Employment Diversity for Selected African Nations[*]

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This analysis uses data supplied by the United Nations on employment for twenty-four African nations to measure employment diversity for 1980 and 1990. The Theil entropy measure was employed for the purpose of rating and ranking the countries according to their level of employment diversity to provide a glimpse of the degree of equalization among and across the countries. Even though on the aggregate level no perceptible statistically significant differences were observed over time and across countries, some economies were identified as attaining a higher level of employment diversity over the decade 1980-1990.

I. Introduction

The international settings of many emerging nations around the world may be characterized by ethnic differences and institutional conflicts within the nations themselves and/or with neighboring nations. Undoubtedly, such conflicts entail constraints on economic policies for regional development. Examples of such conflicts are plentiful-former Yugoslavia, the Russian Federation, Ireland, Sri Lanka, and some Middle Eastern countries, to name only a few. Africa, constituting many young emerging nations, could not escape its ethnic history, constraining what otherwise could have been successful programs of national and sub-national development policies. In fact, according to World Bank (1997), Africa's economic performance is improving; thirty countries out of fifty-three, accounting for 61 percent of Africa's population, recorded positive per capita income growth in 1995. In the Sub-Saharan countries, the estimated growth in gross domestic product grew by 4.0 percent in 1995, while the 1994 gross domestic product in 1987 prices according to World Bank (1996a) was $275 billion, of which South Africa and Nigeria accounted for $125 billion, approximately 45 percent. Value added in agriculture, industry, and services for all of Africa, again in 1987 prices, were in 1994, respectively, $87 billion, $119 billion, and $202 billion, with a total of $408 billion. Thus, services value added comprises the largest share of the total with approximately 50 percent, followed by industry and agriculture value added, with 29 percent and 21 percent, respectively.

It is conceivable that the African countries are destined for a relatively fast catch-up economically with the rest of the world economies, if not converging to the highest levels. The argument goes that initially poor countries grow faster than richer countries. The common trends of such rapid growth were shown to prevail for many advanced industrial nations as

well as developing nations (Bernard and Jones (1996), Mankiw, Romer and Weil (1992), Barro and Sala-i-Martin (1992)). For developing countries, a large role in the process of catching up is played by multinationals, if and when certain linkages are favorable in the host countries (Rodrigues-Clare (1996)).

Inquires on regional development policies take many forms. Researchers' interest may lie with issues of environmental degradation, foreign debt, monetary integration, regional poverty, ethnic and gender inequality, capital instability (Fosu (1991)), political instability (Fosu (1992)), or economic instability. One aspect of economic instability is lack of diversity of economic activity and by implication, lack of diversity of employment.

According to Siegel, Johnson, and Alwang (1985), there are two related, though not necessarily interchangeable, expressions, diversification and diversity. Diversification is the process of making things more unlike, while diversity refers to the state of unlikeness. In development economics, it may be desirable to change the economic structure of an area from declining sectors to growing sectors. On the other hand, diversity of the industrial structure in an area is preferred for its stabilizing influence on employment, income, and other economic activities (Conroy (1974)). In exports, diversification is important in reducing reliance on commodities and markets. Reliance on exportation of limited products, such as a concentration on petroleum or minerals, can lead to wide swings in earnings due to fluctuations in commodity prices. Economic instability results, a particular concern for small economies. Diversification becomes an important policy consideration for commodity exports and imports because the alternative, concentration, presents high risks of instability (Attaran (1990)). It should be pointed out that economic diversity does not necessarily parallel high income. Diversity merely measures the degree of stabilization of employment of the working population, and measuring stability provides a picture of the degree of equalization taking place over time among and across a selection of countries or regions.

The purpose of this paper is to provide a measurement of economic diversity for a group of African countries, all of which are classified by the United Nations as developing economies. In general, such countries are constrained by limited capital, the inadequacy of which may lead to dependency on foreign ownership and control of a portion of the local economy. This is especially true if the attraction to investment is the relatively abundant supply of cheap unskilled labor.

The data set used in this study, which was obtained from United Nations (1995), contained twenty-four African nations, fourteen of which are among the least developed countries. According to World Bank (1996b), per capita income in 1994 showed a wide range of variation: $90 for Mozambique, $140 for Tanzania, $3040 for South Africa, $3150 for Mauritius, and $6680 for Seychelles. These income figures compare with a per capita income of $4640 for upper-middle-income economies and $23,420 for high-income economies.

For a preliminary portrait, Table 1 is set out to investigate the interrelationship of the direction of trade (imports and exports) of the African nations under consideration among themselves as well as the nations of the European Community, North America, and the rest of the world as reported by the *World Bank* (1996a). The surprising finding is that, with the exception of a few countries, imports and exports among the African nations are extremely small. The exceptions were Malawi, Mozambique, Zambia, and Zimbabwe with proportions

of their imports with other African nations of 0.56, 0.30, 0.40, and 0.38, respectively. It was found, however, that a significant portion of imports of these four countries were with South Africa. The respective levels of imports with South Africa were 0.48, 0.26, 0.40, and 0.38. Therefore, it is reasonable to assume a lack of economic interrelation among these countries. In other words, their economies are independent of each other.

Table 1 Direction of Trade:
Proportion of Total Imports and Exports of Twenty Two African Nations, 1992

Country	Imports				Exports			
	Africa	European Community	North America	Rest of World	Africa	European Community	North America	Rest of World
Angola	0.06	0.77	0.07	0.10	0.00	0.00	0.00	0.00
Benin	0.00	0.59	0.06	0.35	0.00	0.00	0.00	0.00
Botswana	-	-	-	-	-	-	-	-
Burundi	0.08	0.69	0.07	0.16	0.00	0.00	0.00	0.00
Central African Rep	0.01	0.83	0.01	0.15	0.00	0.00	0.00	0.00
Chad	0.00	0.88	0.05	0.07	0.00	0.00	0.00	0.00
Cote d'Ivoire	0.06	0.72	0.06	0.16	0.00	0.00	0.00	0.00
Egypt	0.01	0.42	0.28	0.29	0.09	0.59	0.00	0.32
Gambia, The	0.01	0.53	0.04	0.42	0.00	0.00	0.00	0.00
Ghana	0.01	0.59	0.12	0.28	0.17	0.30	0.03	0.50
Kenya	0.05	0.47	0.10	0.38	0.17	0.31	0.04	0.48
Malawi	0.56	0.28	0.03	0.13	0.00	0.00	0.00	0.00
Mauritius	0.14	0.41	0.02	0.43	0.05	0.75	0.13	0.07
Mozambique	0.30	0.29	0.18	0.23	0.00	0.00	0.00	0.00
Niger	0.01	0.80	0.06	0.13	0.00	0.00	0.00	0.00
Seychelles	0.02	0.52	0.19	0.27	0.20	0.73	0.00	0.07
Sierra Leone	0.01	0.61	0.18	0.20	0.00	0.00	0.00	0.00
South Africa	0.02	0.52	0.19	0.27	0.08	0.22	0.07	0.63
Sudan	0.03	0.46	0.08	0.43	0.00	0.00	0.00	0.00
Swaziland	-	-	-	-	-	-	-	-
Togo	0.14	0.48	0.04	0.34	0.00	0.00	0.00	0.00
Tanzania	0.05	0.41	0.04	0.50	0.00	0.00	0.00	0.00
Zambia	0.45	0.27	0.08	0.20	0.00	0.00	0.00	0.00
Zimbabwe	0.38	0.30	0.11	0.21	0.33	0.34	0.07	0.26

Source: World Bank (1996a), imports data are from Table 5-41 and exports data are from Table 5-44. Data were available for only 22 out of 24 countries in this study. The missing data were for Botswana and Swaziland.

II. Measurement of Economic Diversity

Economic fluctuation in a country frequently arise because of national or international instability. Countries which face income-elastic demands for their industrial sectors are subject

to the effects of ups and downs more than are other countries (Kurre and Woodruff III (1995)). Because a country's cycle is an aggregate of the cycles of the individual economic sectors, measurements which take into account economic diversity are helpful in portraying the extent of instability (Brewer (1985)).

A popular measure of diversity is the industrial portfolio which treats a region's economy as a collection of assets producing returns (Conroy (1975)). This approach treats the variance as an acceptable measure of risk or fluctuations. The portfolio variance is given by

$$\sigma_y^2 = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j=1, j \neq i}^{n} w_i w_j \sigma_{ij},$$

where w_i, w_j are sectoral employment proportions, σ_{ij} are the covariances between industry i and industry j, and n is the number of sectors. The goal is to reduce the instability of returns (income or employment of the region). As Brewer and Moomaw (1985) explain, this measure would incorporate the inter-sectoral relationships that exist in a country.

Another measure which has received a great deal of attention and is adopted in this study is given by Theil's entropy formula

$$E = - \sum_{i=1}^{n} p_i \log p_i, \ 0 \leq E \leq \log n, \tag{1}$$

where p_i is the proportion of employment of sector i in a given region. $E = 0$ when employment is concentrated in one sector only, and $E = \log n$ when employment is distributed among the n sectors equally.

The entropy concept in information was introduced by Henri Theil (1967). In information theory it is of interest to give value to a certain event out of a large number of possibilities (probabilities p_i). A number $h(p_i) = - \log p_i$ is assigned to probability p_i as the value of the information content. Probability p_i is used as a weight for the information content $h(p_i)$. In its usage in this paper, p_i is the share of employment of sector i. The expected value is given as E of Equation (1). Entropy was widely used to measure diversity by Attaran (1986), Attaran and Zwick (1987a), Attaran and Zwick (1987b), and Attaran and Zwick (1989).

For this study, employment is disaggregated into nine industrial categories following the United Nations (1995) classifications as follows:

1. Agriculture, hunting, forestry, and fishing
2. Mining and quarrying
3. Manufacturing industries
4. Electricity, gas, water
5. Construction
6. Trade, restaurants, and hotels
7. Transport, storage, communications
8. Finance, insurance, real estate, business services
9. Community, social, and personal services.

The results are intended to provide four comparisons to find out whether (1) the African countries tended to become more diversified in employment over the decade 1980-1990, (2) the effect of the level of development in determining diversity, (3) the effect of per capita income level in determining diversity, and (4) whether diversity or specialization is influenced by the geographic location since different endowments of natural resources (a function of geography) provide a variety of economic development options. The four comparisons will be tested statistically in the "Analysis" section.

Table 2 provides summary information of the share of total employment (P) for 1980 and 1990 for nine industrial sectors for the twenty-four African countries, showing also the per country mean proportion $(\overline{P})$, the standard deviation (S), the coefficient of variation $(V = S/\overline{P})$, and the maximum and minimum of the proportions. For 1980, with a total employment of the twenty-four countries of nearly 20 million, electricity employed about 1.1% of the working population, followed by finance, mining, construction, and transport with percentages of 2.1, 4.6, 6.0, and 7.0, respectively. Manufacturing, community services, and agriculture accounted for the largest percentages of 18.8, 23.2, and 27.0. For 1990, the total employment was approximately 25.7 million. Sectoral employment changed very little from 1980. The largest change was for community services, which increased in percentages from 23.2 of the total to 26.3. Mining and manufacturing showed the largest declines, decreasing from 4.6 and 18.8 to 3.1 and 16.8, respectively.

On comparing the coefficient of variation "V" in Table 2, where the coefficient of variation measures in standardized from the disparity of each observation from the mean, one notices that the disparity remained virtually unchanged for agriculture and manufacturing, meaning that most countries retained their positions during the intervening years. The largest decrease occurred for the finance sector, moving from 1.00 to 0.68, indicating that some countries moved closer to the average during 1990 as compared to 1980. The mining and electricity sectors, on the other hand, showed an increase in the coefficient of variation during the period, indicating that some countries pulled away (had a larger proportion of employment) in these sectors more than others.

Table 3 provides the computed results of the diversity index, the Theil's entropy E of Equation (1) for 1980 and 1990, together with their ranks, where 1 is assigned to the country with the highest level of diversity. Column 5 shows the change in the E-values between the two time periods, where positive values indicate a greater employment diversity in the second period as compared to the first. Columns 6 through 8 contain coding for geographic location (subequatorial Africa, other),[1] development level (developing, least developed),[2] and income (low, middle)[3] which will be used in the analysis portion.

1. Esterhuysen, Fair, and Leistner (1995) indicate that the African subcontinent south of the equator, referred to as subequatorial Africa (SEA), includes 22 countries and covers 37% of Africa's land area. The SEA population is about the same as that of the United States and is also 37% of the African continental total. In 1992, the SEA nations accounted for more than 60% of the sub-Saharan GNP and for almost 40% of the continental total. The SEA countries participate in an informal regional economic association, with South Africa as a leader with respect to trade and industrialization.
2. The development level of the countries was obtained from United Nations (1995, p.228). All of the nations in the study are classified as developing countries, but 14 are also listed among the least developed countries.

3. According to the World Bank (1995, p.249), the income groups are defined as: low income, $695 or less; lower-middle-income, $695-$2,785; upper-middle-income, $2,785-$8,625.

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Table 3   Entropy Measure of Economic Diversity, Ranks, Entropy Change, Geographic Location, Income Level, and Development Level of Twenty-four African Nations

Country	Rank diff	E 1980	Rank 1980	E 1990	Rank 1990	E Change	SEA	Inc	Dev
Angola	-1	0.688	21	0.700	20	0.0120	1	2	1
Benin	2	0.750	15	0.714	17	-0.0355	2	1	1
Botswana	0	0.791	7	0.783	7	-0.0072	1	2	2
Burundi	-13	0.529	24	0.759	11	0.2302	1	1	1
Central African Rep	-10	0.683	22	0.738	12	0.0551	1	1	1
Chad	15	0.830	6	0.689	21	-0.1415	2	1	1
Cote d'Ivoire	6	0.721	17	0.659	23	-0.0619	2	1	2
Egypt	-6	0.693	19	0.729	13	0.0362	2	1	2
Gambia, The	-4	0.779	9	0.795	5	0.0161	2	1	1
Ghana	5	0.773	11	0.721	16	-0.0516	2	1	2
Kenya	-2	0.733	16	0.728	14	-0.0049	2	1	2
Malawi	-2	0.692	20	0.714	18	0.0222	1	1	1
Mauritius	1	0.709	18	0.710	19	0.0018	1	2	2
Mozambique	1	0.591	23	0.591	24	0.0004	1	1	1
Niger	-2	0.844	3	0.915	1	0.0716	2	1	1
Seychelles	4	0.850	2	0.792	6	-0.0578	1	2	2
Sierra Leone	-1	0.842	4	0.828	3	-0.0134	2	1	1
South Africa	0	0.785	8	0.777	8	-0.0074	1	2	2
Sudan	17	0.842	5	0.673	22	-0.1684	2	1	1
Swaziland	-8	0.771	12	0.824	4	0.0532	1	2	2
Togo	2	0.764	13	0.726	15	-0.0378	2	1	1
Tanzania	0	0.778	10	0.764	10	-0.0130	1	1	1
Zambia	1	0.871	1	0.861	2	-0.0107	1	1	1
Zimbabwe	-5	0.754	14	0.765	9	0.0105	1	1	2
Mean		0.752		0.748					
Standard Deviation		0.080		0.068					

Notes: E is entropy by Equation (1), SEA is coding for geographic proximity (See Note 1), Inc is coding for income (See Note 2), and Dev is coding for level of development (See Note 3).
Source: United Nations (1995) and calculations by Equation (1).

The larger the magnitude of E, the more diverse is an economy. With an E-value of 0.529, Burundi exhibited the least diversity in economic employment in 1980 while Zambia with a score of $E = 0.871$ occupied the other extreme position, being the most diverse in 1980. In 1990, Mozambique began the sequence with $E = 0.591$ while Niger had the highest score with $E = 0.915$. Eleven countries were more diversified in 1990 than in 1980, while thirteen showed less employment diversity in the later time period. The largest increase was observed in Burundi while the largest decline occurred in Sudan.

The mean and standard deviation for 1980 were E = 0.752 and s = 0.080 and for 1990 the respective values were E = 0.748 and s = 0.068. Thus, in the intervening decade, a very slight decrease in the mean indicates essentially no change in the level of diversity, but a decrease in the standard deviation indicates a lesser dissimilarity between the countries. The Pearson correlation coefficient between the two periods is r = 0.543 which is significant at the 1 percent level using the t-test (Ostle and Malone (1988))

$$t = r(n-2)^{1/2} / (1-r^2)^{1/2}. \tag{2}$$

Also as indicated by the rankings in the two time periods, the relative position of the countries with respect to diversification remained fairly stable for many of the countries. The Spearman rank correlation (Conover (1980))

$$r_s = 1 - [(6T)/n(n^2-1)]$$

where

$$T = \sum_{j=1}^{24} (Rank\ 1990 - Rank\ 1980)^2$$

is r_s = 0.558 and is significant at the 1 percent level tested by Equation (2). Thus, both the Pearson and the Spearman correlations confirmed that countries with high scores and those with low scores maintained their relative positions.

III. Analysis

The statistical analysis of the results is made in two steps, the first of which is a comparison within nations over the two periods of time. The second analysis compares the diversity between nations based on three criteria: geographic proximity (subequatorial, other), development level (developing, least developed), and income classification (low, middle) for each time period.

The statistical methodology for the first type of analysis is the matched (paired) sample test. An important feature according to Ostle and Malone (1988, p.151) is that if the two samples are of equal size and the observations in one sample are related to the other, in which case the two variables are said to be correlated, the appropriate procedure is the matched test. Wonnacott and Wonnacott (1990, p.270) explain that the pairing achieves a match which keeps many of extraneous variables constant. This aspect produces a better leverage in that what remains to be evaluated is the difference between an observation in one period versus a corresponding observation in a later period. Altman and Nammacher (1987) recommend the method of matched tests on similar grounds. The objective here is to test whether statistically significant differences exist between the values of the diversity measure (E) over the period of time under consideration. For ease of presentation, let the numbers "1" and "2" stand

for 1980 and 1990, respectively. Further, let $j = 1,2,\cdots,24$ be the member country. With these in mind, let E_{1j} and E_{2j} be the measurements of entropy.

Define the difference $d_j = E_{2j} - E_{1j}$, where E_{1j} and E_{2j} are the entropy measures of the same countries over the two time periods, 1980 and 1990. If these differences d_j were treated as random samples with means $\mu_d = \mu_2 - \mu_1$ and variance σ_d^2, then to test for equality of diversity in the two periods, a null hypothesis $H_0: \mu_d = 0$ against an alternative $H_a: \mu_d \neq 0$, the proper test statistic is

$$t = n^{1/2}\, \overline{d}/s_d.$$

where $S_d^2 = \sum_{j=1}^{n}(d_j - \overline{d})^2/(n-1)$, and $\overline{d} = \sum_{j=1}^{n} d_j/n$.

The null hypothesis is rejected for a two-sided test if $t \geq t_{(\alpha/2,\, n-1)}$ or $t \leq -t_{(\alpha/2,\, n-1)}$ where α is the significance level of the test, and $n = 24$, the number of countries in the study.

With $\overline{d} = -.0045$ and $s_{\overline{d}} = 0.015$, $t = -0.30$, with p-value = 0.77, the null hypothesis cannot be rejected at the 95% confidence level. The result supports a conclusion that no significant differences in the levels of diversity among the twenty-four countries as measured by E took place between 1980 and 1990. The negative sign of $\overline{d}$ gives an indication that there was a trend toward less diversity in the second period as compared to the first period.

The statistical methodology for the second step considers the set of countries as two independent samples. The assumption of independence reflects the findings reported earlier through help from Table 1 that the economies of the selected African nations are not interrelated. The comparisons are based on three different categorizations-geographic location (subequatorial Africa, other), development level (developing, least developed), and income level (low, middle). Since two time periods are considered, there will be two analyses for each categorization. Let the numbers "1" and "2" stand for the two groups. Let the entropy associated with diversity for country i, $i = 1,2,\cdots, n_j$, $j = 1,2$ be denoted by X_j, where

$$X_j = -p_j \log p_j.$$

From Equation (1),

$$E = -\sum_{j=1}^{n_j} p_j \log p_j = \sum_{j=1}^{n_j} X_j.$$

Therefore,

$$\overline{X}_j = \sum_{j=1}^{n_j} X_j/n_j.$$

To test the hypothesis of equality of mean entropies, the approximate test statistic is

$$Z = (\overline{X}_1 - \overline{X}_2)/(S_1^2/n_1 + S_2^2/n_2)^{1/2}$$

where $\overline{X}_1$ and $\overline{X}_2$ reflect the average Theil's Entropy for two different groups at a given time period, and S_1^2 and S_2^2 are their respective variances. If $z > 0$ the indication is that on average, countries in group 1 are less economically diverse than those in group 2. The requirement for statistical significance for a one sided-test at $\alpha = .05$ is $|z| > 1.65$.

Table 3, column 6 identifies the countries by their geographic location, where a "1" indicates that a nation is located in Subequatorial Africa (SEA) and "2" that it is not. For 1980, the means of 0.7340 and 0.7746 for SEA and non-SEA countries, respectively, indicate greater industrial diversity for the non-SEA economies but the z-value of -1.27 is not high enough for this difference to be statistically significant. In 1990, the respective means are 0.7514 and 0.7443, indicating a greater employment diversity for the SEA group of countries but again the z-value of 0.24 is too small for significance. However, for the same grouping of countries, the mean differences in diversification (Table 2, column 5) of 0.0184 and -0.301 indicate that the SEA group of countries became more diversified while the non-SEA countries experienced a decline in diversity level since the difference in means is significant at $\alpha = 0.12$.

The second grouping is according to income level (Table 3, column 7) as defined by the World Bank. A "1" indicates low income and "2" indicates lower-middle or upper-middle income. Even with the merged category for middle income, the majority of nations still fall in the low-income group, thereby making it more difficult to obtain significant differences in diversification. Neither of the two difference of mean tests yielded significant z-values. However, the mean E-values for both 1980 and 1990 show that the middle-income group of countries does have the highest level of employment diversity with means of 0.7657 and 0.7643 for 1980 and 1990, compared with 0.7483 and 0.7427 for the low-income group.

Column 8 in Table 3 shows the coding for the development level of the economies, where the least developed economies are coded with a "1" and all others as "2". In 1980, the fourteen least developed nations were less diversified than the ten nations with a higher level of development, with group means of 0.749 and 0.758, respectively. The sign of the z-value of -0.30 indicates that the least developed nations are less diversified; however, the difference is not statistically significant. For 1990, the two means were nearly equal - 0.7476 for group 1 and 0.7488 for group 2, again pointing to non-statistically significant differences.

In spite of the results of these tests, coupled also with the results of significance of the correlation coefficients, there were some countries which moved significantly in the opposite direction in their employment diversity. Burundi and the Central African Republic, for instance, showed a major relative increase in diversity, moving from ranks 24 and 22 to ranks 11 and 12, respectively. Chad and Sudan, on the other hand, became much less diversified, dropping from ranks 6 and 5 to 21 and 22, respectively. The five most diversified economies in 1980 were Zambia, Seychelles, Niger, Sierra Leone, and Sudan. The list for

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the five most diversified economies in 1990 still includes Niger, Zambia, and Sierra Leone, but Seychelles and Sudan have been replaced by Swaziland and The Gambia. Such observed changes can be explained by the changes in sectoral employment by examining the data for each country.

Examination of data for individual countries reveals that in 1980 four economies employed the largest portion of their labor force in agriculture while employment of thirteen economies was concentrated in the services sector. By 1990, sixteen of the twenty-four nations had the largest portion of their employment in the services sector. During the intervening period, Burundi, Niger, Seychelles, South Africa, Sudan, and Zimbabwe experienced a shift toward a higher concentration of employment in the services sector while Chad and Mauritius shifted employment from services to manufacturing. Appendix A provides a brief interpretation of the changes in the entropy index for all 24 countries by looking at the major changes in sectoral employment.

IV. Conclusion

The primary purpose of this research was to rate and rank twenty-four African countries according to their level of employment diversity, using Theil's entropy, a very popular approach in such studies. The statistical analysis explored time, geographic proximity, development level, and income, each designed to shed some light on similarities and differences among and between a set of African countries.

The first finding, a response to the inquiry that economies become more diversified over time, indicates that no perceptible change in the measure of diversity occurred among the countries as a group during the intervening decade 1980-1990, although several countries did experience notable individual changes. Evidently, changes in patterns of employment occur slowly for most economies. In response to the inquiry whether geographic location makes a difference, it was found that geography does have an impact on trends toward specialization or diversification. The third and fourth comparisons showed that economic diversity, in the sense of a more equal distribution of employment, is not significantly greater for higher development levels or higher income levels.

An alternative to the use of the employment classification by the nine major industrial sectors is the classification of employment in tradable sector versus non-tradable sector. As the *World Bank* (1996a, p.217) made clear, however, this approach is difficult to follow because of data problems. In agriculture for instance, much of the output is consumed directly rather than marketed. Furthermore, "paralleled market activity, including trade, may not be fully accounted for." The unavailability of data in usable form other than those provided by the United Nations (1995) on which this research was based, precludes the use of different units of measurements.

Finally, the data used (the latest available) reflect a gap of ten years which coincides with outward-oriented, market-based economic policy as well as prudence, avoidance of inflation, emphasis on education and health care pursued by many African nations (Kristof (1997)). The use of yearly time-series data for the entire decade 1980 to 1990 may have enhanced a more complete picture of employment diversity changes. However, even if such data are

available, the aggregate sectoral employment changes very little from year to year. A lapse of time is, therefore, appropriate to detect a major change if any occurred.

Appendix A

In order to interpret the entropy index E as well as its movement (increasing, decreasing) for the period 1980 to 1990, it is necessary to investigate the sectoral data which enters in the makeup of the index. Below is a brief description of the sectoral employment for each country in the study. The description proceeds in alphabetical order of the countries to coincide with the lineup of countries followed in Table 1 and 3.

Angola had low diversity scores both time periods, which can be attributed to the fact that during 1980 and 1990, 0.79 and 0.77 of employment, respectively, was concentrated in three sectors-agriculture, services, and manufacturing.

Benin, with a moderate diversity score in 1980, did not experience much change. The largest employment sector, services, grew from 0.42 to 0.48, while all other sectors had proportions of 0.13 or less during both periods. There was no employment in mining, which contribute to a lower diversity level.

Botswana remained in the same relative position in both periods. Although the service sector was large in both years (0.40 and 0.37, respectively), employment in each of the other sectors was 0.18 or less.

Burundi, in last place in 1980, experienced a notable increase in diversity in the following decade. Examination of the employment data indicates that in the first period 0.91 of all employment was concentrated in 3 sectors-construction (0.45), manufacturing (0.33), and mining (0.13). In the second period, the service sector comprised 0.41, while employment in each of the other sectors was no more than 0.15

The Central African Republic also experienced a major change in diversity from the first period to the second. In the first period, three sectors-agriculture (0.33), trade (0.33), and manufacturing (0.15) - accounted for 0.81 of all employment and there was no employment reported for mining. In the second period employment shifted from agriculture to manufacturing, resulting in two dominating sectors: trade (0.30) and manufacturing (0.28), with each of the remaining sectors at 0.16 or less.

Chad had a major reversal in diversity, dropping 15 points in the rankings. In the first period employment across the sectors was balanced with the two largest sectors, services and agriculture at 0.24 and 0.20, respectively. In the second period, agriculture accounted for only 0.12 of employment while manufacturing had grown from 0.06 to 0.45 and services had dropped to 0.20. The large proportion for manufacturing was a contributing factor in the decline of diversity.

Cote d'Ivoire was not highly diversified during the first period but during the intervening decade diversity declined further to the next to last ranking. The primary difference in the employment proportion of the two periods was a growth in services from 0.37 to 0.45. No employment was reported in either period for mining, utilities, or finance.

Egypt, during the first period, showed 0.43 of its employment in agriculture along with 0.21 for services and 0.15 for manufacturing. Thus, 0.79 of employment was concentrated in three sectors. During the second period these three sectors accounted for only 0.74 of total employment, primarily due to a decline in the agriculture sector.

The Gambia was, in both periods, placed in the top ten most diversified nations. The

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largest employment sector for both years was services with the same proportion of 0.35. In the first period transportation had a share equal to 0.20, while in the second period trade was the next largest sector with 0.17.

Ghana had one of the largest service sectors in Africa during both periods, 0.43 in 1980 and 0.51 in 1990. There were no other "large" sectors either year, accounting for the middle rankings for Ghana.

Kenya's employment diversity was nearly the same for both periods but there were some shifts, notably a growth in services from 0.43 to 0.51 and a decline in agriculture form 0.23 to 0.19.

Malawi's sectoral employment was similar to Kenya's, with agriculture declining from 0.49 to 0.45 and services growing from 0.15 to 0.17. The large share in a single sector and no reported employment in mining account for Malawi's low diversity measure and low rankings.

Mauritius in 1980 had 0.72 of its employment in three sectors, 0.30 in agriculture, 0.19 in manufacturing, and 0.33 in services. In 1990 there were still three large sectors but some employment shifted form agriculture (0.16) and services (0.25) into manufacturing (0.39) for 0.80 of all employment. This high concentration in only three sectors explains the low diversity scores and rankings.

Mozambique was found to have the lowest employment diversity among the African nations in the sample. In both years, 0.58 of employment was concentrated in manufacturing. The next largest sector was transportation with a share of 0.15 in both periods.

Niger was found to be one of the most diversified with respect to employment. Examination of the sectoral proportion indicates that no single sector dominates. The mining sector for the two periods (0.22 and 0.13) in unusually large in comparison with the other nations in the sample. Only South Africa (0.15 and 0.12) and Zambia (0.17 and 0.15) have similar proportions employed in mining. The primary difference in the second period as compared to the first period is a decline in construction from 0.30 to 0.09 and an increase in services from 0.04 to 0.16. During the second period the largest sector (utilities) had only 0.19 of employment.

Seychelles, like Niger, had a very balanced distribution of employment across the nine sectors, resulting in high diversity scores and rankings. The largest sector in the first period was trade with 0.22 of total employment. In the second period, services, with 0.24, was slightly larger than trade with 0.23.

Sierra Leone had a large proportion of employment in the services sector during both periods (0.35 and 0.37). However, the distribution among the other sectors is very well balanced, ranging between 0.11 and 0.03 in 1980 and 0.12 and 0.03 in 1990. The entire distribution of employment appears very stable with only slight shifts from the first period to the second. The employment in Sierra Leone is among the most diverse in the sample of African nations.

South Africa's largest employment sector is manufacturing, with shares of 0.30 and 0.28 in 1980 and 1990, respectively. The service sector shows growth with shares of 0.20 and 0.26 in the two time periods. Employment in the remaining sectors is fairly well balanced and shows little change from the first to the second period. South Africa's small shares in agriculture and utilities probably account for a diversity score lower than seven of its African neighbors.

Sudan's situation is unique in that it is among the most diversified in the first period and among the least diversified in the second period. It appears that Sudan became much more specialized due to a large increase in the service sector, from 0.19 in 1980 to 0.48 in 1990. During the first period, employment distribution across the sectors was much more balanced, with 0.14 for agriculture, 0.22 each for manufacturing and transportation, and 0.19 for services.

Swaziland, during the first period, was in a middle position with respect to diversity. During the subsequent decade shifts in employment resulted in a notable increase in diversity and ranking. The major shift occurred in agriculture (a drop form 0.40 to 0.30) along with an increase in services (from 0.19 to 0.22) and minor changes in five other sectors.

Togo's diversity dropped slightly from the first period to the second. Employment in most sectors experienced minor changes, but an increase in services from 0.38 to 0.48 indicates more concentration in a single sector and consequently lower diversity.

Tanzania occupied the same relative position for both years. The largest sector, services, employed 0.37 of the total in 1980 and 0.40 in 1990. A decline from 0.17 to 0.14 was noted for agriculture while all other sectors remained essentially stable.

Zambia's sectoral employment distribution shows strong stability as well as a very high level of diversity. The largest sector, services, grew from 0.28 in the first period to 0.31 in the second. Employment in each of the other sectors was no more than 0.17 in both periods.

Zimbabwe moved up in the diversity rankings from a middle position to the top ten. Two sectors dominated employment in both time periods. In 1980 agriculture (0.32) and services (0.28) accounted for 0.60 of total employment, while in 1990 only 0.58 was in these two sectors, agriculture (0.24) and services (0.34). Manufacturing remained stable at 0.16 and only minor shifts occurred in other sectors.

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