,864.3725877	2,673.000000	12,509.000000
Population	29	44,493.8275862	4,233.9595540	38,289.000000	52,389.000000
P_A/P_M	29	0.8780798	0.1319489	0.608069	1.125714
$(P_A/P_M)^2$	29	0.7878343	0.2334065	0.369748	1.267233
Y	29	8,660.9310345	12,128.9458673	4,408.000000	71,400.000000

$$\begin{aligned}
 L_S = & -4,628 + 4,386.1(W_M/P_M) + 7,177.5(P_A/P_M) - 3,687.2(P_A/P_M)^2 \\
 & (-3.87^{**}) \quad (1.60^*) \quad (2.45^{**}) \quad (-2.29^{**}) \\
 & + 0.1232 \times 10^{-2} Y + 0.53434 \times 10^{-1} Pop, \quad (4) \\
 & (0.38) \quad (0.95)
 \end{aligned}$$

$$R^2 = 0.9289.$$

Notice that the estimates of β_2 and β_3 are statistically significantly different from zero using conventional levels of significance. This indicates that the industrial labor supply is indeed a quadratic function of the intersectoral terms of trade in Japan for the period 1887 to 1915. Also the signs of β_2 and β_3 are as hypothesized.

Differentiating equation four with respect to P_A/P_M we get

$$\partial L_S / \partial (P_A/P_M) = 7,177.5 - 7,374.4(P_A/P_M), \quad (5)$$

$$\partial L_S / \partial (P_A/P_M) = -7,374.4(P_A/P_M - 0.9733). \quad (6)$$

Hence $\partial L_S / \partial (P_A/P_M) > 0$ for $P_A/P_M < 0.9733$ and $\partial L_S / \partial (P_A/P_M) < 0$ for $P_A/P_M > 0.9733$. Table III lists the sign and magnitude of $\partial L_S / \partial (P_A/P_M)$ for each year considered in the data set. From Table III we can see that a deterioration in the terms of trade for industry for the most part led to increases in labor supply to that sector. There were only a few years where the deterioration in the terms of trade was large enough to reduce labor supply.

IV

In this short paper we reviewed the workings of the classical model of dualistic development. This model argues that a deterioration in the terms of trade for the industrial sector reduces the incentive to work in that sector and thus induces workers to return to employment in agriculture. Thus the real wage in the industrial sector will rise and thus strangle the expansion of this sector.

Several criticisms of the classical model developed by Yi-hi-Min Ho and Harry Oshima were also discussed. Ho's analysis of the development of Taiwan indicated that a deterioration in the terms of trade for the industrial sector beginning in 1958 did not prevent the rapid expansion of the industrial sector. Oshima also found the classical model to lack relevance for the development experience of several Asian countries. One of the reasons for this lack of relevance was,

TABLE III
THE TERMS OF TRADE (P_A/P_M) AND THE SIGN AND
MAGNITUDE OF $\partial L_S/\partial(P_A/P_M)$

Year	P_A/P_M	$\partial L_S/\partial(P_A/P_M)$
1887	0.61972	2,607.7
1888	0.60807	2,693.6
1889	0.65333	2,359.8
1890	0.86579	792.9
1891	0.80618	1,232.5
1892	0.83286	1,035.7
1893	0.82920	1,062.7
1894	0.88402	658.4
1895	0.87089	755.3
1896	0.87886	696.5
1897	0.97386	-4.1
1898	1.12128	-1,091.3
1899	0.89349	588.6
1900	0.79000	1,351.9
1901	0.76190	1,559.1
1902	0.86219	819.4
1903	0.97364	-2.5
1904	0.86731	781.7
1905	0.88169	675.7
1906	0.92616	347.6
1907	0.96229	81.2
1908	0.95755	116.2
1909	0.89604	569.8
1910	0.80145	1,267.4
1911	1.07256	-732.0
1912	1.11848	-1,070.7
1913	1.12571	-1,124.0
1914	0.78911	1,358.4
1915	0.84069	978.0

according to Oshima, the fact that labor in Asian agriculture is only surplus in a seasonal sense.

Expanding on Oshima's observations it was argued that if job opportunities in agriculture become available only at certain times of the season (planting and harvesting), then for much of the year there are few additional employment opportunities in agriculture. Thus if the terms of trade turn against the industrial sector, there are few opportunities for workers there to find jobs in agriculture. Thus if they are to maintain their already low standard of living they must seek additional employment for themselves and other family members in the modern sector. Thus initially the supply of labor in the modern sector would increase. However, if the terms of trade continue to deteriorate for the modern sector, the workers will eventually find their real incomes falling and their ability to work will decline, i.e., the supply of labor will decline.

The above hypothesis was tested by estimating a supply of labor equation for the manufacturing sector in Japan for the period 1887 to 1915. The empirical

results appear to support the above hypothesis. This implies that a deterioration in the terms of trade for industry need not slow the growth of the modern sector by increasing that sector's wage rate, unless the deterioration reaches some critical level. Thus the importance attached by the classical model to movements in the terms of trade must be modified. It does not seem that this variable is as important in the development process as was once thought.

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