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A SUPPLY AND DEMAND ANALYSIS OF REGULAR BLACK LABOUR IN NATAL

by E.A. LATT and W.L. NIEUWOUDT*

ABSTRACT

The aim of this study was to obtain reliable, consistent estimates of the supply and demand functions for regular Black agricultural labour in Natal. The joint determination of the wage rate and the number of workers necessitated the use of a simultaneous estimating procedure. The Two Stage Least Squares method was used. The results appeared consistent with a priori estimates. A demand elasticity close to unity was found while the supply curve appeared very elastic. Competition was shown to exist between the agricultural and non-agricultural sectors in the labour market. Since the demand curve was not inelastic, and the supply curve was very elastic, it is debatable whether unskilled agricultural labourers would be able to increase their long-run real wages through trade union action. Sociopolitical considerations, although important, were not considered. Trends in the wage rate and employment were studied. It was also shown that the agricultural control measures do not assist the labourers through increased wages.

INTRODUCTION

Agriculture is a major employer of South African labour. The 1980 Statistical Report indicates that 15% of the total labour force is directly involved in agricultural production. In the light of current interest in labour matters, it is surprising to find that only a few reliable attempts at determining the parameters of supply and demand have been made.

In confining this study to regular labour (i.e. those employed for most of the year), problems resulting from varying lengths of service are avoided. The low skills requirement of most agricultural tasks means that, apart from the length of service, there is little difference between casual and regular labourers. The results of this study may therefore be considered generally applicable.

Based on the diversity of production conditions found in Natal, it was decided to divide the province into 10 separate regions (as shown in Appendix 1). A time period long enough to allow inter-region comparisons was originally intended, but owing to data constraints the 1972-1978 period was all that could be considered.

BACKGROUND AND THEORY

Black workers comprise 97% of the total agricultural work force in Natal. Of these 60,6% were classed as regular labour, 34,5% as casual labour and 4,9% as domestic servants (Agricultural Census, 1978).

Demand

The demand for a factor of production, such as labour or capital, may be considered as being derived from the demand for the final product. It is therefore a function of the price of the final product, the price of the input in question, the prices of all other inputs and the level of technology.

When a variable resource is not the only factor of production, it is no longer possible to consider that resource's demand curve as its Value of Marginal Product (VMP) curve. This is because a change in the price of one resource will alter the resources' relative price ratios, which will change the optimum input mix. The actual demand curve is more elastic than that given by the VMP curve (Friedman, 1962).

Friedman (1962) considers that demand analysis is further complicated owing to simultaneous reactions of all firms to price or other resource changes. This will result in a change in total output and hence also in price. Individual VMP curves will change in such a way as to make the industry demand curve less elastic than the sum of the individual demand curves. This study is an attempt to determine the industry demand curve.

Tarr (1975) and Hendrie and Kooy (1976) both attempt to assess the labour inputs required by different types of agricultural production. Sugar-cane production, which is important in Natal, had the highest requirements, followed by poultry and vegetable production and then maize, cereals and cattle production. Regional production variations would therefore affect labour requirements.

Supply

An individual will only offer his labour services if the satisfaction (material and non-material) gained from work is greater than from any alternative

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source. Berg (1961) considers it impossible to extend conclusions drawn in the individual labour market to the aggregate market, unless the classical assumption that the labour force is some constant proportion of the total population is made. This assumption may be misleading in countries with large non-market sectors, since aggregate man-hours are determined not only by the number of workers in the market, but also by the amount of time spent in the market. Both variables are subject to much variation. Thus while the hypothesis of a backward-bending supply of labour may apply in an individual sense, it need not apply in the aggregate labour market.

Most of Natal's agricultural labour is drawn from KwaZulu or Transkei. The rural sectors of these two regions may be considered predominantly subsistence orientated. In terms of the Lewis (1954) dual economy model, Natal may be considered to be in the second stage of development. So even though a positive supply curve is expected, it should be reasonably elastic.

Ardington (1976), in considering the sugar farms' labour supply, suggests that many farmers are of the opinion that labour indicates a backward-bending supply. Periods after pay-days appear particularly prone to high absenteeism. Farmers are faced by the unusual situation of periodic labour shortages even though they are over-staffed.

Ardington also refers to the strong ties between farmers which "prevent" any single farmer from raising his wages, even if faced by labour shortages. Wage-controls do not extend to payments-in-kind and these offer a means of wage differentiation.

Labourers generally do not enter into fixed contract employment. This results in a high labour turn-over since there is no obligation on either party. Even with excess labour, it is therefore unlikely that the wage-rate would be forced down. It is better to endure short periods of unemployment, with the prospect of a good wage, than to work for a lower wage. The availability of small plots in the National States may serve to keep the labour supply down, but this must be weighed against the effect of labour legislation which retards rural depopulation and increases the agricultural labour supply.

DATA CONSIDERATIONS

A major source of agricultural data is the annual Agricultural Census Report. Nieuwoudt (1973) and Hendrie (1976) both criticise the reliability, availability and timeliness of these Reports.

Definitional problems are among the more common reasons given for questioning the reliability of data. For example, the three labour catagories considered are so broadly defined that classification is difficult. There is no guarantee that the views of the farmer will correspond to those of the statistician, or that either will correspond to those of the researcher or reader.

For some series, for example the number of employees, there is no consistent alternative source of data with which to test the reliability of the Census Reports. Hendrie (1976), using data produced by the Department of Agricultural Economics and Marketing, has shown that in 1973-74 the cash wages were well estimated, but payments in kind were grossly under-estimated.

Discontinuity and limited coverage are major problems for time series analysis. Further difficulties arose out of the South African political and social system. The division of the country into White and Black regions meant that no reliable estimates of the Black work force could be obtained on a regional basis. This placed a constraint on the choice of the supply model.

ESTIMATING PROCEDURE

A common assumption of supply and demand analysis is that the price and quantity of goods are jointly determined at the intersection of the supply and demand curves. If this assumption is made with regard to the number of workers and the wage rate, then a method of simultaneous equation estimation is required. The use of Ordinary Least Squares (OLS) will result in an inconsistency bias, based on the likely correlation between the stochastic explanatory variable and the stochastic disturbance term. Previous studies based on OLS methods, e.g. Antrobus (1970), have shown signs of inconsistency.

The simultaneous method used in this study is the Two Stage Least Squares (2SLS) method. This procedure is based on the determination of a "proxy" term for the correlated stochastic explanatory variable that closely resembles the original variable, but is uncorrelated with the stochastic disturbance term.

A problem associated with the 2SLS method is that the standard errors of the estimates in the second stage are not necessarily the correct estimates of the true standard errors (Gujarati, 1978). In order to correct for this the S.E. values are multiplied by a correction factor based on the reduced form residual values.

In small samples the stochastic nature of the reduced form coefficients may result in a correlation between the stochastic explanatory variable and the residual error term. It was therefore not possible to estimate the supply and demand functions on a regional basis.

STATISTICAL MODELS

The full structural demand function for regular labour in agriculture may be considered as follows:

$$Y^{D}_{1} = c_1 + a_1Y_2 + b_1X_1 + b_2X_2 + b_3X_3 + b_4Z_1 + b_5Z_2 + \ldots + b_{12}Z_9 + u$$

Where :
- Y^{D}_{1} = Number of regular labourers demanded/ha/annum
- Y_2 = Real average remuneration of regular labourers/annum
- X_1 = Real value of farm output/ha/annum
- X_2 = Real expenditure on new equipment/ha/annum
- X_3 = Lagged number of regular labourers/ha/annum
- $Z_1 \ldots Z_9$ = Regional dummies. For example, if $Z_1 = 1$ the data are from Region 1, if $Z_2 = 1$, the data are from Region 2, etc., and if $Z_1 \ldots Z_9 = 0$, the data are from Region 10
- c_1 = constant term
- u = Residual error term

The full structural supply model is as follows:-

$$Y^{S}_{1} = c_2 + a_2Y_2 + b_{13}X_3 + b_{14}X_4 + b_{15}Z_1 + \ldots + b_{23}Z_9 + v$$

Where :
- Y^{S}_{1} = Number of regular labourers supplied/ha/annum
- Y_2 = As above
- X_3 = As above
- X_4 = Alternative wage rate
- $Z_1 \ldots Z_9$ = As above
- c_2 = Constant term
- v = Residual error term

A priori expectations

Based on theoretical considerations it is possible to make a priori estimates of the signs and to a certain extent the magnitudes, of the coefficients in the above models.

The assumption of a negatively sloped demand curve implies that $a_1 < o$ is expected.

The real value of farm output is a proxy for the production function and an increase in this value may be attributed to increased use of inputs, including labour (on the assumption that the technology remains the same). Thus $b_1 > o$ is expected.

Since not all new equipment is labour substituting, no a priori estimates of b_2 can be made.

The assumption that agricultural labour is relatively unskilled and that there is almost perfect substitution between regular and casual labour means that most changes in labour supply and demand can occur in the short run. The long-run adjustment coefficients, b_3 and b_{13}, are therefore expected to be non-significant.

The use of dummy variables is based on the expectation that although the different types of agriculture require different levels of employment per ha, the basic coefficients mentioned above remain the same. No a priori expectations were made as regards the dummy values although it was recognised that their use might result in high R^2 values.

On the supply side the curve was considered positively sloped (i.e. $a_2 > o$). In addition tot this, the unskilled nature of the work, the dual labour market and the legislative measures were all expected to result in a very elastic supply curve.

The alternative wage would be regarded by the labourers as an indication of their alternatives. So as this value increases it is expected that the supply of labour to agriculture would decrease (i.e. $b_{14} < o$).

Justifying the choice of variables

(i) *Employment*

The number of regular labourers was obtained on a regional basis from Agricultural Census Reports. In the 1972-78 period one adjustment was made. The 1975 value for Region 5 was given as 39 661, but 27 000 seemed more realistic. The error appears to be due to an over-estimation of about 12 500 units in the Kranskop district.

The figures given did not differentiate between the sexes, but this was thought to be of little consequence because much of the work undertaken allows a substitution of females for males. No attempt was made to consider different skill categories on the assumption that unskilled labour predominates.

(ii) *Remuneration*

These figures are also based on census data. An attempt was made to include both cash wages and payments in kind. The latter figure included either the value of free housing supplied nor that of the land offered to labourers for cultivation or grazing.

The average annual remuneration was estimated by dividing total expenditure on regular wages by the number of regular employees. As a result of the coverage of a complete spectrum of workers, this figure may not correspond to any wage actually received.

(iii) *The real value of farm output*

This variable, based on census data, was used as an indication of the production function. An increase in the real value of output was thought to be the result of increased product demand and improvements in technology. The fact that agricultural product prices are often determined outside the market mechanism in South Africa, is not expected to effect the results of this paper since these prices are exogenous to the function. The figures are given on a per ha basis in order to remove the effect of the input of land.

(iv) *The real value of expenditure on new equipment*

In the Census Reports this value includes the money spent on new motor vehicles, tractors and machinery, water pumps and agricultural implements. This series was intended as a proxy for real capital expenditure.

(v) *Alternative wage*

These figures are based on a composite of mining, construction, manufacturing and retail wage rates. The weights are calculated on the percentage of total employment in each of the above sectors. No attempt was made to determine these figures on a regional basis since it was felt that migrants tend to move off to regions offering the best alternatives rather than merely to move to the nearest town. Bell (1983) shows that the manufacturing wages in most of the traditional centres increased at about the same rate over the 1968-76 period.

The availability of jobs was considered using the physical output of each sector as an indication. This was done because a reliable source of data for the rate of unemployment could not be found. The attractiveness of any sector to potential employees is dependent not only on the wage rate, but also on the chances of getting a job.

Ardington (1976) considers that the industrial and mining sectors are competing strongly with agriculture for the labour supply. This would indicate that the alternative wage rate was an important determinant of agricultural labour supply.

STATISTICAL RESULTS

In both the supply and demand models a Nerlove-type lagged variable was considered in order to determine the long-run elasticities of supply and demand. As expected the values of these coefficients were non-significant in all models ($t = -1{,}09$ in supply and $t = -0{,}36$ in demand). For this reason these models are not considered here.

Demand results

The results of the demand models are presented in Table 1. The reported t values were determined on the basis of the corrected standard errors.

In general the log models appear to describe the demand function most successfully. In these models the coefficients of both Y_2 and X_1 are

TABLE 1 - 2SLS demand model results (t values in parentheses)

Variable \ Model	I+	II+	III++	IV++
Constant (c_1)	0,0511	0,0169	0,055	-1,027
Agric. wage (Y_2)	-0,00015*	-0,00002	-1,386**	-1,048**
	(-2,63)	(-0,45)	(-5,78)	(-3,45)
Real value of	0,00024**	-0,00008	1,012**	0,710**
farm output (X_1)	(5,22)	(-1,26)	(12,11)	(3,95)
Real expenditure		0,0031**		0,275*
on new equip. (X_2)	–	(6,07)	–	(1,97)
Z_1	0,0488**	0,0761**	0,207	0,201
	(3,34)	(6,93)	(1,06)	(1,14)
Z_2	0,0678**	0,745**	0,494*	0,460*
	(6,10)	(10,09)	(2,89)	(2,97)
Z_3	0,0210*	0,0126*	0,593**	0,431**
	(2,32)	(2,08)	(5,37)	(3,37)
Z_4	0,0135	-0,0034	0,087	-0,105
	(1,45)	(-0,50)	(0,80)	(-0,75)
Z_5	0,0253*	0,0337**	0,092	0,063
	(2,37)	(4,71)	(0,56)	(0,43)
Z_6	0,1105**	0,1381**	0,638**	0,639**
	(7,91)	(13,16)	(3,33)	(3,86)
Z_7	0,0525**	0,0557**	0,530**	0,470**
	(5,15)	(8,38)	(3,45)	(3,33)
Z_8	0,0272*	0,0265**	0,726**	0,717**
	(2,99)	(4,48)	(6,56)	(7,14)
Z_9	-0,0084	-0,0085	-0,033	-0,197
	(-0,89)	(-1,39)	(-0,30)	(-1,55)
R^2	92,1	96,7	96,8	97,3
F	63,1**	142,9**	161,6**	180,9**
d.f.	11;48	12;47	11;48	12;48

* = Significance at 5 % level
\+ = Data in linear form
** = Significance at 1 % level
++ = Data in log form

significant at the 1% level. It would appear that in Model IV the value of new equipment, although only significant at the 10% level, has captured some of the variation accounted for by Y_2 and X_1 in Model III.

The demand elasticity for Model I was -1,44 (significant at the 5% level), which was similar to that of Model III (-1,36).

Because the data were collected on a cross-sectional and time-series basis, the distribution of the error terms was complicated, making tests based on a normal distribution suspect. The use of residual plots showed no abnormalities.

Multi-collinearity was expected in Models II and IV owing to the high correlation between X_1 X_2.

Supply results

The results of the supply models are presented in Table 2. With the exception of Model II, the supply function appears to be well described. The numbers of the models refer to the same reduced form equations as the demand models. So Model I and III are just identified, but II and IV are over-identified by one variable.

The results obtained are consistent with a priori expectations of very elastic supply curves. The supply elasticity based on the linear coefficient from Model I is 5,80, which is in the same range as those of Models III and IV.

POLICY IMPLICATIONS

The aim of this section is to consider some of the more topical implications of the results produced here.

Labour unions

In order to be effective a labour union must have economic power. Friedman (1962) considers this power to be greater when the demand for labour is inelastic and the supply is controllable. In the demand models considered above a relatively elastic demand curve is indicated (although close to unity). This may be expected since wages form a fundamental part of total expenditure by farmers and production is relatively labour-intensive. With a relatively elastic demand curve, any wage increases will be met by a more than proportional decrease in total employment. The total returns to labour will therefore decline as wages are forced up. The aim of the union to increase both absolute wages and the total returns to workers is not possible. The non-significance of the lagged variable indicates that changes to the market can be made in the short run

TABLE 2 - 2 SLS supply model results (t values in parentheses)

Variable \ Model	I+	II+	III++	IV++
Constant (c_1)	0,06	0,0392	5,801	2,612
Agric. wage (Y_2)	0,00059**	0,00004	8,302**	5,185**
	(5,08)	(0,36)	(12,25)	(5,67)
Alternative wage (X_4)	-0,00022**	-0,000036	-8,296**	-5,270**
	(-5,22)	(-0,86)	(-12,10)	(-5,65)
Z_1	0,075**	0,1069**	0,838**	1,363**
	(6,61)	(8,30)	(9,71)	(6,90)
Z_2	0,077**	0,1000**	1,245**	1,590**
	(7,61)	(8,31)	(9,70)	(8,29)
Z_3	0,012	0,0225	0,546**	0,735**
	(1,31)	(1,98)	(4,87)	(4,26)
Z_4	-0,008	0,0177	-0,853**	-0,395
	(-0,08)	(1,44)	(-5,92)	(-1,86)
Z_5	0,032**	0,0534**	0,741**	1,088**
	(3,17)	(4,47)	(5,77)	(5,65)
Z_6	0,119**	0,1622**	0,755**	1,452**
	(9,22)	(11,47)	(4,10)	(5,55)
Z_7	0,039**	0,0724**	0,406*	0,972*
	(3,36)	(5,55)	(2,51)	(4,17)
Z_8	0,012	0,0275*	0,484**	0,746**
	(1,25)	(2,38)	(4,07)	(4,13)
Z_9	0,028*	-0,0016	1,389**	0,789**
	(2,58)	(-0,13)	(8,32)	(3,29)
R^2	92,1	87,8	96,8	92,0
F	63,1**	39,67**	161,6**	62,9**
d.f.	11;48	11;48	11;48	11;48

* = Significance at 5 % level
\+ = Data in linear form
** = Significance at 1 % level
++ = Data in log form

(i.e. less than one year) and hence unions cannot expect even short-term improvements.

It is expected that unions will be in a weak position in regard to control over the labour supply. The high elasticity of supply, resulting from the low skill requirements, means that relatively small increases in wages are sufficient to ensure large increases in the labour supply. The lack of viable alternatives may result in displaced workers undermining any gains achieved by the unions.

The high proportion of payments in kind in the total remuneration means that farmers will be able to reduce the effects of increased cash wages by reducing these payments. The unions' effort to increase wages will be seen as benefit reducing and this may result in resentment. Low wages imply low union dues. This shortage of funds may severely reduce the unions' economic power.

Attempts to establish agricultural labour unions in the sugar industry seem to support the above conclusions. The unions are found in large companies as extensions of the mill workers' unions. Many of the overhead costs may be shared by the two groups, which could reduce some of the problems of low dues. These unions do not find it feasible to extend their operations to the smaller farmers since much of their power lies in their industrial roots. This power base is not effective in dealing with the smaller farmers.

Trends in earnings and employment

Ardington (1976) observes that the wage rate in agriculture is directly related to that offered in alternative sectors (he considers the mining sector). This he attributes to the direct competition for labour between these sectors. In terms of the models presented above it is interesting to note that the values of the coefficients of the agricultural wage and the alternative wage were almost the same, but of opposite sign. In order to maintain employment at the current level, these wages must therefore increase at the same rate. The models appear to be consistent with real observations.

Increasing wages must be met by increasing labour productivity if the farmer is to continue to maximise profits. The positive relationship between the real value of farm output/ha and employment/ha may be interpreted in this way. In Model III the value is about one, which would seem to indicate that increased output is a result of increased scale of production rather than the use of new techniques. Models II and IV attribute the increased production to the use of labour complementing equipment.

Agricultural controls

Gisser (1967, 1969) considers the effects of income increasing agricultural controls of farm wages. A major determining factor is the reciprocal of the supply elasticity of labour. The high supply elasticity estimated above results in a low reciprocal value, which means the increased farmers' income will not be passed on as increased wages. Controls therefore cannot be supported on the grounds that they assist farm labourers. Most of the increase in income is accrued as an increased rent to land.

CONCLUSIONS

The fundamental aim of this study was to obtain theoretically sound, consistent estimates of the supply and demand functions for regular Black labour in Natal. In view of the data limitations, the 2SLS models appear to achieve this remarkably well.

The log demand models produced elasticities of -1,027 and -1,386 (both significant at the 1% level). The same models run using OLS methods produced results which were somewhat lower (-0,891 and -0,607), but which still appeared to be consistent. These latter figures compare favourably with results obtained by Nieuwoudt (1970).

The real value of farm output had an elasticity of 1,012 or 0,71 in the two 2SLS log models. This would appear to indicate that increases in this value result from the use of more inputs rather than improved technology (especially labour substituting technology).

The positive values of the coefficient of real expenditure on new equipment would seem to indicate that this equipment is labour complementing.

The log 2SLS supply models produced consistent estimates which indicated very elastic supply curves (8,302 and 5,185). A linear 2SLS model produced an elasticity of 5,8, which is similar to those already mentioned. The OLS supply models were inconsistent.

The coefficients of alternative wage and farm wage indicated that these values move in unison. This was attributed to the competition for labour between the agricultural and non-agricultural sectors.

Using the results produced it was shown that although the idea of an agricultural trade union may be popular, it would be economically weak and hence could not be expected to increase the long-run real wage rate. Similarly, control measures in agriculture may not be supported on the grounds that they improve labourers' welfare.

It is thought that as a result of their theoretical consistency, the results presented will offer useful assistance in related studies.

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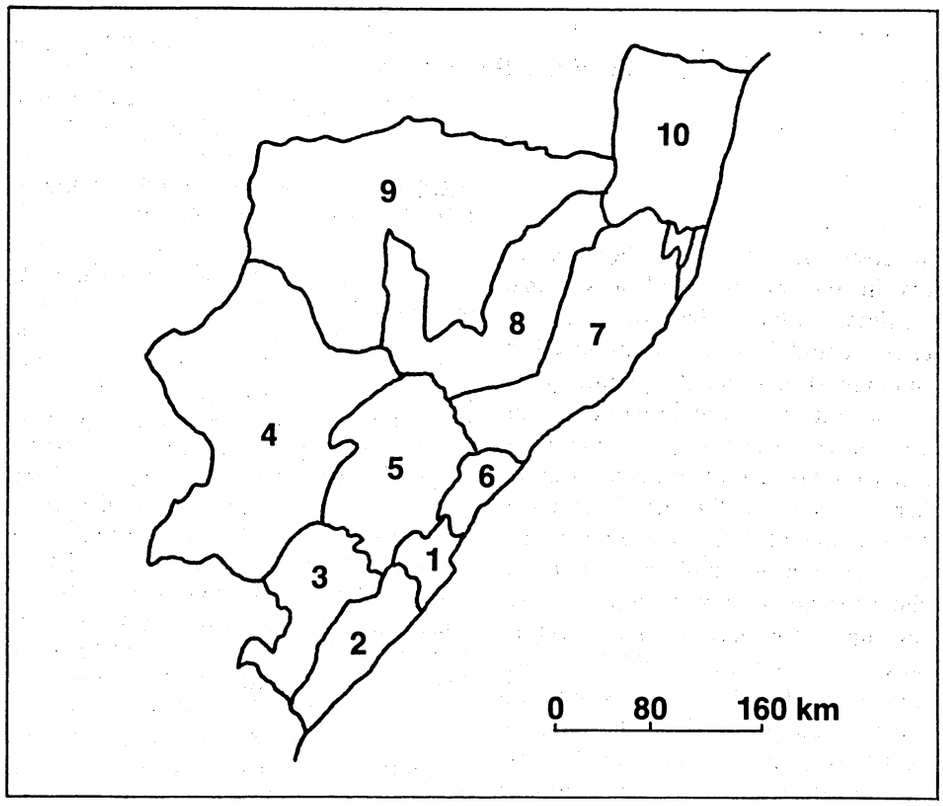
APPENDIX 1

MAGISTERIAL DISTRICTS IN EACH REGION AND REGIONAL MAP



In this study the White, Coloured and Indian farms in the following magisterial Districts were considered:

Region 1	:	Durban, Inanda, Pinetown
Region 2	:	Port Shepstone, Umzinto
Region 3	:	Alfred, Ixopo, Richmond
Region 4	:	Bergville, Estcourt, Impendle, Klip River, Lions River, Mooi River, Polela, Underberg, Weenen
Region 5	:	Camperdown, Kranskop, New Hanover, Pietermaritzburg, Umvoti
Region 6	:	Lower Tugela
Region 7	:	Eshowe, Hlabisa, Lower Umfolozi, Mtunzini
Region 8	:	Mtonjaneni and surrounding areas
Region 9	:	Babanango, Dannhauser, Dundee, Glencoe, Newcastle, Ngotshe, Paulpietersburg, Utrecht, Vryheid
Region 10	:	Ubombo and surrounding areas