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Emigration to South Africa's Mines

By ROBERT E. B. LUCAS*

Temporary labor migration from five countries to South Africa's mines is examined. Emigration (a) *diminishes domestic crop production in the short run;* (b) *enhances crop productivity and cattle accumulation through invested remittances in the long run;* (c) *increases domestic plantation wages. Conflicting interests thus exist between employers in the sending countries and in the mines. State intervention adopted in the sending countries includes forced labor, emigration quotas, and compulsory population relocation.*

For more than a century the circular migration of younger men to the South African mines has profoundly affected the economies, political relations, and social structures of the countries of southern Africa. Indeed, the changes wrought by the continuing temporary emigration have led many observers to question the net benefits to the major labor supplying regions: Botswana, Lesotho, Malawi, Mozambique, and the South African "homelands."[1] The magnitude of miner recruitment and hence potential effects on the labor supplying economies are certainly comparatively large. At about the time of the 1970 censuses, the stock of men employed in the South African mines relative to the *de jure* male population ages 18 to 35 exceeded 80 percent for Lesotho, was close to 50 percent for Botswana, and about 15 percent even for Mozambique where the proportion was lowest.

This paper presents a simultaneous, econometric model of both the determinants of international migration to the South African mines and of some of the economic consequences for each of the labor supplying countries.[2] Not only are the short-run effects of labor withdrawal on traditional crop cultivation and the domestic wage labor markets considered, but also the long-term effects of savings from mine earnings invested in crops and cattle in the home countries.[3]

A stylized model is outlined in Section I. However, variations in institutional arrangements, market conditions, and data avail-

[1] Some of these doubts are beyond the scope of the present study: the substantial external costs imposed by miners returning with tuberculosis or venereal diseases; the proliferation of single-parent households; the risks inherent in continued dependence upon South Africa; or the political costs to frontline nations in implicitly supporting the apartheid regime. However, some of the doubts also hinge on the more limited range of economic issues considered here. See, for example, Fion de Vletter (1981), Walter Elkan (1980), Elizabeth Gordon (1981), J. Halpern (1965), Donald Kowett (1978), Colin Murray (1981), Isaac Schapera (1947), Charles Stahl and Roger Bohning (1981), and Francis Wilson (1976).

[2] Although numerous internal migration functions have been estimated in various contexts, surprisingly little econometric evidence exists on the determinants of international migration for any region. Derek Byerlee (1972), Michael Greenwood (1975), T. Paul Schultz (1982), and Michael Todaro (1976) survey portions of the estimated internal migration equation literature. George Psacharopoulos (1976) and I (1976) present estimates of international migration parameters.

[3] Such long-run effects of out-migration have generally been neglected in the migration literature. See, however, Paul Collier and Deepak Lal (1980), myself and Oded Stark (1985), Henry Rempel and Richard Lobdell (1978), and Stark (1978, 1980).

ability require precise specification of the stylized model to differ from country to country, and these differences are discussed in Section II. Indeed, some of the policies adopted with respect to mine labor and associated markets have been so dramatic as to render the political economy of this market especially intriguing—the cutoff of all mine recruiting from Malawi in 1974, the use of forced labor in Mozambique under the Portuguese, or the forced exodus of South Africans to designated homelands.

The model is estimated over annual time-series data covering 1946 through 1978, the results being presented in Section III.[4] Some implications of these findings and closing remarks are contained in Section IV.

I. A Stylized Approach

The stylized model comprises four main blocks. The first deals with the determinants of migration to the South African mines from each country. In broad terms, the supply of miners is conceived to depend upon employment and earning opportunities at home, either in wage labor or family farming, relative to wages available at the mines. However, the actual flow of migrants may not be supply determined but rather dictated by policy-imposed limits in certain periods. The second block then models own-account crop production as affected both in the short run by labor withdrawal for mine and wage employment, and in the long run by investments saved or remitted by migrants. Third, investments in cattle herds, a major form of wealth in southern Africa, are modeled as a function of savings out of earnings. Lastly, the process of wage formation and extent of wage employment in the domestic labor markets are considered.

In a labor surplus economy, the blocks of this model would not be simultaneous: out-migration would affect neither agricultural production nor domestic wages and employment. But the stylized model allows for the possible absence of surplus labor and hence for simultaneity. Thus, out-migration might raise the domestic wage, diminish crop production in the short run but enhance it in the long run, and through each of these in turn affect the relative attraction of mine migration.

A. Mine Migration

In my article (1985a), I showed that, from 1974 onwards, the South African mining houses, acting in concert through their centralized recruiting agency, exercised a preference for domestic workers, where "domestic" refers to South Africa including the so-called Black States. Thus, after 1974, the market for foreign recruits did not operate on its supply curve. Moreover, as will be described in Section II, some of the sending countries imposed limits on the numbers of recruits during certain intervals. From any country, the number of men employed in the mines, m, is therefore determined through one of two processes: by equality with a quota, M, imposed by the sending country or, after 1974, by the mining houses; by a clearing process in a monopsonistic market with employment equal to supply.

In contrast to the model of John Harris and Michael Todaro (1970), no gamble with respect to likelihood or terms of employment prevails at the mine destination (though life, limb, and pride are certainly at risk). Recruits contract for a definite wage and fixed period of employment, after which they must be repatriated according to South African law.[5] The wage is known before migrating since recruitment occurs at depots scattered throughout the sending countries. Even working conditions are probably well understood by novices, for most are preceded by

relatives. On the other hand, to remain at home does involve a gamble, both in the chances of finding paid employment and of crop failure on one's own land. Reversing Harris-Todaro, but retaining their risk-neutrality assumption, the supply of miners from a given country may then be expressed as

$$(1) \qquad m = M \qquad \text{if a quota prevails,}$$

$$m(v_m - E\{y\}, n) \quad \text{otherwise,}$$

where $E\{y\}$ is the expected real income if one remains at home, v_m is the real mine wage, and n is male population within potential recruitment age.

Although some of the mine earnings are spent while in South Africa, a substantial fraction (approximately 60 percent on average) is remitted or sent as deferred pay for spending in the home country. The real mine wage is therefore measured by

$$(2) \qquad v_m = w_m / (.6 p_h f + .4 p_m),$$

where p_h and p_m are cost-of-living indices in the home country and in South Africa, respectively, w_m is the nominal mine wage and f a foreign exchange rate index between the South African Rand and local currency (where applicable).

Expected home income is derived from two main sources: from potential domestic wage employment and from returns to own-account agriculture.[6] The latter may be expressed as some proportion π of the value of the average product of labor in family farming, pq/l, where p is price of traditional

crops, q is output, and l is labor involved in peasant agriculture. In addition, the expected wage if one seeks paid employment at home may be written $w_h e/(n - m)$ where w_h is the domestic nominal wage rate, and e is the extent of domestic male employment. Thus, the expected real income for those who remain in the country (expressed in local currency) is

$$(3) \quad E\{y\} = (w_h/p_h)(e/(n - m))$$
$$+ \frac{p}{p_h} \pi \frac{q}{l} \phi \left[1 - \frac{e}{n - m} \right],$$

where l is a proportion ϕ of the nonemployed labor force, $n - m - e$. A linear specification of (1) may then be written for nonquota periods as

$$(4) \quad m = \mu_0 + \mu_1 \left[v_m - \frac{w_h}{p_h \eta} \frac{e}{n - m} \right]$$
$$+ \mu_2 \frac{p}{p_h} \frac{q}{n - m} + \mu_3 n$$

in which $\mu_2 = -\mu_1 \pi / \eta$ and η is the base-year exchange rate. It might be expected that $\mu_1 \geq 0$, but a backward-bending supply response cannot be ruled out, a priori, particularly if miners are target savers (see Merle Lipton, 1980). Equation (4) gives the basic form of the migration function to be estimated here, but some modifications for particular circumstances of individual countries are necessary in Section II. In addition a semilogarithmic form is estimated, with $ln(m)$ as dependent variable, but also replacing $\mu_3 n$ with $\mu_3 ln(n)$ so that if $\mu_3 = 1$ this form of (4) could be rewritten with proportion of population migrating as dependent variable.

B. Own-Account Crop Production

Almost no prior estimates of crop production functions exist for this region and in particular for the tribal areas—the so-called Customary Land of Malawi, the "homelands" of South Africa, Tribal Lands of Botswana, and so forth (see, however, my paper, 1985c).

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[6] No time-series data exist on nonagricultural self-employment of men. However, at least in parts of this region, much of the beer brewing and other forms of nonfarm self-employment are undertaken by women, though this may itself be a consequence of the long history of male absence at the mines. The six- and nine-month mine contracts traditional in Botswana, Lesotho, and Swaziland are designed to enable men to plough before signing on for the mines. Nonetheless, mine and crop work are conflicting alternatives, if only because arrival date of the rains is quite uncertain in many areas and it is essential to plow immediately once the rainy season commences. Many men sign on only to find ample rains arriving thereafter.

The chief difficulty is that, as in almost all developing countries, no capital stock series exists for this sector. Suppose, however, that some unknown fraction, σ_w, of wage earnings are saved and invested in equipment, working capital or technological improvement in traditional agriculture. Thus capital stock, k, in any period would be

$$(5) \quad k = k_{-1}[1 - d] + \sigma_w \left[\frac{w_h}{p_h} e + v_m m \right],$$

where subscript -1 indicates a one-period lag and d is a rate of depreciation assumed equal to 0.1. From (5) a capital stock series denoted $kw = k/\sigma_w$ may be computed. However, this is not the only plausible source of savings for investment in crops: crop income itself obviously may also be capitalized in a similar fashion leading to a series denoted kq.[7] Given these capital stock surrogates, kw and kq, a crop output function of the following general form may then be explored in Section III:

$$(6) \quad lnq/N = \gamma_0 + \gamma_1 r + \gamma_2 ln(e + m)/N$$
$$+ \gamma_3 lnkw/N + \gamma_4 lnkq/N,$$

where N is total population, r is annual rainfall, and other variables are as before. Note that (6) has the advantage of emphasizing the short-run role of labor withdrawal through migration to the mines or internally for wage employment, and the long-run possibility of enhanced productivity through accumulation out of migrants' earnings. Clearly, the migration and production functions, (4) and (6), are simultaneously determined.

C. Investments in Cattle

In much of southern Africa, cattle are a major component in the traditional portfolio of assets. Several forms of investment are possible to accelerate the rate of growth in the herd: expenditures on improved veterinary techniques, selective breeding, import of prime beasts, installation of boreholes and fencing, or at least transitionally by postponing slaughter. To explore the contribution of migrants' savings to growth in the herd through such mechanisms, an approach related to (5) is adopted. In particular, let cw and cq be capitalized streams of wage and crop incomes, comparable to kw and kq but with a 20 percent rate of depreciation to allow for the shorter life span of cattle.[8] The desired stock of cattle, c^*, may be written as

$$(7) \qquad c^* = \beta_0^* + \beta_1^* cw + \beta_2^* cq.$$

But ability to adjust quickly to a larger desired herd size is constrained by at least two factors:[9] the prior stock, both through calfing rate and survival (assuming some limitation on numbers imported); and variations in rainfall. Imposing a flexible accelerator modified by an additive rainfall effect, the observed number of cattle may be written

$$(8) \quad c = \beta_0 + \beta_1 cw + \beta_2 cq + \beta_3 r + \beta_4 c_{-1}.$$

D. Domestic Wage Labor

An a priori judgment must be made in each case whether the domestic wage labor market for men clears or even operates on its

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[7] Initial values for the capital stock series are set by means of the formula: $k_0 = i_0/(d + g)$, where i_0 is investment in the initial period, g is the exponential growth rate of the investment series and d is the depreciation rate as before. This formula represents the stock which would have been reached given steady growth at rate g over an infinite horizon with depreciation as in (5). The growth rates are estimated by a simple regression on time over the first 10 years of the sample. In the case of wage earnings, i_0 is set equal to wage earnings in the first period of the sample. For crop income i_0 is measured by the average value of crops in the first 5 years since considerable fluctuations occur in some instances.

[8] Estimates of both the crop output and cattle herd equations with alternative depreciation rates adopted in constructing the various capitalized series (together with appropriately adjusted initial capital stocks) are also explored in Section III.

[9] Indeed, at least in Botswana, limited capacity in organized sector slaughtering has constrained even downward adjustments in herd size at certain peak times.

demand curve. In countries where much of the organized sector employment is in the public domain and parastatals are encouraged to provide jobs, both wage and employment are treated as exogenous. However, in the plantation or estate economies this is not true. Local variations are, however, paramount in formulating any approach to modeling an endogenous wage or level of employment and best considered within the context of specific countries in Section II.

II. The Specific Countries

In view of the diverse institutional arrangements and market conditions in each of the countries to be analyzed, and because of the variegated nature of each nation's data, the precise specifications of the stylized forms must differ from context to context. Unfortunately, it is quite impossible to itemize the extensive set of documents from which consistent time-series data were compiled for the present study, given the confines of space.[10] However, at least certain essential remarks on the data are made in developing the background to particular specifications.

A. Malawi

In April 1974, the government of Dr. Hastings Banda suspended further recruitment of miners. Ostensibly the reason was a plane crash, killing 74 returning Malawian miners. Though the 1974 cutoff was extreme, a precedent in milder form had existed during the colonial period. Prior to independence in 1964, the Nyasaland authorities imposed a quota on the number of men the mines' agents were entitled to recruit each year. The quota was varied from year to year, apparently depending upon the state of the domestic labor market, and was not always binding. By comparing the announced quota with recorded new recruits, years in which the quota actually restricted migration are distinguished. In accordance with (1),

estimation of the mine labor supply equation is then confined to years prior to 1974 in which the quota was not binding.[11]

The distance from Malawi to South Africa is greater than from any of the other major suppliers of miners. Given the greater fixed cost of transporting the Malawi miners, the Employment Bureau of Africa (TEBA, the South African mines' centralized recruiting agency) has used a two-year contract for Malawi in contrast to a six- or nine-month term in Botswana, Lesotho, and Swaziland. The imposition of a two-year contract, combined with a Master and Servants law forbidding deserting that contract, has presumably dampened speed of adjustment to changing conditions for Malawians, and the number of mine workers lagged one year is therefore added to the migration equation (4).

Crop production on the Customary Lands of Malawi includes not only subsistence crops but also tobacco (see Edwin Dean, 1966). Productivity per acre in tobacco growing almost trebled from independence in 1964 to 1977 after far slower growth in the colonial period. In part, this may reflect the expanded use of fertilizers by smallholder farmers, so to the crop production function (6) is added a term for quantity of fertilizer sold to smallholders.[12] In addition, the number of tobacco growers on the Customary Lands has apparently been restricted, though whether this has been to exploit monopoly power in world trade in pipe tobacco or to protect estate producers is unclear. The effect on overall crop productivity of the permitted number of tobacco growers is explored by also adding this number to the crop output equation (6). But the potential restriction on tobacco growing may also affect mine labor migration which is no longer subject to free choice with respect to returns in crop cultivation as in (4). On the other hand, growing

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[10]A detailed appendix is available from the author upon request, listing the data and itemizing the sources and precise definition of all variables in the model.

[11]The years thus excluded are 1951–52, 1954–56, 1958–59, and 1965. In these years the number of recruits actually slightly exceeded the announced quota by approximately 6 percent on average.

[12]A linear form, rather than logarithmic, is adopted since in earlier years fertilizer sales were zero.

of the principal subsistence crop, maize, has not been restricted, so for Malawi the crop value measure actually included in the mine labor supply equation is sales of maize, with tobacco represented by the potentially restricted number of growers.[13]

On the estates, the two major crops are tobacco and tea. The various estates compete amongst themselves for labor, but also compete with own-account agriculture, nonagricultural domestic employment, and the South African mines.[14] To examine the influence of these alternatives on estate work, and in particular to look at the effect of mine migration, structural equations for estate labor demand and supply are estimated. The specifications adopted respectively are

$$(9) \quad ln(e_a) = \delta_0 + \delta_1 ln\left(\frac{w_a}{p_a}\right) + \delta_2 ln(a_{te})$$

$$+ \delta_3 ln(a_{to}) + \delta_4 ln(e_a)_{-1}$$

$$ln(e_a) = \lambda_0 + \lambda_1 ln\left(\frac{w_a}{p_h}\right) + \lambda_2 ln\left(\frac{w_{na}}{p_h}\right)$$

$$+ \lambda_3 ln(m) + \lambda_4 ln\left(\frac{p_c}{p_h}\right)$$

$$+ \lambda_5 ln(n_{to}) + \lambda_6 ln(N),$$

where w_a, e_a are the wage rate and number of employees in estate agriculture; p_a is a price index for tea and tobacco; a_{te} and a_{to} are the areas of estates under tea and tobacco, respectively; w_{na} is the wage rate in nonagricultural work; p_c is the price of maize; n_{to} is the number of tobacco growers, while N, m, and p_h represent population, miners, and home cost of living as before. The areas

under tea and tobacco are included separately in the demand equation to allow for the difference in labor intensities between the two crops. Two of the alternatives to estate work—nonagricultural jobs and own-account maize cultivation—are represented by price terms in the supply equation: mine labor and tobacco growing on Customary Lands are not. Following the 1974 cutoff and during times of binding quotas in the colonial period, the mine wage was not a freely available alternative, and the number of mine workers is therefore included instead. Similarly, the suspected quantitative restrictions on the number of tobacco growers have already been mentioned. Population is included as a factor likely to have enhanced the supply of labor. Plausible hypotheses to be tested in Section III with respect to (9) are thus:

$$(10) \qquad \delta_2, \delta_3, \delta_4, \lambda_1, \lambda_6 > 0$$

$$\delta_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5 < 0.$$

In addition, tests with respect to flexible accelerator terms will also be reported in Section III.

B. *Mozambique*

Since Mozambique gained independence from the Portuguese in 1975, the South African mines have deliberately avoided contracting Mozambican novices, fearing political disruption in the mine compounds by workers from a Marxist state.[15] But disruption of mine recruiting preceded actual independence by several years as the armed conflict between FRELIMO and the Portuguese grew in severity.

In the 1970's, it thus seems migration from Mozambique to the South African mines has

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[13] Data on sales of maize from Customary Lands are adopted as a proxy for value of production in the mine labor equation since output measures for maize are not available.

[14] Labor from Nyasaland also migrated to Northern Rhodesia and Southern Rhodesia prior to independence of the former as Zambia in 1964 and the unilateral declaration of independence in Rhodesia. However, the numbers involved were comparatively small and curtailed after the mid-1960's (Robert Boeder, 1974).

[15] Indeed, immediately following independence, the number of Mozambican miners dropped by half though it is unclear to what extent this reflected mistrust by the South Africans as opposed to initial disorganization in Mozambique and specifically the failure to issue appropriate passports (see W. J. Breytenbach, 1979, and Ruth First, 1983).

been shaped by quite different factors from those outlined in the stylized migration equation (4). A form of this equation is, however, explored for the earlier interval from 1946 through 1970, with four modifications.

(a) According to a 1942 circular issued by the Portuguese authorities, all working-age Africans were required to prove that they had worked for six months in every year (LeRoy Vail and Landeg White, 1980). The required employment could be satisfied voluntarily either through domestic wage work or by contracting with an authorized recruiter for work abroad, of whom the predecessor to TEBA, recruiting for the South African mines, was most important. Forced labor, at least for "vagrants," continued to be the subject of protest and investigation in the International Labour Organization throughout the 1950's (ILO, 1962; James Duffy, 1967). In 1961, a series of decrees altered the system of compulsory employment, and forced labor seems to have been significantly reduced thereafter, though even into the early 1970's reports of some forced labor continue. During the main period of compulsory registration and employment, the need to volunteer for work or face forced labor, under even worse wage and working conditions, is likely to have increased the propensity to migrate to the mines (Jeanne Penvenne, 1979). To test for this, a dummy variable is introduced into the migration equation (4), set equal to one for the period of extensive forced labor and registration up through 1961.

(b) The measures of employment included in defining the expected wage differential between Mozambique and the Rand mines are employment in Mozambican industry, mines and plantations. In addition, the construction sector has been a major source of employment, though no data on the number of workers involved could be located. As a proxy, construction output is therefore inserted into the migration equation.

(c) Annual rainfall is included as a proxy for better and worse growing years in traditional agriculture, lacking data on subsistence crop output.

(d) A typical tour of duty for a Mozambican miner is eighteen months. As in the case of Malawi, this means there is generally a lag in adjustment, and the number of mine workers lagged one year is therefore added to the migration equation.

The 1942 circular meant that "people were forced to work, but not forced to work for anyone in particular," and "[t]he effect of the abolition of the *prazos* [a system of indentured labor formally abolished by the 1930 Labour Code] was to make the search for labour competitive" (Vail and White, pp. 304 and 292). As an approximation, a competitive demand for labor may therefore be envisioned and is estimated in a simple Cobb-Douglas derived demand form with a flexible accelerator term. However, while forced labor remained common, the supply of labor to this market cannot be modeled by a standard supply of labor equation. Nonetheless, the plantations had to compete for their labor with the recruiters from abroad and with nonagricultural employers at home, both of whom offered legal alternative methods of voluntarily satisfying employment requirements, and this competition is likely to have been heightened after 1961 as forced labor diminished. Equations for labor demand and wage determination in the Mozambican plantation sector are therefore estimated as

$$(11) \quad lne_a = \varepsilon_0 + \varepsilon_1 lnw_a/p_a + \varepsilon_2 lna_g$$

$$+ \varepsilon_3 lne_{a(-1)}$$

$$lnw_a/p_a = \omega_0 + \omega_1 m + \omega_2 lnw_{na}/p_h$$

$$+ \omega_3 q_{cn} + \omega_4 fr$$

where p_a is price of plantation crops, a_g is the area of plantation actually used for growing, fr is a dummy set equal to one before 1962 for the period of forced registration, q_{cn} is construction output, and e_a, w_a, p_h, m, and w_{na} are as before. Plausible hypotheses with respect to the equations (11) are

$$(12) \quad \varepsilon_2, \varepsilon_3, \omega_1, \omega_2, \omega_3 > 0 \quad \text{and} \quad \varepsilon_1, \omega_4 < 0.$$

C. South Africa

Since 1960, and predominantly since 1970, some 3.5 million black South Africans deemed not entitled to remain in White Areas have been forcibly relocated in an archipelago of exceedingly poor "homelands" or Black States. It is this group, combined with prior homeland dwellers, who are of concern here. Almost no black workers with Section 10 rights, who are legally entitled to remain in prescribed "White Areas" for more than 72 hours, work in the mines.

As with foreign labor, South African black miners are recruited on contract by TEBA and must return to their homelands between contracts. The main alternatives to mine labor are to help in own-account crop cultivation or to seek wage employment elsewhere in South Africa. With regard to the latter, however, two provisions of South African law warrant a modification in the formulation of (4). Jobs in industry pay considerably better than either mine or farm work, but a substantial fraction of these jobs are held by Section 10 workers to whom preference must be given in hiring. The second provision is that TEBA is banned from recruiting in prescribed "White Farm Areas." But this does not necessarily mean a worker from the homelands may not weigh the possibility of obtaining agricultural wage work rather than contracting as a miner, though preference in agricultural employment goes to those black laborers not yet forcibly removed from the White Farm Areas. The result of these provisions is that industrial and agricultural alternatives probably weigh quite differently in the considerations of potential miners, and in consequence these two expected wage terms and the mine wage are each inserted separately in the mine labor equation, the coefficients thus absorbing the unknown weights. However, since 1978, such deliberations have been largely irrelevant for South Africa's black population. The program of compulsory internment in the homelands has generated a massive pool of unemployment and TEBA has reported excess South African applicants after 1978. Estimation of the mine labor equation for South Africa is therefore confined to 1964 through 1978.

No attempt is made to model wage or employment determination in industry or agriculture in South Africa. Even unskilled blacks' wages in industry are far above those of miners. Real wages in agriculture have risen slightly in the 1970's, at a time when mine employment of South African blacks has risen dramatically, but the connection is probably spurious. The rise in farm wages has almost certainly been occasioned by the forcible removal of squatter families from White Farms on the grounds that they pose a security threat.

D. Botswana and Lesotho

Lastly, Botswana and Lesotho have sufficient in common with regard to specification to warrant joint discussion here. From both Botswana and Lesotho an excess supply of miners has existed since 1974. It is now difficult for a man without a Valid Reengagement Certificate, authenticating satisfactory prior performance, to obtain work and few novices are contracted (see my paper, 1985b). The mine labor equations for Botswana and Lesotho are therefore estimated from 1946 through 1973.

Two variants on the mine labor equations are estimated for both countries: one as in (4), the other replacing crop value by rainfall. In fact, the two countries are each subject to severe, periodic droughts, affecting both crops and livestock, and it seems reasonable to expect an increase in willingness to work in the mines at such times. The rainfall variant is particularly useful in the Lesotho context, however, for data on crop production are available only for occasional years during the colonial period, limiting the sample size and continuity for estimating (4).

In neither country is plantation farming significant, the Freehold Farms in Botswana being essentially cattle breeding and fattening stations employing comparatively little labor. Indeed, in the organized labor market of Botswana, the government plays a major role in setting minimum wages and hiring substantial amounts of labor, either directly or in parastatals paying well above any notion of opportunity cost (Michael Lipton, 1978). In Lesotho, wage employment re-

mains at a minuscule level.[16] No attempt is therefore made to model these labor markets and the domestic wage and employment are taken to be exogenous variables in both cases.[17]

III. Estimation and Results

The estimated equations for mine migration, crop production, cattle accumulation, and estate labor are presented in Tables 1–4, respectively. The *t*-statistics for a zero null hypothesis are given in parentheses beneath each coefficient estimate. The methods of estimation are indicated with each regression.[18] In addition to crop output and mine labor in each context, plus plantation wage and employment in Mozambique and Malawi, the mine wage is also treated as an endogenous variable for the three largest suppliers of mine workers: Malawi, Mozambique, and South Africa.[19] The Appendix Table gives units of measurement, means, and standard deviations of all variables in this paper.

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[16] In earlier years, the South African government discouraged South African companies from opening plants in Lesotho, apparently partially to ensure a continued labor supply for the mines and White Farms.

[17] Annual data on wages and employment in Lesotho could not be located for the earlier years. The expected wage difference through the 1950's thus actually reflects variations in the mine wage around an intercensal trend.

[18] The following acronyms indicate the respective estimation techniques: OL = Ordinary least squares, IV = Instrumental variables, AR = Autoregressive correction by Beach-Mackinnon method; $ARF = AR$ method with Fair's extension of instrumental variables; and COF = Cochrane-Orcutt autoregressive correction for discontinuous samples, with Fair's extension of instrumental variables. For each equation in which a serial correlation correction is made, a common factor restriction test for the first-order autocorrelation specification is also undertaken. For purposes of this test nonlinear least squares is adopted with a likelihood ratio test if no simultaneity correction is involved, or the test suggested in Ronald Gallant and Dale Jorgenson (1979) for nonlinear instrumental variables. Unless otherwise mentioned, the first-order autocorrelation restriction could not be rejected on a 95 percent confidence test.

[19] Instrumental variables are provided by taking principal components of the exogenous variables for all of the labor-supplying countries plus wage rates of white miners in South Africa and prices of the various minerals obtained.

A. Mine Labor Equations

From each one of the major suppliers of labor, the number of miners has responded positively to the expected wage differential between mine and home when not constrained by immigration or emigration quotas.[20] Moreover, if the mine wage and expected home wage are included as separate arguments, then a hypothesis that the respective coefficients are equal and opposite in sign cannot be rejected on a 95 percent confidence test in any of the equations in Table 1, except in the case of Mozambique. Clearly, southern Africa has not been a labor reserve for the mining houses, in the sense of infinite elasticity of labor supply, and recognition of this has been the chief cause of centralized recruiting to exploit monopsony power as explored in my article (1985a).

In each country, more successful harvests or more ample rainfall have significantly reduced the incidence of mine work. Even from Botswana, Lesotho, and the South African homelands, in each of which crop-growing conditions are extremely difficult, better crops are seen within this simultaneous framework to have detracted from migration to the mines. And in Malawi, both enhanced subsistence crops and increases in the number of licensed tobacco growers have tended to diminish mine labor migration.

As population growth has swelled the various labor forces, mine employment has been promoted significantly from each country except Mozambique and South Africa, some of the employment needs of a growing labor force thus being met through emigration.[21] Indeed the reported coefficients on the logarithm of population exceed one, and with at least 95 percent confidence for Botswana and Lesotho, implying that a restricted specification with proportion of population as dependent variable would not have been appropriate.

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[20] The only exception is for Lesotho in the semilogarithmic specification.

[21] In the equations for both Mozambique and South Africa, the coefficient on population proves insignificantly different from zero and this term is excluded from the results reported in Table 1.

TABLE 1 — MINERS IN SOUTH AFRICA

	Botswana				Lesotho			
	Miners	Miners	ln(m)	ln(m)	Miners	Miners	ln(m)	ln(m)
Intercept	−10151 (1.14)	−19402 (2.68)	.897 (0.61)	−.588 (0.53)	−55927 (6.26)	−50462 (4.42)	−.581 (1.18)	−.699 (0.67)
Expected Wage Diff.	586 (1.65)	834 (2.42)	.026 (1.85)	.035 (2.67)	975 (1.87)	1010 (1.57)	.0015 (0.18)	.0028 (0.25)
Crop Value	−63.1 (2.23)		−.0022 (1.95)		−67.7 (2.45)		−.0014 (3.07)	
Rainfall		−5.64 (2.72)		−.247E-3 (3.12)		−16.9 (3.58)		−.309E-3 (3.39)
Population	54.7 (5.18)	68.3 (8.27)			127 (23.0)	127 (11.6)		
ln(pop.)			1.42 (6.61)	1.65 (10.15)			1.73 (22.60)	1.76 (10.84)
Est. method	ARF	AR	ARF	AR	IV	AR	IV	AR
No. obs.	26	27	26	27	16	28	16	28
Adj. R^2		.76		.99		.89		.99
SD dep. var.	3570		.514		23123		.350	
SE regr.	1834		.074		3138		.051	
D-W stat.					1.69		1.86	
Rho	.333	.378	.373	.408		.521		.459
T-stat rho	(1.69)	(2.01)	(1.90)	(2.21)		(3.11)		(2.60)

	Malawi		Mozambique		South Africa			
	Miners	ln(m)	Miners	ln(m)	Miners	Miners	ln(m)	ln(m)
Intercept	−61139 (1.75)	−16.8 (1.84)	−12357 (0.44)	1.96 (0.80)	44817 (1.01)	57840 (1.64)	1.56 (1.31)	1.11 (0.93)
Expected Wage Diff.	5350 (3.79)	.041 (1.44)	4480 (2.55)	.036 (2.57)				
Crop Value	−5389 (3.10)	−.069 (1.67)			−2968 (2.78)	−2900 (2.79)	−.013 (2.76)	−.0096 (1.82)
Rainfall			−24.1 (1.53)	−.206E-3 (1.63)				
Population	5.78 (0.73)							
ln(pop.)		2.56 (1.80)						
No. Tobac. Growers	−.167 (1.25)	−.367E-5 (1.16)						
Construct. Output			−15.1 (1.34)	−.129E-3 (1.44)				
Period Forced Reg.			10766 (1.97)	.083 (1.93)				
Mine Wage					4874 (8.62)	4944 (9.11)	.020 (7.57)	.019 (7.23)
Expected Wage Indus.					−3914 (4.75)	−4080 (5.48)	−.017 (4.36)	−.015 (4.05)
Expected Wage Agric.					1842 (0.47)		.0082 (0.45)	
Lagged Dep. Var.	1.07 (8.60)	.579 (2.19)	.787 (3.47)	.808 (3.65)	.922 (11.04)	.912 (11.32)	.885 (9.94)	.920 (10.16)
Est. method	COF	COF	ARF	ARF	ARF	ARF	ARF	ARF
No. obs.	13	13	23	23	29	29	29	29
SD dep. var.	63581	1.20	25267	2.00	56176	55213	1.41	1.36
SE regr.	6423	.146	5685	.045	11622	11428	.053	.052
Rho	−.417	−.328	−.597	−.605	−.496	−.480	−.474	−.459
T-stat rho	(1.66)	(1.25)	(2.55)	(2.61)	(2.86)	(2.79)	(2.68)	(2.58)

From both Malawi and Mozambique, the longer tours of duty combined with the South African Master and Servants Law against desertion are seen to have significantly retarded responsiveness of labor to changing conditions, for the lagged endogenous variable terms are significantly greater than zero.[22] In conducting specification tests for inclusion of a lagged endogenous variable, a zero null hypothesis could not be rejected for Botswana or Lesotho, but is strongly rejected for South Africa and such a term is therefore included in Table 1 for the South African case.[23] Although South African black migrants are required by law to return to their homelands each year between contracts, as if they were foreign, it seems some continuity in contracts does occur.[24]

South African black labor has been attracted to the mines by rising mine wages and deterred from accepting such contracts when the likelihood of obtaining the far higher industrial wage has increased. However, a negative coefficient is not found on the expected wage in agriculture within South Africa: a hypothesis that changes in agricultural employment conditions have left mine recruiting in South Africa unaffected cannot be rejected, partly because of the ban on TEBA recruiting in White Farm Areas to protect the white farmers.

Even from Mozambique, miners have been able to respond to the differential in earnings. Moreover, as construction output has expanded, presumably employing additional labor, Mozambican workers have been drawn away from mine work, though not always voluntarily. Indeed, the ending of widespread forced labor in the Portuguese colony is seen to have significantly reduced the mine labor available to the Rand. Prior to that, even the harsh conditions in the mines could seem appealing relative to forced labor in Mozambique.

B. *Crop Production and Cattle Accumulation*

In looking at the impact of out-migration on rural areas, there has been much discussion of the consequences of labor withdrawal in reducing subsistence output. The estimated crop production responses in Table 2 reject a simple labor surplus theory; the negative coefficients estimated on the employment variables indicate that increased wage employment (at home or in the mines) from any given level of population has reduced traditional crop output, *ceteris paribus*.

But other things are not equal. The withdrawal of labor for wage employment is also seen in three out of four cases to have significantly raised productivity in crops through additions to the capitalized wage bill.[25] Moreover, in Table 3, the sizes of the cattle herds in Botswana and Malawi are also shown to have been significantly enhanced as wage earnings have accumulated, though the effect is statistically weaker for South Africa.[26] These findings corroborate the results of a growing number of case studies, which illustrate the importance of wage earners in the household to both peasant crop and animal husbandry (Carol

[22] In the case of Malawi, the estimated coefficient on the lagged endogenous variable slightly exceeds one in the linear specification, though not significantly so, and if the equation is reestimated with the first difference in mine labor as dependent variable, other coefficients remain unaffected.

[23] It should however be mentioned that for the second equation reported for Botswana, the common factor restriction test is rejected on a 95 percent confidence likelihood ratio test, though not at a 2.5 percent significance level.

[24] In diamond mining, South African black workers have gained access to more highly skilled jobs previously reserved for white miners and have tended to become more permanent workers with higher pay. In addition, so-called "colored" workers also tend to possess more permanent jobs.

[25] The capitalized wage and crop incomes are highly correlated for Malawi. Table 2 therefore reports variants in which each appears separately. Separate estimates are not reported for size of Malawi's cattle herd in Table 3, despite collinearity, for exclusion of the separate terms leaves the results unaffected. For all countries, the results for both crops and cattle prove quite insensitive to the choice of depreciation rate in computing the capital stocks. Estimates were obtained with stocks evaluated at 5, 10, and 20 percent, and the initial stocks accordingly adjusted.

[26] The marginal significance level on the common factor restriction test for the Botswana cattle equation is, however, particularly low at only 0.6 percent.

TABLE 2—CROP PRODUCTION
(Dependent variable: ln(output/pop.))

	Botswana		Lesotho		Malawi			South Africa
Intercept	−8.53 (1.16)	.487 (0.22)	34.6 (1.20)	5.07 (0.70)	−10.9 (2.89)	−8.89 (4.42)	−13.7 (4.75)	−12.9 (2.13)
ln(accum. wages/pop.)	1.79 (2.18)	1.80 (2.15)	−2.45 (2.90)		.474 (1.18)	.579 (3.20)		2.63 (2.12)
ln(accum. crops/pop.)	.787 (1.28)		−5.31 (1.50)		.366 (0.35)		1.46 (3.18)	1.77 (2.66)
ln(employm. /pop.)	−2.07 (1.30)	−3.43 (2.80)	−1.47 (0.61)	−3.50 (1.92)	−.546 (1.27)	−.691 (1.55)	−.769 (1.90)	−3.62 (2.44)
Rainfall	.0020 (2.90)	.0020 (2.75)	.0018 (1.56)	.0013 (1.73)				.343E-3 (0.75)
Fertilizer					.975E-5 (1.27)	.105E-4 (1.60)	.165E-4 (3.07)	
No. Tobacco Growers			.(3.46)	(3.59)	.756E-5 (3.33)	.774E-5	.737E-5	
ln(time)				.902 (2.53)				
Est. method	IV	IV	IV	IV	ARF	ARF	ARF	IV
No. obs.	31	31	19	19	31	31	31	31
SD dep. var.	.693	.693	.593	.593	.724	.735	.724	.385
SE regr.	.505	.516	.437	.442	.162	.162	.167	.233
D-W stat.	2.03	1.81	1.70	1.74				2.11
Rho					.544	.573	.544	
T-stat rho					(3.19)	(3.53)	(3.15)	

TABLE 3—SIZE OF CATTLE HERD
(Dependent variable: Number of cattle)

	Botswana	Malawi	South Africa
Intercept	−15198 (0.07)	4054 (0.26)	436 (0.60)
Accumulated Wages	8.37 (2.73)	.150 (1.65)	.140E-3 (1.26)
Accumulated Crops	8.64 (0.81)	−.004 (0.09)	.005 (0.97)
Rainfall	167 (1.69)		.552 (1.51)
Lagged Dep. Var.	.644 (3.95)	.963 (10.84)	.613 (3.53)
Est. method	AR	AR	OL
No. obs.	30	27	28
Adj. R^2	.88	.99	.45
Durbin's H			−.98
Rho	.574	−.428	
T-stat rho	(3.69)	(2.23)	

Kerven, 1983). More generally, it appears that wage income of migrants can enhance the working or fixed capital available to the traditional, rural sector, raising productivity in the longer run while in the short-run reducing output.

To this, there is an exception in Table 2 for Lesotho.[27] Earlier in this century, Basutoland was a net exporter of grain. Today it is utterly dependent on emigrant labor; crop production has been neglected and massive soil erosion has ensued (James Cobbe, 1982). Whether the soil erosion would have occurred anyway, resulting from extensive deforestation as population has grown, migration notwithstanding, is unclear. Nonetheless, the second equation reported for Lesotho does indicate a rising trend in per capita crop production offset by the large negative effect of labor withdrawal for employment.[28]

[27] The results on accumulated wages and crop income for Lesotho are independent of whether these terms are included separately or even as a combined capital stock figure.

[28] An exponential time trend added to the crop equations for Botswana and South Africa proves insignificantly different from zero and does not change the estimated effects of other variables included in Table 2. In the case of Malawi, accumulated wages, accumulated crop income, and time are too highly correlated to disentangle successfully.

It may also be mentioned that evidence of accumulated crop income enhancing crop production is clearly significant only for South Africa and there is no evidence to suggest that investments in cattle occur out of crop income in any context.[29] It thus seems some degree of out-migration may even be a requirement of long-term development for traditional agriculture.[30]

C. *Estate Labor*

Almost all of the hypotheses listed with respect to estate labor in (10) and (12), for Malawi and Mozambique, respectively, are supported by the results in Table 4.[31] But the most important terms, from the present perspective, relate to mine labor.

In Mozambique, recruiting of labor for the Rand mines is shown to have made plantation labor significantly more expensive, and in turn higher wages resulted in significantly diminished employment. This raises the question of why the Portuguese

colonial authorities would allow such recruiting, imposing increased costs on the European plantation owners, diminishing plantation employment and hence presumably reducing crop production and export. The answers are essentially twofold. (a) A gap existed between the authorities and plantation owners in regard to their concerns in running the colony. "[T]he specifically anti-capitalist and pro-nationalist ethic of the Estado Novo...predisposed the Administrators to attack the foreign-capitalized companies" (Vail and White, p. 299). (b) And in particular, Portugal managed to gain directly from South African mine recruitment through at least three provisions of various agreements negotiated with the South African state: (*i*) the South Africans agreed to ship specified minimum amounts through the port of Lourenco Marques in return for the right to recruit; (*ii*) a recruiting tax was collected by the Portuguese; (*iii*) but by far the most lucrative arrangement for the Portuguese was a secret clause whereby compulsory deferred pay, kept until the miners returned to Mozambique, was retained by Portugal in the form of gold at a premium price.

Table 4 also shows the major role played by forced labor in holding down plantation wages in Mozambique prior to 1962. The subsequent rise in wage was indeed associated with an absolute decline in plantation employment thereafter, with magnitudes such that the estimated coefficients in Table 4 indicate a rise in expected wage in agriculture, *ceteris paribus*. Such a rise would in itself serve to discourage mine migration, but, according to Table 1, the ending of forced labor reduced such migration beyond any effect on expected wage alone.

In Malawi, too, recruiting by TEBA is seen in Table 4 to have significantly diminished the supply of labor to the estates. Before independence, the colonial authorities did impose quotas on recruiting precisely to hold down such wages, though no doubt this was mitigated by the fact that Nyasaland and South Africa were both British, as protectorate and dominion territory, respectively. In the aftermath of independence, a Malawian Government was understandably reluctant to constrain its own

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[29]Current crop income is an argument in computing capitalized crop income, and this might explain why a weak positive association is found between accumulated crop income and crop productivity but not herd size. However, if $ln(kq/N)$ is replaced by $ln(kq/N)_{-1}$ in the crop equations, the results are unaffected.

[30]In addition, fertilizer inputs and permits for tobacco growers have clearly raised smallholder crop production in Malawi and the importance of adequate rains to both crops and cattle in Botswana, to crops in Lesotho, and cattle in South Africa is apparent. It is not clear why the coefficient on rainfall tends to be negative if inserted into the crop or cattle equations for Malawi, but the inclusion of this term has no significant effect on other coefficients.

[31]The solitary exception is for the effect of the number of tobacco growers on estate labor supply in Malawi which is indistinguishable from zero. Two variants of the wage equation for Mozambique are displayed, with and without construction output included, since correlation between construction and the nonagricultural wage term affects the significance of the latter, though clearly the domestic employment alternative in construction or otherwise proves relevant either way. Adopting an *F*-specification test, the flexible accelerator terms appended to the demand equations for both Malawi and Mozambique prove significantly greater than zero in a 95 percent confidence test or better. However, no such term is included in the supply equation for Malawi since it proves indistinguishable from zero in a likelihood ratio test.

TABLE 4—ESTATE LABOR
(Dependent variable: ln(employment in agriculture))

Malawi

Intercept	−.421	Intercept		−2.55
	(0.38)			(0.66)
ln(agric. wage	−.097	ln(agric. wage		.660
/output price)	(1.41)	/cpi)		(1.28)
ln(area tea)	.279	ln(nonag. wage		−.382
	(2.93)	/cpi)		(1.42)
ln(area tobacco)	.239	ln(mine labor)		−.114
	(3.09)			(2.08)
Lagged Dep. Var.	.577	ln(maize price		−.105
	(4.21)	/cpi)		(1.13)
		ln(no. tobacco		.048
		growers)		(0.42)
		ln(population)		1.75
				(3.73)
Est. method	IV			ARF
No. obs.	21			31
SD dep. var.	.225			.766
SE regr.	.052			.108
Durbin's H	.547			
Rho				.754
T-stat rho				(6.13)

Mozambique

	ln(employment in agric.)		ln(real wage product)	
Intercept	−1.32	Intercept	4.21	2.42
	(1.04)		(2.74)	(2.44)
ln(agric. wage	−.386	Mine labor	.611E-5	.105E-4
/output price)	(8.00)		(1.62)	(3.55)
ln(area	1.00	ln(nonag. wage	.099	.314
plantations)	(7.41)	/cpi)	(0.48)	(2.16)
Lagged Dep. Var.	.218	Construction	.404E-3	
	(2.21)	output	(1.47)	
		Period of forced	−.672	−.601
		registration	(5.70)	(5.52)
Est. method	IV		ARF	ARF
No. obs.	21		21	21
SD dep. var.	.123		.864	.883
SE regr.	.046		.117	.121
Durbin's H	.632			
Rho			−.444	−.455
T-stat rho			(2.08)	(2.20)

people from electing to migrate to the mines. But as estates passed increasingly into Malawian hands, this strategy gathered opponents until recruiting was suspended entirely in 1974.[32] The result was almost an 80

percent rise in estate employment by 1978, and a 15 percent drop in the real wage of estate workers in the first two years after the cutoff. But the additional employment on estates amounted to exactly half the decline in numbers previously at the Rand mines and the slight increase in nonagricultural employment accounted for less than 9 percent extra. The Customary Lands had to

[32] Evidence exists indicating that suspension was planned even prior to the plane crash in April 1974. See Robert Christiansen and Jonathan Kydd (1983).

absorb many of the displaced workers. In general, Table 4 shows the estates have had to compete for their labor against prices of crops grown on these Customary Lands as well as with nonagricultural employers. Yet with this massive infusion of labor, AD-MARC (the state marketing board) could increase its intake while employment rose and wages fell on the estates. From the Customary Lands, ADMARC purchases of tobacco, cotton, maize, groundnuts, and coffee were nearly 60 percent higher in 1978 than in 1974 (measured in constant 1974 prices). Tobacco purchases alone more than doubled, in part because the number of licensed growers on Customary Land was permitted to rise sharply. Nonetheless, dis-content resulted and the ban on TEBA re-cruiting was lifted in June 1977, but by then South Africa no longer trusted Malawi as a source and the number of mine workers from Malawi has never recovered (Robert Christiansen and Jonathan Kydd, 1983).

IV. Closing Remarks

Two major themes pervade this paper. The first extends the analysis of labor withdrawal from agriculture to embrace long-run effects. The development literature on surplus labor has focused on the marginal product of labor either *ceteris paribus* or *mutatis mutandis*, after labor input adjustments by residual rural dwellers (Amartya Sen, 1966). What has been neglected is the possibility that earnings of migrants may serve as a source of capital accumulation in the rural areas.

By specifying a simultaneous framework in which declining agricultural output may increase the propensity to migrate, but also labor departure may diminish agricultural output in the short run while enhancing pro-ductivity in the long run, it has been possible to examine these effects separately. Thus, emigration to the South African mines has been shown to have reduced crop production in the subsistence sectors of Botswana, Lesotho, Malawi, and the South African homelands in the short run. But the results also suggest that earnings of migrants have enhanced both crop productivity and cattle accumulation in the longer run, except in

Lesotho. Whether the mechanism of produc-tivity enhancement is one of physical in-vestment, financing of new techniques, or insurance permitting experimentation with riskier methods cannot be discerned. Given incomplete insurance markets and segmented capital markets, each of these mechanisms may be important, and may effectively serve to lower the shadow cost of labor withdrawn from agriculture.

The other major theme addresses domestic wage formation, desire to emigrate and limits imposed on the flow of migrants. In the context of each of the five regions examined, the gap between the wage available in the South African mines and the domestic wage weighted by probability of employment, is estimated positively to affect the desire to be a miner. In Botswana and Lesotho, this is assumed not to have had any feedback effect on domestic wage and employment, because such wage jobs as exist are largely in the public sector. In Malawi, Mozambique, and South Africa, the story is different.

In both Malawi and Mozambique, emigra-tion to South Africa's mines has significantly inflated labor costs to the local estate and plantation operators. Since, unlike most in-ternal migration, international migration may be fairly readily subjected to control, this raises a fascinating conflict in terms of polit-ical reaction. In colonial Nyasaland, the British imposed quotas on the numbers per-mitted to be recruited for the mines, pre-cisely to protect the white estate owners. After independence, the Malawian govern-ment initially took a broader view. However, the resulting surge in recruiting soon placed pressure on the now Malawian estate owners and ultimately recruiting was suspended en-tirely, with some short-term improvement in smallholder production and drop in estate wages. Yet domestic employment remained inadequate to absorb the restricted miners and Malawi tried subsequently, though with limited success, to increase again the recruit-ing activity. In Mozambique, the Portuguese authorities struck an extremely lucrative deal with South Africa as a price for recruiting privileges. The European plantation owners in Mozambique were to some extent com-pensated for this by the fact that the authori-

ties implicitly permitted continued use of forced labor. Within South Africa itself, the government faced both the interests of the white farmers and of the mining houses. Recruiting for the mines is banned in the White Farm Areas, so no direct pressure on agricultural wages has been permitted. But the political dominance of the Afrikaans farmers is on the wane. Some 3.5 million black South Africans have been forcibly re-located in the Black States, many being removed from White Farm Areas. The pool of South African labor potentially available to the mines has thus dramatically swelled. And the mining houses have swung their recruiting toward South African workers rather than rely on foreign labor supply, which has become inherently unstable with the Malawian suspension and independence in Mozambique.

APPENDIX TABLE — SAMPLE MEANS[a]

Local Currency Units (LCU)		Botswana Rands[b]	Lesotho Rands[b]	Malawi Kwacha	Mozambique Escudos	South Africa Rands
m	No. miners	22104 (5506)	65466 (19589)	38237 (43315)	125676 (7667)	239943 (33112)
$v_m - \dfrac{w_h}{p_h}\dfrac{e}{n-m}$	'70 Rnds/mth.	10.26 (1.95)	16.41 (1.90)	12.08 (2.17)	14.27 (1.59)	–
$\dfrac{p}{p_h}\dfrac{q}{n-m}$	'70 LCU/year	36.88 (21.84)	83.37 (40.50)	1.69 (1.49)	–	9.71 (4.75)
q	Index '70 = 1.0	4.769 (2.397)	1.035 (.378)	.873 (.424)	–	.936 (.254)
c	No. cattle	1431700 (514787)	–	399407 (120343)	–	3642 (239)
r	Mm./year	508 (156)	708 (140)	–	1026 (145)	823 (116)
kw	1000 '70 LCU	75239 (44779)	143138 (54254)	311540 (186508)	–	2082590 (1026307)
kq	1000 '70 LCU	28675 (5927)	91055 (7608)	686976 (207760)	–	158454 (22848)
cw	1000 '70 LCU	43370 (26617)	–	179346 (99546)	–	1253217 (662018)
cq	1000 '70 LCU	13446 (4010)	–	383803 (109241)	–	75786 (13227)
N	1000 people	522 (89)	875 (138)	3823 (744)	–	18272 (4198)
e	No. employed	23072 (13659)	2653 (2044)	171203 (55055)	–	–
e_a	No. employed	–	–	63444 (25318)	110656 (15136)	780062 (49459)
w_a/p_a	'70 LCU/mth.	–	–	9.53 (2.28)	203 (84)	–
w_a/p_h	'70 LUC/mth.	–	–	7.42 (1.44)	–	9.07 (1.50)
w_{na}/p_h	'70 LCU/mth.	–	–	25.40 (8.67)	514 (180)	43.67 (8.82)
Fertilizer	Short tons	–	–	9484 (13501)	–	–
p_c/p_h	'70 Kw/sh. ton	–	–	30.20 (8.11)	–	–
n_{to}	No. growers	–	–	71541 (15661)	–	–
a_{to}	Acres	–	–	25221 (8713)	–	–
a_{te}	Acres	–	–	33401 (5147)	–	–

APPENDIX TABLE—(CONTINUED)

Local Currency Units (LCU)		Botswana	Lesotho	Malawi	Mozambique	South Africa
		Rands[b]	Rands[b]	Kwacha	Escudos	Rands
a_g	Hectares	–	–	–	239646 (32767)	–
q_{cn}	Mill. '70 Esc	–	–	–	381 (168)	–
e_{na}	No. employed	–	–	–	–	845621 (350422)
v_m	'70 Rnds/mth.	–	–	–	–	19.33 (8.01)

[a] Sample sizes are consistent with the equation in which each variable appears. Standard deviations are shown in parentheses.

[b] The Pula and Maloti were introduced into Botswana and Lesotho, respectively, after the termination of the sample period.

REFERENCES

Boeder, Robert B., "Malawians Abroad," unpublished doctoral dissertation, Michigan State University-East Lansing, 1974.

Breytenbach, W. J., Migratory Labour Arrangements in Southern Africa, Pretoria: Africa Institute of South Africa, 1979.

Byerlee, Derek, "Research on Migration in Africa," Africa Rural Employment Paper No. 2, Michigan State University-East Lansing, September 1972.

Christiansen, Robert E. and Kydd, Jonathan G., "The Return of Malawian Labour from South Africa and Zimbabwe," Journal of Modern African Studies, October 1983, 21, 311–26.

Cobbe, James, "Labour-related Aspects of Rural Development in Lesotho," Institute of Labour Studies, Discussion Paper No. 6, National University of Lesotho, Maseru, 1982.

Collier, Paul and Lal, Deepak, "Poverty and Growth in Kenya," World Bank Staff Paper, No. 389, May 1980.

Dean, Edwin, The Supply Responses of African Farmers, Amsterdam: North-Holland, 1966.

de Vletter, Fion, "Conditions Affecting Black Migrant Workers in South Africa," in W. Roger Bohning, ed., Black Migration to South Africa, Geneva: ILO, 1981.

Duffy, James, A Question of Slavery, Cambridge: Harvard University Press, 1967.

Elkan, Walter, "Labour Migration from Botswana, Lesotho and Swaziland," Economic Development and Cultural Change, April 1980, 28, 583–96.

First, Ruth, Black Gold: The Mozambican Miner, Proletarian and Peasant, New York: St. Martin's Press, 1983.

Gallant, A. Ronald and Jorgenson, Dale W., "Statistical Inference for a System of Simultaneous, Non-linear, Implicit Equations in the Context of Instrumental Variable Estimation," Journal of Econometrics, October/December 1979, 11, 275–302.

Gordon, Elizabeth, "Easing the Plight of Migrant Workers' Families in Lesotho," in W. R. Bohning, ed., Black Migration to South Africa, Geneva: ILO, 1981.

Greenwood, Michael J., "Research on Internal Migration in the United States," Journal of Economic Literature, June 1975, 13, 397–433.

Halpern, J., South Africa's Hostages, Baltimore: Penguin, 1965.

Harris, John R. and Todaro, Michael P., "Migration, Unemployment and Development," American Economic Review, March 1970, 60, 126–42.

Kerven, Carol, "The Impact of Wage Labor and Migration on Livestock and Crop Production in African Farming Systems," paper presented at the Third Annual Farming Systems Symposium, Kansas State University, October-November 1983.

Kowett, Donald K., Land, Labour Migration

and Politics in Southern Africa, Uppsala: Scandinavian Institute of African Studies, 1978.

Lipton, Merle, "Men of Two Worlds," Optima, November 1980, 29, 72–201.

Lipton, Michael, Employment and Labour Use in Botswana, Gaborene: Ministry of Finance and Development Planning, 1978.

Lucas, Robert E. B., "The Supply-of-Immigrants Function and Taxation of Immigrants' Incomes," in Jagdish N. Bhagwati, ed., The Brain Drain and Taxation, Amsterdam: North-Holland, 1976.

_____, (1985a) "Mines and Migrants in South Africa," American Economic Review, December 1985, 75, 1094–108.

_____, (1985b) "Migration Amongst the Batswana," Economic Journal, June 1985, 95, 358–82.

_____, (1985c) "The Distribution and Efficiency of Crop Production in Tribal Areas of Botswana," World Bank Staff Working Papers, No. 715, 1985.

_____ and Stark, Oded, "Motivations to Remit: Evidence from Botswana," Journal of Political Economy, October 1985, 93, 901–18.

Murray, Colin, Families Divided: The Impact of Migrant Labour in Lesotho, London: Cambridge University Press, 1981.

Penvenne, Jeanne, "Forced Labor and the Origin of an African Working Class: Lourenco Marques, 1870–1962," Working Papers in African Studies No. 13, African Studies Center, Boston University, 1979.

Psacharopoulos, George, "Estimating Some Key Parameters in the Brain Drain Taxation Model," in J. N. Bhagwati, ed., The Brain Drain and Taxation, Amsterdam: North-Holland, 1976.

Rempel, Henry and Lobdell, Richard A., "The Role of Rural-to-Urban Remittances in Rural Development," Journal of Development Studies, April 1978, 14, 324–41.

Schapera, Isaac, Migrant Labour and Tribal Life, London: Oxford University Press, 1947.

Schultz, T. Paul, "Notes on the Estimation of Migration Decision Functions," in Richard H. Sabot, ed., Migration and the Labor Market in Developing Countries, Boulder: Westview Press, 1982.

Sen, Amartya K., "Peasants and Dualism with or without Surplus Labor," Journal of Political Economy, October 1966, 74, 425–50.

Stahl, Charles W. and Bohning, W. Roger, "Reducing Dependence on Migration in Southern Africa," in W. R. Bohning, ed., Black Migration to South Africa, Geneva: ILO, 1981.

Stark, Oded, Economic-Demographic Interaction in Agricultural Development, Rome: F. A. O., 1978.

_____, "On the Role of Urban-to-Rural Remittances in Rural Development," Journal of Development Studies, April 1980, 16, 369–74.

Todaro, Michael P., Internal Migration in Developing Countries, Geneva: ILO, 1976.

Vail, Leroy and White, Landeg, Capitalism and Colonialism in Mozambique, Minneapolis: University of Minnesota Press, 1980.

Wilson, Francis, "International Migration in Southern Africa," International Migration Review, Winter 1976, 10, 451–88.

International Labour Organization, Report Concerning the Observance by the Government of Portugal of the Abolition of Forced Labour Convention, Geneva, 1962.