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Proposal to the

Agency for International Development

from the

Economic Growth Center

Yale University

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Technology Choice and Employment

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Technology Choice and Employment

I. Background

During the last three years, members of the Yale Economic Growth Center have been undertaking studies of employment and unemployment in developing countries. Studies of agricultural, service and industrial sector employment have been combined with an examination of specific countries' performance over time. Given the difficult and novel nature of these problems, these studies have been essentially inductive, aiming at the development of new analytic frameworks. A substantial number of Discussion Papers and Journal articles has resulted (Appendix A). A summary of our major findings to date, theoretical and empirical, is attached (Appendix B).

These investigations have served to confirm the notion that the issues of employment and unemployment must be examined in the context of the overall growth process, with an eye to the type of LDC under consideration and the historical growth phase in which it finds itself. Moreover, the effort has focussed our attention on an important related area for further research, i.e. the role of technology transfer and adaptation processes in the context of the existence and persistence of technological dualism. A statement of the problem and an outline of the proposed research follow.

A. Introduction and Issues

It has been argued that one of the main advantages of the developing countries is their capacity to benefit from the broad technological experience of the more advanced countries and to be able to select from a wide range of equipment embodying a wide choice of contemporary and historical factor proportions. However, we also have overwhelming evidence that the actual technology choices have, in fact, most often turned out to be very limited and concentrated in the highly capital intensive or modern end of the spectrum. The choice of from whom to borrow and of what vintage seems to be constrained not only by a

set of distortions in the economic signals, but also by other inadequacies in the overall institutional setting.

Yet we do encounter dramatic differences in industrial capital/labor ratios as between the labor-scarce developed countries and at least a "deviant" subset of LDCs (e.g., Korea and Taiwan), and somewhat less dramatic differences across scales even in the more typical cases (e.g. Colombia and Kenya). Considerable scope seems to exist for the adoption of labor using innovations on top of imported "shelf" technology, for purely indigenous innovations, as well as for increases in the output share of labor intensive commodities via changes in domestic demand patterns and/or the expansion of trade. Such scope has been demonstrated especially in the case of countries whose policies shifted as they moved from import into export substitution. The existence and persistence of technological dualism, as one moves across scales or types of ownership, even in countries still following an overall protectionist policy, gives further evidence of the relatively wide potential range of technology choice that does exist in response to differences in the overall environment.

The importance of technology choice in determining an economy's performance with respect to the minimization of trade-offs and the maximization of complementarities among employment, output and income distribution is being increasingly recognized. The factors determining the choices actually made and the causes behind the various configurations of technology dualism actually encountered are, however, still not very well understood. While a more realistic set of price signals is clearly _necessary_ for the achievement of an adequate innovative response in an endowment-sensitive direction, it is equally clearly

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[1] See Fei and Ranis, "A Model of Growth and Employment in the Open Dualistic Economy: The Cases of Korea and Taiwan," paper presented to the SEADAG Conference on Employment (December 6-9, 1972); and Ranis' "Industrial Sector Labor Absorption," forthcoming in _Economic Development and Cultural Change,_ Spring, 1973.

not _sufficient._ There exist important differences in the initial entrepreneurial and institutional endowment as well as in the nature of the science and technology infrastructure created during the import-substitution phase. It will be our objective to determine, by analysis at both the aggregative, sectoral and micro levels, the causes of the differential technological performance across countries and over time and derive conclusions for possible policy actions by government to affect the related employment/output/income distribution outcome.

Our analysis will be focussed on identifying those factors, beyond the degree of distortion of relative factor and commodity prices, which make for differential observed performance across countries and across scales within countries. Our intensive focus will be on five countries: two "successful" and therefore instructive, but in many ways also atypical Asian countries--Japan, whose historical record in terms of the selective use of imported and adaptive technology is unequalled, and Taiwan, which seems to have performed best in these regards during the post-World War II period; the Philippines, a much less successful, more typical, labor surplus Asian economy; Brazil, a large, relatively advanced Latin American country which has been growing rapidly, especially during the past few years, but whose technology experience and its impact on employment and distributional outcomes has not as yet been analyzed; and either Kenya, one of the more advanced and "open" African countries with a relatively large role accorded to private foreign capital, or Nigeria, a more typical and more domestically oriented African country.

For a number of other important country cases in which the issue of technological dualism has received the attention of analysts and policy makers for some time in the past, e.g. India, Pakistan, Colombia and Turkey, secondary materials and interviews will be utilized to evaluate the relevance of their

experience. Much past effort has been expended in this general area by founda-
tions, aid agencies and private groups; but, to our knowledge, no one has
yet made the effort to glean what might be called transferable knowledge and
insights useful for further study.

Other groups are currently active in this general area, the importance
of which is quickly gaining increased recognition. At M.I.T. the Sloan School
is beginning work on engineering choices under an AID 211d grant. The National
Academy of Sciences is sponsoring country workshops on industrial technology
research, conceptual studies on the suitability of technology as well as
specialized technical studies on such subjects as solar energy and other
power sources. The Science Policy Research Unit at the University of Sussex is attempting
to examine the nature of the international technology shelf, and of tech-
nology gaps among countries especially, but not exclusively, in the Europe/U.S.
context. The Schumacher Intermediate Technology Group, also in the U.K., has
concentrated for some time on the identification of existing alternative pro-
duction techniques. The OAS has tried to collect information on technology
choices and transfer among the Latin American countries. Dr. Khan and others
at the International Rice Research Institute in the Philippines, on the other
hand, have concentrated on the creation of modern indigenous labor-intensive
technology, first in agricultural machinery and now moving towards metal working
and other small industries.

While it is always difficult and dangerous to categorize what are bound
to be substantially diversified efforts, the aforementioned research activities
appear to focus on the science and technology end of the spectrum, a hitherto
substantially neglected area.

On the other end of that same spectrum, i.e. groups emphasizing economic
factors and the importance of relative prices, we may list work being undertaken,

especially on the services sector but ranging beyond it, at the ILO in Geneva, earlier work at the Yale Economic Growth Center (Pack's and Ranis' on industrial sector technology) and work commissioned in the past by UNITAR (e.g. Hal Mason's study of the multinational corporation's impact on technology choice) and activities currently being contemplated by the OECD Development Center. We are aware that other indirectly relevant work is being undertaken by individuals elsewhere, e.g. at Williams, Rice, in Asia under CAMS sponsorship and in Latin America under the ECIEL umbrella, and there may be other activities which we are unaware of. Few, if any, however, seem to have the precise focus of the study proposed here which may be viewed as attempting to build a bridge of understanding between the technological and economic aspects of the problem. We intend, however, to keep in close contact with the other on-going efforts both to benefit from mutual interaction and to avoid undue duplication.

B. <u>Specific Studies</u>

1. <u>Aggregate and Sectoral Analysis</u>

Making factor prices more realistic, along with other important changes in the environment, may be expected to affect the choice of imported technology, the strength and bias of any additional technical change it induces, as well as changes in the output mix made possible. To date, however, it has been difficult to quantify these relationships in any meaningful sense at the economy-wide or sectoral levels across countries or within countries over time. Fei and Ranis have devised a technique which will permit them to use time series data for the total economy, as well as for agriculture, non-agriculture, and industry taken separately, to trace the relative impact on the output and employment performance of straightforward technological borrowing and that attributable to indigenous labor-using innovations.

The rate at which labor is absorbed by the commercialized sectors of the typical developing economy (η_L) can be shown to be a function of (a) the strength or intensity of innovations (J); (b) the bias or slantedness of innovations (B_L); (c) changes in the wage rate (η_w); and the strength of the law of diminishing returns to labor (ε_{LL}).[1]

As far as empirical work is concerned, it has thus far been impossible to proceed beyond the identification of the contribution of capital accumulation and technology change, taken as a whole. Fei and Ranis have recently devised a statistical technique, which, under not unduly heroic assumptions[2] permits separate identification of the impact of innovational intensity, which is associated with technological borrowing, innovational bias, associated with adaptations "on top of" imported technology, and changes in the wage rate.

Much of the criticism directed at the so-called "mistaken" choices of technology has been aimed at developing countries' unduly heavy reliance on latest vintage technology imports, their inability and/or unwillingness to exploit the entire historical shelf and introduce indigenous labor-using innovations of their own. The analysis here will permit us to quantify the relative importance of high intensity and labor-using bias for labor absorption as well as output generation in different country situations. Moreover, since we know that, even in labor surplus countries, the organized sectors' real wage is likely to rise exogenously due to union, large company and government pressures, the importance of this phenomenon for the system's capacity to generate labor reallocation rates in excess of population growth can also be determined.

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[1] For the derivation of this relationship, see Fei and Ranis, "Innovation, Capital Accumulation and Economic Development," American Economic Review, June 1963.

[2] With respect to the short-run stability of the elasticity of substitution.

Time series data for the postwar period in Taiwan, the Philippines, Brazil, and Kenya (or Nigeria) will be used to test our basic working hypotheses that (a) the biased nature of innovation, along with its intensity, play a substantially larger role than capital accumulation in determining the generation of employment and output as well as the pattern of the emerging distribution of income via more, or less, labor-intensive growth paths; that (b) the contribution of innovational intensity associated with the act of international shelf borrowing is likely to decline over time as the technology gap narrows, while that of innovational bias is more closely related to the economy's changing endowment position--including its entrepreneurial capacity, plus the extent of the "veil" between that endowment and the environment actually faced by decision makers. Differences across countries by size of country and by the importance of trade, by natural or human resource endowment and by level of educational achievement can also be analyzed. A similar effort will be made for the historical case of Japan where good data exist going back to the late 19th century and where meaningful related sub-phases of growth can be identified.

A further, related hypothesis is that straight technology borrowing is likely to be substantially more important during the import substitution sub-phase, with technological adaptation more important during the relatively more "open" export substitution sub-phase. It will be interesting in this context to contrast how much (percentagewise) of the movement of labor from subsistence agricultural and non-commercialized urban activities (services, distribution, trade, etc.) to commercialized agriculture and industry is due to changes in the capital stock, changes in the state of technology and changes in the wage rate during periods of relatively controlled and liberalized policy settings. Estimates of the rate of indigenous labor-using technical change relative to the rate of innovational intensity associated with technological borrowing will thus

be obtained for different sectors and for different historical sub-phases. Conclusions follow for the appropriate public policy in altering the overall environment to accommodate the different types of technology change which become appropriate with changes in the human, physical and institutional endowment over time. Such overall policy options extend beyond the correction of various relative price distortions to questions of the overall market structure, patent legislation, organization of domestic R & D, education and other aspects of the overall science and technology infrastructure.

2. Micro Studies

Studies at the aggregate or sectoral level are important for generating information on the meaningfulness of certain hypothesized behavioral relationships in terms of different systems' total economic performance. But in order to substantially enrich our understanding of what is really going on in the realm of the total institutional milieu "beyond relative factor prices," we must also be ready to examine the record of relative success and failure at a much more disaggregate level. Moreover, we must be willing to be somewhat open-ended and entertain relevant hypotheses which extend beyond the traditional economic landscape. For example, the actual importance of prestige considerations, information lags, inequality of entry and of access to intermediate goods markets dominated by multinational corporations, transport, power and other physical constraints, patents and trade-marks on the choice of appropriate technology, all extend beyond the normal scope of inquiry. Yet they may well be crucial to our understanding. By concentrating most of our efforts on examining the way technology choices are made at the industry and firm level, including the real and perceived constraints on the scope for choice, we hope to achieve a more detailed understanding of the important elements of a supportive science and technology infrastructure. Questions for public policy,

including the role of domestic R & D institutes, adaptive engineering schools,
patent enforcement, etc. can only be addressed as a consequence of a broader
somewhat open-ended inquiry.

The work will be carried out in the context of the five country cases
already cited, i.e. Brazil, Kenya (or Nigeria), the Philippines, Taiwan and
historical Japan. Moreover, as we have indicated, we shall attempt to survey
existing second-hand materials in the effort to evaluate the substantial past
analytical and policy efforts in this general area in such countries as India,
Pakistan, Turkey and Colombia.

Whatever the reasons, there exists clear and convincing evidence of the
persistence of substantial technological dualism in most developing countries;
our own work as well as that of others indicates the presence of substantial
gaps in capital-labor ratios as well as capital productivity by firms of different
scales in the same industry.[1] Such discrepancies in efficient factor use across
scale can be explained in part--but only in part--by the fact that the smaller
firms frequently face higher costs of capital and lower costs of labor than
do the large. Moreover, it has sometimes been argued that substantial economies
of scale exist and that such economies of scale have a labor-saving bias, i.e.
as firm size increases, with relative factor prices held constant, the capital-
labor ratio will rise even as the capital-output ratio declines. More recently,
however, the importance of such economies of scale has been subjected to ques-
tion, especially for the more common discrete process industries. Such ·

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[1] e.g. for Pakistan in Gustav Ranis, "Production Functions, Market Im-
perfections and Economic Development," Economic Journal, June 1962; for Mexico
in Saul Trejo, "Industrialization and EmploymentGrowth: Mexico 1950-1965,"
unpublished Yale Ph.D. Dissertation, 1971; for Colombia in Albert Berry, "The
Relevance and Prospects of Small Scale Industry in Colombia," Yale Economic
Growth Center, mimeo, October 1971 and John Todd, "Size of Firm and Efficiency
in Colombian Manufacturing," Research Memorandum 41, Center for Development
Economics, Williams College, October 1971; as well as for other countries, in
the U.N. Industry and Productivity, annuals.

industries, in contrast to the continuous process industries, are apparently
not characterized by marked economies of scale and have cost minimizing capital-
labor ratios which, for a given set of relative factor prices, are independent
of firm size.

Two types of technological dualism can be distinguished from each other:
the coexistence of different technologies for essentially the same production
process--which may be called horizontal dualism--and the presence of different
types of technologies at different processing stages of production--which may
be called vertical dualism. We intend to investigate the relative importance
and the causal factors underlying both types of technology dualism in the five
aforementioned countries as a way of shaping our understanding of the basic con-
dition favoring or disfavoring the use of an indigenous endowment-sensitive
technology.

Our earlier work led us to differentiate among machine-related, machine
peripheral and plant-related types of labor-using technological change. Adapta-
tions related to the more intensive use of machinery and the handling of
materials in such machine-peripheral activities as receiving, storage, internal
transport and packaging represent the main ingredients of the horizontal type
of technological dualism. The plant-saving type of innovation, including sub-
contracting, represents a major ingredient of vertical dualism. Both types
clearly exist and persist in varying degrees in all the countries to be examined--
both of the "deviant" and the "non-deviant" variety. One basic question to be
addressed is to what extent vertical dualism is a functional response to the
total environment and to what extent a disfunctional remnant of the past or a
temporary "make work" accommodation to population pressures. In a number of
LDCs, for example India, cottage industries have been artificially assisted to
provide raw materials for urban textile mills. Medium scale competitive

producers are frozen out and often destroyed. The putting out system employed by the Japanese textile firms, on the other hand, represents an example of functional vertical integration between various stages of textile processing. It seems clear that the role of complementarity as opposed to competitiveness among various scales in a given industry, i.e. the extent of functional vertical dualism, will be a key element in our analysis.

Our investigation into the causes of both types of technology dualism will be open-ended; but it will include, among others (1) the nature of credit and financial intermediation networks affecting size; (2) the extent to which small scale is a response to demand and liquidity risks; (3) the importance of entrepreneurial, information and market channel limitations; (4) the impact of additional supervisory or skilled labor input requirements; (5) the importance of limited distribution and transportation capacity; (6) the relevance of patents, trade-marks and R & D locations.

In the best-behaved or "deviant" country cases, i.e. historical Japan and Taiwan, complementary relationships, through subcontracting in particular, were established early in the game, addressing themselves to the credit risk and entrepreneurial supply dimensions as well as to the differential set of price signals in producing a substantial volume of labor using adaptive technology. The Japanese cotton textile industry, for example, for which detailed data are available, provides an especially interesting test case: in spinning, the "latest" machinery was imported and then improved upon; in weaving, traditional machinery was retained but modernized. Since structures make up about 50 percent of the capital stock, the performance of manufacturing operations in rural dwellings, once used for rural industry purposes, considerably reduces capital requirements. In cotton weaving most of the yarn was "put out" to farm

households, But even in the modern factory style spinning industry, some preparatory and finishing processes were carried out at the cottage level.

In postwar Taiwan not only domestic subcontracting but also an emerging international division of labor by process (as opposed to by product)--with the multi-national corporation playing a substantial role--represents another increasingly important manifestation of this phenomenon. Previous work on Mexico as well as on Korea, Kenya and Taiwan, has pinpointed areas (by stage of production, product type, and specific process change) in which the pay-off for labor-using innovations seems to be the highest, as well as indicating possible bottlenecks which may prevent such innovations from taking place even when economic signals are changed in the appropriate direction.

In the more common "non-deviant" country cases, on the other hand, the evidence is overwhelming that the volume of local adaptations is much less pronounced, as with small and large scale often engaged in competitive activities and the expansion of the latter most often at the expense of the former.[1] The factors which seem to be contributing to this--in addition to the distortion of relative factor and commodity prices--include: inadequate information on markets as well as on technological choice (especially among smaller and rural units) managerial, entrepreneurial and credit constraints, as well as differences in transportation infrastructure and the lack of managerial resources to supervise decentralized labor intensive activities.

We hope, moreover, to establish the specific importance of R & D and manpower training to the successful application and spread of labor-using innovations in relation to the in-plant machine processes. One main obstacle seems

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[1]See, for example, Stephen Resnick, "The Decline of Rural Industry Under Export Expansion: A Comparison Among Burma, Philippines, and Thailand," Journal of Economic History, March 1970.

to lie in the availability of indigenous machine shop graduates and applied engineers who will provide adequate adaptive capacity. A number of LDCs have demonstrated an ability to train the required additional supervisory personnel through both within plant training and less formal learning-by-doing processes. By contrast, only in a few countries have firm-supported applied engineering schools been established. Where they do exist, the capacity of these schools to eliminate the applied engineering constraint needs to be examined. The role of these institutions in supplying the needed technical inputs in the case of the Japanese textile firms has been discussed but not as yet thoroughly investigated by Saxonhouse.[1] Ranis will undertake an analysis of the impact of R & D plus educational strategy on labor-using innovations in that industry. We will, moreover, try to identify those shortcomings in this broader science and technology infrastructure which constituted bottlenecks of varying consequence in the cases of the textile industry in Taiwan, the Philippines, Brazil and Kenya (or Nigeria).

One additional, possibly important, dimension of an economy's capacity to innovate in a labor-using direction resides in the capacity to produce one's own flexible capital goods. Pack[2] and others have pointed out that light machinery and engineering industries lend themselves easily to fairly small scale operation and tend themselves to be labor-intensive. Moreover, the degree of success in adapting Western technology and especially in inducing home-grown labor-using innovations elsewhere may be crucially dependent on the existence of a reasonably developed domestic capital goods industry. Locally available technical knowhow

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[1] See Gary Saxonhouse, Ph. D. Dissertation, "Productivity Change in the Japanese Cotton Spinning Industry, 1891-1935," Yale University, 1971.

[2] Howard Pack and Michael Todaro, "Technological Transfer, Labour Absorption, and Economic Development," Oxford Economic Papers, Vol. 21, No. 3, November, 1969.

and a knowledge of local conditions, both technical and economic, may be essential for successful innovation and adaptation to proceed. On the other hand, difficulties may arise in absorbing the output of the sector if the country is small and opportunities for export, at least initially, are limited (because they tend to be non-standard products requiring a fairly sophisticated sales and service network). In the course of our intensive country studies we intend to ascertain the relevance of this industry as well as to identify its limitations. A study of the structure of any existing capital goods sector will be undertaken concentrating on such questions as (1) size distribution of firms, (2) range of products, (3) types of domestically performed operations, (4) domestic capability for design and adaptation, (5) sources of modifications in borrowed technology, (6) comparative prices and (7) characteristics of the users of domestic machinery.

Finally, while our working hypotheses, based on previous research in this field, have been stated in this proposal, we intend, as already mentioned, to approach these difficult problems by keeping the door open to the formulation of additional hypotheses, including some lying outside the traditional field of economic inquiry. This objective will be advanced in two ways: first, as already mentioned by culling the records, and the brains, associated with past efforts at building viable dualistic industrial structures, we hope to learn something which can be generalized about the proximate causes of failure in much of this activity, as well as its occasional successes. Second, we intend to involve a few people in some of the other related disciplines including engineering, political science and sociology, in an effort to assess the importance of such factors as prestige, inadequacies of information, patents, etc. This broadening of the landscape for analysis will be attempted by involving representatives of

the science and technology community as well as of relevant other social sciences in an early working conference. A small number of follow-up consultancies may also be possible.

In summary, the objective is to go beyond the extent to which various relative prices are distorted in laying bare the reasons for differential technological response across countries and scales. The causes of the appearance, and persistence, through various phases of growth, of technological dualism, differentiating between the complementary type, including urban-urban and rural-urban subcontracting, and the more common competitive or destructive type, will be a major focus. The apparent high correlation between some kinds of vertical technological dualism, both of the urban-urban and rural-urban variety, as a technology choice, on the one hand, and satisfactory growth and employment performance, on the other, will be examined. The very successful Japanese experience will be contrasted with the intermediate case of Taiwan and such more "standard" LDC cases as the Philippines, Brazil, and Kenya (or Nigeria).

The ultimate purpose of all our work is to shed light on the type of public policies which must be implemented, in addition to changes in relative factor and commodity prices, to enhance the chances for more "appropriate" technology choice as a method of enhancing employment, distribution and output performance in the labor surplus developing economy. Such policies may take a variety of forms, including, for example, government expenditures on transport infrastructure to reduce the cost of cottage industry subcontracting, tax incentives to locate industry rurally, and the support of applied engineering and R & D institutions. It is usually agreed that the success of liberalization and of making price signals more realistic depends in substantial part on the development of such infrastructural managerial and entrepreneurial capacities during a

usually prolonged prior period of import substitution.[1] The same thing holds

for the quality of the science and technology infrastructure built up during

the import substitution regime. The effective removal of the often stubborn

veil between an economy's resource endowment and its technology and product

mix pattern depends not only on the reduction of distortions in prices but also

on the extent of overall "workably competitive" market conditions and the

existence of a conducive educational, scientific and R & D environment. The

attempt will be made here to isolate and identify the essential components of

this broader environment so that developmental resources and energies may be

allocated to those areas likely to facilitate the wise choice of shelf technology

along with the domestic discovery and labor-using adaptation of imported tech-

nology.

Research Methodology

Micro-economic data in sufficient detail are available only for Japan;

thus sample surveys will have to be conducted in Taiwan, the Philippines,

Brazil and Kenya (or Nigeria). For the basic 5 country study outlined, 2 or 3

important industries, e.g. textiles, electronics, and light machinery will be

selected. Information will be obtained on a sample basis with respect to,

inter alia, (1) technical coefficients, (2) relative prices faced in input and

commodity markets, (3) the extent of workable competition in the industry,

(4) background and length of experience of the entrepreneurs, (5) need and

availability of supervisory labor and other "third" factors, (6) sources of

financing, (7) motivations for innovational modifications, including vertical

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[1]See comments by Julian Engel, National Academy of Sciences on Ranis'
"Some Observations on the Economic Framework for Optimum LDC Utilization of
Technology," in Technology and Economics in International Development, Report
of a Seminar, Agency for International Development, May 1972.

integration versus subcontracting (8) actual sources of innovational modifica-
tions made, and (9) domestic versus foreign market destination of the product.

Fei and Ranis, plus one Yale Assistant Professor, expect to work very
closely with senior researchers and institutes in Brazil, Kenya (or Nigeria),
the Philippines and Taiwan, both in the analytic and empirical phases of the
project. The Growth Center already has strong contacts and personal ties--in
some cases informal "treaties of friendship"--with the Academia Sinica in
Taiwan, the Instituto de Pesquisas Economicas in Sao Paulo, the Institute of
Economic Development Research in the Philippines and the Institute of Develop-
ment Studies in Nairobi. In each country we expect to locate at least one in-
terested colleague and a research assistant to work with. Hopefully, the afore-
mentioned institutes will make additional resources available to the project.

In order to ensure a fully collaborative arrangement with these insti-
tutions and individual associates, we intend to work out agreement on scope,
methodology, questionnaires, etc. at an early meeting, probably in New Haven.
At this same meeting representatives of the science and technology community and
of other related social sciences will be asked to participate.

We shall, in addition, look at a number of other important country cases,
e.g. India, Pakistan, Colombia, Turkey, in terms of the secondary materials
available, both at Ford, AID, SRI, IBRD, etc. and in the research and policy
communities. The purpose of this activity is to take advantage of the substan-
tial efforts, national and inter-national, made in the small industry/appropriate
technology areas over the past two decades, in an attempt to survey the relevant
analytical findings and evaluative efforts. This attempt should prove of value
not only in and of itself, but also in terms of providing further insights into
our working hypotheses for the country-intensive micro studies.

At the conclusion of our studies the results of the entire analysis will be summarized in a synthesis paper. This paper will summarize the new analytical ground broken, and emphasize conclusions for policy makers in both the recipient and donor communities.

II. Dissemination of Research Results

As has already been stated, activity under this contract will be carried out jointly with a number of LDC institutions and researchers. This is the most important and lasting dimension of LDC involvement. In addition, given our unique, now library exchange-focussed network of relationships with 175 government and private institutions in developing countries, we intend to utilize this facility for a broadened direct research findings dissemination effort.

III. Budget

The budget covering this proposal, broken down by major categories, is shown in Table 1.

Table 1

3/7/73

TECHNOLOGY CHOICE AND EMPLOYMENT

Proposed Budget

July 1, 1973 - June 30, 1976

	1973-74	1974-75	1975-76	Total
SALARIES	($38,298)	($40,255)	($42,341)	($120,894)
1) Faculty - AY	5,500	5,775	6,050	17,325
2) Faculty - Summer	8,505	8,935	9,430	26,870
3) Research Assistants & Programmer	11,318	11,920	12,556	35,794
4) Adm., Sec., Cler.	12,975	13,625	14,305	40,905
FRINGE BENEFITS	(6,213)	(6,529)	(6,866)	(19,608)
23.5 % of 1 above	1,293	1,357	1,422	4,072
15% of 2, 3, & 4 above	4,920	5,172	5,444	15,536
OVERHEAD				
(at 66% of salaries)	25,277	26,568	27,945	79,790
OVERSEAS ASSOCIATES AND ASSISTANTS	25,000	25,000	25,000	75,000
DATA PROCESSING	5,000	5,000	5,000	15,000
TRAVEL, Research	3,000	5,000	2,000	10,000
Conferences	1,000	1,000	1,000	3,000
PUBLICATIONS & DISSEMINATION	1,000	1,500	2,000	4,500
OFFICE SUPPLY	3,000	3,500	4,000	10,500
Sub-Total	107,788	114,352	116,152	338,292
INTERDISCIPLINARY SEMINAR				
Consultants	2,000	1,500	1,500	5,000
Travel	10,000	-0-	-0-	10,000
	12,000	1,500	1,500	15,000
GRAND TOTAL	$119,788	$115,852	$117,652	$353,292

Table 2
3/7/73

PIO/T ANALYSIS
TECHNOLOGY CHOICE & EMPLOYMENT
1973-76

	1973-74			1974-75			1975-76		
	$	Man Mos.	Mos. O'seas	$	Man Mos.	Mos. O'seas	$	Man Mos.	Mos. O'seas
AGGREGATIVE									
2 Faculty	1,030	1.25	-0-	1,085	1.25	-0-	1,150	1.25	-0-
1 Research Assistant	1,333	2.0	-0-	1,400	2.0	-0-	1,470	2.0	-0-
3 Technicians	2,363	3.25	-0-	2,485	3.25	-0-	2,620	3.25	-0-
COUNTRY STUDIES									
Taiwan:									
3 Faculty	2,389	2.1	1.0	2,508	2.1	1.0	2,636	2.1	-0-
Overseas Associate	3,750	6.0	6.0	3,750	6.0	6.0	3,750	6.0	6.0
" Assistant	1,250	6.0	6.0	1,250	6.0	6.0	1,250	6.0	6.0
Programmer	664	0.8	-0-	704	0.8	-0-	748	0.8	-0-
Research Assistant	1,333	2.0	-0-	1,400	2.0	-0-	1,470	2.0	-0-
7 Technicians	9,386	17.0	13.0	9,612	17.0	13.0	9,854	17.0	12.0
3 Adm., Sec., Cler.	2,595	5.0	-0-	2,725	5.0	-0-	2,861	5.0	-0-
Total	11,981	22.0	13.0	12,337	22.0	13.0	12,715	22.0	12.0
Philippines:									
3 Faculty	2,389	2.1	1.0	2,508	2.1	-0-	2,636	2.1	0.5
Overseas Associate	3,000	6.0	6.0	3,000	6.0	6.0	3,000	6.0	6.0
" Assistant	1,000	6.0	6.0	1,000	6.0	6.0	1,000	6.0	6.0
Programmer	664	0.8	-0-	704	0.8	-0-	748	0.8	-0-
Research Assistant	1,333	2.0	-0-	1,400	2.0	-0-	1,470	2.0	-0-
7 Technicians	8,386	17.0	13.0	8,612	17.0	12.0	8,854	17.0	12.5
3 Adm., Sec., Cler.	2,595	5.0	-0-	2,725	5.0	-0-	2,861	5.0	-0-
Total	10,981	22.0	13.0	11,337	22.0	12.0	11,715	22.0	12.5
Japan:									
3 Faculty	2,389	2.1	-0-	2,508	2.1	1.0	2,636	2.1	0.5
Overseas Associate	3,000	6.0	6.0	3,000	6.0	6.0	3,000	6.0	6.0
" Assistant	1,000	6.0	6.0	1,000	6.0	6.0	1,000	6.0	6.0
Programmer	664	0.8	-0-	704	0.8	-0-	748	0.8	-0-
Research Assistant	1,333	2.0	-0-	1,400	2.0	-0-	1,470	2.0	-0-
7 Technicians	8,386	17.0	12.0	8,612	17.0	13.0	8,854	17.0	12.5
3 Adm., Sec., Cler.	2,595	5.0	-0-	2,725	5.0	-0-	2,861	5.0	-0-
Total	10,981	22.0	12.0	11,337	22.0	13.0	11,715	22.0	12.5

Table 2 (cont'd.)

COUNTRY STUDIES (cont'd.)

	1973-74			1974-75			1975-76		
	$	Man Mos.	Mos. O'seas	$	Man Mos.	Mos. O'seas	$	Man Mos.	Mos. O'seas
Kenya:									
3 Faculty	2,389	2.1	1.0	2,508	2.1	1.0	2,636	2.1	-0-
Overseas Associate	4,500	6.0	6.0	4,500	6.0	6.0	4,500	6.0	6.0
" Assistant	1,500	6.0	6.0	1,500	6.0	6.0	1,500	6.0	6.0
Programmer	664	0.8	-0-	704	0.8	-0-	748	0.8	-0-
Research Assistant	1,333	2.0	-0-	1,400	2.0	-0-	1,470	2.0	-0-
7 Technicians	10,386	17.0	13.0	10,612	17.0	13.0	10,854	17.0	12.0
3 Adm., Sec., Cler.	2,595	5.0	-0-	2,725	5.0	-0-	2,861	5.0	-0-
Total	12,981	22.0	13.0	13,337	22.0	13.0	13,715	22.0	12.0
Brazil:									
3 Faculty	2,389	2.1	-0-	2,508	2.1	1.0	2,636	2.1	1.0
Overseas Associate	4,500	6.0	6.0	4,500	6.0	6.0	4,500	6.0	6.0
" Assistant	1,500	6.0	6.0	1,500	6.0	6.0	1,500	6.0	6.0
Programmer	664	0.8	-0-	704	0.8	-0-	748	0.8	-0-
Research Assistant	1,333	2.0	-0-	1,400	2.0	-0-	1,470	2.0	-0-
7 Technicians	10,386	17.0	12.0	10,612	17.0	13.0	10,854	17.0	13.0
3 Adm., Sec., Cler.	2,595	5.0	-0-	2,725	5.0	-0-	2,861	5.0	-0-
Total	12,981	22.0	12.0	13,337	22.0	13.0	13,715	22.0	13.0
SECONDARY MATERIALS AND SYNTHESIS									
2 Faculty	1,030	1.25	-0-	1,085	1.25	-0-	1,150	1.25	-0-
CONTRACT TOTALS:	63,298	114.5	63.0	65,255	114.5	64.0	67,345	114.5	62.0

ALL SALARIES $195,898
(Overseas & Domestic)

MAN-MONTHS   343.5

Of which,   189.0 will be spent overseas

Table 3

3/7/73

TECHNOLOGY CHOICE & EMPLOYMENT

1973-76

Analysis by Components

AGGREGATIVE	$16,205
COUNTRY STUDIES	
Taiwan	63,206
Philippines	60,206
Japan	60,206
Kenya	66,206
Brazil	66,206
SECONDARY MATERIALS AND SYNTHESIS	6,057
INTERDISCIPLINARY SEMINAR	15,000
	$353,292

ECONOMIC GROWTH CENTER

Employment Studies Publications
Supported by the Agency for International Development

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Discussion Papers

71. "Technological Transfer, Employment, and Development,   J.C.H. Fei and
     (Revised)," August 1, 1969   Gustav Ranis

89. "Income and Wealth Distribution in the Development
     Process and Their Relationship to Output Growth,"   R.A. Berry
     July 1970

90. "Relative Prices in Planning for Economic Development,"
     July 1970   Gustav Ranis

94. "Economic Efficiency, Capital-Intensity and Capital-
     Labour Substitution in Retail Trade," September 1970   A.S. Bhalla

95. "Industrialization, Employment, and the Choice of Al-
     ternative Vintage Equipment in Less Developed Countries," Howard Pack and
     (No. 43 Revised), September 1970.   Michael Todaro

96. "A Disaggregative Approach to LDCs' Tertiary Sector,"
     (No. 88 Revised) September 1970   A.S. Bhalla

97. "Technology Choice, Employment and Growth," Septem-
     ber 1970   Gustav Ranis

98. "LDC Innovation Analysis and the Technology Gap,"   J.C.H. Fei and
     September 1970   Gustav Ranis

105. "Labor Productivity and Other Characteristics of   Carlos Diaz
     Cement Plants: An International Comparison," Feb-   Alejandro
     ruary 1971

107. "Land Reform and the Agricultural Income Distribu-
     tion," March 1971   R.A. Berry

108. "Land Distribution, Income Distribution and the
     Productive Efficiency of Colombian Agriculture,"   R.A. Berry
     March 1971

110. "Development and Employment in the Open Dualistic   J.C.H. Fei and
     Economy," April 1971   Gustav Ranis

116. "Industrial Sector Labor Absorption," July 1971   Gustav Ranis

Employment Studies

Publications

DP 124.	"Investment in Agricultural Research and Extension: A Study of International Data," August 1971	Robert Evenson & Yoav Kislev
DP 125.	"The Role of the Industrial Sector in Korea's Transition to Economic Maturity," August 1971	Gustav Ranis
DP 142.	"The Relevance and Prospects of Small Scale Industry in Colombia," April 1972	Albert Berry
DP 144.	"The Rate of Interest and the Demand for Labor," May 1972	Albert Berry
DP 145.	"Unemployment as a Social Problem in Urban Colombia: Some Preliminary Hypotheses and Conclusions," May 1972	Albert Berry
DP 152.	"Some Observations on the Economic Framework for Optimum LDC Utilization of Technology," August 1972	Gustav Ranis
DP 163.	"Unemployment as a Social Welfare Problem in Urban Zaire" November 1972	James McCabe
DP 168.	"Rural-Urban Migration, Urban Unemployment and Underemployment, and Job Search Activity in LDCs," December 1972	Gary Fields
DP 170.	"Tariff Policy, Equipment Production and Employment in Developing Countries," January 1973	James McCabe

Employment Studies
Publications

Other Papers (cont'd.)

"Employment and Productivity in Kenyan Manufacturing"
    November 1972   Howard Pack

"Factor Intensity of Consumption Patterns, Income Dis-
    tribution and Employment Growth in West Pakistan,"   Ronald Soligo
    November 1972

"Labor in the Indian Agriculture Sector," November 1972   Robert Evenson

"Some Evidence on Educational Relationships in Chile,"   Marsha Goldfarb
    November 1972

Economic Growth Center

Summary of Recent Research Results

Relevant to Employment in LDC's

Introduction

Since its inception, researchers at the Growth Center have been con-

cerned with the problem of LDC unemployment (either open or disguised). The

initial theoretical construct centered around the concept of labor surplus and

emphasized disguised unemployment. This original Fei-Ranis system has been

subsequently modified to allow for the possibility of external trade. Moreover,

a land-surplus model has been developed,[1] and countries where this framework

seems most appropriate have been or are being analyzed. (The Ghana and Zaire

studies to which this model is applicable are in their initial stages and not

reported on here.) In addition, a model of open unemployment, attributable

to an institutionally-determined floor on the real wage, has been formulated.

These models have been used as a means of explaining observed phenomena,

since the main approach of the Center's research has been empirical. In addi-

tion to historical case studies of individual countries, this **empirical** re-

search has taken the form of analysis of factor proportions in specific **sectors**

or **industries** and an examination of the relevance for employment and output

generation of different growth phases (e.g., import vs. export substitution).

There has been a good deal of work and data evaluation concerning the entire

mechanism of technological transfer from advanced to developing countries and

of the importance of labor-using innovations "on-top-of" imported techniques.

This analysis of individual processes has provided policy implications with

regard to effective means of overcoming unemployment which go well beyond

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[1] A land surplus model was formulated by Gerald K. Helleiner in "Typology
in Development Theory: The Land Surplus Economy (Nigeria)." (Food Research
Institute Studies, Vol. VI, No. 2, 1966).

those associated with the conventional production function approach. While
trade policies have been emphasized as the principal means of achieving a more
labor-intensive output mix and possibly greater income equality, especially
in the smaller LDC's, some consideration has also been given to changes in the
bill of goods associated with an exogenous redistribution of income.

While the Growth Center's work to date has dealt with the employment
problem mainly from the demand side, some work on the determinants of the
supply of labor has been initiated as well. For the cases of Pakistan and
Turkey, for instance, an extensive analysis of the determinants of labor force
participation and of fertility rates, respectively, has been carried out. In
a more general study, evidence of negative relationships between household in-
come and household fertility rates in cross-section samples has been collected.
Conclusions have been drawn regarding the impact of such differential fer-
tility on changes in the mean level and dispersion of per capita income over
time.

The following pages present a brief summary of recent Center papers and
journal articles (1968-1972) relating to LDC employment. It is presented by
way of a topical ordering proceeding from the general to the specific. The
presentation begins with the theoretical framework, then moves to country
case studies and the analysis of technology choice and transfer over space
and time. It concludes with studies of individual sectors, the impact of exogenously
redistributing income, and an investigation of the determinants of labor
supply.

1. Macro-Economic Models

Open Dualistic Economy Model. Fei and Ranis[1] have developed a model linking agricultural production to urban employment via the supply schedule for industrial labor. When, as a consequence of slow growth of agricultural production, the terms of trade shift against industry (i.e., the price of agricultural goods rises relative to that of industrial goods) the real wage (expressed in terms of industrial goods) must rise. Under these circumstances the industrial entrepreneur is likely to offset possible encroachment of his profits by adopting labor-saving innovations. Also, reduced profit margins may cause savings to decline and the rate of capital formation to decrease. For both reasons, industrial employment is adversely affected.

Another factor detrimental to urban employment is the possibility of a rise in the agricultural real wage as development progresses. Fei and Ranis contend that while some rise is inevitable if agricultural productivity increases, a sustained increase takes place when, with the elimination of disguised unemployment, the agricultural real wage is increasingly determined by market forces rather than an institutional consensus. The rise in the agricultural real wage will also cause the industrial labor supply schedule to shift to the left and bring on the employment difficulties described above.

One way of preventing the terms of trade from shifting against industry is to expand food imports by means of labor-intensive industrial exports. By maintaining industrial real wage stability in this manner the country can sustain a much higher pace of industrial output and employment growth in the face of relative agricultural stagnation than would have been possible in the closed economy.

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[1]J.C.H. Fei and Gustav Ranis, "Development and Employment in the Open Dualistic Economy," Growth Center Discussion Paper No. 110, April 1971.

Fei and Ranis show that countries actually have adjusted to agricultural stagnation in the manner prescribed by their analytic framework. A good contemporary example is Korea; historical cases include the repeal of the Corn Laws in the U.K. and Japanese food imports from her colonies after 1900.

Fei and Ranis emphasize, however, that it may be desirable or even necessary to attempt an increase in agricultural productivity before diverting resources to industrial exports. They indicate that if a very large fraction of the population initially resides in the agricultural sector, the country should concentrate on agricultural policy as a prerequisite for solving its total ' unemployment problem. In cases where the resource endowment is unfavorable to the expansion of agricultural productivity, stress should be placed on industrial exports even before the commercialization point characterized by substantial increases in the agricultural real wage and the disappearance of underemployment.

Minimum Wage Model. Most of the pure theory of international trade deals with full-employment economies. By relaxing the usual assumption that the real wage is perfectly flexible, it is possible to focus upon a situation of unemployment. Brecher's work extends the standard Heckscher-Ohlin type of analysis of an open economy to the case where the real wage is subject to an exogenously specified floor or minimum.[1] This floor--institutionally determined at the same level in all sectors of the economy--constrains the actual wage to exceed the wage required for full employment. Therefore the labor force is partially unemployed. Once market forces have bid the wage down to the minimum level, any of the given labor not yet utilized forms a pool of unemployed who are willing to work at the going (minimum) wage but

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[1]R. Brecher, "Minimum Wage Rates and the Pure Theory of International Trade," Growth Center Discussion Paper No. 140, April 1972.

are unable to get hired. Producers in the minimum-wage economy hire no more labor from the pool of unemployed than is needed to satisfy demand and supply in world commodity markets. In contrast to the open dualistic economy model, Brecher assumes that the real wage in agriculture is equal to the marginal product; hence, his is a model of open unemployment rather than underemployment.

A standard foreign offer curve is introduced in order to determine equilibrium in all markets, including the labor market of the home country. The following propositions are then demonstrated: (1) a minimum wage imposed in only the home country may be sufficient to restrict the wage in both countries to the home floor; (2) a move from autarky to free trade may decrease home employment and home welfare--not the case with a perfectly flexible wage; and (3) imposing a minimum-wage constraint in a free-trade situation will generally decrease home employment, but may still improve home welfare, and may reverse the direction of trade (in which case welfare decreases).

Traditional changes in tariffs are analyzed. It is shown that, when a tariff is raised: (1) home employment may decrease, although an increase (decrease) in some welfare may accompany a decrease (increase) in employment; (2) an inelastic foreign offer curve ensures a rise in home welfare (as in the case of a perfectly flexible wage), even when home employment drops; and (3) when the home country possesses (lacks) monopoly power in trade, a zero (positive) trade tax may be superior to any positive (zero) trade tax--also not the case with a perfectly flexible wage.

Brecher shows that in cases where open unemployment is attributable
to factor price rigidity and fixed proportions in different sectors, rather
than a lack of aggregate demand, a decrease in the tariff rate will in most
cases increase aggregate employment. This is true simply because demand and
resources are shifted to an export sector, assumed to be relatively labor-
intensive. Such an effect, of course, runs counter to the typical Keynesian
view which emphasizes the reduction in expenditure leakage brought on by
a tariff increase and the accompanying rise in aggregate demand.

2. Country Cases

Taiwan and Korea. By examining factors affecting the growth of employ-
ment in Korea and Taiwan, Fei and Ranis have shown that important exceptions
exist to the overall experience of LDC's during the 50s and 60s, which has
been one of increasing underemployment and open unemployment rates despite
often quite satisfactory per capita income growth.[1] They divide the post-
colonial period of development in Korea and Taiwan into two important sub-
phases: import substitution and export substitution.

The analysis clearly indicates that the so-called conflict between
output and employment objectives in the open labor surplus type of economy
necessarily holds only during the import substitution phase when a number of
key relative prices are severely distorted, for some good and some not so
good reasons, and the veil between factor endowment and factor use is conse-
quently most pronounced. During this period, the development process is
fuelled largely via traditional agricultural exports, with output mixes
changing mainly through the substitution of consumer good imports while

[1] J.C.H. Fei and G. Ranis, "Growth and Employment in South Korea and
Taiwan," November 1971 and J.C.H. Fei and G. Ranis, "A Model of Growth and
Employment in the Open Dualistic Economy: The Cases of Korea and Taiwan,"
May 1972, papers presented at the Employment Conference, Economic Growth
Center, 1972.

technology in the rapidly growing industrial sector is mainly of the imitative or transplanted variety.

Once entrepreneurial maturation and the creation of the requisite overheads have been achieved and the economy is capable, politically as well as in the changing resource endowment sense, to adjust the crucial relative prices in the direction of their equilibrium values, the system is in position to enter its export substitution sub-phase. This began around 1960 and 1963 for Taiwan and Korea respectively, when there was reduction in the level of protection and relative factor prices were adjusted to reflect more closely the economies' endowment. In both countries such changes were achieved via packages of devaluation, import liberalization and interest rate reform. In both countries, there was marked change in the composition of exports at approximately the same time, with industrial exports as a fraction of the total moving up in Taiwan after 1960 and a few years later in the case of Korea. In both countries, total industrial exports, generally of a labor-intensive nature, have been growing at an average rate of 35 percent annually. There is also evidence that the more realistic sets of factor prices have induced innovations "on top of" imported capital equipment. The success of this policy is documented by not only a relative but also an absolute decline in the number of underemployed persons during the late 1960s in both countries. (In the Taiwan and Korean cases, unemployment takes mainly the disguised rather than the open form.) Moreover, partly as a consequence of these employment promoting policies, the decade of the 1960s was a period of a more rapid output growth than the 1950s in both countries.

Colombia. Berry[1] finds an inverted U-shaped relationship between the rate of underemployment and the degree of income inequality, on the one hand,

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[1]See A. Berry, "Some Determinants of Changing Income Distribution in Colombia: 1930-1970," Growth Center Discussion Paper No. 137, March 22, 1972; and A. Berry, "Unemployment as a Social Problem in Urban Colombia: Some Preliminary Hypotheses and Conclusions," Growth Center Discussion Paper No. 145, May 1972.

and real per capita GNP on the other in Colombia. He finds evidence of a growing rate of underemployment from about 1945 to 1953 in urban areas and a worsening of the aggregate income distribution. From 1953 to the end of the 1960s, he finds important reductions in the rate of urban underemployment. This decline, combined with a decrease in the relative number of persons employed (but generally not fully) in agriculture, implies a decrease in the aggregate underemployment rate. At the same time Colombia experienced quite a high growth rate in per capita real output.

Like Fei and Ranis, Berry finds a definite association between protectionest trade policies and growing income inequality and underemployment up to the mid-1950s. He, however, places more emphasis on the impact of these policies on income distribution (size as well as functional) than do Fei and Ranis.[1] Even allowing for reduction in payments in kind and self-employment (which would cause the paid labor share to increase even though the true labor share remained constant), there is evidence of a significant decrease in the share of capital during the period following the exchange reform of 1958 (which characterized both exchange rate devaluation and liberalization measures). By examining changes in the relative wage and employment rates of workers at different skill levels, Berry makes a gross estimate of the variation in the size distribution of wage income during the post-devaluation period, and concludes that it has improved. Berry presents evidence that the urban open unemployment which existed at the end of the 1960s was essentially among workers with white-collar education. This, he argues, is attributable

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[1]The size distribution of income refers to an ordering of economic units by total income received irrespective of source. The estimation of this distribution requires data at the micro level, usually consisting of a sample of households or individuals. The functional distribution refers to a classification of aggregate income by source. The basic distinction usually made is between labor income and capital income--where the former includes money wages (and imputations, if the calculation is a sophisticated one) to labor.

to an aspiration level which is inconsistent with the occupational structure of labor demand.

Chile. The Chilean experience during the decade of the 1960s offers a possible attempted solution to growing unemployment rates in developing countries of somewhat larger size than Korea and Taiwan. Mamalakis shows that, even in a relatively small country like Chile, significant reductions in open unemployment rates have been effected by a significant increase in the output share of the labor-intensive domestic capital goods industry. This is different from the Taiwan and Korea cases which have been characterized by expansion of labor-intensive industrial exports and, especially in the former, negligible import substitution in capital goods.

The model constructed by Fei and Fanis for Korea and Taiwan serves to demonstrate the importance of agricultural production to achieving reduced open or underemployment rates along with rapid output growth. High rates of agricultural productivity tend to keep the real wage (expressed in terms of the industrial commodity) relatively low, though the real wage expressed in terms of the domestic agricultural commodity may be increasing along with the supply of labor available to the industrial sector. This is true simply because the relative price of the agricultural commodity is decreasing (or at least not increasing as rapidly). Under these conditions, the capital/employment ratio may fall because of the demand for labor increases in the industrial sector despite a rapidly rising real wage expressed in terms of the agricultural commodity. Mamalakis notes that, unlike the land reform in Taiwan, the land reform in Chile has caused agricultural output to decrease rather than increase even though it has increased the amount of labor employed in agriculture. To the extent that this may cause rapid increases in the real wage expressed in terms of the industrial commodity, the rate of

industrial sector labor absorption may be substantially decreased. This

problem, Fei and Ranis fear, may also impede rapid growth in industrial em-

ployment in Korea in future years

Mamalakis also comments on the possible employment effects of shifts

in the bill of goods demanded brought on by direct re-distribution of income

on the part of the Allende government:

> The Chilean socialist-radical-communist government has assumed,
> along with most development economists, that profits are
> widely used for luxury consumption and wages for mass-produced,
> labor-intensive industrial goods. As expected, its policies of
> redistributing income in favor of labor have substantially
> increased demand for industrial products, reduced low utiliza-
> tion of employed labor and capital stocks, and even expanded
> employment. The redistribution cf industrial profits in
> selected firms has also, however, brought them to bankruptcy and
> led to take over by the government.

Mamalakis concludes that it is still too early to tell what the full effect

will be of such a radical transformation in the structure of ownership on em-

ployment and output growth. One of the main questions, of course, is whether

or not wage earners and the government are able to maintain a high enough

savings rate to prevent a significant decline in the rate of growth of total

capital. Another problem is that Chile does not fit the Socialist model

well to the extent that there is not a neat division between capitalists and

laborers. Persons earning wages in Chile include such diverse groups as low

paid agricultural workers and high paid professionals who may have radically

different demand patterns. Finally, while the government sector is very im-

portant in Chile, the Socialists usually place little emphasis on the level

and composition of government expenditure and its effect on the labor-

intensity of output mix. Therefore Mamalakis is proceeding to analyze the

growth and employment impact of the redistribution and expenditure policies

of the Allende government with his own somewhat modified version of the Socialist model.

3. Technology Choice and Adaptation

The Role of the Domestic Equipment Industry. The desirability for underdeveloped countries to further their productive potential in capital goods is analyzed by Pack and Todaro[1] who feel that, as long as LDCs import capital goods, their choice is too restricted. As long as capital goods production is concentrated almost exclusively in developed countries, the relatively insignificant demands of the LDCs for these goods can have only a negligible impact on both current production decisions and, more important, on the direction the factor saving bias will take in the future. The authors argue that, to help alleviate the output and employment conflict, the LDCs, especially larger ones, should produce their own machinery, initially copying the earlier, more labor intensive designs, of the Western countries. This would permit the adoption of more recent labor saving techniques to be introduced at a speed consistent with changing domestic factor availabilities. Further, domestic users of the equipment are then enabled to work closely with the producers--a feature which is of considerable importance given the made-to-order nature of most machinery.

The authors further support their contention by presenting data which suggests that the capital/labor ratio in the machinery industry is typically quite low. The absence of substantial economies of scale (a result of the specialized non-mass production nature of the industry) also makes the industry a natural choice. Probably the main precondition for the establishment of the

[1] Howard Pack and Michael Todaro, "Technological Transfer, Labor Absorption, and Economic Development," Oxford Economic Papers, November 1969.

capital goods industry is the provision of limited amounts of skilled and semi-skilled labor where it does not already exist.

Evidence from a number of countries (e.g. Brazil, Argentina, Pakistan) suggests that LDCs can be competitive in the production of machines. It is suggested that, since specialization does have its advantages in this branch of industry, trade among LDCs would increase the overall potential of the proposed strategy.

International Borrowing. Ranis and Fei[1] discuss the principles and rules under which it appears that LDCs could benefit most from borrowed technology. At a given point in time, an LDC may be thought of as having access to a shelf of technology corresponding to the various vintages in the more developed countries, with the more recent vintages typically characterized by higher capital/labor ratios. The shelf continuously expands and changes composition as technological change proceeds in the more developed countries, but it always involves some range of choice among capital/labor ratios. The authors emphasize the fact that the technology which can be adopted at a point in time is closely related to the skill and education characteristics of the adopter. A wise borrower is constrained by the education and skill attainment levels of its own economic agents.

Technological borrowing may involve "pure transplantation" or "technological assimilation." In the latter, domestic innovative effort is imposed on the imported technology in order to modify and adapt its initially capital using character to make it more suitable to the labor rich/capital scarce factor endowment situation of the typical LDC. Such assimilation has been documented for Japan (Ranis,) Mexico (Strassman), and the Soviet Union

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[1] Gustav Ranis and John C.H Fei, "Technological Transfer, Employment and Development," (revised). Growth Center Discussion Paper No. 71, August, 1969.

(Granick). The importance of technological borrowing, and especially of successful assimilation, helps to make human resource development somewhat disregarded in the early phases of contemporary growth theory, a key factor. Economies which try to borrow ahead of their skill level find it more difficult or even impossible to effectively assimilate what they borrow.

The authors develop a model to analyze the relationship between technological transfer and technical unemployment. They focus on the complementarity (for the resolution of the unemployment problem) of an adequate level of austerity, the creation of the proper educational preconditions in terms of both quality and quantity, and sufficient ability and willingness to assimilate imported technology. In this model, the twin social objectives of raising per capita income and eliminating unemployment are not in conflict.

The conclusion emerges that, if there is simply pure transplantation, successful growth can occur if and only if increasing labor productivity in the mature economy (from which borrowing occurs) is accompanied by a sustained decrease in the capital/output ratio. Empirical studies have shown that the capital/output ratio in mature countries seems to have undergone long swings in both upward and downward directions, so this would not be a plausible assumption. Assimilation is therefore required.

The aforementioned paper both outlines a plausible model of the interaction of relevant economic variables and presents some evidence that the historical evolution of the Japanese economy between 1878 and 1939 is consistent with the interpretation proposed. In doing so, it pinpoints the possible substantial benefits which may accrue to the country that borrows wisely, i.e. at factor proportions as consistent with its own as possible; that exercises a substantial effort to assimilate and modify the technology; and that develops its own human resources in such a way as to complement the foreign

technology and to permit its assimilation. As a consequence, from an initial level of technical unemployment of 10-20 percent in 1870, the Japanese economy reached the turning point (where unemployment ended) by the 1930s--a conclusion supported independently by other evidence.

Pack and Todaro[1] argue that, in an analysis of the lag of employment behind output growth in LDC manufacturing sectors, it is necessary to consider the technological alternatives faced by firms of different size and, above all, the choices made by expanding firms. Several empirical studies show that, over certain ranges, the productivity of both capital and labor tend to increase. This could be explained by increasing returns to scale, but the authors think that it is the heterogeneous nature of equipment used by firms of different size which is more likely responsible. Much of the evidence suggests that capital-labor substitution becomes profitable only at relatively high volumes of production.

The authors also contend that, as the firm's profits grow, retained earnings permit more extensive choice among technologies. It may be anticipated that, when current machinery wears out, the choice will be among more capital intensive technologies. If the technological choice set has little convexity, then there will be a strong bias towards adopting the new labor saving technology. The authors suggest that, even with uniform low wages, a small employment elasticity will result as the economy expands, assuming that a good number of smaller firms are growing. Until most firms are in the modern regime, the changing distribution of output among firms is likely to produce lower employment elasticities than found in developed countries. The main possibility for mitigating this lag is the adaptation (along the Japanese and

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[1] Howard Pack and Michael Todaro, "Industrialization, Employment and the Choice of Alternative Vintage Equipment in Less Developed Countries," Growth Center Discussion Paper No. 95, September 1970.

Russian lines) of labor intensive methods in peripheral activities such as conveyance.

The more modern vintage capital of larger firms and its higher productivity probably implies that these firms are willing to pay higher wages than do small firms. The observed higher wages are not necessarily a main cause of the employment problem but rather the result of the higher productivity of recent vintage capital; measures to eliminate wage differentials might result merely in an increase in quasi-rents on the existing vintages. A wage subsidy could even decrease employment in certain cases, where, in effect, it gives the firms more capital with which to expand to a newer vintage technology.

The Pack-Todaro arguments provide interesting possible explanations of wage differentials by size of firm and suggest the need for caution in the assessment of the employment generating effect of a wage control policy. Their exposition is designed as an interpretation of the historical record and does not, of course, imply that all industries are or must be characterized by important increases in capital intensity by firm size.

Indigenous Adaptation. Ranis[1] has undertaken an extensive analysis of methods used to increase the labor intensity of production techniques at the individual process level. On the basis of Japanese, Taiwanese, and Korean experiences, he shows that even when the choice of machine type is limited, considerable change in factor proportions from that appearing in more developed countries may be effected. This change, which Ranis has labeled "capital stretching" takes three forms. Ranis writes:

> In assessing the importance of capital stretching innovations, it is useful to recognize distinctions between innovations relating to the machine proper; innovations relating to the

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[1] Gustav Ranis, "Industrial Sector Labor Absorption," forthcoming in Economic Development and Cultural Change, March 1973.

production process as a whole, emphasizing the importance of
activities within the plant but peripheral to the machine; and
innovations with respect to the production process as a whole,
emphasizing plant size and organization at various stages of
that process.

The most common examples of the first type of innovations are machine speedups
and increases in the number of shifts. Ranis' paper illustrates several cases
of such increases in utilization in the textile industries of post-Restoration
Japan and contemporary Korea and Taiwan.

Intra-plant increases in labor intensity may be achieved in a variety
of ways other than increases in the utilization of machinery. One innovation
involves the substitution of cheap for expensive raw materials in Japanese
textile production. The use of shorter staple cotton saves machinery necessary
for raw material production. The additional number of broken threads can be
handled by employing more women. Greater use of human conveyor belts and hand
packaging also affords greater labor intensity. In Korean cotton weaving, for
example, there is no mechanical conveyor belt in the carding and combing opera-
tions.

The third type of innovation is plant-saving. This is accomplished
generally by means of a "putting-out" system and rural sub-contracting.

From the micro-economic data he was able to collect for contemporary
Korea and Taiwan, Ranis concludes that capital-stretching innovations are more
prevalent the closer the process is to the finished product stage. This is con-
sistent with the hypothesis that, in a developing country which is open and
not too large in size, the appropriate price incentives may be expected to pro-
duce a substantial increase in the employment-capital ratio, despite a depen-
dence on imported machinery.

4. Government Policy Employment and Distribution

Wage Differentials. In this paper,[1] Reynolds reviews some of the information on the behavior of earnings and examines a number of factors which would affect the over time movement of real agricultural earnings in particular. In the discussion of rural earnings it is necessary to take account of the fact that, at an early stage of development, farm income consists largely of production for home use. Although the Lewis or Ranis-Fei type growth models often conclude that these earnings are likely to lag behind productivity increase over time, factors other than those mentioned also play a role. The relationship between these wage rates and the urban wage level (related by migration and other mechanisms) is an important question still to be answered.

In the low productivity urban sector, as in agriculture, most people are self-employed; there is a crowding into these activities which leads to low output and low income per worker. Little is known about incomes in this sector although it is widely assumed that rural-urban migration is a substantial equilibrating factor. Exactly what sort of relationship is provided depends on how accurate is the information concerning migrants, how high migration costs are, how important are the non-monetary attractions of the city, and so on. Although models frequently assume that average earnings will be higher in the cities, one could readily argue that they would be lower.

With respect to wages of unskilled labor in the modern urban sector, limited statistical evidence suggests that (a) they vary considerably more among the stablishments than is true in more developed countries (suggesting greater labor market imperfections) with the small firm-large firm differential

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[1] Lloyd G. Reynolds, "Relative Earnings and Manpower Allocation in Developing Economies," (The Pakistan Development Review, Vol. IIXI, No. 2, May 1969).

much greater than is the case in the developed countries; (b) wage levels in the modern sector seem high relative to earnings in traditional activities-- they are often 2 or 3 times as high--well above the 30 or 40 percent differential hypothesized in some growth models. The high wage policy may **persist** because is has little effect on costs in the "leading" capital intensive manufacturing and extractive industries, because it has productivity and intangible public relations advantages and because the employers are not entirely free to choose. This latter element is especially true for the government sector, but also for large scale industry. Minimum wage legislation is widespread in LDCs and usually exerts substantial pressure on the wage structure.

Once a wage differential has developed it tends to harden into custom. The modern-traditional gap may widen over the early decades of development as value added per worker in the modern sector rises rapidly over time. Earnings in traditional activities are likely to rise only gradually.

The wages of skilled manual workers are basically market-determined and their premium over non-skilled workers is considerably larger than in more developed countries. There are also indications that large wage differentials for educated white collar workers are common in the LDCs.

The wage information summarized by Reynolds suggests that, for many LDCs, skilled blue collar and white collar workers remain a scarce resource and the corresponding levels of education should still be quite productive. The apparently negative relationship between wage rates and employment in the modern sector and rural-urban migration is relevant both to government wage legislation policy and general questions of efficient allocation of resources in the economy; the implication is strong that too much intervention may de- crease allocative efficiency.

<u>Policies Affecting Factor Prices</u>. What role do relative prices have in planning? Ranis[1] notes that their role has been depicted in classical and neoclassical literature, as instruments in the achievement of efficient resource allocation over time and space. However, since the market left to its own devices is often hypothesized to generate the right prices, the relevance for practical planning may be meager. In order to make the price system the central instrument in achieving efficient resource allocation, there must be (a) no economic necessity for the government to play a substantial role in the economy's directly productive areas, (b) relatively full and free flow of information and resources and (c) no overriding ideological or other non-economic necessity for intervention. Frequently none of these conditions are fully satisfied.

The development problem requires much more than the simple policy advice flowing from the analysis of a general equilibrium system. Structural change via a broadening of the resource base--both human and material--is needed. At this stage of development the infant industry argument has much validity. During the import substitution phase, however, there is much distortion of prices as exchange rates become overvalued, interest rates decline, and rationing exerts its influence. Typically there is also neglect of agriculture as its terms of trade are depressed. This stage may be useful in the long run only if it can be gradually dismantled; otherwise the assumed absence of entrepreneurs may be self-fulfilling; its logic depends on its uncovering additional resources, rather than its efficiently allocating known and given resources.

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[1]Gustav Ranis, "Relative Prices in Planning for Economic Development," in <u>International Comparisons of Prices and Outputs</u>, D. J. Daly, editor, N.B.E.R. 1972.

The next stage requires a broadening of the development base to harness a larger proportion of the previously disenfranchised economic agents. In this phase it is impossible for direct government ownership or control to play an important role. Relative price adjustments for agriculture are likely to be a _sine qua non_ for the adoption of available new technology. Probably the most important relative price to be adjusted is the exchange rate, but the significance of the interest rate and other administered prices should not be neglected.

Changes in Income Distribution. Soligo examines the effect of equalizing the size and sectoral distribution of income on output and employment.[1] Results for Pakistan show that the capital and labor intensity of the household consumption pattern increases with income and is higher for urban consumers. He then examines the effect of an equalization of the distribution of income on output and employment growth. This involves two experiments. In the first experiment, he demonstrates the effect on output and employment of a policy of distributing the increments in income equally among all persons. The output and employment level associated with this policy are compared with those resulting from a policy which leaves the existing size distribution intact. In the second experiment, he compares the case where the existing distribution remains intact with the case where the distribution of income within each sector (rural and urban) remains the same but the overall distribution of both sectors combined changes because of unequal growth of each sector's income.

The results show that short-run employment is insensitive to changes in the sectoral and size distribution of income, although the extreme alterations which Soligo considers do significantly affect the long-run output growth

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[1] Ronald Soligo, "Factor Intensity of Consumption Patterns in West Pakistan," April 1972.

rate Soligo concludes that, by following a perfect equalization policy with respect to the distribution of income growth, West Pakistan could increase its rate of growth of output and long-run employment growth rate by 10 percent. The experiment involving a redistribution of income in favor of agriculture increases the output growth rate.

It should be pointed out that Soligo's experiments involve large degrees of redistribution which go well beyond alterations in fiscal activity observed in most LDC's. With this point in mind, Soligo's results indicate that changes in income distribution reasonably within the limits of current fiscal practice would have negligible impact on both output and employment. Hence, the hypothesis now fashionable that exogenous income redistribution will cause both output and employment to increase significantly by increasing the output share of labor-intensive goods is not supported.

5. Industrial Sector Employment

Latin American Cement. Carlos Diaz's comparison of the cement industry in Latin America with that in the U.S., Canada, and Australia[1] is a "micro" attempt to explain and quantify the sources of productivity difference in this industry. It also attempts to measure the degree of capital-labor substitution that exists in this activity.

Differences in average labor productivity between LA and non-LA plants, Diaz concludes, are only partly attributable to differences in capital-labor ratios and scale. Structural differences are so great between the two groups that it may be said that they operate on different production functions.

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[1] Carlos Díaz-Alejandro, "Labor Productivity and Other Characteristics of Cement Plants: An International Comparison," Growth Center Discussion Paper No. 105, February 1971. To be published in Jagdish Bhagwati and Richard Eckaus, ed., Development and Planning: Essays in Honor of Paul Rosenstein-Rodan (Allen and Unwin in collaboration with the MIT Press).

Factor proportions even in the cement industry seem to be somewhat sensitive to relative factor prices. The estimated elasticity of substitution, though not high, is significantly greater than zero. Moreover, this estimate may well be biased downward since the capital proxies used may not pick up equipment used in quarries and for material handling, as well as computers.

Diaz also lays out interesting areas of further research. He points out that "the data leave unclear what kinds of capital labor can substitute for. A closer look at labor allocation within cement plants, as well as a more detailed inventory of capital goods, is the next step in clarifying this point. Such an investigation may also shed light on what other factors, besides scale and capital per worker, account for the much higher average labor productivity of non Latin American plants. It should also help to establish whether efficiency differences are neutral regarding labor and capital, or whether systematic biases exist. A last point which could be cleared up with the help of these detailed data concerns the degree to which the LA plants incorporate within themselves a larger amount of processes and social overhead facilities, including not only bagging and electricity but also housing and repairs, which are excluded from NLA cement plants."

Diaz's results bear on the factor substitutability and efficiency issues as they arise in one fairly important industry. The further work outlined above and now being undertaken by Diaz should provide additional insights along these lines.

Korean Industry. Ranis draws a contrast between the role of the industrial sector in Korean development and that in Japan and Taiwan.[1] He draws a "normal" scenario for the open labor surplus type of economy, in which one point of

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[1] Gustav Ranis, "The Role of the Industrial Sector in Korea's Transition to Economic Maturity," Growth Center Discussion Paper No. 125, October 1971. Published in Basic Documents and Selected Papers of Korea's Third Five-Year Economic Development Plan (1972-1976), Sung Hwan Jo and Seong-Young Park, editors, Sogang University, Seoul, Korea, 1972.

interest is when import substitution--fuelled mainly by traditional land based

exports--gives way to export substitution, fuelled by non-traditional labor

based exports (called the switching point), and another at which the economy

becomes a net food importer. Finally, of relevance in all labor surplus economies,

is the commercialization point when the basic condition of labor surplus gives

way to that of labor scarcity. In Japan and Taiwan Ranis interprets the role

of the agricultural sector as providing exports to fuel the import substitution

phase; he dates the switching point for Japan around 1900, and that for Taiwan

around 1959. But in Korea the agricultural sector has not fulfilled its his-

torical mission as a result of which, although entrepreneurial maturation did

take place during the import substitution phase, the "essential fuel for the

substitution phase to follow was never generated." The export oriented indus-

trial sector had to pay for its own continued expansion and also for food

imports which have grown very rapidly. The heavy demands made on this sector

have led to significant distortions, with the drive probably going beyond the

point warranted by long run comparative advantage and culminating in negative

value added in some sub-sectors. The imported raw material component of exports

as well as their capital intensity has been rising. Many special incentives

have been established for the industrial export sector (although this was

partially adjustment for increasing overvaluation).

Instead of moving first to labor intensive, then to skill intensive,

and finally to capital intensive production for export, Korea has been forced

to attempt to move directly into at least some fairly technology intensive and

capital intensive activities. It has also been forced to admit an unusually

heavy inflow, first, of foreign aid and more recently of private foreign

capital to keep the process going.

An interesting difference between Japan and Taiwan, on the one hand, and Korea on the other is that the former have been characterized by a good deal of industrial subcontracting, with medium and small scale firms reaching out into the countryside, while processes taking advantage of the economies of scale remained mainly in the urban centers. Korea is marked by very little complementarity between the agricultural and non-agricultural sectors. This lack of symbiosis between medium and large scale industry has had the effect of higher import and capital intensities, but perhaps more importantly adverse effects on agricultural productivity, when the distance between the two sectors is substantial and farmers cannot perceive investment opportunities outside of agriculture and are thus less interested in exploring new technology.

Colombian Industry. Berry's analysis of small scale industry in Colombia, and its relation to large scale industry, is relevant in the context of the employment question.[1] It is noted that, despite a rather lengthy history of industrial growth, the majority of the manufacturing labor force (including in repair) is found in cottage-style establishments (less than five workers). The share of this sub-sector of industry appears not to have been declining significantly in recent years. Looking across plant sizes in industry, the largest plants have labor productivity eight or nine times higher than independent workers and about three times as high as plants with five to nine workers. The output-capital ratio appears to go in the other direction, i.e., to be higher for small firms, although the relationship with size over the small and intermediate ranges is not ascertainable with precision to date. In most two-digit sectors small scale industry has retained at least its absolute number of workers (the exception is textiles and footwear) and in many the employment

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[1] Albert Berry, "The Relevance and Prospects of Small Scale Industry in Colombia," Growth Center Discussion Paper No. 142, April 1972.

is rising rapidly as in food products, wood and products, and metal products, especially transportation equipment and manufacturing repair.

The tremendous differences in labor productivity imply at first glance substantial employment opportunities in a shift of the size structure away from the larger towards the smaller firms, with an accompanying increase in total output. But the feasibility of such a shift depends on the flexibility of the composition of industrial output and possible differences in dynamic efficiency which are not captured in static factor productivity. The figures suggest rather strongly that one factor weighing against rapid employment expansion and improved income distribution in recent years has been the focus on industries characterized by large firms and high capital intensity and the relative disinterest of public policy in the smaller firms. An important question for policy is the extent to which small scale producers can be linked to international trade (exports) in a situation in which market intermediaries are not usually efficient aggregators of small scale production for such purposes. Given the closeness of the relationship between size and capital intensity, there exists doubt that industrial exports will contribute much to the unemployment problem unless small scale firms can somehow become part of this phenomenon.

Kenyan Industry. Pack's study at the micro level[1] indicates, for the case of Kenya, that disembodied technical progress, not capital deepening, has accounted for most of the rise of labor productivity. This contradicts his intercountry cross-section result (below) which is based on the assumption that disembodied technical progress is very low in the LDCs relative to that in the DCs. Pack contends that Kenya may well be an exceptional case for at least two reasons: (1) the presence of foreign firms in Kenya whose managers are very adept at achieving labor productivity increases through reorganization;

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[1] Howard Pack, "Employment in Kenyan Manufacturing - Some Microeconomic Evidence," April 1972.

(2) the fact that operations in Kenya are highly labor-intensive even by LDC standards and disembodied technical change appears to be an increasing function of labor intensity.

Pack's data suggest that unemployment in Kenya may be effectively eliminated by decreasing excess capacity. His study reveals a high level of single shift excess capacity and a lack of multiple shifts which do not seem to be attributable to factor price distortions. The most important factor leading to substantial single shift excess capacity seemed to be an overestimate of sales growth on the part of individual firms. (Such a situation has also been observed in Latin America where rapid industrial growth in the early stages of an import substitution program has often been followed by a considerable slowing after primary import substitution has been completed.) Most managers indicated a preference for investment in new capacity rather than increasing the number of shifts beyond one. Neither shift differentials in wage rates nor a lack of supervisory personnel for night shifts seemed to be very important constraining factors.

Inter-country Industry Comparison. Pack[1] has also been concerned with examining determinants of the employment elasticity (the ratio of the percentage change in employment to the percentage change in output) for two digit industrial sectors. This work is based on a continuous, inter-country cross section sample of two-digit industries. If employment elasticity is less than unity, it is possible to have a decreasing ratio of industrial employment to total labor force in the economy even though the ratio of industrial output to total labor force is increasing. Pack shows that the total industrial employment elasticities for both DCs and LDCs are significantly less than unity.

[1] Howard Pack, "Employment and Industrial Growth-Some Cross-Section Results: 1953-63," November 1971.

With no technological change and fixed factor prices, the employment

elasticity for a cost minimizing firm is unity in the long run. Given the

simple Cobb-Douglas production function which Pack uses, the employment elas-

ticity for such firms will be less than unity only under two conditions:

neutral technological change (which is a function of time and/or capital

deepening (which is the result of increases in the wage-capital/rent ratio).

Pack provides evidence to the effect that employment elasticities for the DCs

and LDCs are not significantly different at the two-digit level. He then

combines this fact with results taken from case studies which indicate that dis-

embodied technical progress accounts for a much larger percentage of labor

productivity growth in DCs than it does in LDCs. It is clear, therefore, that

if the parameters of the Cobb-Douglas function are the same (except for the

constant term) in both the DCs and the LDCs, capital deepening has been much

greater in the LDCs than it has been in the DCs. The policy implication of this

result, Pack argues, is that the LDCs would have had a substantially higher

employment elasticity than the DCs if their wage-rental rates had increased at

the same (rather than a greater) rate. Also, since case studies indicate an

almost negligible rate of disembodied technical change at the aggregate level

in LDCs, an employment elasticity close to unity could have been achieved had

relative factor prices been held constant in the LDCs.

6. Agricultural Sector Employment

Colombian Agriculture. Berry[1] discusses some of the technical aspects

of land reform and the attendant conditions which determine its possible impact

on employment and income distribution, often the main goals. The model used

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[1] Albert Berry, "Land Reform and the Agricultural Income Distribution,"
Growth Center Discussion Paper No. 97, March 1971.

is designed to capture the main relevant features of LDC agricultural sectors,
i.e. the different factor proportions typically characterizing farms of
different sizes, different crop compositions and different home consumption
ratios. It is argued that, while land redistribution may be expected to raise
agricultural output in many cases, it may well worsen the distribution of income
by lowering the demand for hired labor. The mechanism which may produce this
effect is a decrease in the amount of labor hired per unit of land when the
land passes from large farms to relatively small ones; the damaged groups are
those which earn most or all of their incomes from working on other people's land.

The model used to isolate the conditions under which this undesirable
effect may occur separates the agricultural population into three groups:
large landowners, small farmers (either owners or tenants), and landless
farmers. With this model Berry analyzes the determinants of how land redistri-
bution may be expected to affect income distribution--in particular how it
will affect the incomes of landless workers (through the agricultural wage rate),
and of new land recipients. Berry shows that a wage decrease is a definite
theoretical possibility (as well as one which a number of observers believe
has occurred in certain countries). This has an important policy implication,
namely, a need, in the design of reforms, for more careful thinking about dis-
tribution effects.

In a more general study of Colombian agriculture,[1] Berry concludes that
overall there exists rather persuasive evidence that output and distribution
goals are complementary rather than in conflict. He shows that income distri-
bution in agriculture has, in fact, worsened over time but that this is attri-
butable to two factors: the advent and rapid growth of the commercialized
agricultural sector which uses relatively capital intensive technologies, and,

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[1]Albert Berry, "Land Distribution, Income Distribution, and the Produc-
tive Efficiency of Colombian Agriculture," Growth Center Discussion Paper No. 108,
March 1971.

in lesser degree, to the relative decline of the importance of coffee in agriculture (an exogenous factor from the country's point of view).

Berry considers the implications of land redistribution as a means of counteracting these factors. The study compares factor productivities by farm size: labor productivity is much higher on the larger farms, land and capital productivity substantially higher on the small ones. Plausible measures of overall social efficiency of resource utilization tend to favor farms in the range of 3-10 hectares over either the larger or very small ones.

The policy implications of these results are then discussed at some length. For example, redistribution and/or credit reallocation are likely to have a positive impact on output (as well as on income distribution) in Colombian agriculture, a result similar to that encountered for other countries, including India and Brazil.

Indian Agriculture. Robert Evenson has reported the results of his research on employment and productivity change in two papers: "Employment and Indian Agriculture" (1972) and "Labor in the Indian Agricultural Sector" (1972). His work has focussed on three aspects of the Indian experience over the last decade. First, total factor productivity indices for the agricultural sector have been calculated for each State in India. These measure the regional disparities in productivity change in a more meaningful sense than standard yield per hectare measures. Second, micro-data from producers have been utilized to investigate substitution elasticities between factors of production. Then, an analysis of the effects of technical change and subsidized mechanization on the demand for labor is undertaken. Real wages by State over time are measured and related to productivity gains in agricultural and non-agricultural labor.

The total factor productivity measures show a pattern of productivity gain that differs somewhat from that reflected by simple yield measures. In particular it shows a somewhat more diffuse pattern with some producing regions only reflecting substantial gains. The study reports, for the first time, measures of the elasticity of substitution between labor and other factors of production. A relatively low substitution elasticity (.4) is estimated between labor and bullock labor, fertilizer and seeds, and traditional implements, indicating that a relative rise in the wages of laborers will induce very little substitution of these factors for labor in production. The elasticity of substitution between labor and medium implements (tractors) is estimated to be relatively high however (1.0). Thus a rise in wages and a decrease in machinery prices would induce substantial substitution of machinery for labor, with serious implications for the labor market in the sector.

Some controversy over the extent to which real wages have changed over the 1961-71 period in India still exists. The evidence assembled in this study shows quite clearly that real wages have risen by up to 40 percent in the States which have experienced the most productivity gains (Punjab, Haryana, Gujarat) and have actually fallen in States with little or no productivity gains (West Bengal and Bihar). A model of wage determination is developed to show the expected relationship between productivity and wages. The key determinant of the positive correlation is shown to be the demand for product relationship. A region with a very elastic demand will experience an increase in the demand for labor when it achieves productivity gains. It will also have the effect of lowering product prices and decreasing the demand for labor in regions where productivity gains have not been achieved.

The policy implications of uneven productivity gains are quite important for they lead to uneven shifts in labor demand which show up quite dramatically in wages, labor, migration and unemployment. This work shows that policy decisions are required with respect to modifying the regional pattern of productivity gains as well as in dealing with labor markets generally in disequilibrium.

7. The Service Sector

The early labor surplus models were composed of two sectors, the traditional and the modern. While a useful starting point, a two sector model may represent fairly serious oversimplification. One form of elaboration of the original labor surplus model suggested by Reynolds (among others) is a disaggregation into two traditional sectors--agriculture and the urban "trade-service" sector--and two modern ones--industry and government.[1] Each of the four sectors may be expected to show characteristically different behavior in productivity and employment over time. The urban trade-service sector is linked closely to the rural traditional sector by migration, and may be expected to have a related but not necessarily equivalent wage level. The nature of unemployment may also differ with differences in the wage determination process as between the modern industrial sector and the government sector, the market playing a substantial role in the former but not in the latter. Since government tends to expand over time, this can become of substantial importance.

Reynolds suggests that the many possible variations of assumptions which might be relevant in terms of such a four-sector model argue for the use of simulation as a fruitful way of exploring the consequences of varying values within prescribed ranges.

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[1] Lloyd G. Reynolds, "Economic Development with Surplus Labour: Some Complications," published in Oxford Economic Papers, Vol. IX, No. 1, March 1969.

The direction of research suggested by Reynolds' contribution seems increasingly important in view of the mounting evidence that sectors frequently treated as homogeneous are, in fact, far from it. This is clearly the case for the urban sector as a whole. Here the difference between the industrial and non-industrial components is considerable. In particular, in understanding unemployment it is important to analyze fully the absorptive characteristics of the non-industrial urban sector and at the same time its production characteristics.

Edgar Edwards discusses, in the context of labor surplus societies,[1] the relative efficiency of alternative market forms--in particular, of competition and institutionalized work sharing--in the generation of an investible surplus available to the economy. He argues that, in economies with too little work to keep everyone employed for full working days, the solution observed in some societies of having everyone work part time may be a more efficient strategy than pure competition, so long as one assumes the society has the responsibility of keeping everyone alive. This argument rests on the (plausible) assumption that the function relating food input above that necessary to keep a person alive to hours of work shows diminishing marginal productivity, i.e. the first units of food (above that necessary for subsistence) are more productive than later units. With the food required to keep everyone alive treated as a fixed cost, minimization of total cost corresponding to a given amount of work (the amount which is required, given the capital stock available) involves sharing the work equally among all members of the potential labor force. Under the circumstance of insufficient work to provide full employment for all, a competitive system, on the other hand, with its allocation of resources by factor prices would give rise to a bidding down of the wage rate and to unemployment.

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[1] Edgar O. Edwards, "Work Effort, Investible Surplus and the Inferiority of Competition," Growth Center Discussion Paper No. 64, May 1969.

In this situation, Edwards concludes that unemployment cannot be relied on as a signal that the related factor price is too high; such reliance could lead to inefficient pricing.

The paper raises interesting questions with respect to certain policy issues in capital-short countries. Where social institutions have developed apparently efficient mechanisms to effect sharing of the work available, it may be an error to try to tear down these institutions prematurely. In situations where such institutions do not exist or are being dismantled, the analysis lends weight to the argument for either the use of a labor subsidy on the part of the government, or some provision of the right to work. Edwards throws out the idea that, for example, a person could be given the right to work for any company he wishes, but at a wage rate specified by the market--a market whose rules of the game would have to be specified. Edwards' contention strengthens the efficiency arguments for such policies; they are of course favorable, when correctly handled, to improved distribution and increased employment. At the same time Edwards' arguments suggest that, even with an optimal use of labor, one should not expect that everyone will be fully employed all the time. This in turn suggests strongly the need for reinforcing existing institutions or even developing new institutions which prevent some individuals from working very long hours in a system in which competition tends generally to prevail.

Questions of the relationship between economic efficiency, size and factor proportions in retail trade have been examined by A. S. Bhalla.[1] Bhalla notes that a typical weakness in analyses of capital intensity and factor substitutability in the manufacturing sectors is the failure to include working capital. Since this is the main form of capital used in retail trade this is of special interest as far as this sector is concerned.

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[1] A. S. Bhalla, "Economic Efficiency, Capital Intensity and Capital Labor Substitution in Retail Trade," Growth Center Discussion Paper No. 94, September 1970.

The usual indicators of capital intensity found in the economic litera-
ture are the capital-labor and capital-output ratios. Bhalla points out that
in retailing, with fixed capital relatively insignificant, the stock-sales
ratio becomes analogous to the capital-output ratio and the inventory-labor
ratio to the capital-labor ratio.

In the context of Colombia's 1954 commerce census, the author finds that,
in four of the seven sectors considered, the inventory-sales ratio was a mono-
tonically decreasing function of sales; in the other cases there either was
no relation or there was a non-monotonic but still generally negative trend.
The inventory-labor ratio, like the inventory-sales ratio, usually declined with
sales. This combination could be due to economies of scale or superior manage-
ment on the part of these firms. Equations to explain sales per person and
sales per employee in terms of size fitted best when a wage variable was also
included; most of the coefficients of the size variable were positive and the
degree of explanation ranged from reasonable to good.

Bhalla performed a series of statistical tests designed to measure the
elasticity of labor/capital substitution. This parameter represents the ratio
of the percentage change in factor proportions to the percentage change in rela-
tive factor prices. The higher the magnitude of this elasticity, the more we
would expect factor proportions to be sensitive to changes in relative factor
prices.

Although no simple generalization emerges from Bhalla's tests, there
are hints of substantial elasticity. When a variable is included to capture
economies of scale, the elasticity of substitution for the three types of re-
tailing for which the measure could be effected ranged from .6 to 1.4.

A more complicated exercise, which distinguished between employed labor
and family labor and between fixed and working capital, was applied to data

for 20 retail industries in Taiwan, producing an elasticity of substitution
estimate of 2.3. An elasticity estimate of this magnitude implies that policies
designed to decrease the effective real wage (e.g. payroll subsidies and food
price reductions) may stimulate employment in retail trade without unfavorable
effects on income distribution. That is to say, wage income would tend to rise
relative to non-wage income as a result of a decline in the effective real wage.

In general, the following point should be made: while the severe data
problems plaguing this sort of research preclude its leading quickly to policy
implications, this line of analysis should, as data become more available,
eventually prove fruitful in our understanding of a rapidly expanding share of
the LDC economy.

Another useful study of the LDC tertiary sector was also performed by
Ajit Bhalla.[1] He observes that Colin Clark's hypothesis that the percentage
share of the tertiary sector in output and employment rises with increases in
per capita income has often been misinterpreted in the context of LDCs. The
rise, he contends, may well be a supply side phenomenon. Bhalla argues that the
estimation of employment functions at the disaggregate level is more likely to
reduce the difficult identification problem.

Bhalla presents evidence for Japan (1950-1964) on employment elastici-
ties with respect to income and finds that (a) only for wage employment is this
elasticity significantly greater than zero in most of the non-agricultural
sectors examined; (b) own employment has a negative elasticity in all sectors
and (c) family employment usually has a low one. Identifying supply and demand
remains difficult since for self-employed labor there is no real theory of allo-
cation and supply of effort. One hypothesis is that self-employment should be

[1] Ajit Bhalla, "A Disaggregative Approach to LDC's Tertiary Sector,"
Growth Center Discussion Paper No. 96, September 1970.

related to unemployment, but a linear estimation of the relationship does not yield significant results. Using participation rates as an independent variable improves the fit in all sectors and all labor categories, especially for owner operators and family labor. Bhalla interprets the evidence as implying that pressures of labor supply do tend to show up in increases in self-employment in commerce and, to a lesser extent, in other economic activities. These employment elasticities provide detailed and interesting benchmarks against which the data of other countries can be measured.

8. Labor Supply: Level and Composition

Differential Fertility. A study by Farooq and Tuncer attempts to show the effects of modernization on the observed fertility pattern in the sixty-two provinces of Turkey over the 1935-1965 period. The quinquennial censuses are the main source of data for estimation of provincial fertility and for corresponding series on socio-economic variables such as literacy, female labor force participation, industrialization, urbanization and marital rate. Crude birth rates are used as the fertility variable and are estimated by the reverse projection technique.

The analysis consists of two parts. In the first, the interrelationships among the variables are examined in depth using simple correlation and ranking techniques. In the second, an attempt is made to approximate a functional relationship between fertility and the development variables using multiple regression techniques within the framework of a chain relationship model. The model is estimated from cross-sectional and then pooled data.

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[1] Ghazi M. Farooq and Baran Tuncer, "Provincial Fertility and Social and Economic Development in Turkey." Growth Center Discussion Paper No. 159, October 1972.

The analysis shows that there is a definite negative relationship between socio-economic advancement and the level of fertility. The bivariate relationships between fertility and selected development variables all had expected signs, with the level of literacy having the highest correlation coefficient, followed by female labor force participation, industrialization, marital rate, and urbanization. On the regional picture, there emerges an interesting geographical grouping of the provinces with the western most (closer to Europe) typically more economically advanced and with lower fertility. In the regression model, the variables immediately affecting fertility are female literacy and marital rates, with the influence of the former consistently stable and more important over time. Literacy or education level is actually a composite of both fertility control knowledge and the effects of development variables like industrialization and urbanization.

The conclusion of the study is that as the female literacy level increases and the marital rate declines with increasing industrialization and female labor force participation levels, the overall Turkish fertility level will decline.

Kuznets presents evidence based mainly on U.S. data of a negative association between household rates of natural increase and initial secular income levels over space.[1] The existence of such differential rates of natural increase is supported by data in LDCs. These data show a negative correlation of rates of natural increase and fertility rates with such proxies for per capita income as degree of urbanization and industrialization.

Given an inverse relationship between household income per capita and the household rate of natural increase, Kuznets shows, by means of illustrative

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[1]Simon Kuznets, "Income-Related Differences in Natural Increase; Bearing on Growth and Distribution of Income," Growth Center Discussion Paper No. 162, October 1972.

simulation exercises, that if the per unit growth rate of income is the same for all households and equal to g, the growth rate in aggregate per unit income will be less than g. This is true simply because aggregate per unit income is a weighted average of each of the units in the economy. Due to the differential in rates of natural increase, the weight given to groups with per unit income below the expected country per unit average (i.e., initial incomes times 1 + g) has increased.

Hence, as a consequence of differential rates of increase in the number of units, there will be a worsening of the size distribution of income and a reduced rate of per capita income growth even with equal growth rates in per unit income. Kuznets points out that in many LDCs income is growing at higher rates in families with high initial levels of per unit income than in families with low initial levels of per unit income. For one thing, low income families are frequently undergoing a process of migration, which is precipitated by differences in per capita income and fertility rates between rural and urban areas. This process is frequently associated with long periods of underemployment or open unemployment which perpetuates initial low per capita income levels. Secondly, improved occupational status may require extensive formal education which involves a high opportunity cost for low-income families and, perhaps more importantly, extensive informal training at home based on the previous occupational experience of parents.

Kuznets indicates that the tendency toward a worsening size distribution may lessen as a country develops and aggregate rates of natural increase decline, (a) because lower income groups are more mobile at this stage (possibly due to the lower migration rates and reduced total expenditure requirements for minimal education); and (b) because different rates of natural increase

associated with differences in household income may not be as great. This difference in rates of natural increase across economic units may well be greater in some LDCs than it is in the United States. There is evidence that the mortality decline for low income families in these countries comes significantly after that of families with high income. Hence the difference in rates of natural increase is magnified during this period owing to the observed lag in the response of fertility to mortality declines.

Labor-force Participation. Ghazi Farooq analyzes the determinants of labor force participation in Pakistan.[1] He notes that an accurate prediction of the labor force is particularly important in the context of employment and income distribution problems. Given the numerical importance of marginal workers (particularly women and children) in the LDCs, the supply of labor even in the short run cannot be taken as exogenous. Farooo considers, as determinants of labor force participation, the level of industrialization, the degree of urbanization, the male (and female) industry mix index, unemployment, level of educational attainment in schooling, marital status, geographical mobility, density of the population, percent of nuclear families, and child-woman ratio. He uses a single equation cross-sectional regression to evaluate the significance of these various determinants. The observations are on districts, and the analysis is performed separately for (previously) East and West Pakistan. The educational variable "attending school" has a strong negative impact on the male participation rates in both areas. Population density is the statistically most powerful variable in Bengal, also having a negative effect (although this impact is substantially less) when analysis is in terms of refined (age specific) activity rates rather than crude ones.

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[1]Ghazi M. Farooq, "An Aggregative Model of Labor Force Participation in Pakistan," Growth Center Discussion Paper No. 13?, December 1971.

Urbanization is an important explanatory factor in both regions with respect to the refined activity rate. In East Bengal family composition, high educational attainment, and density, which are important determinants of the crude participation or activity rate, are statistically not very significant with respect to the refined activity rate.

Analysis of female participation rate determinants was considerably less successful; this appears partly to be due to bad measurement of female labor activity. In (West) Pakistan the parameters for industrialization, industry mix, education, and marital status were significant.