# Unlimited Supply of Labour and the Concept of Balanced Growth

JOHN C. H. FEI AND GUSTAV RANIS*

It is the purpose of this paper to construct an economic model which, we hope, will serve as a point of departure for the study of certain key policy issues in the long-run economic development of less developed countries like Pakistan. As we see it, the key issue of developmental policy centres about the question of balanced growth of the two main sectors: the industrial sector and the agricultural sector. The identification of this as the key issue is not at variance with the Pakistan Government's official position which aims at a "substantial increase in industrial production" over the next five years, while, at the same time, attaching the "highest priority to increasing agricultural production".[1] In view of this dual aim, a consistent theoretical framework is needed to facilitate rational planning by pointing up the various facets of the balanced growth problem.

In order to construct a balanced growth model amenable to quantitative implementation we shall accept, as a starting point, the basic outline of Professor Lewis' theoretical scheme.[2] This well-known model is briefly summarized in Section I below. As a tool for the analysis of balanced growth, Professor Lewis' model is, however, defective in that it is somewhat biased in favour of the industrial sector while the agricultural sector is treated more or less as an afterthought. Our basic model, presented in Section II, gives a more explicit treatment to the agricultural sector. Then, in Section III we take the initial step toward modifying our basic model, by analyzing the so-called terms of trade problem between the two sectors. This analysis, as we shall show, is closely related to the phenomenon of rent (or agricultural surplus) which gradually appears in the developmental process. Certain restrictive assumptions of Section III are relaxed in Section IV. Section V examines the effects of increases in agricultural productivity from the point of view of the industrial sector and Section VI leads to the emergence of a clearly-definable balanced growth criterion. The analysis of balanced growth, not unexpectedly, is found to be not an easy problem even when it is stated at a high level of abstraction and simplification. Finally, in Section VII, we shall briefly deal with the issue of economic maturity which is implied by the logical structure of our model.

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*The authors, formerly economic advisers to the Institute of Development Economics, are Associate Professor at Antoich College and Assistant Professor at Yale University.

1. Government of Pakistan, *Second Five Year Plan*, Karachi, 1960, p. 5.

2. W. A. Lewis, "Economic Development with Unlimited Supplies of Labour", *The Manchester School of Economic and Social Studies*, May 1954.

## SECTION I

In his celebrated article, Professor Lewis postulated the condition of an "unlimited supply of labour" as a major analytical tool for the study of the process of economic growth in a country characterized by over-population and disguised unemployment. According to Professor Lewis, such an economy is a dualistic economy in which a "capitalist sector" and a "subsistence sector" co-exist. The operational significance of this dualistic character is based on the assumption that the subsistence sector is a source of *supply* of labour to the capitalistic sector and, hence, a continuous reallocation of labour from the subsistence sector to the capitalistic sector occurs as the central phenomenon of the process of economic growth.

The concept of labour supply mentioned above does *not* mean a movement of population as a demographic phenomenon or an availability of manpower as an engineering phenomenon. Rather, "supply" is strictly an economic phenomenon in the ordinary sense, namely, the capitalistic sector can purchase the services of labour according to a given supply schedule (*i.e.*, a supply curve) the shape of which is determined by the forces operating in the subsistence sector. Such a supply curve was postulated by Professor Lewis, *e.g.*, the curve QPS in Diagram 1. We shall call this curve the *industrial supply curve*—as a shorthand expression for "the supply curve of labour to the capitalistic sector as determined by the subsistence sector". Notice that in Diagram 1, the horizontal axis measures labour and the vertical axis measures the real wage in terms of *industrial goods, i.e.*, the goods produced by the capitalistic sector.

According to Professor Lewis, the industrial supply curve has a horizontal portion (*e.g.*, the portion QP). Furthermore, the logic of Professor Lewis' argument implies that the *unlimitedness* of the supply of labour can be measured by the length of this horizontal portion. The supply of labour is literally "unlimited" only when this horizontal portion is of infinite length. However, Professor Lewis recognizes this to be unrealistic when he points out that ".... once capital catches up with labour, the supply of labour becomes inelastic"[3]. Since "inelasticity of supply", as a market phenomenon, means an increase in the supply price, we may postulate a turning point (*e.g.*, point P in Diagram 1) after which the industrial supply curve turns up. We shall call such a point the *Lewis turning point.*

In discussing the expansion process in the capitalistic sector, Professor Lewis assumes profit-maximizing behaviour on the part of the industrial

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[3]. W. A. Lewis, "Unlimited Labour, Further Notes", *The Manchester School of Economic and Social Studies*, January 1958, p. 25.

entrepreneurs. Given a real capital stock at their disposal, the entrepreneurs can calculate the MPP (marginal physical productivity) curve of labour, *e.g.*, curve $D_1D_1$ in Diagram 1. The intersection of this curve with the industrial supply curve (at $P_1$) then determines the short-run equilibrium level of employment ($QP_1$) and profit (shaded area $\pi_1$). When this profit is reinvested (partly or wholly) by the entrepreneurs, the size of the real capital stock increases and the MPP-curve shifts to the right (*e.g.*, $D_2D_2$). This determines a new level of employment ($QP_2$) and a new (larger) profit. The argument is then repeated to yield a sequence of MPP-curves $D_1D_1$, $D_2D_2$, $D_3D_3$..... and a sequence of short-run equilibrium employment points $P_1$, $P_2$, $P_3$.....moving to the right and signifying a continuous absorption of labour by the capitalistic sector throughout the developmental process.

This expansion process goes on until the Lewis turning point is passed (*e.g.*, to MPP-curve $D_4D_4$), *i.e.*, until "capital catches up with labour". Professor Lewis refers to the expansion process before the Lewis turning point as the "first stage of development" and the expansion process after the Lewis turning point as the "second stage of development".[4] In the first stage of development, ".... unlimited supplies of labour are available at a constant real wage and if any part of profits is reinvested in productive capacity, profits will grow continuously relative to national income." Since "practically all savings is done by people who receive profits", savings, as a percentage of national income, will increase, a phenomenon which Professor Lewis believes to be the central problem in the theory of economic development.[5] On the other hand, in the second stage of development, ".... wages are no longer constant as accumulation proceeds.... and the profit margin does not necessarily increase all the time".[6] In other words, with the turning up of the industrial supply curve, the increase of real wage spells an end to a stage of development in which the bounty of the unlimitedness of the supply of labour in the subsistence sector has contributed to a sustained growth of the capitalistic sector.

Lewis seems to have attached great economic significance to this distinction of "two different stages of economic development with two different sets of results". The very logic of his arguments testifies to the importance of this distinction. Furthermore, in order to strengthen his case, Lewis examined the historical experience of some of the developed countries (France, U.K., Germany, *etc.*) in the light of this distinction. Thus, it is no exaggeration to say that the Lewis turning point is a most significant landmark for his theory of economic development because it marks off the two stages of development.

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4. W. A. Lewis, "Unlimited Labour, Further Notes", *op. cit.*, p. 25.
5. W. A. Lewis, "Development with Unlimited Supplies of Labour", *op. cit.*, pp. 155-158.
6. W. A. Lewis, "Unlimited Labour, Further Notes," *op. cit.*, p. 76.

To explain the occurrence of the turning point, Lewis cites three classes of reasons:[7]

(i) "exogenous" factors defined as "not due to the expansion of the capitalist sector"

(ii) a "terms of trade factor, since the terms of trade may turn against the capitalist sector because of its expansion"

(iii) the "basic reason", namely "the capitalist sector will expand until the capital accumulation catches up with the labour supply ....and the supply of labour becomes inelastic"

In view of the strategic importance of the Lewis turning point, these reasons should be closely and carefully examined. For although Professor Lewis recognizes their relevance, he does not make an attempt to integrate this aspect of the problem within the formal logical structure of his model. We shall show that all these "reasons" are related and that they can be satisfactorily treated only when the subsistence sector is also formally analyzed.

In order to facilitate our exposition, we shall make the following simplifying assumption. First, we shall assume a *closed* economy and shall neglect all problems of an open economy considered by Professor Lewis. Second, we shall identify, with Lewis, the subsistence sector with the *agricultural sector* and the capitalistic sector with the *industrial sector*. Although we shall examine some of the arguments of Professor Lewis at appropriate places in the following sections, our main purpose is to construct a model involving the interaction of the agricultural and industrial sectors in the developmental process and culminating in the emergence of the Lewis turning point.

## SECTION II

Let us examine the Lewis explanation for the horizontal portion of the industrial supply curve. Although Professor Lewis did not state so explicitly, the explanation is based on the prevalence of an institutional or subsistence level of real wages in the agricultural sector. At this wage level, a part of the agricultural labour force is disguisedly unemployed, *i.e.*, its marginal physical productivity is less than the subsistence wage rate.

In order to formulate the above ideas rigorously, we must investigate the forces operating in the agricultural sector. This is illustrated in Diagram 2 in which the marginal physical productivity of labour in the agricultural

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7. W. A. Lewis, "Unlimited Labour, Further Notes", *op. cit.*, pp. 19-20.

sector is represented by the curve MPS. (In this diagram, labour is measured on the horizontal axis to the *left* of the origin O' and the MPP, measured in terms of the agricultural product, is measured on the vertical axis O'Y'.) A horizontal subsistence wage line WQ is shown in the diagram where the dis-distance WO' represents the subsistence wage rate. Let point P be the point of intersection of the subsistence wage line and the MPP-curve.

Suppose the employed labour force in the agricultural sector is WQ where Q is a point to the left of P. We can then say that PQ represents the disguisedly unemployed labour force. For, the withdrawal of PQ units of labour will equalize the MPP and real wage. The fact that such a state of affairs can persist at all is due to the non-competitive behaviour attributed to the employers in the agricultural sector. There are well-known sociological reasons why, in such circumstances, the casual labourers do not bid earnings down to zero. Diagram 2 is an exact description of all the conditions mentioned in the first paragraph above.

Let us now try to explain the Lewis turning point with the aid of the above elementary, but nevertheless rigorous, analysis of the agricultural sector. For this purpose, let us make a simplifying assumption (which will be relaxed in the next section) that the terms of trade between the agricultural sector and the industrial sector remain constant. We can then combine Diagrams 1 and 2. The result is Diagram 3 in which the vertical axes OY (on the left) and O'Y' (on the right) measure industrial goods and agricultural goods, respectively, in dollar units. The total labour force in the economy is represented by the distance OO'. Any point on the horizontal axis would indicate a different pattern of allocation of labour between the two sectors. For example, at point A, the labour allocated to the industrial sector is OA and that allocated to the agricultural sector is O'A. The subsistence wage line WQ and the MPP-curve of labour, MPS, in the agricultural sector are once again shown in this diagram.

Professor Lewis assumes that the subsistence wage rate determined in the agricultural sector determines the ruling wage in the industrial sector. This is due to the fact that ".... that wage which the expanding capitalistic sector has to pay is determined by what people can earn outside that sector". Such an assumption is fundamentally due to the fact that a maximizing (*i.e.*, competitive) behaviour *is* attributed to labour. As a result, there is perfect mobility of labour (in the sense used in international trade theory) leading to an equalization of wage rates between the two sectors. In terms of our diagram, the assumption of "perfect mobility of labour" implies that the subsistence wage line (PQ) becomes the horizontal portion of the industrial supply curve.

Thus, as the capitalistic sector expands (*i.e.*, the demand curves $D_iD_i$

DIAGRAM 1

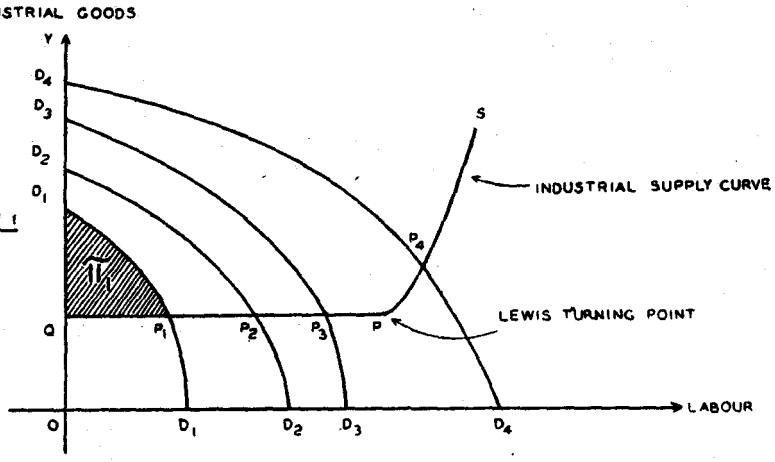



DIAGRAM 2

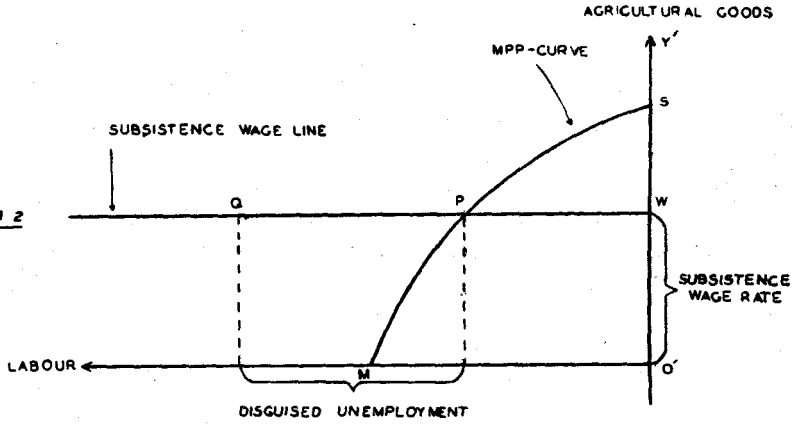
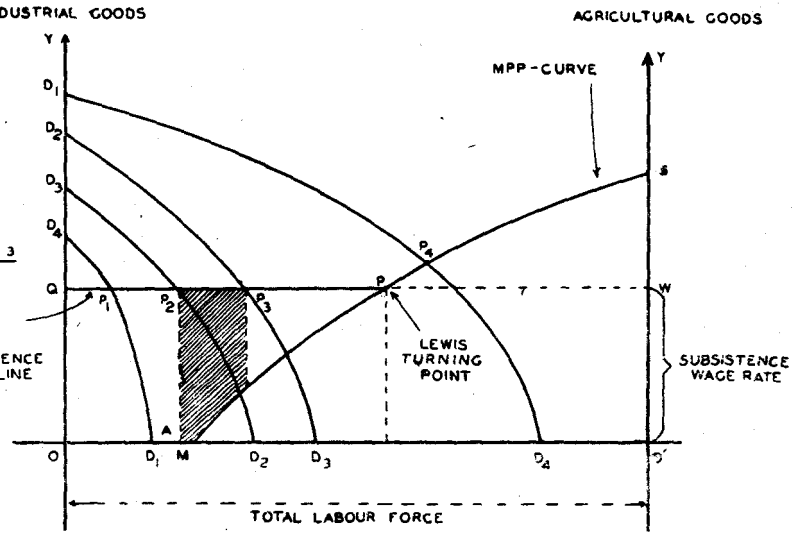



DIAGRAM 3



shift to the right) entrepreneurs can purchase labour at a constant subsistence wage rate before point P is reached. This is due to the fact that the reallocation of labour will not encounter any resistance from employers or heads of family in the agricultural sector. In fact, the latter are only too happy to release extra heads since a reduction of the disguisedly unemployed serves to increase their income. (For example, as $P_2P_3$ additional units of labour are absorbed by the industrial sector, the incremental income for the agricultural employer is represented by the shaded area in Diagram 3.[8] Thus, in this "stage one" of development, there exists a harmony of interests between the agricultural and industrial employers. Furthermore, if any portion of the incremental income of agricultural employers is saved, the total investment fund in the economy increases. This conclusion strengthens Professor Lewis' assertion that in this first stage, "profits will grow continuously relative to national income".[9]

Stage-one expansion, however, comes to an end after the demand curve for labour (*e.g.*, $D_4E_4$) has shifted to the right of point P. For to the right of point P, the real wage in the subsistence sector will move up with the MPP curve. "Capital has caught up with labour" and the supply of labour becomes inelastic, as Professor Lewis would say. The increase of the real wage is due to the fact that the employers in the agricultural sector will now offer resistance to further acquisitions of labour by the industrialists. They will resist by bidding up the real wage to that level which equates the MPP of labour at the margin since it is to their advantage to do so. With an increase in the real wage, the developmental process enters into the "second stage".

Thus we have presented a model which corresponds to what we believe to be the "basic reason" (*see* last section) for the occurrence of the Lewis turning point. According to this model, the horizontal portion of the industrial supply curve (PQ) is the subsistence wage line governing the disguisedly unemployed labour force and the rising portion of the industrial supply curve (PS) is the MPP curve of labour governing the non-disguisedly unemployed labour force in the agricultural sector. In this way, it is seen, that the industrial supply curve of labour and the Lewis turniug point are completely determined by the forces operating in the agricultural sector.

It should be noted here that in the model just constructed we witness a "switching" in the behaviouristic pattern attributed to employers in the agricultural sector between the two stages of development. In stage one, the landlords do *not* behave competitively while in stage two they *do* behave

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8. This will be called "rent" and will be fully analyzed in Section IV below.
9. W. A. Lewis, "Unlimited Supply, Further Notes", *op. cit.*, p. 58.

competitively. Such a "switching" is absolutely essential if the turning point phenomenon is to be established. Professor Lewis probably would argue that, with the gradual industrialization and monetization of the economy in the course of the developmental process such a "switching" is likely to occur. If this interpretation is correct then the Lewis turning point is, indeed, a most significant turning point in the developmental process. For, not only the quantity of profits and savings are different for the two stages of development (a fact emphasized by Lewis) but there is also a *qualitative transformation* of the economy, *i.e.*, on entering stage two the agricultural sector, hitherto a dragging sector, becomes commercialized. Since the labour surplus type of economy envisaged in Lewis' model is likely to be predominantly agricultural, a commercialization of the agricultural sector cannot fail to be a most significant landmark in the developmental process.

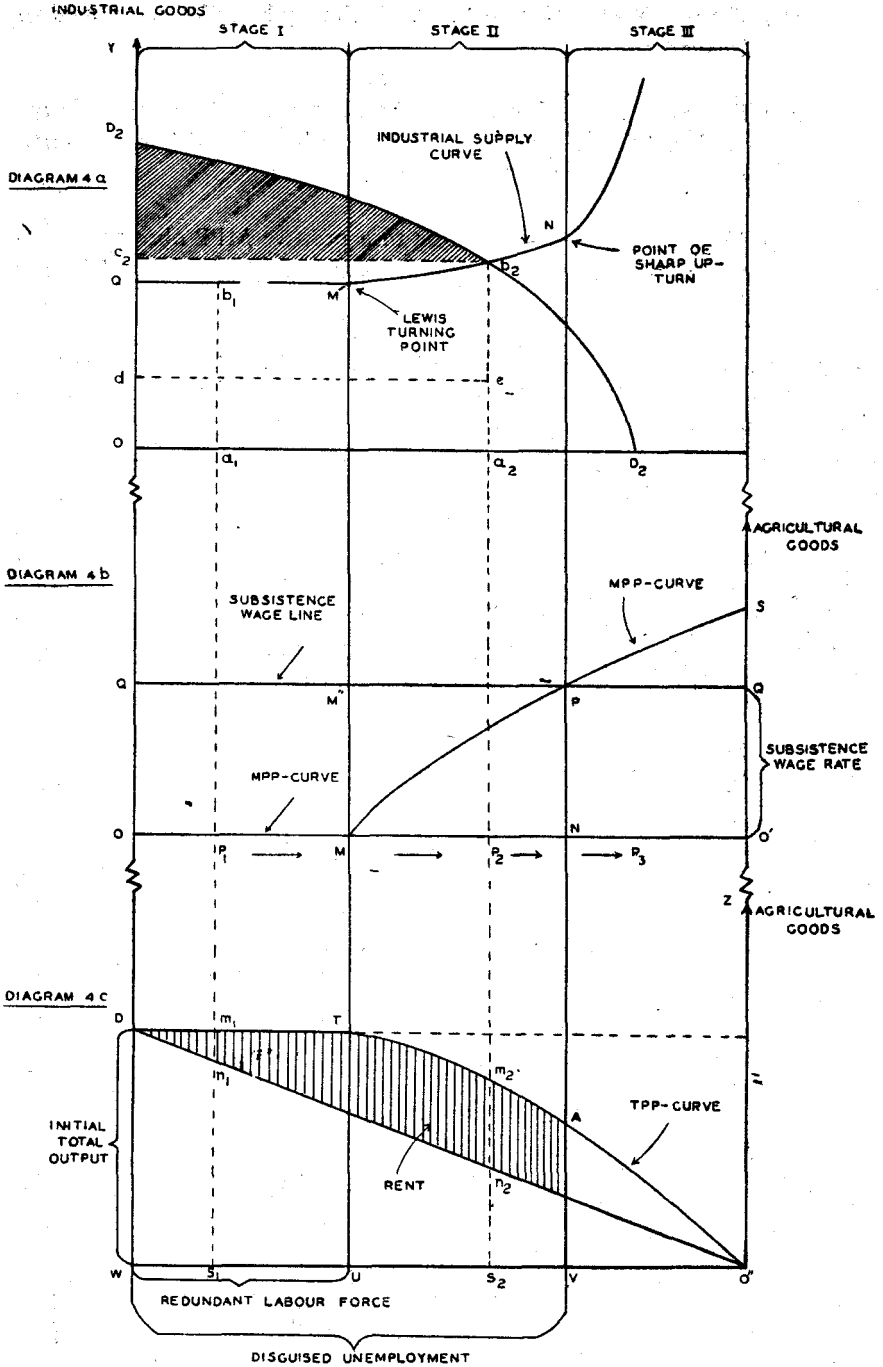
## SECTION III

One of the major restrictive assumptions in the construction of our basic model upto now is that of constancy in the terms of trade, *i.e.*, fixity in the exchange value of agricultural goods and industrial goods in terms of each other. To relax this assumption, economic common sense suggests that we should carefully analyze both the *supply* conditions and the *demand* conditions in the market.

Let the MPP-curve MPS and the horizontal wage line QP of Diagram 3 be reproduced in Diagram 4b, the middle section of Diagram 4. (Diagram 4 is formed of three layers 4a, 4b and 4c lined up vertically; as in Diagram 3, the horizontal axis measures labour and 00' in Diagram 4b represents the size of the total labour force). For a study of the terms of trade problem, however, the unit of measurement of the commodities involved must be unambiguously specified in physical units (not in terms of dollars as in Diagram 3). We shall let the vertical axis OY of Diagram 4a measure units of industrial goods and the vertical axes of Diagrams 4b and 4c measure units of agricultural goods.

In Diagram 4c, let the total physical productivity (TPP)-curve of labour in the agricultural sector O"ATD be shown. This curve is formed of two segments: a horizontal segment TD, giving a zero MPP, and a segment O"AT demonstrating the conventional diminishing MPP. The choice of such a TPP-curve is dictated by the requirement that the MPP-curve of Diagram 4b must be consistent with this TPP-curve. Thus, for the horizontal segment TD of the TPP-curve, the MPP-curve in Diagram 4b coincides with the horizontal axis OM, *etc.*

From the viewpoint of the agricultural sector, the total labour force O"W (Diagram 4c) can be divided into three parts:


INDUSTRIAL GOODS
STAGE I
STAGE II
STAGE III
Y
DIAGRAM 4 a
D2
INDUSTRIAL SUPPLY CURVE
N
C2
POINT OF SHARP UP-TURN
Q
b1
M
b2
LEWIS TURNING POINT
d
e
O
a1
a2
D2
A AGRICULTURAL GOODS
DIAGRAM 4 b
SUBSISTENCE WAGE LINE
MPP-CURVE
S
Q
M'
P
Q
SUBSISTENCE WAGE RATE
MPP-CURVE
O
N
O'
P1
M
P2
P3
Z
A AGRICULTURAL GOODS
DIAGRAM 4 C
D
m1
T
n1
m2
A
TPP-CURVE
INITIAL TOTAL OUTPUT
RENT
n2
W
S1
U
S2
V
O''
REDUNDANT LABOUR FORCE
DISGUISED UNEMPLOYMENT

(i) The part WU, with zero MPP, which may be called the *redundant labour force.*

(ii) The parts UV and WU, together, constitute the *disguisedly unemployed labour force.* (In other words, point V lines up vertically with point P of Diagram 4b).

(iii) The part VO", corresponding to a positive MPP above the subsistence wage, constitutes the *non-disguisedly* unemployed labour force.

Although Lewis believes that "whether marginal productivity is zero or negligible is not of fundamental importance to our analysis", we shall show that this tripartite division is important for the study of the turning point problem.[10] In anticipation, let us refer to the above division as corresponding to *three stages of development.* As indicated at the top of Diagram 4, the three stages, I, II and III are marked off by the two vertical lines cutting through the three layers of this diagram. The choice of this terminology is due to the fact that the absorption of labour by the industrial sector can be represented by a sequence of points O, $P_1$, M, $P_2$, N, $P_3$ ....(Diagram 4b) gradually moving toward the right so that the developmental process is seen to move from stage I to stages II and III in that order.

At the beginning of the developmental process, the entire labour force 00' may be assumed to be located in the agricultural sector, producing a total output of WD (Diagram 4c). For the sake of simplicity, let us assume that this output is consumed entirely by the agricultural workers.[11] Under this assumption, the subsistence wage rate, in terms of agricultural goods, is represented by the slope of the straight line O"D. In other words, the vertical distance O'Q in Diagram 4b, which represents the prevailing subsistence wage in stages I and II, is determined by this assumption and is equal in value to the slope of O"D in Diagram 4c.

Starting from the initial position (point W in Diagram 4c) it is seen that an economic rent gradually appears in the agricultural sector as labour is

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[10]. W. A. Lewis, "Economic Development with Unlimited Supplies of Labour", *op. cit.*, p. 142. Lewis' position may be interpreted as a special case of our model. This special case is derived by assuming that the total labour force is less than O"U (Diagram 4c) so that stage I can be neglected.

[11]. Realistically, a part of the total agricultural output WD may go to the landlords as rent even at the beginning of the developmental process. The analysis of rent which will be undertaken in this paper is then an analysis of the significance of the *incremental rent, i.e.*, the rent which gradually appears in the developmental process. It is not difficult to modify our model to take care of this additional complication. However, for expositional simplicity, this aspect of the problem will be neglected.

(1) *Agricultural labour* (*i.e.*, workers that remain in the agricultural sector) *consume only agricultural products and hence do not participate in the market.*

Since, in stages I and II, the subsistence wage rate of agricultural labour remains unchanged, it is reasonable to assume that their participation in the market (for the conceivable purpose of purchasing industrial consumer goods) is limited and hence can be neglected. (In stage III, because of the increase of the real wage, agricultural labourer may become more active market participants. However, our analysis below will indicate that the emphasis is on stages I and II).

(2) *Economic rent is received by landlords as incremental income.*

In view of the fact that rent is an "unearned increment", it is likely that the government will adopt taxation policies to siphon off at least a part of this rent for developmental purposes. The consequence of such a policy will be examined later.

(3) *Landlords do not withhold agricultural goods for their own consumption.*

This is not an unreasonable assumption since the landlords are few in number and relatively wealthy, thus likely to have a high income elasticity of demand for industrial goods. In any case, the consequences of relaxing this assumption will also be examined later.

Under these assumptions, the market participants on one side are the landlords. Furthermore, at each point in time, the amount of agricultural goods which the landlords will dispose of in the market is equivalent to rent. For example, if $WS_2$ units of labour are absorbed by the industrial sector (Diagram 4c) the disposable supply of agricultural goods is $m_2n_2$.

These agricultural goods may be viewed as constituting a "wages fund" to support the industrial workers ($WS_2$) absorbed by the industrial sector. In order to measure the amount of "support" available to an average industrial worker, let us define *average rent* as the *rent per unit of industrial worker*; (*i.e.* the ratio $m_2n_2/WS_2$). As a market phenomenon, the average rent is the supply of agricultural goods computed on a per unit of industrial worker basis.

The concept of average rent is a function of the amount of workers absorbed by the industrial workers. During Stage I it can be easily seen from the shaded distances of Diagram 4c that the average rent remains constant

and is equal in value to the subsistence wage rate. However, entering stage II, the average rent starts to decline as more workers are absorbed by the industrial sector. These conclusions are primarily based on the fact that, in stage I, the withdrawal of redundant labour will not affect total agricultural output but that, in stage II, the withdrawal of labour with a positive MPP will cause a decline in total output. These important conclusions follow from the definition of our two stages.

Concerning the buyers of agricultural goods, this side of the market consists of:

(i) industrialists demanding agricultural goods for consumption,

(ii) industrialists demanding agricultural goods as industrial raw materials,

(iii) industrial labour demanding agricultural goods for consumption.

We shall neglect (i) on the same grounds which led us to neglect the consumption of agricultural goods by the landlords (assumption 3 above). For the moment let us put aside (ii) and concentrate our analysis on (iii).

We can imagine that a typical industrial worker is paid by his employer in the form of a basket of industrial goods which he brings to the market seeking exchange for agricultural goods. Furthermore, in stages I and II, it is obvious that this basket of wage goods *has the same exchange value as the subsistence wage measured in terms of agricultural goods* (O'Q in Diagram 4b) regardless of the equilibrium terms of trade which we seek to determine. This is due to the assumption of "perfect mobility of labour" so that, in value terms, an industrial worker must have the same income as an agricultural worker. We shall make the further reasonable assumption that a typical industrial worker does not save so that he will spend all his income for purposes of consumption.

When a typical industrial worker enters the market what he encounters is a landlord willing to dispose of a quantity of agricultural goods equal to the average rent. Since we know the income of the worker, a knowledge of his preference system is all we need to determine the equilibrium value of the terms of trade. This is indicated in Diagram 5 in which the vertical axis denotes agricultural goods and the horizontal axis denotes industrial goods. The curves indexed by $P_1$, $P_2$, $P_3$. . . . are the consumption indifference curves of a typical industrial worker. The distance OA stands for the real income of an industrial worker, in stages I and II, which is the same as the subsistence wage rate in terms of agricultural goods (OA equals the distance O'Q in Dia-

gram 4b). From point A an *income-consumption line* $AA_1A_2A_3$ may be shown.

Assume $OR_1$ represents the amount of average rent available at a point in time. In order to determine the resulting equilibrium terms of trade, draw a horizontal line through $R_1$ intersecting the income-consumption line at point $A_1$. Connect the straight line $AA_1$ and extend it to point $T_1$ on the horizontal axis. The terms of trade are now indicated by the slope of $AT_1$. For, at these terms of trade, the equilibrium consumption point is at point $A_1$: the reservation demand for industrial goods by the typical industrial worker is $OQ_1$, and the demand for agricultural goods is $OR_1$, which clears the market. The real wage in terms of industrial goods is then represented by the distance $OT_1$.[15]

In this way, we have shown the determination of the terms of trade (slope of $AT_1$) and the real wage measured in terms of industrial goods ($OT_1$). It should be noted that, given the consumer's preferences of a typical industrial worker, the real wage (measured in terms of industrial goods) is determined *completely by the conditions prevailing in the agricultural sector.* These conditions include the average rent and the subsistence real wage measured in terms of agricultural goods. Referring once again to Diagram 4c, when $WS_2$ units of labour are absorbed by the industrial sector, the average rent ($m_2n_2/WS_2$) and the subsistence wage ($S_2n_2/O''S_2$) at that point determine the industrial real wage which is represented by the vertical distance $a_2b_2$ in Diagram 4a.[16] As the amount of industrial labour varies (as $WS_2$ varies), the locus of point "$b_2$" traces out the industrial supply curve $Q'b_1b_2N$ in Diagram 4a. Thus, it is seen that Lewis' industrial supply curve is determined by conditions prevailing in the agricultural sector in spite of the fact that the terms of trade are now being taken into consideration.

As the developmental process enters stage II, we have shown that the average rent decreases as more labourers are absorbed by the industrial sector. It follows that real wages, measured in terms of industrial goods must increase. (This is shown in Diagram 5, as $OR_2 < OR_1$, we see $OT_2 > OT_1$). Thus, in Diagram 4a the industrial supply curve gradually rises in stage II beginning from point M'. On the other hand, in stage I, the real wage is constant (because the average rent is constant) and the industrial supply curve is represented by the horizontal line Q'M'.

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15. An implicit assumption of this analysis is that the landlords intend to dispose of their rental income in exchange for industrial goods at whatever price level. Technically, this means that the indifference curves of the landlords are assumed to be vertical lines.

16. In other words, $a_2b_2$ in Diagram 4a has the same length as $OT_1$ in Diagram 5.

In this way, we have demonstrated that the Lewis turning point occurs at the boundary point (M') between stages I and II. The industrial supply curve turns up after this point because of the shortage of agricultural goods which is traced to the disappearance of the *redundant labour force.* This happens in spite of the fact that workers are still available to the industrial sector at the ruling subsistence wage, measured in terms of *agricultural product,* (the horizontal wage line M"P in Diagram 4b still rules in the agricultural sector in stage II).

When the developmental process enters stage III, the above causation for the upturn of the industrial supply curve is reinforced by the rise of the real wage in the subsistence sector. It is then due not only to a physical shortage of agricultural goods, but also to a change in the mode of social relations, *i.e.*, the commercialization of the agricultural sector. As a result the industrial supply curve will turn up *sharply* in stage III (after point N in Diagram 4a).

The above analysis, we think, is a reasonably accurate description of the process of economic development in a dualistic economy which completely neglects the agricultural sector. This negligence makes itself felt in the rising price of food grains to the urban workers forcing a slowdown of the rate of expansion in the industrial sector. Furthermore, unless something is done to raise agricultural productivity, the rise in the price of food grains eventually will be greatly intensified. In such an economy, we shall witness an increase in the real wage in the agricultural sector accompanied by a decline in the total volume of agricultural output. In the absence of foreign aid, a government policy aiming at suppressing workers' consumption and/or increasing agricultural productivity is unavoidable, if the expansion of the industrial sector is to be sustained.

## SECTION IV

In this section, we hope to modify our model by relaxing certain restrictive assumptions. For the moment, however, we shall retain the assumption that there is no increase in agricultural productivity. Whatever conclusions may be drawn are still pertinent to a country entirely neglecting the agricultural sector. Since this is patently unrealistic, our analysis here will be brief.

Referring to Diagram 4a, we see that as $Oa_2$ units of labour are absorbed by the industrial sector, the wage bill of the industrial sector is represented by the area $Oa_2b_2c_2$ and the profit by area $c_2b_2D_2$ (shaded). Since the industrial workers spend a part of their income on agricultural goods, we shall let the area $Oa_2ed$ represent the "reservation demand" of workers

(*i.e.*, the consumption of industrial goods by the industrial worker) and the area $deb_2c_2$ represent industrial goods acquired by the landlord in the course of the exchange process analyzed in the last section.[17]

After the acquisition of the industrial goods ($c_2deb_2$), the landlord may choose to consume or save any portion he desires. To the extent that the landlord refrains from consumption, these goods are investment goods which the landlord either holds directly as owner or indirectly through financial intermediaries (possibly government financial corporations). In other words, this constitutes an additional source of savings, additional to industrial profits (area $c_2b_2D_2$), which can be traced directly to the emergence of agricultural rent ($m_2n_2$) in the developmental process. Since rent increases to a maximum at the end of stage II, we can say that there is a tendency for the savings share of national income to decline when the developmental process enters stage III. This conclusion confirms the general conclusion of Lewis, subject to the qualification that the rate of growth of the profit share does not decline immediately after the Lewis turning point (M') but only somewhat later. The "unlimited supply of labour" (in stages I and II) is a blessing to the industrial sector not only from the viewpoint of "labour availability" but also from the viewpoint of "savings availability".

If landlords do not choose to save, our analysis suggests that the optimum course of action may be for the government to siphon off economic rent by means of its fiscal powers. Suppose the entire economic rent is siphoned off in this fashion and the proceeds are used for the development of the industrial sector. Then total savings are represented by area $D_2deb_2$ in Diagram 4a. To the extent that government subsidizes industry the entire amount of new investment goods ($D_2deb_2$) will be privately owned and to the extent that government uses a part of the tax proceeds for public investment some of the new investment goods will be publicly owned.

If the landlords are the recipients of rent, they may, however, choose to with-hold a portion for their own consumption (the consumption of agricultural goods by landlords may increase.). When this occurs in stage I, it is seen, working through the terms of trade argument, that the condition of an "unlimited supply of labour" is immediately ruined, *i.e.*, the industrial supply curve will rise.[18] Furthermore, savings originating from rent will also de-

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[17]. The relationship between Diagrams 4 and 5 may be briefly indicated. The distance $Oc_2$ (Diagram 4a) is the same as the distance $OT_1$ (Diagram 5). The distance Od (Diagram 4a) is the same as the distance $OQ_1$ (Diagram 5). The distance $dc_2$ (Diagram 4a) is the same or the distance $Q_1T_1$ (Diagram 5). The area $c_2deb_2$ (Diagram 4a) has the same exchange value as the distance $m_2n_2$ (Diagram 4c).

[18]. If any portion of rent is withheld from the market, average rent will decline in stage I. With the aid of Diagram 5, we can easily analyze the impact on the turning point by postulating alternative patterns of landlord consumption of agricultural goods.

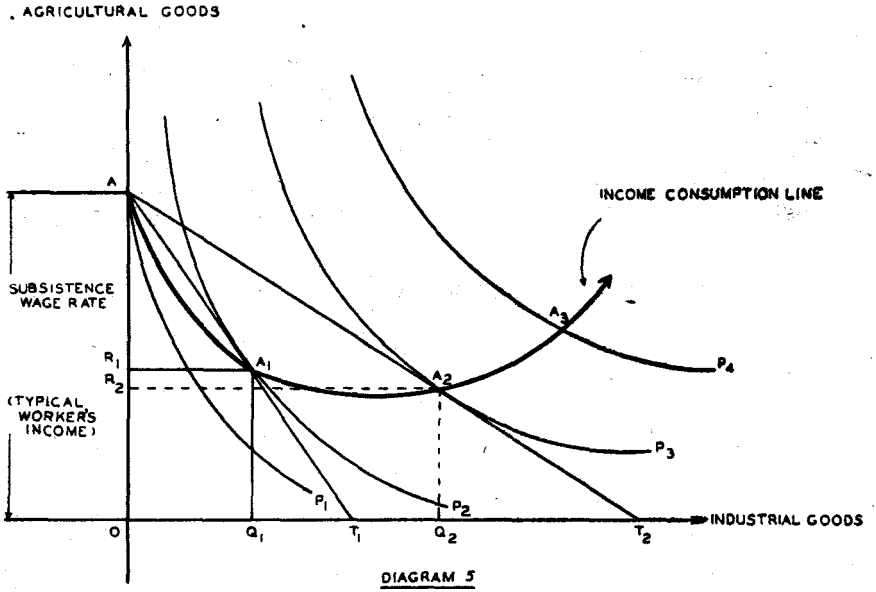
AGRICULTURAL GOODS
A
INCOME CONSUMPTION LINE
SUBSISTENCE WAGE RATE
$R_1$
$R_2$
(TYPICAL WORKER'S INCOME)
$A_1$
$A_2$
$A_3$
$P_4$
$P_3$
$P_2$
$P_1$
O
$Q_1$
$T_1$
$Q_2$
$T_2$
INDUSTRIAL GOODS

DIAGRAM 5

cline. Thus, any increase in consumption by the landlords is detrimental to the development of the industrial sector. (If they choose to consume industrial goods, the terms of trade will not deteriorate against the industrial sector; if they choose to consume agricultural goods, these terms of trade will deteriorate. This fine difference should not hide the fact that *any* consumption by the landlord will be detrimental to development). Finally, as economic development takes place, it is possible that the industrial sector will need more domestically-produced raw materials or, more likely, imported raw materials obtained by exporting agricultural goods. When this occurs in stage I, there will result a shortage of agricultural goods. Working through the terms of trade argument again we can easily establish the fact that once again the condition of the "unlimited supply of labour" is ruined.

The above analysis makes it clear that if there is any increase in demand or decrease in the supply of agricultural goods, not accounted for in the model of the last section, the condition of unlimited supply of labour (in the sense of a horizontal industrial supply curve) is *not likely* to prevail. And, since these events are not unlikely to occur, this points to the conclusion that in order to sustain the growth of the industrial sector a country must also develop its agricultural sector. Our analysis will turn in this direction in the next section.

## SECTION V

In this section, we intend to analyze the development of the no-longer-neglected agricultural sector and its impact on the expansion of the industrial sector. In Diagram 6c, let the initial agricultural TPP-curve of Diagram 4c be reproduced. This is the curve $O''T_0D$, which is now, for simplicity, indexed by $F_0$. The increases of agricultural productivity can be represented by an upward shift of the entire TPP-curve. Thus, as productivity increases in the course of the developmental process, the upward shift in the TPP-curve is represented by the sequence of curves indexed by $F_0, F_1, F_2, F_3, \ldots$ For the sake of simplicity, we shall assume that these curves shift up "proportionally" [19]. This implies that the size of the redundant labour force, $DT_0$, remains unchanged as productivity increases.

Relative to each particular TPP-curve in Diagram 6c, we can derive an MPP-curve (Diagram 6b) and, by means of the now familiar "terms of trade analysis" derive an industrial supply curve (Diagram 6a). The MPP-curves are indexed by $M_0, M_1, M_2, \ldots$ and the industrial supply curves by $S_0, S_1, S_2, \ldots$ Our immediate task is to investigate the relative positions of these sets of curves.

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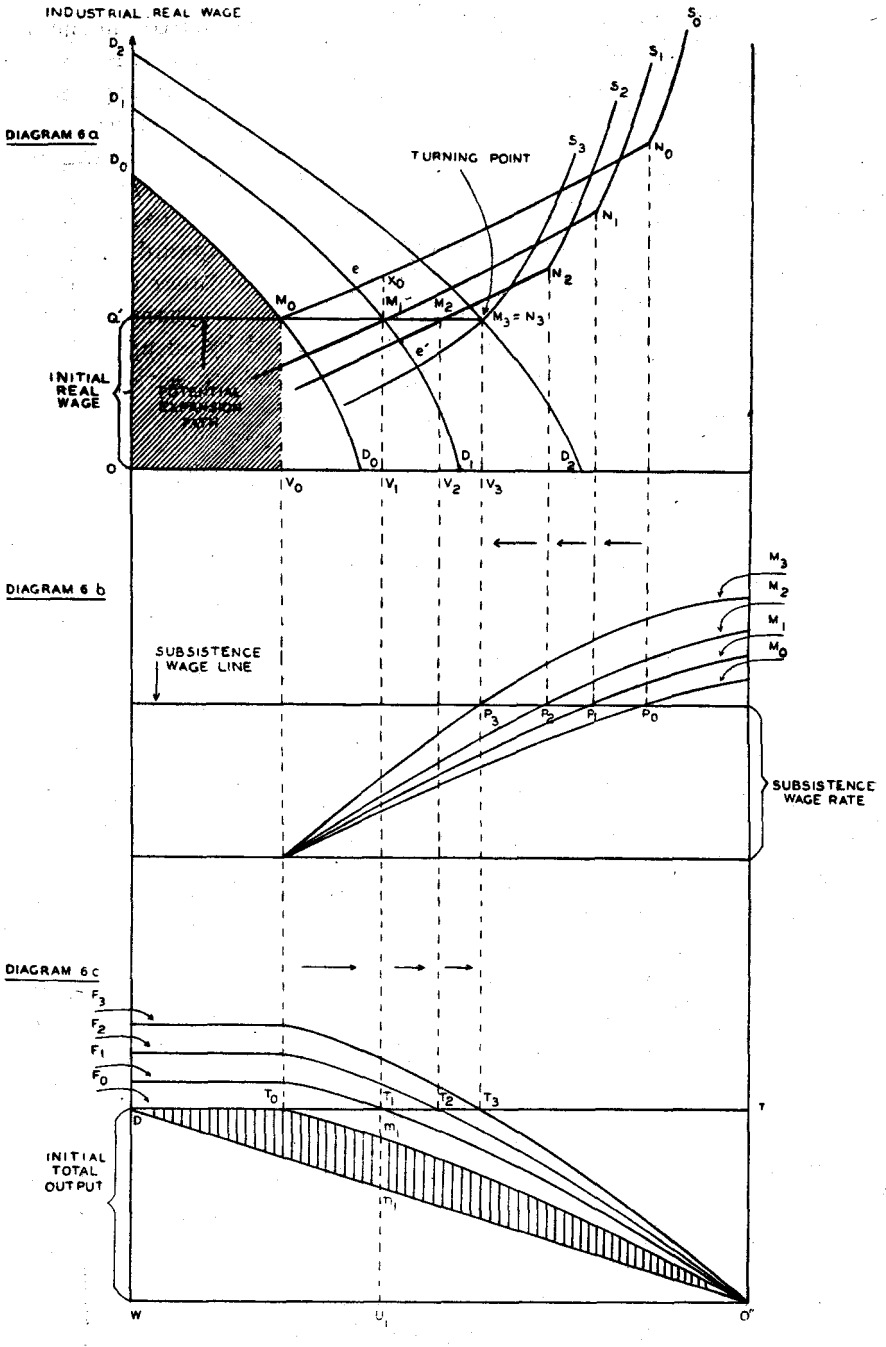
[19]. If $y=f(4)$ is the $F_0$-curve, then the subsequent TPP-curves are represented by $kf(L)$ where $k$ is a constant for each levle of productivity increase.

An increase in agricultural productivity will have a "mixed" impact on the position of the industrial supply curve. For, intuitively, it is obvious that an increase of agricultural output will increase rent, and, working through the terms of trade argument, will cause the industrial supply curve to shift *downward* as the terms of trade become more favourable to the industrial sector. However, this downward effect is counterbalanced by an *upward effect* at a later stage due to the fact that an increase in TPP is likely to increase the MPP, thus causing the industrial supply curve to shift upward. Thus, we see from Diagram 6a, that the industrial supply curve "after agricultural innovation" (this expression will be used, from now on, as synonymous with "an increase in agricultural productivity", represented by an upward shift of the TPP-curve) cuts the industrial supply curve before agricultural innovation from *below*.

More explicitly, from Diagram 6b, we see that as agricultural innovation takes place, the points of intersection of successive MPP-curves with the horizontal subsistence wage line move to the *left*, $P_0, P_1, P_2, \ldots$ . In the language used earlier, we can say that the beginning point of stage III arrives earlier, and hence the sharp upturn of the industrial supply curve occurs earlier also. (In Diagram 6a, the points of sharp upturn of the industrial supply curves are $N_0$, $N_1, N_2 \ldots\ldots$ which line up vertically with the points $P_0, P_1, P_2, \ldots$ . This is then the upward-shifting effect of agricultural innovation.

The above analysis assumes that the subsistence wage rate in the agricultural sector is unaffected by an increase in agricultural productivity. Realistically, this assumption means that agricultural innovations will not lead to social pressures for raising the subsistence wage rate. We can justify this assumption on the grounds that, with an increase in the degree of monetization and commercialization of the agricultural sector, the strength of the institutional forces which sustained the "high" real wage, will be gradually replaced by the market force. Consequently, we shall assume that the subsistence wage level (above the MPP of agricultural workers) will not be affected as agricultural innovation takes place before stage III is reached.

Under the above assumption, it is immediately clear, from Diagram 6c, that for a given amount of labour absorbed, the size of total and average rent increases as agricultural innovation takes place. Working through the terms of trade analysis again, the appearance of a larger average rent will cause the terms of trade to move against the agricultural sector and effect a decline in the industrial real wage. For example, if $WU_1$ units of labour are absorbed by the industrial sector, and if the TPP-curve moves from $F_0$ to $F_1$, the average rent increases from $m_1n_1/WU_1$ to $T_1n_1/WU_1$, and, in Diagram 6a, the real wage declines from $V_1 X_0$ to $V_1M_1$. This is then the downward-shifting effect of agricultural innovation.


INDUSTRIAL REAL WAGE
DIAGRAM 6 a
TURNING POINT
INITIAL REAL WAGE
POTENTIAL EXPANSION PATH
DIAGRAM 6 b
SUBSISTENCE WAGE LINE
SUBSISTENCE WAGE RATE
DIAGRAM 6 c
INITIAL TOTAL OUTPUT

The economic significance of the downward-shifting effect of agricultural innovation lies in the demonstration that the upturn of the industrial supply curve can thus be postponed. Such a postponement results from the availability of more agricultural goods in the market preventing the terms of trade from turning against the industrial sector. By keeping down the price of food grains the industrial real wage can be stabilized or even depressed. This contributes to the accumulation of industrial profits and to a sustained growth of the industrial sector. This is recognized by Lewis when he states that "if we postulate that the capitalist sector is not producing food, we must either postulate that the subsistence sector is increasing its output, or else conclude that the expansion of the capitalist sector will be brought to an end through adverse terms of trade eating into profit."[20]

## SECTION VI

When the possibility of agricultural innovation is admitted, it is no longer easy to give an analytical interpretation of the condition of "unlimited supply of labour", the key Lewis assumption. For, in Diagram 6a, we no longer have a horizontal segment of the industrial supply curve. To stress the point at issue, suppose $OV_1$ units of labour are absorbed by the industrial sector at time 't'. The level of industrial real wage which prevails at the same time may be higher than, lower than or equal to $V_1M_1$ depending upon the level of agricultural productivity achieved at the same moment of time (t).

In the dualistic economy of our model, the developmental process through time is most likely to be characterized by a simultaneous expansion of both sectors: the industrial sector absorbs labour continuously and the agricultural sector increases productivity continuously. In this (most probable) situation, a question pertinent to the industrial real wage is: what is the *time path of the short-run equilibrium wage rate*? The answer to this question obviously depends on the *comparative rate of expansion* of the two sectors. In other words, the by-now-familiar concept of *balanced growth* is at the heart of this issue.

Referring to Diagram 6a, let us call OQ' the *initial industrial wage, i.e.*, the wage rate which prevails at the beginning of the developmental process when the industrial sector has not yet absorbed any labour and when agricultural productivity (represented by the $F_0$-curve in Diagram 6c) has not yet been raised. Using this initial industrial wage as a point of reference, we may ask: if agricultural productivity is raised, say, to the $F_1$-curve, how many units of labour must be absorbed by the industrial sector to bring the industrial wage rate back to the same level as the initial industrial wage?

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20. W. A. Lewis, "Economic Development with Unlimited Supplies of Labour," *op. cit.*, p. 173.

To answer this question, let the horizontal line DT be drawn in Diagram 6c; the vertical distance DW of this line from the horizontal axis indicates the *initial* volume of agricultural output. Let the $F_1$-curve intersect DT at the point $T_1$. The horizontal distance $DT_1$ is then the answer. For if $DT_1$ units of labour are absorbed by the industrial sector, the total output, and hence the average rent ($T_1n_1/DT_1$), are restored to the same levels which prevailed at the beginning of the developmental process. Our terms of trade analysis implies that the industrial wage will be restored to the same level as the initial industrial wage rate.

The above analysis is indicated in Diagram 6 in the following way. In Diagram 6a, draw a horizontal line $Q'M_3$ through point Q' and call this line the *potential expansion path.* From points $T_0, T_1, T_2, \ldots$ determined in Diagram 6c (by a procedure described in the last paragraph) draw the vertical lines $T_0M_0$, $T_1M_1$, $T_2M_2$, .... intersecting the potential expansion path at $M_0, M_1, M_2, \ldots$ . It is then obvious that the industrial supply curves indexed by $S_0, S_1, S_2$ will cross the potential expansion path at the points $M_0, M_1, M_2 \ldots$ In this way the industrial supply curve $S_i$ is being divided into two segments:

(1) A segment which lies *above* the potential expansion path, indicating that the industrial wage rate is *higher* than the initial wage rate OQ'. From Diagram 6c, it is seen that this is due to a *deficiency* of agricultural product (indicated by the fact that the corresponding TPP-curve lies *below* the DT line.)
(2) A segment which lies *below* the potential expansion path, indicating that the industrial wage rate is *lower* than the initial wage rate OQ'. From Diagram 6c, it is seen that this is due to an *affluence* in agricultural product (indicated by the fact that the corresponding TPP-curve lies *above* the DT line.)

With this interpretation in mind, the potential expansion path is really a *balanced growth path* in that it provides a balanced growth criterion. Suppose a short-run equilibrium position is temporarily established at point $M_0$ in Diagram 6a (*i.e.*, with industrial demand curve $D_0D_0$ and the industrial supply curve $S_0$). In the next period, suppose the industrial demand curve shifts to the position $D_1D_1$. The balanced growth criterion specifies that agricultural productivity *should be* raised to the level represented by the $F_1$-curve, enabling $V_0V_1$ additional units of labour to be absorbed by the industrial sector, so that the short-run equilibrium position in the next period is again established at a point, $M_1$, which lies on the potential expansion path.

When we say that the country "should do" certain things, we have impli-

citly assumed that it has accepted, as given, certain policy aims. The balanced growth criterion just presented is based on the reasonable assumption that the country aims to develop the industrial sector as quickly as possible subject to the limitation that a minimum amount of food must be produced to feed the entire population at the subsistence wage at all times in the course of the developmental process. Under this assumption, new employment opportunities should be made available in the industrial sector as soon as possible subject to the limitation that the same amount of food must now be grown by a smaller labour force in the agricultural sector. (We assume, at this stage, that there is no population growth or other additional demand for agricultural products.) Defined in this sense, the balanced growth criterion is a normative concept independent of the economic system, *i.e.*, free market vs. controlled economy.

However, in the environment of a free market system, the potential growth path also has the operational significance of representing the equilibrium growth path if we may assume, as a first approximation, that the allocation of investment funds to the two sectors is *regulated by the terms of trade* as determined in the market. The above analysis of the economic significance of the potential expansion path (*i.e.*, it divides every short-run industrial supply curve $S_i$ into two segments) makes it clear that a temporary short-run equilibrium position which deviates from the potential expansion path will invoke a countervailing force causing the equilibrium path to "bend toward" the potential expansion path in the future. (For example, if the short-run equilibrium point is at point "e" which lies above the potential expansion path, there would be a worsening of the terms of trade for the industrial sector caused by a deficiency in agricultural output. Future investment will tend to be attracted to the agricultural sector causing the point of short-run equilibrium to move back toward the potential expansion path, *etc.*).

In the context of a competitive market system, the potential expansion path is a balanced growth path in the sense that it maintains investment incentives for both sectors at all times during the developmental process. Investment incentives are maintained because market outlets are provided for the product of both sectors in the system. The provisions of market outlets and investment incentives are the basic arguments for the balanced growth thesis in a free market system. The terms of trade argument is an exact (although imperfect) formulation of the "market outlet" argument for a developmental process characterized by a continuous allocation of labour out of the agricultural sector.

The above discussion brings us to a most important problem of economic policy for an underdeveloped country: to what extent can the free market

be relied upon to ensure balanced growth. There are familiar "institutional" arguments in favour of the free market (*e.g.*, bureaucratic inefficiency, difficulties of organization, *etc.*) as well as in favour of a controlled system (lack of financial institutions, monetization and commercial "attitude", *etc.*) which need not concern us, as the analytical tools used in this paper (or used by the economic profession at large) are clearly not suitable for this type of problem. What we can do reasonably well is analyze the technical complexities of the balanced growth problem, from the economic standpoint, which constitutes the "minimum knowledge" required for rational policy choices.

Assuming that the government is to take active measures to ensure balanced growth, it would have to determine, among other things so far neglected in our model, the *efficiency of investment* (the "cost-benefit ratio", to use a popular terminology) for both the industrial sector and the agricultural sector. For example, suppose again the equilibrium position is temporarily established at point $M_0$ (Diagram 6a) and a volume of savings (a fraction of the shaded area $OV_0M_0D_0$) is generated. The allocation of this investment fund to the two sectors depends on the extent to which the $D_0D_0$-curve can be raised (*i.e.* the investment efficiency in the industrial sector) and the extent to which the $S_0$-curve can be raised (*i.e.*, the investment efficiency in the agricultural sector) for *all* alternative patterns of allocation of a given investment fund. Provided such information is available, one can then solve the problem of an optimum allocation of the investment fund, at each point of time, to ensure balanced growth, that is to ensure, on the one hand, that employment opportunities are created for the new industrial workers at a rate of remuneration calculated to sustain high rate of expansion of the industrial sector, and, on the other hand, that enough food will be produced in the agricultural sector to feed the entire population.

It is not difficult to give a more rigorous formulation of the above dynamic balanced growth problem. As the outline of our model would suggest, such a theory will have to be based on the recognition of the following facets of the growth process: (i) allocation of labour out of the agricultural sector; (ii) investment efficiency in both sectors; (iii) availability of industrial profits and agricultural rent as sources of savings. Future theoretical research in this direction, taking into consideration the complications due to an "open economy" (*see* below), should be undertaken by growth theorists to help long-run policy planning.

However, if any such model is to be useful for planning, the bottleneck due to the shortage of statistical data must be overcome. This is true especially for the agricultural sector, *i.e.*, for investment efficiency in the agricultural sector relative to which, and *only* relative to which, long-run policy decisions

can be made rationally. (We assume that statistical knowledge of the investment efficiency in the industrial sector is less of a bottleneck).

For suppose the investment efficiency in the agricultural sector, either due to technical difficulties (lack of fertilizer, irrigation, mechanization, *etc.*) or due to institutional difficulties (lack of individual initiative, policy implementation ability *etc.*), is low. In this case, the country is practically forced to "neglect" the agricultural sector and to concentrate on the development of the industrial sector as the only alternative. For such a country an increase in the real wage in terms of industrial goods will be unavoidable and, in the absence of foreign aid, drastic measures to suppress standards of consumption of agricultural goods must be undertaken if the rate of development of the industrial sector is to be maintained. Our model implies that such measures have to become increasingly severe through time, the more so if the growth of the industrial sector is accelerated. A situation of this type is currently being experienced by many developing countries (*e.g.*, China) and will be experienced by other economies with similar aims and limitations.

If foreign aid is available to such a country (with low investment efficiency in the agricultural sector), the aid should be used, first, to import foodgrains when such foreign supplies (*e.g.*, U.S. agricultural surpluses) are available. A more rigorous formulation then enables us to determine the needed quantity of imported food through time, relative to a particular rate of expansion of the industrial sector.

Conversely, when the natural resources base of a country is more favourable, that is investment efficiency in the agricultural sector is not so limited, a "balanced growth" path becomes more feasible. Our model can be used to give us an estimation of the required agricultural surplus or rent. Additional decisions must be made concerning the specific types of agricultural goods which must be produced, *e.g.*, for domestic use or for export, depending upon the availability of foreign markets, the possibility of import substitutability, *etc.*

The above remarks are evidently not meant to represent a systematic outline of the balanced growth problem. Rather, it is to convince the reader that the issue of balanced growth raised in this paper is not a marginal issue in the area of development policy. It is perhaps *the* basic issue in the light of which all other economic policy decisions may be judged and evaluated. It is thus hoped that the model presented may serve as a point of departure for future research in this direction.

## SECTION VII

The logical structure of the model presented thus far implies a theory

of economic maturity which will be presented in this final section. First of all, let us recall that, under the assumption of "balanced growth" defined in the last section, the potential expansion path $O'M_3$ (Diagram 6a) becomes the time path of the short-run equilibrium wage rate in the industrial sector. Since it is a horizontal line, we can interpret $O'M_3$ as the horizontal portion of the "industrial supply curve" in the sense of Section I, namely, as the industrial demand curves $D_iD_i$ move to the right, the points of intersection of $D_iD_i$ with $O'M_3$ indicate the short-run equilibrium position. In this way the concept of an "industrial supply curve" can be restored even when the realistic possibility of agricultural innovation is admitted.

We may then raise the question which has been the starting point of our analysis in Section I, namely, what is the Lewis turning point for the "industrial supply curve"? In other words, what is the boundary point between what Lewis has called stage I and stage II of development, if the possibility of agricultural innovation is admitted?

Referring to Diagram 6b, we see that, with agricultural innovation, the sequence of points $P_0, P_1, P_2, \ldots$ gradually moves to the *left* and that, in Diagram 6c, the sequence of points $T_0, T_1, T_2 \ldots$ gradually moves to the *right*. Sooner or later, the two sequences will meet. In other words, there is one particular level of agricultural productivity which, if reached, will make the $P_i$ point lie directly on top of the corresponding $T_i$ point. In Diagram 6, this occurs when the TPP-curve is raised to the level represented by the $F_3$-curve, when the points $P_3$ and $T_3$ are vertically lined up.

If we recall the significance of the $T_i$ points (the fact that the potential expansion path was defined with the aid of $T_i$—*see* Section VI), we see immediately that the potential expansion path will extend *at least* to the point $M_3$ (vertically lined up with $T_3$). On the other hand, the economic significance of the $P_i$ points analyzed in Section V (the fact that the industrial supply curves begin to rise sharply at point $N_i$, vertically lined up with the $P_i$ points) makes it clear that the potential expansion path extends, *at most*, to $N_3$, vertically lined up with $P_3$. Hence the points $N_3$ and $M_3$ are the same point (Diagram 6a) which is, in fact, the Lewis turning point.[21]

The economic argument leading to the emergence of this Lewis turning point may be briefly reviewed. *Before* this point is reached continuous agricultural innovation prevents the industrial real wage from rising. *After* this

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[21]. In terms of our previous analysis, the "horizontal distances" $T_0P_0$, $T_1P_1$, $T_2P_2$, .. (which mark off "stage II" for each level of agricultural productivity) gradually approach zero as agricultural innovation takes place. When the Lewis turning point is reached, "stage II" shrinks to a *point* and the short-run industrial supply curve $S_s$ rises sharply at the (initial) turning point.

point is reached the industrial real wage will tend to rise as a result of the commercialization of the agricultural sector.[22] Thus, the Lewis turning point, defined in this way, indicates economic maturity not only in the sense that the industrial real wage will start to rise but also in the sense that there takes place a basic institutional transformation, namely the *commercialization of the agricultural sector.*

Lewis seems to believe that economic maturity can be identified by means of a "saving index" when he states that,

> "the central problem in the theory of economic development is to understand the process by which a community which was previously saving and investing 4 or 5 per cent of its national income or less, converts itself into an economy where voluntary saving is running about 12 to 15 per cent of national income or more."[23]

Such indices, to our knowledge, are derived from inductive evidence, *i.e.*, from the experiences of the Western countries (and Japan) which have already gone beyond the Lewis turning point as an accomplished historical fact. For Professor Lewis has *not* proved, by the method of theoretic deductive reasoning, that the saving index must be "12 per cent to 15 per cent or more", instead of certain other values, when the turning point is reached.

In view of fact that the allocation of labour and the gradual shrinking of the agricultural population are the central theme of our model, perhaps we should use a "population index"—agricultural population as a percentage of total population—in place of the "savings index" as a signal for economic maturity. Such a population index conforms to the commonly-held belief that, for an underdeveloped country to mature, it must change from a predominantly agricultural economy, with upward of 80 per cent of her population engaged in this sector, to an economy in which the industrial population is in the ascendancy.

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22. Thus the signals for the arrival of the Lewis turning point are a rise of the real wage in terms of industrial goods as well as a deterioration of the terms of trade against the industrial sector. However, these purely theoretical results must be modified when other realistic complexities are considered. In the first place, development before the turning point may witness the phenomenon of a "wage gap" or a lag in the development of the agricultural sector thus, violating the balanced growth criterion. For these reasons, the industrial real wage may rise gradually before the turning point is reached. On the other hand, development *after* the turning point is likely to generate forces which cause the terms of trade to move against the agricultural sector—a well-known phenomenon in a mature economy. (This "long-run" developmental problem will be commented upon later). For these reasons, it is unlikely that, in a statistical implementation of our model, a sharp rise in the industrial wage and/or a sharp turn of the terms of trade against the industrial sector will be observed at the turning point.

23. W. A. Lewis, "Economic Development with Unlimited Supplies of Labour", *op. cit.*, p. 55.

Exactly where the value of this index is going to settle depends, among other things, on the natural resources base of the country. If the country is more favourably endowed with natural resources, development tends to be oriented in the agricultural direction. Consequently, a somewhat higher percentage of the total population will still be in the agricultural sector when the turning point is reached. Conversely, with a less favourable natural resources base to begin with, the country's development will have to be industrially oriented, a higher percentage of the total population will have had to be allocated to the industrial sector.

We have now come to the major thesis of this section: the population index mentioned in the last paragraph *can be* deduced from the logical structure of our model. The mathematical derivation of this result, although requiring only elementary mathematical knowledge, is somewhat involved and will be omitted. We shall only present the result and then proceed to examine the economic rationality of the conclusions.

Referring to Diagram 6c, we see that the Distance $TT_0$ measures the amount of *non-redundant* labour force in the agricultural sector (*see* Section IV). Let 'r' denote the non-redundant labour force as a percentage of total population ($TDr = TT_0$ in Diagram 6c, where TD is the total population). The number "r" may be called a "coefficient of non-redundancy" as it measures how favourable the natural resources base of the country is in relation to the size of the population. A large value of "r" indicates a higher percentage of the labour force in the agricultural sector is non-redundant and the country is starting from a more favourable natural resources base at the beginning of the developmental process. Conversely, when "r" is smaller, the country is beginning her developmental process with a less favourable natural resources base.

From the procedure which we have used for the construction of Diagram 6, it is intuitively obvious that when a value of "r" is given, the Lewis turning point can be uniquely determined. Let the "population index" be denoted by V (V is the *turning point of agricultural population as a percentage of total population*, or, $VTD = TT_3$, in Diagram 6c). The following formula can then be rigorously derived:

$$V = 1 + r - \sqrt{1 + r^2}$$

A range of values for V corresponding to a reasonable range of values postulated for "r" is indicated in the following table:

| r | .7 | .8 | .9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 | 2.0 |
|---|---|---|---|---|---|---|---|---|---|
| V | .48 | .52 | .55 | .58 | .61 | .64 | .66 | .68 | .75 |

It is seen that the value of V (the percentage of agricultural population at the turning point) increases as the value of 'r' increases (as the percentage of non-redundant agricultural labour force increases). This confirms the intuitively-expected result, namely, if a country is starting from a more favourable natural resources base (larger r), its economic development will be oriented in the agricultural direction or indicated by a larger V.

For the range of reasonable values of "r", we have selected a maximum of "2" and a minimum of ".7". The minimum value of ".7" means that we have assumed that an underdeveloped country may have up to 30 per cent of its agricultural labour force redundant at the beginning of the developmental process. On the other hand, the maximum value of "2" means that we have assumed that a country, at the beginning of the developmental process, could have tolerated at most a 100 per cent increase in its agricultural population (in the agricultural sector) before *any* portion of the labour force becomes redundant. This range of values for "r" seems to be both realistic and wide enough for our purposes.

For this reasonable range of values of "r", the table shows that the agricultural population will have to decline to 75 *per cent or less* by the time the turning point arrives.[24] This conclusion, which is implied by the logical structure of our model, seems to conform to "common sense" and, for this reason, constitutes evidence testifying to the empirical relevance of our model.

The basic result of our model can be modified in several directions. Up to now we have assumed that the population is constant. However, we could have postulated a positive rate of increase of population during the developmental process and then investigated to what extent the turning point will have to be "postponed". Proceeding along this line will eventually lead us to a version of the "big push" thesis indicating the needed minimum investment to overcome the Malthusian trap so as to enable the country to reach economic maturity.

Another direction in which our basic model can be modified is to take into consideration some of the factors considered above, *e.g.*, the "wage gap", landlord consumption, raw material and export demands for agricultural output, *etc.* All such additional complications can easily be accommodated by our basic model structure.

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[24]. An inspection of the mathematical formula presented above would show that the value of V approaches *one* (from below) as the value of "r" approaches infinity. Thus, when the value of "r" changes from "2" upward, the value of V is not likely to change very much. The economic significance of this is that the "75 per cent or less" figure derived from our theory is a rather stable and "reliable" estimation.

In conclusion, the relationship between this section and our previous work ought to be recalled. The turning point problem is decidedly a long-run problem which a country like Pakistan will *not* have to face for, say, 20 years.[25] Immediately, its policy problem is the problem of balanced growth as analyzed in Sections I-VI. The longer-run analysis, however, is also useful to give us some indications as to the adequacy of short-run policies to enable the country to reach economic maturity.

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[25]. The precise estimation of the length of this time period can be made when the big push thesis is rigorously formulated.