US ISSN 0022-037X

THE JOURNAL OF DEVELOPING AREAS

VOLUME 30
NUMBER 3
APRIL
1996

Editorial Staff

General Editor
Nicholas C. Pano
Associate Editor
Spencer H. Brown

Publications Editor
Joan A. Pano
Book Review Editor
Ronald E. Nelson

Editorial Board

William L. Burton
Arlin D. Fentem
Robert E. Gabler
Charles J. Helm
Jai Hyon Lee
Michael T. Pledge
Vaman Rao
Richard T. Schaefer
James A. Yunker

Advisory Editorial Board

J. F. Ade Ajayi
University of Ibadan
Gilbert Etienne
Graduate Institute of International Studies
Geneva
V. B. Kamath
University of Bombay
Manwoo Lee
Millersville State College
Peter C. Lloyd
University of Sussex
Monte Palmer
Florida State University
J. Norman Parmer
Trinity University
Xavier de Planhol
University of Paris
Richard D. Robinson
University of Puget Sound
Hans W. Singer
University of Sussex
W. Paul Strassmann
Michigan State University
Erol Tümertekin
University of Istanbul

THE JOURNAL OF DEVELOPING AREAS (ISSN 0022-037X) is published quarterly in October, January, April, and July by Western Illinois University, 1 University Circle, Macomb, Illinois 61455-1390. Periodicals-class postage paid at Macomb, IL, and additional mailing offices. POSTMASTER: Send address changes to THE JOURNAL OF DEVELOPING AREAS, 1 University Circle, Macomb IL 61455-1390.

Articles in the *JDA* are abstracted or indexed in the following: *ABI/INFORM*; *Abstracts in Anthropology*; *Academic Abstracts*; *African Studies Abstracts*; *African Urban and Regional Science Index* (*AURSI*); *AGRICOLA*; *A Matter of Fact*; *America: History and Life*; *Bulletin de Signalétique Sciences Humaines*; *Community Development Abstracts*; *Economic Abstracts*; *Ekistic Index of Periodical Articles on Human Settlements*; *Geographical Abstracts*; *Hispanic American Periodicals Index* (*HAPI*); *Historical Abstracts*; Nexus Information Services' computerized data banks; *Referativnyi Zhurnal*; *Sociological Abstracts*; and *United States Political Science Documents*. The *JDA* contents are listed in: *ABC POL SCI: A Bibliography of Contents: Political Science and Government*; *Current Contents*; *Behavioral, Social, and Management Sciences*, *Economic Contents*; *IBR* (*International Bibliography of Book Reviews*); *IBZ* (*International Bibliography of Periodical Literature*); *PAIS BULLETIN*; and *Periodica Islamica*.

Subscription rates per year as of July 1, 1996 are: U.S. and Canada: Personal—$29.00; Institutional—$39.00; Elsewhere—$39.00. Airmail rates by special arrangement. Subscription requests should be directed to: Business Manager, JDA, 232 Morgan Hall, Western Illinois University, Macomb, IL 61455.

©1996 by Western Illinois University. All rights reserved.

Printed in the United States of America.

The Journal of Developing Areas

VOLUME 30 • NUMBER 3 APRIL 1996

ARTICLES

The Socioeconomic Development Levels of the People of Amazonian Brazil—1970 and 1980
Archibald O. Haller, Ramon S. Torrecilha, Maria Cristina Del Peloso Haller, and Manoel M. Tourinho 293

Foreign Investment and Economic Development in Singapore: A Policy-Oriented Approach
Teck-Wong Soon and William A. Stoever 317

Macroeconomic Performance and External Shocks on Small, Open Economies: The Caribbean Experience
John Gafar 341

Deepening and Widening the Economic Reform in China: From Enterprise Reform to Macroeconomic Stability
Xu Yi-chong 361

BOOK REVIEWS

Between Reform and Revolution: Political Struggles in the Peruvian Andes, 1969–1991
By Linda J. Seligmann
Reviewed by Susan C. Bourque 385

The Journal of Developing Areas 30 (April1996) 293–316

The Socioeconomic Development Levels of the People of Amazonian Brazil—1970 and 1980

ARCHIBALD O. HALLER, RAMON S. TORRECILHA,
MARIA CRISTINA DEL PELOSO HALLER,
and MANOEL M. TOURINHO

This paper presents the measurement of the socioeconomic development (SED) of the populations of the municípios of Brazil's Legal Amazonia for 1970 and 1980, the only years for which appropriate data yet exist, and applies it to the widely held, but previously untested, hypothesis that holds that large-scale investment in the frontier land called "Amazonia," an "extreme extractive periphery,"[1] reduces the SED levels of the people. As a contribution to this effort, it proposes and employs a new definition of the concept of the frontier—a concept now re-entering the sociological literature, but one which may not previously have received proper consideration. Certain logical consequences of the definition appear to have implications for frontier situations everywhere.

At 5.2 million square kilometers (km^2), Brazil's Legal Amazonia covers about three-fifths of Brazil's territory, and about 30 percent of that of all of South America. Its location in Brazil is shown in figure 1. We estimate the region's total population at 15 to 16 million as of 1991.

Archibald O. Haller is Professor Emeritus, Department of Rural Sociology, University of Wisconsin-Madison; Ramon S. Torrecilha is Program Director, Social Science Research Council; Maria Cristina Del Peloso Haller was formerly Associate Professor and Chair of the Department of Plant Pathology, Universidade Federal de Viçosa, Brazil; and Manoel M. Tourinho is Professor, Faculdade de Ciências Agrárias do Pará, Belém, Brazil.

The writers wish to thank Marisa M. T. L. Barbosa, Raymond Guries, Tarcízio R. Quirino, José Bolivar V. da Rocha, José A. Drummond, Tseng Min Chieh, Danielle Fernandes, Rhonda Kranz, Jorge A. Neves, and Diane Venden for their help, and the Brazilian Institute of Geography and Statistics for providing the data; and to acknowledge the support of the University of Wisconsin-Madison, the Social Science Research Council, and EMBRAPA (the Agricultural Research Corporation of Brazil).

© 1996 by Western Illinois University. All rights reserved.

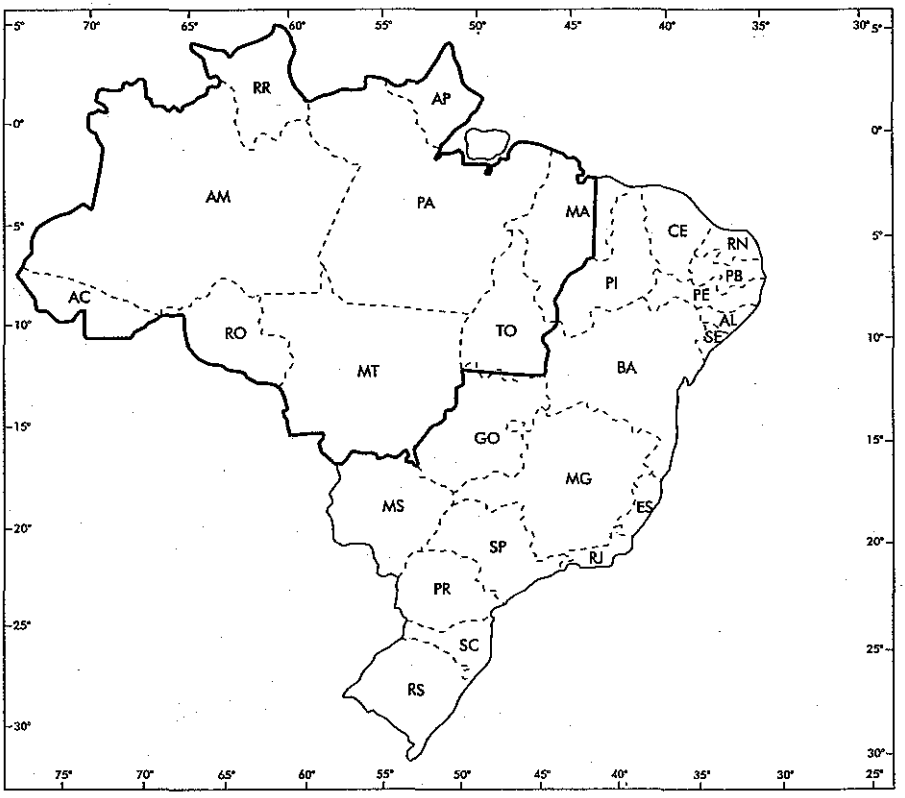

Fig. 1. Brazil's Legal Amazonia

SOURCE: Pedro Edson Leal Bezerra et al., *Projeto Zoneamento das Potencialidades dos Recursos Naturais da Amazônia Legal* (Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística [IBGE], 1990).

NOTES: **States in Legal Amazonia:** AC-Acre; AM-Amazônas; AP-Amapá; MA-Maranhão; MT-Mato Grosso; RO-Rondônia; RR-Roraima; TO-Tocantíns (formerly northern Goiás). **All Other States:** AL-Alagôas; BA-Bahia; CE-Ceará; ES-Espírito Santo; GO-Goiás; MG-Minas Gerais; MS-Mato Grosso do Sul; PA-Pará; PB-Paraiba; PE-Pernambuco; PI-Piauí; PR-Paraná; RJ-Rio de Janeiro; RN-Rio Grande do Norte; RS-Rio Grande do Sul; SC-Santa Catarina; SE-Sergipe; SP-São Paulo.

Theoretical Considerations

The question of development levels of Amazonia is important to sociological thinking and the analysis of development for two related reasons. The one concerns the supposed effects of outside investment; the other, the concept of the frontier and what it implies.

First, extreme extractive frontiers are viewed as places where exploitation from abroad underdevelops resident populations.[2] Amazonia is the world's prime example today. Its export economy is almost exclusively extractive in the sense that its products are collected from the forest (rubber tapping, Brazil-nut gathering, timber cutting), from agriculture, or from mining. Regarding early history,

Stephen G. Bunker's position is that prior to European contact Amazonian populations were large and well-adapted to their environment.[3] Recent archeological data appear to bear this out.[4] Subsequent contact with Europeans and their descendants was devastating to indigenous peoples and their cultures, as a result of both enslavement and disease.[5] Bunker holds further that the process of "underdeveloping" the region and its people has continued at least down to 1980. This belief implies that investment in Amazonian "development" projects is detrimental to the socioeconomic development of the region's population, because the activities of modern bureaucracies of the richer nations, when operating in Third World countries, "are so costly that their imposition in energy-diffuse social formations accelerates underdevelopment."[6] To be more explicit, this is because owing to "the mode of extraction [the area] loses energy and so becomes socially and economically simpler, less diversified, and subject to technologically determined changes in market demand."[7] Up until 1960 or so, large-scale investments in Amazonia yielded little more than "boom-and-bust" cycles, as has long been documented.[8] In recent decades, very large investments of labor and capital have been made in the region in various areas: in agriculture, especially in the states of Mato Grosso and Rondônia; in mining, energy, and transportation, especially in Pará and Maranhão; and in assembling, at Manaus. If appropriate data were available from 1960 to the present, it would be possible to test over a full generation the hypothesis that large-scale economic investment lowers the SED levels of the population. Data for the whole of this span and before do not exist, however. Indeed, there are no publications providing defensible tests of the hypothesis over this or any other period in recent Amazonian history. Furthermore, our stating the hypothesis does not mean we agree with it or the theory upon which it is based, at least as these apply to the Amazonian frontier in the 1970s and beyond. Indeed, there are good reasons to believe that the hypothesis is invalid and possibly that the theory is inapplicable.

Such data do exist, however, for 1970 and 1980. This is a crucial decade for the hypothesis: the Transamazonian Highway was begun in that period, the huge Carajás mining complex was growing, large hydroelectric dams were being built, and farmlands in various Amazonian states were established on a large scale. Indeed, Anna L. O. de Almeida opens her book on the region with this sentence: "Large-scale occupation of the Amazon began during the 1970s."[9] Obviously, the rate of investment in Amazonia was much greater during that decade than ever before. Present data permit the measurement of SED/k for the municípios (small political divisions) of Legal Amazonia as these were defined in 1970—329 in all, 327 in practice (owing to data anomalies for two). So data from 1970 and 1980 can provide the best currently feasible test for the hypothesis.

The second theoretical concern is closely related. In our opinion, Amazonia today is perhaps the world's best empirical instance of a frontier. This topic has been of interest to scholars off and on for a century. Turner's famous paper, "The Significance of the Frontier in American History," was presented on 12 July 1893 in Chicago.[10] Both Bunker[11] and Thomas B. Hall[12] have recently opened the discussion of the theoretic relevance of frontiers for sociology. Moreover, several

works have appeared lately on South American frontiers. But so far as we can determine, the concept has not yet received the theoretic explication it deserves. In our opinion, the term "frontier" implies the existence of a *generic* type of social configuration that would be applicable anywhere at any time in history, with *particular* types of subfrontiers fitting various special cases. Much of the work on South American frontiers concerns Brazil. De Almeida,[13] Marianne Schmink and Charles H. Wood,[14] Joe Foweraker,[15] Dennis J. Mahar,[16] and Maxine L. Margolis,[17] among others, have written about Brazilian frontiers, sometimes even specifying subtypes or processes such as rural and urban frontiers (de Almeida), moving frontiers (Margolis), and frontier change (Schmink and Wood). But as of today, we are not aware of the existence of a convincing definition of the generic concept of the frontier and its subtypes as sociological phenomena. Thus, we offer our own tentative definition, plus a specification of four Amazonian subtypes and two sociological consequences of the definition.

In general, a frontier may be seen as a sparsely populated geographical area with relatively weak and fragmentary institutions, and with social structures and populations that are haphazardly integrated into a larger society of which the area is a part. Into this geographical area large-scale external governmental and/or economic organizations have suddenly begun to invest large amounts of capital, which attracts increased numbers of people who are drawn by high wages or by newly discovered or anticipated sources of as yet unassigned wealth.

The same region may be a frontier at various times: almost every part of Amazonia that has been heavily exploited by outside organizations has passed through one or more phases of being a frontier. The same area may not only be a frontier at two different times, but also with respect to more than one central society, as in the case of the southwest of the United States—once as a Spanish frontier and then as an American frontier.[18]

Types of Amazonian Subfrontiers. There are four types of subfrontiers in the region. One is the *classical moving wave*. This type involves subjection of the wilderness, as the clearing wave moves outward from the already densely populated parts of the country and as towns rise behind it, using previously settled communities as bases for expansion. One example is the expansion from the Cuiabá area into northern Mato Grosso. Expansion southeastward from Bôa Vista in Roraima may be another. The farmlands so opened may well be permanent.

The second phenomenon qualifying as a special class of frontier may be new. We might call it the *drop-in* type of subfrontier. This phenomenon was made possible by recently developed fast long-range modes of transportation such as airplanes, helicopters, and motor launches. Drop-in frontiers are usually small, remote, and isolated. Many gold-mining sites in Amazonia are of this type. Some will die out as the gold or other mineral deposits are exhausted. Others may endure and expand if their resources last long enough to attract highways, agriculture, and services.

The third type we may call *line subfrontiers*. These are long, narrow bands of cleared lands. They are more like the moving wave than the drop-in type because

their economic bases are in farming, fishing, and sometimes services to local residents and passing travelers. In Amazonia, line frontiers are built around roads and rivers. Perhaps the best examples are along the Transamazonian highway.

Fourth are the *subfrontiers of concentrated investment*. The current extreme case of this type of frontier is the Carajás mining region. Farming, too, appears to be spreading in the Grande Carajás region. A port facility for the Carajás complex has been built near São Luis, with a new railroad between the two areas. This type of subfrontier absorbs much capital per unit area. At least for a while, it employs a large proportion of highly qualified personnel (who thus attract expensive services and consumer goods). And it involves large-scale construction and equipment. It may also demand large-scale transportation facilities—roads, railroads, ships, and so on. Unlike the isolated drop-in mining operations, which are much smaller and to which (with minor changes) the forest may return someday, these settlements will probably result in substantial and permanent changes in the biosphere. Some may transform themselves into permanent urban areas.

Naturally, one type of frontier may become the basis for another. For example, roads extending out from frontiers of concentrated investment may give rise to new line frontiers, or such large-scale frontiers may generate their own moving waves. Then, too, rapid expansion may produce urban subfrontiers as well as those that are rural.

Actually, the main frontiers are combinations—for example, the moving wave and the line frontier. Some of the more important concentrations of expansion follow two roads—Brasília to Belém, and Cuiabá to Pôrto Velho, each of which connects Amazonia with the nation's main urban network in the South. But there are also waves pushing from east to west in the northeast of Amazonia, and from south to north and southeast to northwest in southern Amazonia. Others are expanding out from the capital cities such as Belém, Manaus, and São Luis, and from the Carajás area, among others.

Sociological Consequences. Two postulated social effects of frontiers may be of special importance. One concerns income. The other concerns anomic behavior.

Regarding the economic situation of frontier populations, organizations need personnel with locally scarce skills. Such skilled people are ordinarily well situated in more comfortable regions. Thus, in frontier areas organizations provide more than the normal benefits for their services, sometimes very much more. Also, there is a rise in the demand for those locals who can provide essential services and information that outsiders cannot. In addition, such organizations also often need substantial numbers of people who are not especially skilled. Unskilled workers will come to a frontier if there are few job opportunities where they are or if they are offered unusual inducements. Lastly, locally specific labor shortages tend to drive up wages of indigenous, unskilled workers who live near expanding subfrontiers. The upshot is that wages in frontiers are higher than in many more-settled areas. Specifically, in terms of average SED in the 1970s, Amazonia was almost exactly at the same level as the Northeast.[19] But in 1973 Northeastern men and women earned only 53 and 49 percent respectively of the

earnings of men and women of Amazonia. By 1982, these percentages were still low, though they had risen to 72 and 76.[20]

A second consequence of the definition concerns anomie. This has been a well-known sociological phenomenon since Emile Durkheim's *Suicide, a Study in Sociology*, which was first published in 1897.[21] Here, we elaborate our own understanding of the concept, because it bears heavily on the question of Amazonian frontier development.

All social groups develop norms of behavior guiding the overt activities of their members. This means that people come to an habitual understanding of the behaviors that are regularly rewarded, permitted, prohibited, or punished. Such understandings come into being whether by consensus or coercion; whether people accept them or merely acquiesce in them. With the passage of time, the body of a group's norms comes to fit the resources available to it and to specify the degrees and forms by which such resources are distributed. Sets of norms are specific to time and place. Usually they change slowly in response to evolutionary changes in the demographic composition of the group or in the resources available to it. But different groups have different norms, and behaviors that are rewarded in one may be ignored or punished in another. Furthermore, when the distribution of resources available to a group changes dramatically (owing to rapid accumulation or impoverishment, or to rapid changes in the composition of the group, or to the merging of one group with another), some of the norms that previously facilitated more or less orderly interaction no longer work: formerly approved behaviors may go unrewarded or may even elicit punishment, and formerly disapproved behaviors may be ignored or perhaps rewarded. Consistent with the foregoing, norms promoted by powerful outside groups may be imposed upon peoples formerly having few external relations, as when governments or mass media suddenly become involved with remote populations of little previous national or international interest. This is what we mean by "anomic situations." Situations of extreme normative confusion, of great anomie, are considered to be breeding grounds for suicide, murder, robbery, social unrest, and organized violence.

Norms are supported by sanctions. Some are as benign as praise, blame, or ridicule; some are as severe as imprisonment, death, or torture. Systems for articulating legal norms and for meting out severe sanctions are costly and take time to set up. Thus, they tend to be lacking in frontier areas. Frontiers are turbulent for several reasons. Within groups, old norms are often no longer effective. Among groups in contact with each other, the norms themselves may differ. Then, too, some unprincipled frontiersmen are unimpressed by the norms of any of the participating groups and simply take advantage of those they meet. Also, police power is often absent or under the control of some of the contending parties. Above all, contending parties see the fluidity of the frontier as offering the promise of riches they might gain or the threat of losing that which they already have. And, the real losses that many incur are bitterly resented. Thus a high rate of conflict is characteristic of frontiers. It would be a mistake to think of such conflicts as unexpected instances of deviant behavior. The goals, norms, and resources of groups do differ, and such differences often generate conflict—conflict

that in frontier areas is all the more intense as a result of the weakness of the law and its enforcement.

We take it to be typical of frontiers that the in-migrants contribute more than their share of adventurers, of those who are desperate, and of those who seek quick riches. Also, the arrival of large numbers of outsiders upsets relationships among those who were already there. The anomie of frontiers is a consequence of the rapid increase in population, the rise of new communities populated by mutual strangers, rapid change in the social composition of existing communities, rapid turnover of residents, and participants with conflicting interests. In particular, frontier anomie is aggravated by the seeming availability of new sources of wealth regarding which normatively structured and effectively sanctioned property rights have yet to be established.

Conflicting interests and conflictive behavior exist everywhere, of course. In settled communities, serious contentions are under control most of the time, either by more or less legitimate force or by consensual mechanisms of conflict diminution. So in such places, conflict *seems* abnormal, though in reality it is not. Frontiers are different. There, conflict—even open, deadly conflict—is *obviously* normal. Those who would analyze frontier behavior or would make policy for frontiers would do well to give this characteristic serious attention.

Schmink and Wood have discussed the roots of Amazonian conflict in terms of power differentials.[22] We have no debate with this except to note that, by definition, exercises of power tend to be more disorderly in anomic situations than in situations where relevant laws exist, are known, and are enforced under rules supported by widespread acquiescence or consensus.

Today, almost any inhabited part of Amazonia—except perhaps around the old cities of Belém, Manaus, Cuiabá, and São Luis—is a frontier by the present definition. The main cleared areas are, of course, lands opened to farming, ranching, or large-scale mining. For data up to 1984, these lands are illustrated in figure 2, where the cross-hatched areas are those of agricultural expansion. It will be noted that these major areas are located around or near highways. One runs north through Tocantíns ("Goiás" on the map) to Belém, another northwest from Cuiabá to Pôrto Velho, a third north and west along the eastern end of the Transamazonian Highway. Still another runs north along the western side of the Araguaia River, where indeed another road exists (though it is not shown on the map.) But the main area of conflict has been in the south of Pará.

In frontier regions, socioeconomic development and anomic conflict may go hand in hand. Often conflict may be an initial consequence of such development. Thus it is quite possible that a given município whose SED scores rose in the 1970s may also show a rise in such anomie indicators as murder rates, suicide rates, infant mortality, and the like. In other words, in frontier regions, there is no logical inconsistency between rising average levels of SED and rising levels of violence, including high infant mortality rates (which are often used as indications of measures of SED, though inappropriately in frontier areas). On the contrary, we should expect a *positive* correlation between rapid SED and the incidence of anomic behavior. Later on in the evolution of once-frontier settlements, the earlier positive correlation between anomie indicators and SED would be expected

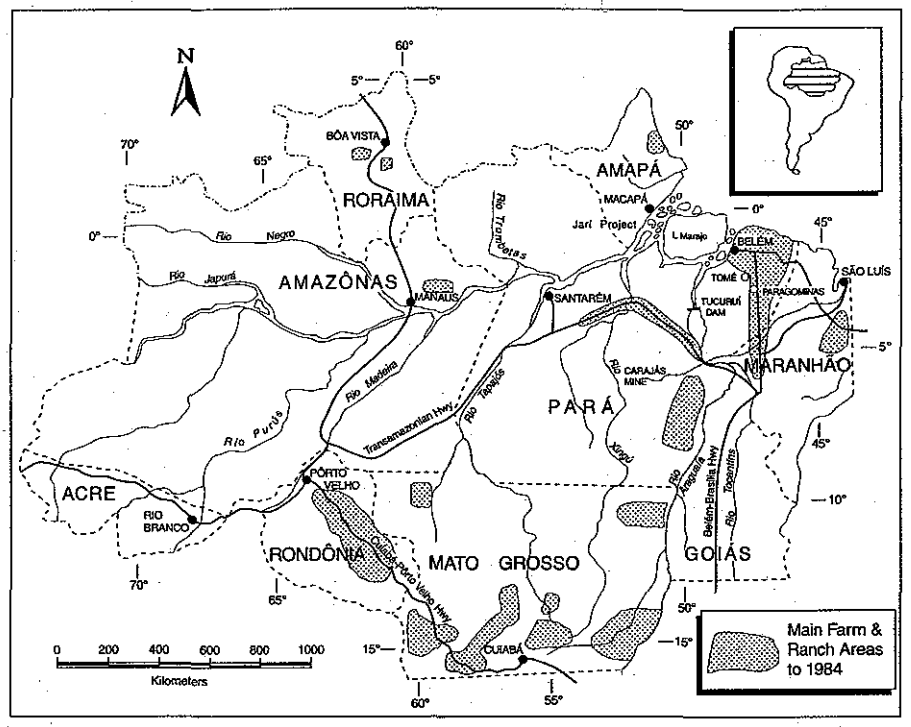

Fig. 2. Brazil's Legal Amazonia: Cleared Areas

SOURCE: Philip M. Fearnside, "Predominant Land Uses in Brazilian Amazonia," from *Alternatives to Deforestation: Steps toward Sustainable Use of the Amazon Rain Forest*, ed. Anthony B. Anderson [New York: Columbia University Press, Copyright (c), 1990], pp. 233–51; map on p. 235 reprinted with minor modifications with the permission of the publisher; Rivaldo P. Gusmão et al., *Diagnóstico Brasil: A Ocupação do Território e O Meio Ambiente* (Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística, 1990).

NOTE: Late in the 1980s, the new state of Tocantins was separated from Goiás, its parent state.

to reverse itself. But that may be many years from today in Amazonia, except in and near a few long settled-cities.

Implications for Measurement. In a few words, the measurement of changes in SED between 1970 and 1980 should permit a test of the hypothesis, implied by Bunker[23] and perhaps others, that large-scale economic investment lowers the SED level of the population. Data by which to test the hypothesis that anomie rises with development are not yet available. But the reasoning spelled out earlier makes it clear that the measurement of SED must not be allowed to be contaminated by the anomic behaviors that are characteristic of frontiers.

Measuring the Socioeconomic Development of Amazonia's Populations in 1970 and 1980

Our index of SED/k_{mu} (socioeconomic development per capita per município) for 1970 and 1980 in Brazil's Legal Amazonia is an application of the logic of selecting component variables, performing factor analyses, and conducting

factor weighting that was applied earlier in a regionalization of Brazil as a whole.[24] At the beginning of that prior analysis, it was not known whether there was a distinction between the social development and economic development of a population. More important yet, there was confusion about which conceptual variables and their empirical representations would be appropriate to measure development levels of a population. A book by Janet D. Henshall and Richard P. Momsen inadvertently highlights this problem and also indicates another.[25] They set out to identify socioeconomic macroregions of Brazil by factor analyzing the correlations among a large number of variables at the level of the 26 states and territories of the Federation. Their analysis demonstrated certain important errors: the first was in selecting variables—37 of them—merely because they were available and they *might* have measured something that could be called SED; the second was in using states and territories as the units of analysis. This information was organized into a data matrix of 37 variables by 26 units of observation. When factor analyzed, the matrix yielded a large set of small factors which, to us, were unintelligible. Second, the units of analysis varied in population from around 20 million to less than 50 thousand, and in size from 1.5 million km^2 to 22 thousand km^2. These units are too heterogeneous for statistical analysis. The Henshall-Momsen format and other regionalizations of Brazil that use the 26 states and territories as units of analysis have disadvantages for those interested in SED. Several states have internal regional development differences that are quite marked, and the same development pattern may cut across the boundaries of two or more contiguous states.

Clearly the solution is (1) to use a selection of variables based on either an explicit theory that dictates the appropriate variables; or, failing this, to draw upon the experience of previous researchers concerned with economic development and socioeconomic levels of living; and (2) to divide the nation into much smaller areal units which are more nearly homogeneous.

Such an explicit theory does not exist. So the second strategy just noted as part of (1) was followed in earlier work[26] and extended to the present one. Briefly, it holds that there are two long-term research lines of relevance. One draws upon variables used to measure the economic development of nations, measured at the per capita level. The list of such variables is short: gross national product, energy consumption, manufacturing, nonagricultural employment, commercial activity, and literacy. The other research line draws upon socioeconomic status differences among households. Its main variables measured household amenities, communication facilities, transportation facilities, and literacy. The earlier indicator of SED of Brazil and the present one of Amazonia are based upon variables drawn from each of these two lines. This was the solution followed in selecting variables.

Regarding the problem of areal units, during the 1970s and 1980s continental Brazil was divided into 360 official microregions, composed of contiguous, homogeneous sets of municípios (or "counties"), averaging around 11 municípios per microregion. Microregions were used in the prior 1970 analysis.[27] For the present analyses, the units are 327 of the 329 municípios of Legal Amazonia

(1970 boundaries). As before, all data were reduced to the per capita level so as to measure the average condition of the population of each small unit. The strategy of intercorrelating and factor analyzing the correlation matrix of variables fitting the two preceding criteria was followed. For the present analyses, variables for 1970 and 1980 that were conceptually similar to and, where possible, operationally identical to those of the earlier analyses were used.[28]

When this was done, it was found, both for Brazil's 360 microregions in 1970 (70) and 327 of the region's 329 municípios in 1970 (70) and in 1980 (80) (two were dropped because of data anomalies), that the correlation matrices were saturated with but one factor: clearly, SED. The variable constructed from the earlier analysis of all Brazil is called SED/k_{mr}, for socioeconomic development per capita per *microregion*. The variable constructed for the present analysis of Amazonia is called SED/k_{mu}, for socioeconomic development per capita per *município*. The final results of the principle components analyses are presented in table 1. The analyses and resulting factor scoring were carried out by standard procedures.[29]

Set A presents the analysis of SED/k_{mr}70. This set provides the crucial information needed to understand how the SED/k_{mu} instrument for Amazonia follows logically from the SED/k_{mr} instrument developed earlier for Brazil. (The discussion of Sets B, C, and D, and their role in formulating the SED/k_{mu} instrument, will follow immediately.)

The first variable in Set A is the number of workers employed in manufacturing per employed person per microregion (manufacturing workers/w). This variable correlates at $r = .999$ with the horsepower of installed manufacturing machinery per capita per microregion. Note that one of these variables is based on people (workers) while the other is based on potential energy availability of machines (per population). Common sense might hold these to be quite different from each other. But because this correlation is practically perfect, the analysis shows that they measure the same underlying variable: industrial development per capita. The second variable is commercial sales per capita. It is a measure of the volume of purchases of goods per capita. The third is the inverse of the number of agricultural workers per capita. All three of these are consistent with the literature on the economic development levels of nations.[30] This is also true of the eighth variable, literacy per capita. Access in the household to a radio, a refrigerator, a television receiver, and an automobile (as well as literacy) are variables consistent with those normally included in measures of household socioeconomic status.[31] It will be noted that together these items express one and only one factor—SED/k_{mr}. That factor is the only one with an eigenvalue greater than one (5.956), the usual cut-off criterion. The factor accounts for 74.5 percent of the total variance. Finally, the factor weights are uniformly high: .691 to .965, averaging .858. This factor analysis provides strong formal *internal* evidence of the validity of the SED/k_{mr} scale that was constructed from the weights of the factor.[32] Standard procedures were used in constructing the scale itself.

Later events provided strong evidence of the *external* validity of the 1970 SED/k_{mr} scale for Brazil. This external evidence is both formal and informal.

TABLE 1

AMAZONIAN SOCIOECONOMIC DEVELOPMENT ANALYSIS: FACTOR WEIGHTS OF COMPARABLE ITEMS—BRAZIL'S MICROREGIONS (MR) IN 1970 AND LEGAL AMAZONIA'S MUNICÍPIOS (MU) IN 1970 AND 1980

(SED/k Factor Loadings x 10^3)

Set A Brazil 1970 (MR)		Set B Legal Amazonia 1970 (MU)		Set C Legal Amazonia 1980 (MU)		Set D Legal Amazonia 1970 and 1980 Together (MU)		
Variable	Loadings	Variable	Loadings	Variable	Loadings	Variable	Loadings	
							1970	1980
1 Manufacturing workers/w[1]	691	Industrial KWH/k	707	–	–	–	–	–
2 Sales/k	831	–	–	–	–	–	–	–
3 Agricultural workers/k (reflected)	744	–	–	–	–	–	–	–
4 Radios/k (access)	895	–	–	–	–	–	–	–
5 Refrigerators/k (access)	965	Refrigerators/k (access)	945	Refrigerators/k (access)	959	Refrigerators/k (access)	923	930
6 Television sets/k (access)	935	Television sets/k (access)	866	Television sets/k (access)	957	Television sets/k (access)	772	926
7 Automobiles/k (access)	947	Automobiles/k (access)	794	Automobiles/k (access)	756	Automobiles/k (access)	823	690
8 Literacy/k	856	Primary Schooling/k[2]	914	Secondary Schooling/k[2]	853	Schooling/k	929	849
9 –	–	Household lighting/k	910	Household lighting/k	953	Household lighting/k	896	904
10 –	–	Residential electricity/k	739	–	–	–	–	–
Eigenvalue:	5.956		4.981		4.092		7.526	
% Total Variance:	74.5		71.2		81.8		75.3	

SOURCES: The table is slightly modified from Archibald O. Haller and Ramon S. Torrecilha, "Measuring the Socioeconomic Development of the People of Amazonia, Brazil 1970 and 1980" (presented at the 1993 meetings of the Midwest Sociological Society, Chicago, IL, April 1992). Data for Set A were published in Archibald O. Haller's "A Socioeconomic Regionalization of Brazil," *Geographical Review* 72 (October 1982): 450–64. Calculations for Sets B–D were performed by Haller and Torrecilha.

NOTES: All four principal components analyzed yielded just one factor with an eigenvalue of E < 1.00. The right-hand panel was calculated from the correlation matrix of 1970 and 1980 (Legal Amazonia) combined.

LEGEND: /w = per employed worker; /k = per capita.

[1] $MW_w \times HP_k$: $r = .999$.

[2] The zero-order correlation between primary schooling in 1970 and secondary schooling in 1980 is $r = .801$.

We shall consider first the formal external validity evidence, correlation with per capita consumption of electricity. Statistics obtained after publication of the socioeconomic regionalization of Brazil that was based on the SED/k_{mr} scale of 1970 permitted a formal check of the *external* validity of the scale. This augments the formal *internal* evidence of validity provided by the factor analysis just reviewed. Data covering the consumption of electricity in Brazil in 1970 were provided by Eletrobras—the national electricity monopoly. The data on total consumption of electricity in each município of any given microregion were summed to provide a total consumption for that microregion. This figure was divided by the total population of the microregion in 1970. This procedure was carried out for all 360 continental microregions.[33] The natural logarithm of the total number of kilowatt hours consumed per capita was calculated for each microregion (for 1970, of course). The Pearsonian correlation of SED/k_{mr} 70 and KWH/k_{mr} 70 was then calculated to be $r = .84$. This value is about what should be expected if the SED/k_{mr} scale is valid. Perfect correlation ($r = 1.00$) would not be reasonable because not all of the constituents of SED require electricity and because the electricity of a few remote areas was supplied by generators whose output was not within the national measurement network.

Thus, variables taken from a well-understood *macroeconomic* research line and others taken from a *microsociological* research line are shown to measure just one general factor at a "mezzo-sociological" level, the microregion. The uniformly high factor weights provide internal evidence of the validity of the index over Brazil as a whole in 1970. Its correlation with KWH/k_{mr} (ln) provides external evidence of its validity.

Next we shall consider informal external validity evidence, that is, policy decisions. A very different type of external evidence of the validity of the SED/k_{mr} scale for Brazil (1970 data) appeared unexpectedly when, in 1988, the nation's new constitution was written. But let us back up for a moment. The 1970 macroregionalization of Brazil was carried out by mapping the SED/k_{mr} scores of all microregions and then observing their natural groupings. Five such appeared. One of these, the most clearly marked of the five, was an immense area of about 1,000 x 1,600 km. Its municípios had uniformly low SED/k_{mr} scores—strikingly low. This area, which may now be called the Middle North, comprised the states of Maranhão and Piauí, much of eastern Pará, half of Bahia, all of northern Goiás (now Tocantíns), part of northern Minas Gerais (and tiny parts of two others). Before the publication of these results there was nothing in the literature suggesting the existence, as such, of this homogeneously impoverished region.

The 1988 constitution authorized exactly five states to divide if they wished. These five (all of those named above except Piauí), and only these, were given this authority. Obviously, the signers of the constitution believed the development of these impoverished states might be enhanced by divisions that could increase the flow of federal funds to the people of each.[34] We have no way of knowing whether the writers of the constitution had access to the appropriate research literature. But whether they did or not, official identification of these five contiguous states—essentially, our Middle North—as the participants in a previously

unrecognized region so poor that break-up could improve each provides a unique practical test of the external validity of the scale.

In short, three types of evidence provide empirical support for the validity of the 1970 $SED/_{mr}$ scale for Brazil: factor structure, KWH/k_{mr} x SED/k_{mr} correlation, and the 1988 constitution's authority to each state of the lowest-scoring macroregion to divide into two.[35]

Such affirmation should not be surprising. As we have seen, the variables were taken from the two research literatures that were logically closest to SED measurement. Each variable is a reasonable manifestation of either the economic development of an area's people or of the socioeconomic status of individual households. Moreover, in accord with the earlier discussion of the disarticulation of SED and anomie in frontier regions, neither of these two literatures nor the SED/k_{mr} includes extraneous variables of illogical or unknown relation to SED such as anomie, health, "quality of life," infant mortality, and so on. The resulting scale is thus a pure measure of the average *socioeconomic* development level of the people of the microregions of Brazil as of 1970.

The SED/k_{mu} (município) index for Amazonian municípios, using the same logic as the preceding analysis, draws upon comparable variables that are available. Data for 1970 (Set B) and 1980 (Set C) are first analyzed separately. Then, because of the striking similarity of the factor patterns of each to the other and both to the original 1970 SED/k_{mr} items, the analysis is extended to a similar analysis (Set D) of the 5 variables common to the 1970 and 1980 Amazonian município data taken together as if there were no temporal difference among them. The latter analysis shows the same basic factor pattern as in the previous three factor analyses, now based upon 5 comparable variables each taken two times—10 in all, 5 for 1970 and 5 for 1980—as we shall show.

In the following paragraphs, we shall compare data from each of the four sets presented in table 1. It is important to note that these comparisons, though extremely informative, are not exact. This is because the factor-weighted eigenvalues and percentage variance depend upon the exact variables included. So the sets are not precisely comparable even though the variables within each set are.

Let us examine Sets B, C, and D separately. Set B—Amazonian municípios in 1970—includes a third measure of manufacturing emphasis, paralleling Set A's (1970 microregion analysis of Brazil as a whole) manufacturing workers per worker (MW_w) and horsepower of the installed manufacturing machinery per capita (HP/k). This third manufacturing variable is KWH/k/year/município of electricity consumed in manufacturing. Note that the factor weight of this variable (.707), is almost identical to the weight of MW_w in Set A (.691). Set B lacks three variables of Set A (numbers 2, 3, and 4). Instead of the literacy rate, it has the per capita rate of exposure to primary school. It has two variables that are not in Set A: household lighting per capita and residential electricity per capita. The corresponding factor weights, those of Set B preceding those of Set A, are as follows. For access to refrigeration per capita they are .945 and .965, respectively. For access to a television receiver per capita they are .866 and .935, respectively.

For access to an automobile per capita they are .794 and .947, respectively. For primary schooling per capita (Set B) and literacy per capita (Set A), the respective weights are .914 and .856. Household lighting per capita (Set B only) weighs .910, and residential electricity per capita (also Set B only) weighs .739.[36] Thus, *identical* variables weigh about the same in the two sets; *similar* variables also weigh about the same in the two sets; and *all* variables weigh heavily in each set, including the three from Set A that are not shared by Set B and the two from Set B that are not shared by Set A. The eigenvalue of the first factor of Set B (whose weights we just discussed) is 4.981. As for Set A, except for the first factor, no other eigenvalue reaches the level of 1.000, the conventional level indicating the acceptability of the factor. So this, too, is a one-factor solution. Again almost identical to Set A, the percentage of the total variance in Set B that is explained by the factor is 71.2 percent. (Set A was 74.5 percent). Thus, the 1970 município data for Amazonia show the existence of a single factor, clearly SED/k_{mu}, and that factor is comparable to the factor of Set A.

Set C concerns the Amazonian municípios in 1980. Three of its five variables are identical to three in both Sets A and B (numbers 5, 6, and 7). A fourth is identical to one in Set B that is not in Set A (number 9), and the fifth, secondary schooling per capita, is similar, but not identical, to the educational variables in Sets B and A. (In the Amazonian data, the correlation between these two is r = .80). Note the respective factor weights of Sets C, B, and A (in that order). For variable 5, they are .959, .945, and .965. For variable 6, they are .957, .866, and .935. For variable 7, .756, .794, and .947. For variable 8 (education), they are .853, .914, and .856. For household lighting, shared with Set B, Set C's weight is .953 and Set B's is .910. (The average of Set C's factor weights is .896; for Set B, .839; and for Set A, .858). Like Sets B and A, only one eigenvalue of Set C rises above 1.000; it is 4.092. As before, this shows that one factor is sufficient to describe the common variance. The percentage of total variance explained by the factor is 81.8 (as against 71.2 for Set B and 74.5 for Set A). Here again we have powerful evidence of the existence of a single factor measuring SED/k_{mu} for Amazonian municípios, this time in 1980. This factor is impressively comparable to that measured for 1970 in the region and for 1970 over all of Brazil.

Given such a high degree of apparent comparability, it follows that a correlation matrix composed of the 5 variables that are shared by Sets B (1970) and C (1980) for Amazonia should be explicable by a single factor, SED/k_{mu}, that is independent of year, thus measuring SED/k_{mu} of each of the 327 municípios in *each* of the two years. This hypothesis may be tested by factor analyzing the 10 x 10 correlation matrix generated by variables 5, 6, 7, 8, and 9 measured twice, once for 1970 and once for 1980. A one-factor solution with weights for all 10 variables (5 through 9 in table 1, each taken twice), comparable to those we have already seen, would be sufficient evidence both to accept the one-factor hypothesis and to permit the development of an SED scale to measure it. A two-factor solution, one of which would probably be "year," would be sufficient evidence to reject the hypothesis and thus to interdict plans to measure SED.[37]

Here again, a one-factor solution is sufficient. (This is from Set D of table 1.) The eigenvalue of the first factor is 7.526 and no other eigenvalue reaches 1.000. Here, too, the total matrix variance accounted for by the factor is in the range we have seen before. It is 75.3 percent. (The others were Set C, 81.8; B, 71.2; and A, 74.5). Here again, too, the factor weights are comparable to those we have seen before. Those for 1970 and 1980 are presented in order—variable 5: .923, .930; variable 6: .772, .926; variable 7: .823, .690; variable 8: .929, .849; and variable 9: .896 and .904). (The average of the weights is .864. For Sets C, B, and A, they were .896, .839 and .858.)

The conclusion is that for 1970 and 1980, over all of Brazil's 360 microregions in 1970 and over the 327 (of 329) Amazonian municípios in both years, there existed one and only one exceedingly robust variable. The content of that variable is faithful to both of the major variables from two well-worked research traditions—international economic development and household socioeconomic status. It is uncontaminated with variables that in Amazonia would measure anomie. Its weights as presented in Set D thus appear to be acceptable as bases for the construction of a factor-weighted index of SED/k_{mu} that would be capable of showing the changes, município by município, in the SED levels of the populations of Legal Amazonia between those two years. In other words, an index so constructed should provide a valid measurement instrument by which to test the hypothesis holding that the economic boom in Amazonia in the 1970s reduced the SED levels of the population.

The SED/k_{mu} scale was constructed by standard factor-weighting procedures that do not need to be repeated here,[38] modified slightly to take into account the fact that the number of municípios was 327 while the number of units in the correlation matrix was 654 (327 municípios measured in 1970 and in 1980, or 327 x 2). Its limits were set arbitrarily at zero for the lowest score of any município and 100 for that of the highest.

$$S_1 = W_1\left[\frac{X_1 - \bar{x}_1}{\sigma_1}\right] + W_2\left[\frac{X_2 - \bar{x}_2}{\sigma_2}\right] + \ldots + W_n\left[\frac{X_n - \bar{x}_n}{\sigma_n}\right],$$

where

S_1 = the preliminary SED/k_{mu} score for each município at each time, prior to setting the zero-100 scaling of the final SED/k_{mu} score,
W = the factor weight of the variable,
X = the unit's score on the variable,
$\bar{x}$ = the mean of the Xs
σ = the standard deviation of the variable over all the units.[39]

In this case, we actually have 327 units (municípios), with each variable measured at two times (1970 and 1980). We constructed two different SED/k scales. Each employed the mean weights of the factor at the two times and the

average of the means of each variable over the two times. Method 1 used the mean of the standard deviation of each variable at the two times. Method 2 used the overall standard deviation of each variable as if $N = 2 \times 327$, or 654. The two methods correlate at $r = .99$. Thus, each is as good as the other. To provide another check on their validity, we ran their correlation with one of the items.[40]

As explained earlier, a general idea of the validity of the scale is provided by the detail of the factor analyses. We briefly review these here. The variables included in the first scale (SED/k_{mr}), published over a decade ago, were based on 1970 data for all of Brazil.[41] They conform quite well to those of the two research traditions from which they were drawn. The scale constructed from them (SED/k_{mr}) appears valid from both the internal evidence provided by the factor analysis and from the external evidence provided by the scale's correlation with consumption per capita of electricity and by the striking correspondence of its results with authorizations written into the 1988 constitution of the nation. Set B, for Amazonia's municípios, appears generally consistent with Set A. Set C appears consistent with Sets A and B. Set D really repeats the content of Set C, but for both 1970 and 1980. Analysis of it appears to show the existence of the same powerful SED variable that shows itself in the other analyses.[42]

It would be useful to perform tests of the external validity of the SED/k_{mu} scale itself (as contrasted to the validity of the variable it is to measure). In a way, a hint of its validity according to external evidence has already appeared. The final scale did not use per capita consumption of electricity, either for residences or for industry. But Set B includes those data. The factor weights, it will be recalled, are .739 for residential consumption and .707 for industrial consumption.

A more direct test of external validity of the 1970 and 1980 SED/k_{mu} scales for Legal Amazonia's municípios was carried out by calculating the Pearsonian correlation coefficients the SED/k_{mr} scale for the 360 microregions (sets of municípios) of Brazil as a whole for 1970 with the SED/k_{mu} scores averaged over all of the municípios in each of the 55 microregions implicated in Legal Amazonia. We say "implicated" because Legal Amazonia's borders cut through nine of the 55 microregions. This is one of the reasons why the coefficients measuring the validity of the SED/k_{mr} scale underestimate the true correlations, and thus underestimate the degree of validity of the scale. Another reason is that the number of municípios within the borders of microregions varies from microregion to microregion. In Amazonia the exact number per microregion is never very large, averaging around six. Obviously, some have fewer yet, especially some of those cut by Legal Amazonia's boundaries. Thus, for this test, the reliability of both scales is probably attenuated to a degree. Reliabilities that are less than the maximum of $r_{tt} = 1.00$ reduce the value of validity coefficients pertaining to them. The upshot of this is that both of these, the best and most nearly comparable measures obtainable, probably underestimate the true SED of each Amazonian microregion.

The results of this analysis follow. The Pearsonian correlation of SED/k_{mr} of the microregions in 1970 with the mean SED/k_{mu} of the municípios within the 55

microregions in 1970 was found to be $r = .79$. For the same SED/k_{mu} 70 scale with the 1980 mean, SED/k_{mu} was $r = .78$. (The SED/k_{mu} means and standard deviations are 1970: $\bar{x} = .574$, s.d. = 5.34; 1980: $\bar{x} = 19.67$, s.d. = 13.33.) When the 1970 and 1980 SED/k_{mu} means are averaged and that average is correlated with the SED/k_{mu}, the correlation is $r = .89$. These validity coefficients are high despite the attenuation owing to the partial unreliability of each measure. The test itself necessarily reduces the apparent validity of the SED/k_{mu} scale, so its true validity is undoubtedly higher yet.

As a general conclusion, it seems safe to say that the SED/k_{mu} scale for 1970 and 1980 is valid for the 327 (of 329) municípios of Legal Amazonia as these boundaries were drawn in 1970.

Thus it appears that the instrument is fully adequate for use in testing the hypothesis that heavy investment in Brazil's Amazonian frontier during the 1970–80 period tended to reduce the SED levels of the region's populations.

Results

There is no doubt concerning the heavy investment in Legal Amazonia between 1970 and 1980. This is well documented.[43] What has been in doubt is what happened to the population's SED during the decade. The SED/k_{mu} scores for 1970 and 1980 will answer the question.

The scale scores run from 0 to 100 and may be used to compare the development levels of any given Amazonian município in 1970 and 1980, or any set of Amazonian municípios at one or both times. Because similar analyses and scorings for the beginning of the present decade can only be calculated after Brazil's 1991 census data become available at the município level, we cannot yet say anything about the municípios' development levels for the decade of the 1980s. But in fact, on a casual basis, in March 1992 we used the 1970 and 1980 SED/k_{mu} values to give an idea of the relative development levels of 13 municípios in eastern Pará in 1992, and then, on site, we visually checked the life situations of inhabitants of each. The 1970 and 1980 SED/k_{mu} levels do appear to provide a good forecast of intermunicípio variations that one can see with one's own eyes as late as 1992.

Using 1970 municipal boundaries, there were 329 municípios. Two of these were excluded from the analysis, partly because of unexplained anomalies in the data. Thus we were left with 327 municípios each for both 1970 and 1980.

What do the scores for 1970 and 1980 tell us about Legal Amazonia's municípios?

1. The SED level of the people of all but two municípios rose from 1970 to 1980. Each of the two municípios that fell is, in its own way, especially isolated. Atilaia do Norte (5.38 in 1970 and 5.09 in 1980) is on Amazonas's western border, and Luis Domingues (4.07 in 1970 and 1.31 in 1980) appears cut off from the rest of Maranhão.
2. The mean SED/k_{mu} level for 1970 was 4.96. For 1980 it was 17.70. The standard deviations were 6.87 and 16.25, respectively. Over *both* years

(i.e., 327 x 2 = 654 observations), the mean was 11.37 and the standard deviation was 14.00. This shows not only the rise in SED/k_{mu}, but also the fact that the development level of the population of most municípios was low in both years. This was thus a skewed distribution.

3. The municípios where SED/k_{mu} was highest were the metropolises of Legal Amazonia as they stood in 1980. The 1980 scores of these were Cuiabá 100.00, Belém 98.26, Manaus 96.51, and São Luis 89.24. Other state capitals were also relatively high. These include Pôrto Velho 36.19, Rio Branco 64.68, Bôa Vista 72.67, and Macapá 69.04.[44]
4. A few municípios outside the capitals had rather high scores in 1980. In Pará in 1980 these included Altamira 40.55, Ananindeuá 74.71, Capenema 41.42, Castanhal 55.81, Marabá 41.13, and Tucuruí 60.17. In Maranhão, Santa Inês was 41.28. In Mato Grosso, the scores were Alto Araguaia 57.27, Alto Garças 60.17, Barra do Garças 58.58, Dom Aquino 40.41, Guiratinga 49.71, Itaquira 40.41, Jaciara 53.20, Nobres 42.73, Nortelândia 45.35, Rondonôpolis 62.50, and Várzea Grande 72.38. In the part of Goiás that later became Tocantíns, Gurupí was 50.44 and Paraiso do Norte de Goiás was 43.31. It will be noticed that, in Pará these municípios either are near Belém and thus in the long-settled area, or are central points on major highways, or are connected with large-scale construction. In Mato Grosso, they are in the south and east of the state, thus in areas less distant from the markets of the developed South. The two in Goiás are both on the Belém-Brasília highway.
5. Only the metropolises were higher than 40.00 points in 1970: Cuiabá 56.40, Belém 59.16, Manaus 53.78, and São Luis 44.33. Thus the average levels of SED of the people of practically all of Brazil's Amazonian municípios rose, and the greatest increases were in or near the metropolises, in other capitals, and in a few rural municípios on or near major highways and construction works or relatively near to the South.[45]

Conclusion

The paper restates the hypothesis, which seems current among Amazon scholars despite the fact that it has never been tested, that large-scale economic investment in Amazonia lowers the SED levels of the population. A measuring instrument (SED/k_{mu}) was prepared to determine the change in this variable that actually occurred from 1970 to 1980, a decade of substantial investment. It would appear that the instrument is a valid measure of an SED variable that seems quite robust over Amazonia in 1970 and 1980. When this instrument is applied to measure the SED levels (SED/k_{mu}) of the people of 327 (of 329) of Legal Amazonia's municípios, it was found that only 2 (less than one percent) of the municípios fell. Over 99 percent rose.

It is concluded that the hypothesis cannot be sustained for the period in question: economic development was accompanied by the SED of the people of practically all of the municípios.

It is important to repeat that this does not mean that life was "better" in 1980 than in 1970. Indeed, other evidence shows that what we have called "anomie" was rampant in some parts of the region.[46] Note, too, that previous economic booms may indeed have reduced the SED levels of the population. But there is no way to determine whether this really happened, except for the city of Manaus and the rubber-collecting areas, which went into decline after the rubber boom was over. Then, too, one decade is a short period in which to test the hypothesis. A generation or two would be better. Still, this is the only decade for which the right conditions and proper data exist by which to test it. Finally, the repercussions of the 1970s "development decade" continuing into the 1980s, 1990s, and beyond are unknown. Our conjecture is that the level of anomie will drop as frontier areas become stable communities and that SED/k levels will have risen and will continue to rise.

Discussion

The reasoning and research results presented herein have implications for more general sociological theory and for understanding change in Amazonia. For sociological theory, a definition of the concept of the frontier, with specifications for subfrontiers, is offered. The definition appears to work well for Amazonia. Whether it will be as useful for such different frontiers as Antarctica and large parts of Canada, Siberia, and Alaska remains to be seen. But this seems likely. Two implications of the definition also seem promising. One concerns the inducements frontier investors use to encourage people to migrate to the frontier or to divert locals from their previous activities to those of interest to the investors. These inducements raise wages, as is well known to those residing in Amazonia. The other implication concerns the role of anomie and its relation to rapid socioeconomic change. Frontier areas attract new groups whose norms may differ from those of each other and from those of the few locals already there. This situation augments the potential for a series of consequences typical of anomic situations—rising murder rates, increases in infant mortality, perhaps health-threatening dietary changes. Beyond this, frontier areas are "lawless": in frontiers the laws of more-settled regions are less well understood, local law codes are nonexistent, and law enforcement is weak and easily corrupted.

This latter consideration implies that anomie and SED are distinctly different variables. In long-settled areas, anomie and SED levels may well be negatively correlated: the higher the level of such development, the lower the level of anomic behavior. But in frontier areas (which by definition are undergoing rapid, disarticulated change) the higher the level of such development, the higher the level of anomie. In the present research, this consideration dictated that variables measuring anomie were to be excluded from the measurement of the SED of the population. But, while compelling, the frontier anomie hypothesis has not really been tested, although spotty evidence suggests that it holds.[47]

Regarding change in Amazonia, such considerations call attention to the role of large-scale organizations in the "assaults" on the region's rainforest. Over the

long term, the Brazilian population has steadily expanded westward and northward toward the Amazonian forests. In a sense, large-scale organizations (government and private companies) have harnessed part of this massive movement and are enhancing its impact on the region. Much of Amazonia's southwestern, southern, and eastern fringes have effectively been deforested, and long rays of deforestation now penetrate some of the central areas.[48]

With the passage of time, clearing and occupation triggered by large-scale organizations and general population growth will probably result in a myriad of activities that will be initiated by small-scale groups. Specifically, the better soils in such areas will surely be turned to farming. Such areas are unlikely ever to revert to forest lands. (What will happen to the cleared areas of poor soils is a subject of much current concern. Will they remain barren, or be covered by second growth, or revert to ranching, or what?) In time, the populations of settlements and clearings in some of today's subfrontiers will come to some sort of *modus vivendi*: with greater normative consensus (whether imposed or emergent), the rate of anomic behaviors will decrease. (This assumes that nationwide social unrest will not increase and penetrate Amazonia.) Assuming the present theory of frontiers is valid, as occupation and socioeconomic development proceed, relative wages will fall back to levels that correspond more closely to the overall level of SED of the region within Brazil as a whole, continuing the change already noted between 1973 and 1982.[49]

Regarding future research, much of it multidisciplinary with substantial inputs from sociology, some of the issues that could build upon the present paper are (1) assessment of the SED/k_{mu} in Amazonia in the 1990s and beyond; (2) expansion of population in Amazonia; and (3) relationship between soil quality, socioeconomic development, and the expansion of farming and related settlements. At a more theoretical level, it is important to test the hypothesis that anomie varies positively with SED in frontier regions, but negatively in long-settled areas.

Clearly, the original hypothesis is invalid. Contrary to this hypothesis, frontier Amazonia's peoples experienced a higher average level of SED at the end of the booming 1970s than at the beginning. What then can be said about the theory that dictated the hypothesis? In its most concise form, it holds that external exploitation extracts but does not replenish energy from "extractive peripheries," of which Amazonia is one. The postulated decrease in energy undermines the development levels of the population. In short, exploitation impoverishes the population. The present analysis neither supports nor denies the theory. These results leave the question open as applied to more or less contemporary Amazonia: either the theory is not applicable under recent conditions of the Amazonian frontier, or it is invalid. Why did the theory not work? Basically, this question is unanswerable, but our supposition is that the theory lacked a full consideration of the nature of frontiers. By underestimating the impact of external investment and population growth, and ignoring or misinterpreting the anomic situation endemic in frontiers, the theory failed to take into account that investment and growth may override the postulated energy depletion and that heightened anomic behavior may obscure the actual increases in socioeconomic development.[50]

Appendix

TABLE A1

PEARSONIAN CORRELATION COEFFICIENTS (r), MEANS ($\bar{X}$), STANDARD DEVIATIONS (sd), AND SKEW (Sk): BASIC INDICATORS OF THE SOCIOECONOMIC DEVELOPMENT OF THE POPULATIONS OF LEGAL AMAZONIAN BRAZIL'S MUNICÍPIOS, 1970 AND 1980

		1970 (r)[1]					1980 (r)[1]							
YEAR	VARIABLE	V_1	V_2	V_3	V_4	V_5	V_1	V_2	V_3	V_4	V_5	$\bar{X}$[1]	sd[1]	Sk
1970	V_1 Refrig./k (access)	–										006	008	4.557
	V_2 TV sets/k (access)	790	–									001	005	8.475
	V_3 Autos/k (access)	735	621	–								001	002	3.245
	V_4 Schooling/k[2](prim.)	887	778	776	–							005	007	4.376
	V_5 Hsehld lighting/k	904	708	679	828	–						012	015	3.557
1980	V_1 Refrig./k (access)	840	609	672	804	810	–					023	021	2.421
	V_2 TV sets/k (access)	808	630	698	807	774	941	–				017	022	2.547
	V_3 Autos/k (access)	496	327	682	565	538	640	639	–			008	010	2.001
	V_4 Schooling/k[2] (sec.)	711	661	656	801	683	740	776	555	–		008	008	3.069
	V_5 Hsehld lighting/k	774	558	651	767	793	945	910	630	758	–	036	029	1.909

NOTES: $N = 327$. Data for 1980 was reaggregated to conform to the município boundaries of 1970. All new municípios were formed by bifurcating former municípios. Thus, after reaggregation, the 1970 and 1980 boundaries are identical, and the data for a given variable are comparable. (But see note 2.) Two municípios were omitted from the analysis.

[1]Decimals omitted. The true value is $X \times 10^{-3}$.

[2]Data for 1970 pertain to primary school (grades 0–8); and data for 1980 pertain to secondary school (grades 9–11).

TABLE A2

PRINCIPAL COMPONENT ANALYSES: BASIC INDICATORS OF THE SOCIOECONOMIC DEVELOPMENT OF THE POPULATIONS OF LEGAL AMAZONIAN BRAZIL'S MUNICÍPIOS, 1970 AND 1980 ($N = 327$)

Year	Variable	Communalities[1]	Factor Weights[1] (F_1 Only)
1970	V_1 Refrigerators/k (access)	852	923
	V_2 Television sets/k (access)	596	772
	V_3 Automobiles/k (access)	678	823
	V_4 Schooling/k (primary)	862	928
	V_5 Household lighting/k	802	896
1980	V_1 Refrigerators/k (access)	864	930
	V_2 Television sets/k (access)	858	926
	V_3 Automobiles/k (access)	477	690
	V_4 Schooling/k (primary)	726	849
	V_5 Household lighting/k	818	904

NOTES: $N = 327$. Two municípios were omitted from the analyses. Eigenvalue of Factor I = 7.52573. (Ten factors were extracted on a trial basis. All but F_1 were < 1.00000, the cut-off criterion for deciding which factors to retain.) Percentage of matrix variance explained by Factor $F_1 = 75.3$.

[1]Decimal points omitted. True values are $X \times 10^{-3}$.

NOTES

1. Stephen G. Bunker, *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State* (Chicago, IL: University of Chicago Press, 1988).

2. Bunker, *Underdeveloping the Amazon*.

3. Stephen G. Bunker, "Modes of Extraction, Unequal Exchange, and the Progressive Underdevelopment of an Extreme Periphery: The Brazilian Amazon: 1600–1980," *American Journal of Sociology* 89 (March 1984): 1017–64; Bunker, *Underdeveloping the Amazon*.

4. Anna C. Roosevelt, "Secrets of the Forest," *Sciences* (November/December 1992): 22–28.

5. Charles R. Boxer, *The Golden Age of Brazil, 1695–1750: Growing Pains of a Colonial Society* (Berkeley and Los Angeles: University of California Press, 1962).

6. See Bunker, *Underdeveloping the Amazon*, p. 145.

7. Ibid., p. 47.

8. Celso Furtado, *Formação Econômica do Brasil* (Rio de Janeiro: Editôra Civilização Brasileira, 1959).

9. Anna Luiza Ozorio de Almeida, *The Colonization of the Amazon* (Austin: University of Texas Press, 1992).

10. See Ann Fabian, "History for the Masses: Commercializing the Western Past," in *Under an Open Sky: Rethinking America's Past*, ed. William Cronon, George Miles, and Jay Gitlin (New York: Norton, 1992), p. 223.

11. Bunker, *Underdeveloping the Amazon.*

12. Thomas D. Hall, "Incorporation into the World System: A Critique," *American Sociological Review* 51 (June 1986): 390–402.

13. See de Almeida, *Colonization of the Amazon.*

14. Marianne Schmink and Charles H. Wood, *Contested Frontiers in Amazonia* (New York: Columbia University Press, 1992).

15. Joe Foweraker, *The Struggle for Land: A Political Economy of the Pioneers in Brazil from 1930 to the Present Day* (New York: Cambridge University Press, 1981).

16. Dennis J. Mahar, *Frontier Development Policy in Brazil: A Study of Amazonia* (New York: Praeger, 1979).

17. Maxine L. Margolis, *The Moving Frontier: Social and Economic Change in a Southern Brazilian Community* (Gainesville: University of Florida Press, 1973).

18. See Hall, "Incorporation into the World System."

19. Archibald O. Haller, "A Socioeconomic Regionalization of Brazil," *Geographical Review* 72 (October 1982): 450–64.

20. Archibald O. Haller and Hélcio U. Saraiva, "The Income Effects of Education in a Developing Country: Brazil—1973 and 1982," *Research in Social Stratification and Mobility* 11 (1992): 295–336.

21. Emile Durkheim, *Suicide, a Study in Sociology* (Glencoe, IL: Free Press, [1897], 1951).

22. See Schmink and Wood, *Contested Frontiers in Amazonia.*

23. See Bunker, "Modes of Extraction"; idem, *Underdeveloping the Amazon.*

24. See Haller, "Socioeconomic Regionalization of Brazil"; idem, "The Socioeconomic Macroregions of Brazil—1970" (Nagoya, Japan: United Nations Center for Regional Development, 1983).

25. Janet D. Henshall and Richard P. Momsen, *A Geography of Brazilian Development* (London: Bell, 1974).

26. See Haller, "Socioeconomic Regionalization of Brazil"; idem, "Socioeconomic Macroregions of Brazil."

27. See Haller, "Socioeconomic Regionalization of Brazil"; idem, "Socioeconomic Macroregions of Brazil."

28. All original data, coded in Portuguese, were provided by the Brazilian Institute of Geography and Statistics (IBGE). A few of the município boundaries for 1970 and 1980 differ from each other. In Brazil, new municípios come into existence by binary fission. The data for 1980 municípios that were officially formed from those of 1970 were reaggregated by our research team so as to maintain comparability. Município boundaries of 1970 and 1980 were reconciled using documents published by the Brazilian Institute of Geography and Statistics (IBGE 1990, 1984, 1980, 1968), which present the legal delineation of each município.

29. Jae-on Kim and Charles W. Mueller, *Introduction to Factor Analysis: What It Is and How to Do It* (Beverly Hills, CA: Sage, 1978); idem, *Factor Analysis: Statistical Methods and Practical Issues* (Beverly Hills, CA: Sage, 1978).

30. See Irma Adelman and Cynthia Taft Morris, *Economic Growth and Social Equity in Developing Countries* (Stanford, CA: Stanford University Press, 1973); Felix Paukert, "Income

Distribution at Different Levels of Development: A Survey of Evidence," *International Labour Review* 108 (August–September 1973): 97–119; World Bank, *Social Indicators of Development 1989* (Baltimore, MD, and London: Johns Hopkins University Press for the World Bank, 1989).

31. Archibald O. Haller and Hélcio U. Saraiva, "Status Measurement and the Variable Discrimination Hypothesis in an Isolated Brazilian Region," *Rural Sociology* 37 (September 1972): 325–51.

32. The classical works on tests of validity and reliability are Donald T. Campbell and Donald W. Fiske, "Convergent and Discriminant Validation by the Multitrait–Multimethod Matrix," *Psychological Bulletin* 56 (1959): 81–105; and Jum C. Nunnally, *Psychometric Theory* (New York: McGraw-Hill, 1967), 75–102 and 172–234. Validity deals with the extent to which an instrument is successful in measuring variations of a phenomenon. Reliability deals with the measurement consistency of the instrument.

33. At that time Eletrobras kept the records on all production and consumption of electricity for each município in Brazil—then over 4,000—except for that produced by mechanical generators held by private parties.

34. Actually, only old Goiás divided itself into two—Goiás and Tocantíns.

35. Note, too, that the five SED macroregions were identified by research using 1970 data; whereas the constitution was promulgated 18 years later. Evidently, macroregional boundaries change slowly, if at all.

36. The average factor weight for Set B is .839, very close to the .858 of Set A.

37. See appendix table 1 for the correlation coefficients, means, standard deviations, and skewness coefficients for Set D; and appendix table 2 for further details of the principal component analysis of the set.

38. See Kim and Mueller, *Introduction to Factor Analysis*; and idem, *Factor Analysis: Statistical Methods and Practical Issues*.

39. See Kim and Mueller, *Introduction to Factor Analysis*; and idem, *Factor Analysis: Statistical Methods and Practical Issues*.

40. Note that a slightly more complete analysis would use factor coefficient scores as $W_1, W_2, \ldots, W_n$. When calculated, these range from .09174 to .12353. In the present case, the factor weights and the factor score coefficients are perfectly correlated, so it makes no difference which was used. See SPSSX Inc.: 1988; Kim and Mueller, *Introduction to Factor Analysis*; and idem, *Factor Analysis: Statistical Methods and Practical Issues*.

41. Set A of the table. See Haller, "Socioeconomic Regionalization of Brazil"; and idem, "Socioeconomic Macroregions of Brazil."

42. See appendix tables 1 and 2 for further details.

43. See de Almeida, *Colonization of the Amazon*.

44. We omit Tocantíns's capital because the state had not yet separated from Goías.

45. An additional analysis was performed to determine the relation between socioeconomic development and total population. Some may assume that the two variables are really the same thing—that the correlation between the two is nearly perfect: $r \cong 1.00$. They are indeed positively related, as the SED/k_{mu} levels of the municípios presented earlier have shown. But in reality the correlation is not particularly high. This may be seen from data on microregions. For 1970, SED/k_{mr} x total population is $r = .43$ (or $r^2 = .18$). For 1980, the comparable value is $r = .42$ (or $r^2 = .18$).

46. See Schmink and Wood, *Contested Frontiers in Amazonia*.

47. See Schmink and Wood, *Contested Frontiers in Amazonia*.

48. D. L. Skole, W. H. Chomentowski, W. A. Sales, and A. D. Nobre, "Physical and Human Dimensions of Deforestation in Amazonia," *BioScience* 44 (May 1994): 314–22.

49. See Haller and Saraiva, "Income Effects of Education."

50. SED/k_{mu} scores for the municípios of Legal Amazonia (1970 boundaries) may be obtained by writing to the senior author.