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A Note on Wage-Labour Supply Under Rationing, With Some Indirect Evidence from Mozambique (1981-85)

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Discussion Paper 91

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This paper is circulated for discussion purposes only, and its contents should be considered preliminary.

A NOTE ON WAGE-LABOUR SUPPLY UNDER RATIONING, WITH SOME INDIRECT EVIDENCE FROM MOZAMBIQUE (1981-85)

by

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October 1988 (revised version)

Abstract: After a brief sketch of the recent economic history of Mozambique, a theoretical model of seasonal labour supply is analysed and tested indirectly on Mozambican data. Its aim is to explain why farms in the mechanized sector have been constrained by shortages of seasonnal labour. Some policy lessons are drawn in the conclusion.

* This note uses some ideas and data collected in Maputo (Mozambique), when doing a research with J.J. Faucher, as part of a research program of the OECD-Development Center, headed by Ch. Morrisson. I wish to thank these persons and this institution without implicating their responsibility for any ideas or errors contained in this note. It has been presented in Warwick at the DERC/EDI (The World Bank) workshop on "Labour Markets in an Era of Adjustment", and has benefitted from comments by some participants, including Tim Besley, Paul Collier, Ravi Kanbur, Dipak Mazumdar, the late Shiv Nath, and Graham Pyatt. I wish to thank them, with the usual disclaimer.

It is not too clear to determine what "labour supply" means exactly in many LDC's, and especially so in rural Africa. The point is that most of the exchange of labour takes place outside the wage system ; one can rather observe various forms of share cropping, including, so to speak "mutual sharecropping" (farmers going in turn to work on each other's farm, for a given share of the crop) (see e.g. Sen, 1975, Hill, 1986, etc..). It does not seem especially useful, a priori, to include this type of behaviour under the "labour supply" heading as distinct from the "peasant supply response" type of analysis.

It seems more intuitively appealing to call "labour supply" the supply of labour seeking payment of a wage. In rural Africa, this concerns primarily labour hired by large plantations. These large farms of the "modern sector" may be private, as it is mainly the case, say, in Kenya, or State-owned, as it was mainly the case in Mozambique in the early 80's. It has become fashionable to distinguish between "insiders" and "outsiders" to describe the different positions of various wage earners in industrialized countries (see e.g. Lindbeck and Snower, 1986), and it is useful as well to distinguish between full-time employees of the plantations, and seasonnal labourers. The latter are usually young peasants who need to accumulate some money to establish themselves as farmers, later on. They sometimes travel long distances to get jobs.

A very popular way of modelling the supply of labour to the modern sector has been initiated in the classic paper by Lewis (Lewis, 1954). The "Unlimited Supplies of Labour" hypothesis amounts to assuming a perfectly elastic supply of labour, at an exogenously given real wage. Such an assumption is obviously not meant to describe the behaviour of "insiders", who are in limited supply at any time, but it might be regarded as suitable for seasonal labour. This assumption has been modified in different ways, as did e.g. Sen (1966). Recently, this type of assumption has played a crucial role in the literature on North-South trade (e.g. Findlay, 1981 or Chichilnisky and Heal, 1986). These authors typically assume that the supply of wage-labour is much more elastic in the South than in the North, with respect to the real wage rate.

The aim of the present paper is to show that such an assumption may be very misleading, as it cannot account for labour shortages which may occur in controlled economies of the South. More precisely, when staying in Maputo (Mozambique), we heard people (officials or "cooperantes") in interviews blaming on labour shortages some bad results of State-farms. To try and understand such a phenomenon in the following, section II provides a theoretical analysis of wage-labour supply by a representative agricultural household facing rationing on his consumption possibilities (see Singh, Squire and Strauss, 1986, on the standard agricultural

household model, and Berthélemy and Gagey, 1984, Bevan, Bigsten, Collier and Gunning, 1987, and Azam, 1988, on the role of rationing). Then, the empirical relevance of this analysis is tested, using however some admittedly inadequate data. The evidence sought is only indirect, using the output of farms of the mechanized sector as a proxy for labour supply, as defined above, assuming in effect a fixed coefficient technology.

But, as the recent economic history of Mozambique is probably unfamiliar to most readers, a preliminary section is devoted to a description of its main features. Further details can be found in Azam and Faucher (1988), hereafter referred to as AF, and references therein.

I/ The Economic Collapse of Mozambique Since Independence.

Mozambique gained independence in 1975, after the overthrow of the authoritarian regime in Portugal, and more than ten years of struggle for independence led by the Frelimo party in the country.

Before that date, this colony was relatively prosperous, but its external equilibrium was rather insecure. Its balance of trade was structurally unbalanced, with export revenues covering only between 1/2 and 2/3 of the imports

bill. The remaining gap was filled by selling transport services to the landlocked neighbouring countries, taking advantage of this country's natural ports, and by letting migrant workers go to the mines and plantations of South Africa and (then) Rhodesia.

This source of foreign currency dried up quite rapidly after independence, because South Africa started using its newly opened port of Richards Bay, instead of Maputo, and because Mozambique decided to take part in the international blockade of Rhodesia. Half of the railway traffic was thus cut by 1976. Moreover, the number of migrant miners to South Africa was divided by three at the same time.

Despite these strongly reduced external revenues, Frelimo engaged the country in a capital-intensive development strategy, involving massive imports of tractors, combined harvesters, etc. This orientation has two causes. First, as the Portugueses fled the country, with their number falling from 250 000 to 20 000, they took away with them most of the country's human capital, as no educational policies had been pursued in colonial time, and they destroyed massively the physical capital which they could not take with them. Underestimating the complementarities which exist between these two kinds of capital, Frelimo wanted to rebuild the capital stock rapidly. Secondly, at the 3rd Congress of the Frelimo party in February 1977, a Marxist-Leninist line was

adopted, which was only latent until that date. Oversized and overmechanized State-farms were then established, in an attempt to feed the cities and to socialize the peasants.

None of these two objectives was attained, but the resulting overinvestment and disorganization of rural production opened large deficits in the government budget and in the country's balance of payments.

The policy reactions triggered by these combined deficits entailed a downward spiral, based on two "vicious circles". The first one, which may be called the external loop, starts with a very common occurrence in the third world: imports compression. In view of the balance of payments problems and the priority given to imports of investment goods, the government began to cut drastically the imports of consumer goods and the imports of intermediate goods required to produce consumer goods. The resulting shortage of marketed consumer goods in the rural areas has the unwanted consequence of discouraging sooner or later the peasants from producing cash crops, as there are no goods in the shops or the markets to spend the money earnt.

This negative reaction, which can be analysed theoretically with the tools of rationing theory (e.g. Benassy, 1982), has been studied econometrically in several countries. Berthélemy (1988) for Madagascar, Bevan, Collier

and Horsnell (1988) for Tanzania, and Azam and Faucher (1988) for Mozambique, have provided econometric evidence in favor of this theory. Berthélemy and Gagey (1984), Bevan, Bigsten, Collier and Gunning (1987) and Azam (1988) have provided the theoretical underpinnings.

The reduced production of cash crops means that there are less goods to export, so that the balance of payments does not improve as the government wants, in response to imports compression, leading the government to tighten the restrictions.

The second mechanism involved, which we may call the internal loop, is based on the monetary financing of budget deficits. As cash crop production drops, tax revenues go down, and the government deficit widens. More money is then printed, and flows in the country. In the controlled economies, where inflation is repressed, the increased stock of money chasing a reduced quantity of goods leads to further reductions in the incentives for farmers to produce cash crops, and hence to increased deficits and accelerated growth of the quantity of money. This negative cash balance effect has been especially evidenced by AF, in the Mozambican case. In less controlled economies, like Ghana, this monetary deterrent to cash crop production is defused by price inflation on the parallel market (see Azam and Besley, 1988.a).

The model analysed below shows that the foregoing analysis is not only relevant for the peasant agricultural sector, but applies as well to some extent for the mechanized sector. This is due to the shortage of seasonal labour, which is needed in plantations for some of the agricultural works, but which is not supplied when monetary incomes are not wanted because of the shortage of goods. The theoretical model underlying this effect is analysed in the next section.

II/ Theoretical Analysis of Seasonal Labour Supply.

We analyse the supply of seasonal labour as the decision problem of a representative agricultural household seeking to allocate optimally its labour endowment between labour done on the farm, labour done outside the farm for a wage, and leisure. The latter is a catch-all word for all the non-traded goods which are either produced and consumed within the household, or which are traded on a Walrasian local market, as usual with this type of models. We do not analyse the decision to migrate, which involves the choice between two kinds of labour which can't be done in the same period.

1) Definitions and notations

C : consumption of manufactured goods

C^R : quantitative constraint on the above

X : output of food crop

X_a : consumption of food

X_s : sales of food

N : total labour time available

L : time of labour expended

L_a : labour done on the farm

L_m : labour done outside, for a wage

Z : output of cash crop

M_o : initial money balances

M : end-of-period money balances

p : price of manufactured goods

s : price of food crop

q : price of cash crop

w : wage rate

2) Microeconomic foundations of the agricultural household's behaviour

Assume that the representative agricultural household seeks to solve the following problem :

$$\text{Max } U(C, X_a, N-L, M/p) \qquad (1)$$

$$s.t.\ pC + M = wL_m + qZ + sX_s + M_o \qquad (2)$$

$$L_a = R(X,Z) \qquad (3)$$

$$X = X_s + X_a \qquad (4)$$

$$L = L_a + L_m \qquad (5)$$

$$C = C^R \qquad (6)$$

Assume that the utility function U(-) is increasing, twice differentiable, and strictly quasi-concave. Including real end-of-period cash balances as an argument in the utility function is a well-known simplification which enables one to take into account the intertemporal nature of the decision problem, while dealing only with current variables (see e.g. Benassy, 1982). It implicitely assumes that the future path of all the relevant exogenous variables is given exogenously. The resulting model has therefore a short-run flavour.

The technical possibilities are represented by the labour requirement function R(-), which is assumed to be strictly convex, with a negative cross-second derivative ($R_{zx}<0$). This is meant to capture the fact that some of the work done on the farm may benefit several crops, as is probably the case in Africa, where mixed crops are the rule.

This problem can be solved easily by taking advantage of its convenient recursive structure. First, define the household's profit function as :

$$G(q, s, w) = \max_{(+)(+)(-)} (qZ + sX - wR(Z, X)) \qquad (7)$$

This results in the following first order conditions :

$$q = wR_z \qquad (8)$$

$$s = wR_x \qquad (9)$$

By Hotelling's lemma, one then gets easily :

$$\frac{\delta G}{\delta q} = Z \; ; \; \frac{\delta G}{\delta s} = X \; ; \; - \frac{\delta G}{\delta w} = L_a$$

Now, the properties of these demand and supply functions can be derived, using the assumption $R_{zx} \leq 0$. One gets :

$$Z\underset{(+)\ (+)}{(q/w,\ s/w)} \qquad (11)$$

$$X\underset{(+)\ (+)}{(q/w,\ s/w)} \qquad (12)$$

$$L_a \ (q/w, \ s/w) \qquad (13)$$
$$(+) \quad (+)$$

Notice that in this model, the peasant supply function for the cash crop Z(-) is increasing in the cash crop price q. This is at variance with some other models of supply response under rationing (Berthélemy and Gagey, 1984, Bevan, Bigsten, Collier and Gunning, 1987), where a perverse response of output to its price is found. As illustrated by Besley (1988) and Azam and Besley (1988.b), the perverse supply response occurs when there is no "vent for excess demand", i.e. when any excess demand due to rationing can't spill over on another good, so that the only possibility is to reduce income. In this model, the household is facing two given prices on unrationed markets: s and w. In other words, the excess demand for the rationed manufactured good C spills over on food and leisure.

Define now the household's full wealth as :

$$W \ (M_o, \ N, \ w, \ q, \ s) = M_o + wN + G(q, \ s, \ w) \qquad (14)$$
$$(+) \quad (+)(+)(+)(+)$$

The maximization problem to be solved by our representative agricultural household can then be written as :

$$\text{Max } U \ (C^R, \ X_a, \ N-L, \ M/p) \qquad (15)$$

$$s.t.\ M + w\,(N - L) + sX_a = W - pC^R \qquad (16)$$

The first order conditions resulting from this problem can be written :

$$\frac{U_X}{U_M} = \frac{s}{p}\ ;\ \frac{U_N}{U_M} = \frac{w}{p}\ ;\ U_C > U_M\,, \qquad (17)$$

where a subscript denotes a partial derivative.

One then gets the following demand and supply functions :

$$\frac{M}{p} = m\left(\frac{s}{p}, \frac{w}{p}, \frac{W}{p}, C^R\right) \qquad (18)$$

$$L = L\left(\frac{s}{p}, \frac{w}{p}, \frac{W}{p}, C^R\right) \qquad (19)$$

$$X_a = X_a\left(\frac{s}{p}, \frac{w}{p}, \frac{W}{p}, C^R\right) \qquad (20)$$

One can notice that the agricultural household is affected by the constraint C^R in its demand functions for money, leisure, and food, as shown by the above equations, while it is not so for the behavioural functions (11), (12) and (13). This is the result of the recursive nature of this problem, which allows for a separate treatment of the agricultural household "as a profit-maximizing firm", as described in (11)-(13), and "as a consuming household",as described here.

To interpret correctly the various effects described by these functions, one must remember that we assume in fact that the future path of the relevant exogenous variables is fixed by assumption. Therefore, price changes here are temporary in nature, and imply an intertemporal substitution effect, in addition to the static substitution and income effects (see Azam, 1988, for elaboration on this point).

We need not dwell on the comparative statics of equations (18)-(20), and we can now concentrate our attention on the supply of wage labour, which is the topic of this note.

3) The wage-labour supply function

The wage-labour supply function can be derived as the difference between total labour L and the labour spent on the farm L_a :

$$L_m = L\,(-) - L_a\,(-) \qquad (21)$$

Figure I illustrates the determination of this function. The wage rate w is measured on the vertical axis, while the various components of labour time are described on the horizontal axis. One notices that in order to restrict the analysis to the cases where wage-labour is positive, one must assume that $w > w_-$. The latter is a function of all the arguments of L and L_a.

Some tedious calculations provide the following signs :

$$L_m \underset{(-)}{\left(\frac{M_o}{p}\right)}, \underset{(+)}{C^R}, \underset{(-)}{\frac{q}{p}}, \underset{(?-)}{\frac{s}{p}}, \underset{(?+)}{\frac{w}{p}} \qquad (22)$$

The unambiguous signs do not call for much comments : the real balance effect has a positive impact on the consumption of "leisure", while an increased availability of consumer goods provides an incentive to earn more income ; an increased price for the cash crop reduces the attraction of wage-labour, relative to working on the farm.

The two other arguments have an ambiguous impact. As far as the price of the food crop is concerned, there are three effects : a positive effect on the labour spent on the farm, a negative wealth effect on the total labour spent, and an ambiguous substitution effect on the total labour spent. The impact of the real-wage rate is as well made of three competing effects : a negative effect on the labour spent on the farm, a positive substitution effect on the total labour spent, and a negative wealth effect on the latter. Therefore, the two ambiguous effects have probably the signs written beside the question marks.

We have tried to perform a test of this function, using however some very inadequate data.

III/ Some indirect econometric evidence from Mozambique (1981-85)

Agriculture in Mozambique had a deep depression in the early 80's. An extensive analysis of this economic phenomenon is provided in AF, and a quick sketch of its main reasons was provided above.

The agricultural sector there is highly dualistic, with a sector of small peasant farmers, referred to as the "family sector", beside a "mechanized sector", made of large or very large farms. The latter were mainly State farms until the recent reforms, but some private farms continued to exist after independance (1975). In particular the huge private company João Ferreira Dos Santos runs several large farms, growing Coton, Sisal, etc.

We managed to collect some data (pooling cross section and time series data) disaggregated in 10 provinces over 5 years, for the early 80's. Their features are extensively described in AF. Nevertheless, two series are worth a comment. First, the series representing the availability of manufactured consumption goods has been constructed from disaggregated series of deliveries of 22 items in the provinces, from the State-Agency Agricom which controls most of the wholesale trade in the country, and a large part of the retail trade. The deflator used to compute real producer prices and real cash balances was obtained from

the ratio of the current price value to the constant price value of this series. Therefore, as it is influenced by the composition of the consumption good bundle made available in each province, this deflator is not identical in all the provinces for all the dates.

What made possible the construction of the cash balances series per provinces is that the Mozambican government switched from the Mozambican escudo to the metical in 1980, for political and military reasons. Therefore, new banknotes where issued in the provinces at that date, and their quantity has been registered by the Bank of Mozambique. Therefore, we have a snapshot of the stock of cash in each provinces at the beginning of the period under study. We extended these series using the national data for the subsequent years, assuming that the share of each province remained roughly constant in the subsequent five years.

Hence, we had a data set of up to 50 observations, which had to be reduced for estimating the supply functions, because some crops do not grow in some provinces.

To bring these data to bear on the issue adressed here, we assume that the relationship between the output of the mechanized farms and the amount of seasonal labour can be roughly approximated by a fixed coefficient technology, allowing probably for some impact of rainfall. Then, we try to

explain econometrically the quantities produced by the "mechanized" agricultural sector as if they were in fact constrained by the labour supply. This squares quite well with the diagnostic of "repressed inflation in a semi-monetarized economy", which we offered elsewhere to explain the economic collapse which took place in Mozambique in the early 80's (Azam, 1988). It accords as well with the complaints of pervasive labour shortages which could be heard in Maputo in Spring 1987, and which are referred to above.

In other words, the econometric tests performed below involve two assumptions :

i) the supply of labour seeking a wage payment in the mechanized sector is governed by the supply function derived above ;

ii) the output of these farms is closely enough related to the quantity of labour hired, to enable one to infer some information on labour supply from the analysis of the output data.

Notice that the general inadequacy of the data which leads us to this two-step assumption and testing procedure reduces the possibilities of rejecting the labour-supply assumption, as a failure to pass the test may be due to the falsification of the fixed coefficient assumption.

Moreover, the tests performed are made even weaker because we have an omitted variable : we could not get data on the wage rate. As shown above, the theory to be tested does not impose strong restrictions on the coefficient of this variable, as it has theoretically an ambiguous impact. Nevertheless, its omission may contaminate in an unknown direction the estimated coefficients of the included variables, to the extent that they are correlated with the wage rate.

Nevertheless, we get results which suggests that output of the mechanized sector is possibly constrained by labour supply, and that the latter is far from beeing perfectly elastic with respect to the wage rate.

The preferred equations are :

a) Rice :

$$\log Q_R = \underset{}{-\ 48.25} + \underset{(2.17)}{2.26}\ \log C^R + \underset{(1.54)}{7.86}\ \log P_{MA} - \underset{(1.16)}{7.39}\ \log P_{RI}$$

$$+\ \underset{(1.83)}{19.68}\ RF - \underset{(1.88)}{3.57}\ (RF)^2$$

$R^2 = 0.26$; $N = 30$; $F = 1.78$

Q_R is the output of rice of the mechanized sector, in different provinces. P_{MA} is the price of maize and P_{RI} is

the price of rice ; RF is rainfall, constructed as a number between 1 and 5. N is the number of observations. The fit is rather poor, in terms of R^2, but one gets the predicted signs, with rather high t-ratios. Real cash balances are missing.

b) Coton

$$\log Q_c = \underset{(33.66)}{0.61 \log C^R} - \underset{(3.00)}{0.98 \log RCB} - \underset{(7.36)}{2.99 SUD}$$

$$- \underset{(2.09)}{1.05 SOF} - \underset{(4.26)}{2.02 INT}$$

$R^2 = 0.76$; $N = 36$; $F = 24.32$

Q_c is the output of coton in the mechanized sector and RCB is real cash balances. SUD, SOF and INT are dummy variables to capture some regional effects, for the 3 provinces of the south (SUD), which belong to a dry tropical area, and the 3 provinces of the interior (INT), which are higher in altitude, and hence have more rainfall. The dummy variable SOF captures the "fixed effect" of the Sofala province, which includes the second city and port in Mozambique, Beira, and has been under the control and the protection of the Zimbabwean army for the whole period of analysis.

The fit is much better than that of the previous equation, and the ration of manufactured consumer goods as well as real cash balances are significant, in agreement with our theory. However, the real price of the crop is missing.

c) Maize

$$\log Q_{MA} = \underset{(34.09)}{1.13 \log POP} - \underset{(3.48)}{1.36 \log RCB} - \underset{(4.41)}{3.49 SOF}$$

$$R^2 = 0.48 \; ; \; N = 44 \; ; \; F = 19.03$$

Q_{MA} is the output of maize, and POP is population. The fit is not impressive, but real cash balances have the predicted sign with a significant t - ratio. Nevertheless, consumer goods availability and the real price of the crop did not turn out to be significant.

5) Conclusions

The evidence provided by the econometric equations above are not fully satisfactory, so that no firm conclusion may be drawn. Nevertheless, we have found that either the availability of consumption goods, or the real cash balances, or both have been significant in the equations, with the sign predicted by our model. This can be explained with the present

theory, while it does not square well with the assumption of unlimited supplies of labour.

Therefore, despite its obvious limitations, the present model is suggestive of the potential relevance of the hypothesis tested for the Mozambican case. But, some other relevant variables are probably missing : beside the real wage rate, which belongs to our model, one would like to have indicators of the state of "ideological mobilization", or of the security situation. Notice however that we have used data for the years 1981-85, after the main effort in the struggle against Ian Smith's Rhodesia, and before the security situation became intolerable under the influence of the Renamo and the "armed bandits".

If one accepts this hypothesis as a fair description of the Mozambican situation, as well as the similar analysis done for the peasant sector in AF and Azam (1988), one can draw some important policy conclusions.

First of all, the real producer price is not in this case as central a policy tool as it is in other countries, where the shortage of consumer goods is less acute. Second, the main instrument to bring back the peasants in the market economy, and to induce workers to resume the seasonal migrations which are necessary for the recovery of the mechanized sector is the appropriate procurement of consumer

goods in rural areas. Note however that this necessary condition is far from being sufficient to turn State-farms into efficient units. There is plenty of evidence that these enormous agricultural firms (now dismantled) were the cause of tremendous wastage of resources.

Moreover, to the extent that seasonnal labourers are young peasants who seek not only money to buy goods, but as well for accumulating some capital in order to buy a farm (and a wife) later on, one could try to attract them by paying their wage with bonds promising to pay a high rate of interest, as suggested by the late Shiv Nath, at the conference where the preliminary version of this paper was presented. The difficulty with such a scheme is to evaluate the rate of time preference of the seasonal labourers, as well as the impact that the security situation might have on it.

Thirdly, if this analysis is correct, one must take into account that huge cash balances are in fact being held in the countryside, and must be soacked up before the sale of consumer goods to the farmers provides them with a lasting incentive to produce more cash crops.

To some extent, the policies which have been applied since 1985 for the first one, and since 1987 for the second one, are going in the right direction. The former has been pursued by the Mozambican government with the help of the

French Caisse Centrale de Coopération Economique (CCCE) under the acronym of PSRE. Its main point was to finance the imports of consumer goods and to assure that these goods could be sold in the rural area. Some attempts have been made to revitalize the private trading network. The latter follows from the agreement reached with the IMF and involves repeated devaluations and all round price increases. In terms of our model, this may help to soak up the cash hang up.

Probably, these two types of actions have to be combined in a move towards economic recovery, in order to bring back peasants in the monetary economy. But many other policy measures are needed, to reconstruct an active trading network, with a tolerable security situation, to reactivate the local production of consumer goods, etc.

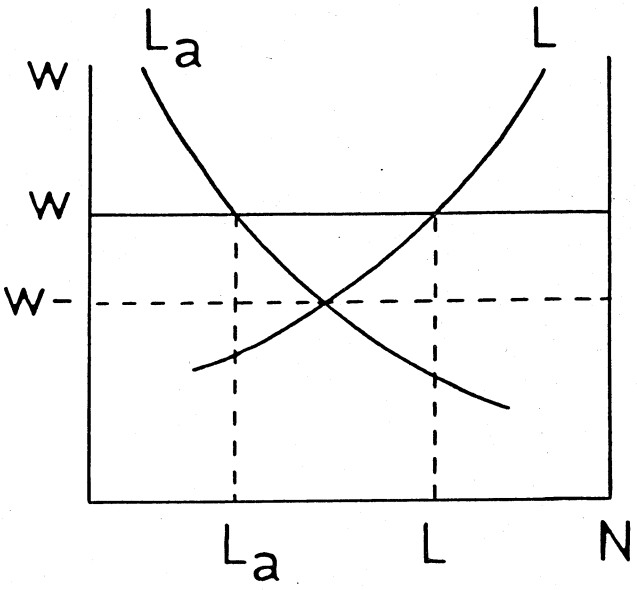

Figure I

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