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PROGRESS REPORT

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"Comparative Studies of Resource Allocation
and
Development Policy"

December 1, 1967 to June 30, 1968

"Comparative Studies of Resource Allocation and Development Policy."

Progress Report: December 1, 1967

to

June 30, 1968

This report describes work completed during the seven-month period December 1, 1967 through June 30, 1968 under AID contract CSD 1543. Part I, which indicates substantive progress, is intentionally brief, since most of the various papers referred to are themselves available^{1/}. Part II provides a listing of senior personnel who have worked under the contract as well as a preliminary estimate of contract expenditures.

Part I.

The rapid progress cited in the first progress report has been maintained during the past half-year. Substantial progress has been made on six books and monographs: (Richard Bird: Taxation and Development: Lessons from Colombian Experience; Samuel Bowles: Planning Educational Systems for Economic Growth; Dorris Brown, Agricultural Development in India; Hollis Chenery: Patterns of Economic Development; David Cole and Princeton Lyman, Korean Development: The Interplay of Politics and Economics; and Walter Falcon and Carl Gotsch: Agricultural Development in West Pakistan: Past Progress and Future Prospects). In addition, some fifty journal articles are now in near-final form.

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A limited number of copies of the papers (marked in the text with an asterisk) are available from the Project Director upon request. Also available is a checklist which includes all of the reports prepared by the Development Advisory Service and the Project for Quantitative Research on Economic Development.

Before turning to these specific studies, several more general comments should be made about the work of the last six months. During this period, more emphasis has been given to comparative analysis. This has become possible as a result of the individual country studies, reported upon earlier, which have provided the necessary building blocks. Second, a somewhat higher proportion of time during the second contract period has been devoted to revising previous drafts for general publication. However, unless the conclusions have changed substantially, the discussion of earlier drafts covered in the first progress report will not be repeated in this review. Third, the listing that follows roughly parallels the outline of the original proposal. As noted before, however, the specific classification of a number of these studies is largely arbitrary, since they overlap several substantive areas.

A. AGRICULTURE

a) Agriculture in the Two Punjabs

Agricultural performance in the Indian and Pakistan Punjabs, as assessed in terms of trend rates of growth, appears to have been roughly the same in both areas and quite satisfactory during the period 1953/54 to 1965/66. Surprisingly perhaps, this similarity has occurred despite several major differences in agricultural policies on the part of the respective governments.

The causes of this growth in output, the structure of resource inputs, and the response of the agricultural sectors to various economic directives, provide the main topics of analysis in a study by Walter Falcon and Carl Gotsch, "Agriculture Policy and Performance in the Punjab:

A Comparative Study of India and Pakistan."* [A shorter version of this report appeared in the Asian Review, July, 1968]. Despite complications introduced by considerable variation in the commodity and intra-regional composition of output, growth over the entire period appears about equal and there is some evidence to suggest that West Punjab has done better relative to its earlier performance. Disaggregation of the data yielded the additional conclusions that in both regions, cash crops have grown most rapidly, and that districts of growth and stagnation have existed side by side.

The inputs supporting agriculture expansion were quite similar in the two Punjabs -- fertilizer, irrigation water, and improved varieties. India and Pakistan, however, followed very different policies on fertilizer distribution and pricing. While India has retained the cooperative distribution system and rarely offered subsidies, Pakistan has increasingly relied on private trade since 1964 and has continued to subsidize fertilizer costs to farmers. The authors conclude that fertilizer has accounted for approximately one fourth of the 3% annual growth of crops in the Punjabs. Regarding irrigation water, East Punjab has chosen to increase surface water supplies while West Punjab has very successfully exploited the potential for groundwater development. Because tubewells also attacked the problems of water-logging and salinity and reduced farmer's risk, equal quantities of water probably produced more growth in West than East Punjab. Nevertheless, irrigation water appears to have been the single most important factor in explaining growth in both regions.

b) Programming Models

As discussed in the previous report, Carl Gotsch's paper, "A Programming Approach to Agricultural Policy Planning"* , illustrated the methodological usefulness of optimizing models as an aid in the analysis of agricultural policy issues. This paper has now been revised for publication in The Pakistan Development Review. While the conclusions remain basically unchanged, the author has expanded the sections on methodology and policy implications. The potentialities of parametric variation of objective-function weights and resource constraints have been underscored; substantively, the importance of the tubewell program to agricultural development in West Pakistan remains of utmost importance.

c) IADP in India

Dorris Brown has continued his analysis of the role and effectiveness of the Intensive Agricultural Districts Programme in India and other activities of the agricultural development program in India. The main emphasis is the identification and analysis of factors that are responsible for agricultural development on a district-by-district basis. The study is concentrated in the IADP and nearby districts where wheat and paddy are the major crops. One section deals with development under conditions of limited rainfall and limited irrigation, while another emphasises irrigated agriculture. "Agricultural Development in India - a progress report"*

was presented in a DAS seminar. Another paper, "Effective Demand for Fertilizers and Self-Sufficiency in Foodgrains for India"* , written with Harold Dunkerley, will soon be offered for publication. Research plans for the near future are centered on completing the IADP study and writing a book covering this activity.

From January to April, Brown was on leave in Brazil working on a USAID-financed project concerned with the economic feasibility of investments in Farm Service Centers. These facilities are intended to serve Brazil's farmers in the procurement of agricultural production requisites and in the marketing of agricultural produce.

d) Additional Topics

Three Economic Development Reports, discussed in previous reports, were published in final form during this reporting period. A study by Walter Falcon, "Agricultural and Industrial Relations in West Pakistan"* , (published in the Journal of Farm Economics, December 1967) focused on the flow of resources from agriculture to industry for development purposes. Carl Gotsch's paper, "Regional Agricultural Growth: The Case of West Pakistan", (published in the Asian Survey, March 1968) was concerned with factors responsible for disparities in the growth rates within West Pakistan. "Agricultural Development in Pakistan: Lessons from the Second Plan Period"* by Falcon and Gotsch, also appeared in final form in Development Policy - Theory and Practice, edited by Gustav Papanek.

B. TRANSPORTATION

a) Project Analyzer

The Project Analyzer routines described in the previous progress report have been completed and used in two separate sub-studies. The first is a study of the timing of paving in the Colombian Road System. Through use of the Project Analyzer routines, it was discovered that the optimum paving decision occurred at a very low traffic volume, somewhat less than 50 vehicles per day. It was also determined that in no case was it desirable to gravel a road surface. Although these findings are neither completely new nor unique, they do indicate the type of study which can be undertaken with this analytical tool.

A second study which has been done in the context of the Project Analyzer routine by a graduate student in Economics, Gregory Ingram, has involved a comparison of truck travel with the costs of travel by pack animal. His findings indicate the capital expenditure levels at which replacement with trucks on newly constructed roads is at a break-even point. Further similar studies are planned with this routine.

b) Commodity Transport

The studies described by Clell Harral on the cost of transporting commodities by various transport modes have now been completed and a final report is being prepared. These studies, which have been performed for

transport in India, compare the costs of road and railroad transport and examine their relationships to planning, regulation and pricing policies in the Indian Transport sector.

Another aspect of the commodity transport problem, the transfer problem, is perhaps generally unappreciated by those who have not had direct contact with the delays and high costs of many terminal operations. Paul Roberts, Donald Shoup, and J. Royce Ginn, discuss the transfer process in their paper entitled: "A Model for the Simulation of Transfer Operations in Multi-Mode Transportation Networks."* The high costs associated with transfer are often a primary reason for selecting highway over rail transportation, especially for short hauls. Many of the problems associated with a transfer link are caused by the fact that the transfer is an intermodal operation. Ignoring this time/cost interface between modes can lead to irrational flow patterns. In the above study, the authors have set forth a framework to analyze such transfer problems. Their approach is to divide the process into subparts and to develop mathematical expressions for relating performance measures and transfer-link characteristics.

c) Macroeconomic Simulation Model

The macroeconomic model, which was developed as part of the Transport Research Program, has been expanded by David Kresge into four quite distinct types of models.

The first model operates on aggregate data, treating the country as a single region. The second model splits the country into a number of major geographic/economic areas. The latter model can be used to examine regional differences in growth patterns and to analyze the economic relationships among the various regions. The third model is designed to be used with the large transport simulation model. The combined economic and transport models are able to simulate both general economic activity and the detailed operational characteristics of the transport network. The fourth model, which was developed by Harold Luft, expands the foreign trade sector of the aggregate model. This extension facilitates the analysis of import substitution, export subsidies, and tariffs.

Each of the models above is currently operational and has been calibrated to replicate the behavior of the Colombian economy. "Simulation of Transport Policy Alternatives for Colombia"* , by Paul Roberts and David Kresge, begins with a general description of the national macroeconomic model, the regional breakdown, the transport model, and a summary view of the Colombian economy and transportation system. A series of experiments were then conducted with the combined models, using as a comparative base the unaltered 1956 transport network (NULL). The advantages of alternative plans were determined by examining the differences between NULL and the plans for time series of various economic indicators (GNP, total transport costs, total shipping, etc.)

One important aspect of the study involves the model's usefulness from an analytical and pedagogical standpoint. With regard to conclusions from the large system, results indicate that it is difficult to make changes that lead to total transport cost savings of more than 20 to 25 percent over a ten year period. (At the same time, of course, it is unusual for transportation to account for more than 10 percent of total output). Thus, while cost savings as a percent of GNP may be fairly small, they are by no means insignificant.

As mentioned above, Harold Luft has expanded the simulation model to make it more appropriate for policy-planning purposes. ("The Use of a Long-Range Simulation Model for Policy Planning in a Developing Country: The Colombian Example" *). Two groups of experiments were performed in this study -- one aimed at policies to promote the growth of exports and ease Colombia's balance of payments problem, and the other to investigate general macroeconomic policies that might be used to promote overall growth.

A related paper describing the use of simulation in large-scale system studies, "Problems in the Application of Systems Simulation to Transport Planning" *, has been prepared by Paul Roberts and Donald Dewees. This study describes the problems associated with large-scale system models, their definition and their use in real-world analyses. The paper has grown out of the experiences obtained in the application of the large scale macro-

economic and transport simulation models to developing countries.

In general, the simulation models described here have proved sufficiently flexible to allow them to analyze a wide variety of policy alternatives. And because of this flexibility, a major effort is planned to calibrate the models for use in and on Pakistan. Mr. Javed Asfar, a graduate student in economics, has already begun this process. There is great interest in this work within the Pakistan Planning Commission, and it is likely that a substantial part of the proposed analysis will be used directly in the Fourth Five Year Plan.

e) Pricing and Project Evaluation Techniques

Mahlon Straszheim has been editing and revising a study on pricing and project evaluation techniques in transportation planning. This study is a compendium of existing costing, pricing, capital budgeting, demand forecasting and investment analysis techniques. The study critically examines and evaluates these procedures and then attempts to synthesize a decision procedure for transport project planning. Benefit measurement and pricing policies as they relate to project evaluation and financing are discussed. Considerable attention is devoted to the analysis under conditions of uncertainty using Bayesian statistical methods. Programming methods for planning additions to a network and for choosing among projects given fixed budgets are also developed,

with project returns treated as being a stochastic variable. Straszheim expects to continue work on this project for the next several months.

Straszheim has also completed a paper on air technology for the developing countries ("Air Passenger Technology and Public Policy in the Developing Countries" which delineates the evolving role of jet technology. The cost trade-offs implicit in aircraft choice are developed in the first part of the paper and the second part discusses airport and aircraft investment planning in Colombia. Particular attention is devoted to the replacement of piston aircraft in domestic operations whose maintenance is proving to be an increasingly costly proposition. Implications for equipment and airport investment staging are drawn, and suggestions are offered on the appropriate mix of public/private facilities and financing.

C. EDUCATION AND MANPOWER

a) Educational Planning

During the period under review, Samuel Bowles has continued his work in educational planning, the major emphasis of which has been on experiments with educational planning models. Bowles has tested the policy implications of using four alternative educational planning models in the Greek setting. He has also extended some of his previous work on educational planning in Nigeria.

His interest in educational planning has also led him to investigate the nature of "The Long-run Demand

for Educated Labor" . This study, which was separately published as Economic Development Report No. 89, will also form the basis of a chapter for his forthcoming book, Planning Education for Economic Growth. In this project, Bowles made use of comparative international data on labor demand and supply conditions. Determination of the elasticity of the long run demand function for educated labor necessitates examination of the substitution possibilities between labor of various types and between labor and other factors. It was found, in fact, that there exists a high degree of substitutability in the economy between labor classified by different levels of education. In addition, training and on-the-spot experience, as well as capital and foreign labor, provide substitutes for education. These findings, Bowles concludes, have important implications for the choice of an appropriate education planning model. First, because of the high degree of labor substitutability, i.e., because types of labor are not demanded in rigidly fixed proportions, it is impossible to derive an estimate of the number of each type of labor demanded solely on the basis of the level of output. Secondly, the degree of substitutability in the economy is not immutable, but may be increased by a conscious policy to increase the occupational and geographic mobility of labor.

b) Educational Production Functions

Research on the relation between inputs and outputs in the educational production process is still in a

primitive, exploratory form. Bowles is using data on student achievement, student social class, and the quality and quantity of school facilities available to each child to estimate what could be called an "educational production function". A better understanding of this relationship is central to the successful application of public expenditure criteria in the field of education. The results of this work should also cast some light on the nature of racial and class biases in the acquisition of human capital.

Education and Growth

Marcelo Selowsky has continued his recent work on "Educational Capital in a Model of Growth and Distribution"*. In contrast to Bowles' detailed analysis of an educational production process, Selowsky has been working with aggregate production functions using three factors of production, i.e. treating educational capital as an explicit input. Thus, Selowsky's approach to the problem of the "residual" has been not to treat technical change as exogenous. Rather he makes use of the central proposition of the human capital hypothesis, i.e., that improvement in the quality of labor represents an important source of growth. Selowsky argues that placing education in a capital accumulation context serves to emphasize that education is not free but involves the use of real resources. It also allows examination of the productivity of those resources and the rate of return to education. The model, therefore, attempts to incorporate

the human capital hypothesis in such a way that not only "residual" growth is explained, but also the long-run behavior of distributive shares. The empirical portion of this research includes international comparison of the rates of return to investment in human capital, as well as estimates of the elasticity of substitution among various types of labor.

D. COUNTRY STUDIES

a) Pakistan

1) Regional Growth

Joseph Stern's work on regional growth in Pakistan, 'National and Regional Growth: The Case of Pakistan', has been discussed in the previous progress report. Briefly summarized, Stern uses aggregative regional models within a programming framework to examine the consequences of achieving equal regional per capita incomes by 1985. He has continued his analysis of the problems of regional equity and efficiency, and in particular has examined the question of the absorptive capacity for investment in East Pakistan.

A further attempt has been made by Stern to specify an investment function which would reflect the ability of East Pakistan to step up its rate of investment by capitalizing on the learning effects of a past high rate of growth. While the addition of such a dynamic absorptive capacity constraint has the clear effect of

lowering the cost of achieving regional income parity in a short time, Stern's major conclusion still remains that the present regional policy is likely to be a costly one in terms of national income foregone. This essay is now ready for final publication.

A new study was begun by Stern on the predictive reliability of inter-industry tables in Pakistan. Given the increasing use of input-output analysis, it is hoped that this study can provide some guidelines on the accuracy of the existing tables, both for the economy as a whole and for the two provinces. In addition, an examination of the sensitivity of various coefficients should provide some insight into those coefficients whose importance warrants a more careful estimation.

2) East Pakistan Rural Works Program

The East Pakistan Rural Works Program is the subject of a major paper by John Thomas, who has utilized data collected in Pakistan during 1967 ("Rural Public Works and East Pakistan's Development" *). The first part of the study deals with the general political, administrative, and economic aspects of the Rural Works Program while the latter part of it focuses more specifically on its economic contribution to East Pakistan's development. Included in the analysis is an examination of the impact of the Works Program on

transportation and rural economic organization. Further topics include the specific contribution of projects to agricultural production, to the creation of employment, to the determination of rural wage rates, and to the creation of net demand for domestic manufactured goods. Finally, the paper includes a benefit-cost analysis of the Rural Works Program, reaching the overall conclusion that the Program has been an important factor in recent progress in East Pakistan.

3) Education and Development

Gustav Papanek has continued work on a paper dealing with Pakistan's entrepreneurs and their financing. One of the most interesting of the preliminary conclusions is that formal education was of surprisingly little importance during the early stages of Pakistan's industrial development, both in promoting entrepreneurship and in explaining the success of industrialists. Businessmen, operating on a large scale with adequate access to capital, were able to "buy" the necessary educated manpower, both technical and managerial, about as readily as they were able to buy their machinery. A large proportion of this manpower was imported. Pakistan's experience suggests that in some circumstances substantial and rapid industrial development can take place on a very poor educational base and that improved education may follow, rather than precede, industrial development.

4) Export Promotion

An analysis of Pakistan's export performance is being continued by Khalid Ikram. This study, which is under the general supervision of Gustav Papanek, is concerned with the various factors which have accounted for Pakistan's outstanding trade performance. Ikram is completing a quantitative analysis of the structural factors that have been important for the major commodities. He is also analyzing in some detail the bonus voucher system and other policy measures that have been used by the Pakistan government.

b) Korea

Prior to his departure for Indonesia as a member of the DAS Advisory Group, David Cole, in collaboration with Princeton Lyman, completed the manuscript of a book entitled: Korean Development: The Interplay of Politics and Economics. This study analyzes the economic and political progress which Korea has achieved since the end of the Korean War and gives particular attention to the interaction of politics and economics. The major question posed is, "What are the factors behind Korea's transition from an economically and politically sick country at the beginning of the decade, to a rapidly growing and far more stable economy, much less dependent on foreign aid?" In Cole's and Lyman's view, there are no simple answers -- resurgence was the result of a

complex politico-economic process. Nevertheless, certain factors stand out, among which are the return to civilian government led by a new and very different generation, and the acceptance of economic growth as a tangible base for national consensus.

Economic growth was provided through structural reform, revitalization of key institutions such as the banking sectors, modernization of agriculture, changes in the incentive structure for industrial production and investment, and more efficient economic administration and relevant economic planning. (The specific role of planning is discussed in greater detail below). Although institutional changes in the political area were far less sweeping, Korea has at least attained a belief in the state as a viable entity -- one that could expand economically and become increasingly independent.

In addition, Cole, in collaboration with Mr. Young Woo Nam of the Korea Economic Planning Board, has completed a paper entitled: "The Pattern and Significance of Economic Planning in Korea"*. This study reviews Korean planning since the end of the Korean War, giving special emphasis to the Second Five Year Plan which was approved in 1966. The issues which have been of most concern in Korean planning appear to have been the overall rate of growth, the structure of industrial production and foreign trade, the division between domestic and foreign savings and between various forms

of domestic saving, and the structure of markets and the extent of the Government's role in making or guiding investment decisions. Cole's overall conclusion is that the Second Plan, the first to combine an adequate technical base and realistic political dimensions, has led Korea to new acceptance of this development methodology and strengthened the legitimacy of the government.

c) Colombia

Prior to his departure for the University of Toronto, Richard Bird completed the draft of his book -- Taxation and Development: Lessons from Colombian Experience . The principal thesis of this volume is that tax policy in developing countries ought to be considered an essential instrument of development policy. The major topics included in the study have been summarized in the previous report and in a separate paper, "Taxation and Development in Colombia"* . The present discussion will therefore concentrate on Bird's conclusions as to the major tasks of a developing economy's tax system and the possibilities for implementing these goals.

Bird concludes that the strategy of tax reform in Colombia became all the more compelling when viewed against his analysis of past public sector performance. He states that the main cause of the Colombia fiscal crisis

of the early 1960's, and the resultant sluggishness of the development effort, was the failure of national government revenues to increase. In Bird's view, tax yields must be made more responsive to increased money income to avoid feeding inflationary pressures through budget deficits. The goals of increased revenue and greater elasticity can best be achieved through greater effective progressivity of incidence. In addition, the tax system should be used to correct distortions in market factor prices. In particular, tax policy should attempt to correct some of the distortions in the choice of technology with regard to the use of capital and labor, and of imports, import-competing goods and exports. Finally, given the Colombian political and administrative environment, Bird feels that tax reform can only be implemented by a series of tactical seizures of "crisis" opportunities, i.e., periods during which it is fairly obvious that something must be done. Thus, the specific reforms recommended are not viewed by Bird as being implemented as a package, but rather as a set of goals toward which a series of changes would tend.

In addition to his book, Bird, together with Oliver Oldman, has completed a survey article entitled "Tax Research and Tax Reform in Latin America -- A Survey and Commentary"* . The purpose of this study was to bring into focus those major changes of direction upon which future tax research must be based if it is to be

effective as a discipline affecting policy and development. A summary of recent Latin American fiscal performance is provided as background. In this section, they argue that tax revenues have failed to keep pace with government expenditures, primarily because of the inability of tax systems to capture a proportionate share of inflation - generated increases in money income. Against these problems, Bird and Oldman outline areas of research which should be, but seldom are, included in tax reports. Of great importance is the relation at the macroeconomic level between increased fiscal revenue per se and considerations dictated by the balance of payments, inflation and the rate of economic growth.

d) Argentina

Richard Mallon has continued his work on a quantitative history of economic policy in Argentina, giving the work a somewhat broader focus in order to examine some of the unique economic policy problems of Latin American middle-income, semi-industrialized countries. His first report, entitled "Balance of Payments Adjustment in a Semi-industrialized, Agricultural Export Economy: The Argentine Case"* has been completed. At the present time Mallon is analyzing Argentine imports. Preliminary regression analyses tend to confirm the existence of a low price-elasticity of demand, and work will soon begin using distributed lag techniques to analyze interactions

between monetary, price and wage variables in the Argentine economy. Mallon expects to complete several specific reports during the next six months, and to pull all of his material together in book form in late 1969.

e) India

Morton Grossman has continued the work on India outlined in the first progress report. About two-thirds of his draft volume on Indian economic planning has been completed. Presently Grossman is expanding his work of the next year to include a major section on Indian export policy. One part of this research will be an analysis of the present balance of payments trends under current policies. Forecasts of foreign interest and debt payments will be reviewed and recent export policies and performance will be studied, especially since the 1966 devaluation and import-liberalization reform. In addition, the study will concentrate upon an analysis of the increases in export earnings needed to meet India's foreign exchange requirements, and the concomitant changes required in Indian export policies and programs to achieve these increases.

E. INDUSTRIALIZATION AND STRUCTURAL CHANGE

a) Patterns of Structural Change

As discussed in the previous report, the aim of our studies of structural change has been to uncover systematic

relationships across countries and over time between the size and growth of the producing sectors of under-developed economies and such explanatory variables as per capita income, population, country size and factors influencing international trade. The general tendency for agricultural output to decline while the industrial share rises with income has not been adequately described in quantitative terms, nor have its complex interactions with the factors listed above been sufficiently explained.

Prior to his departure to Chile for a year, Lance Taylor completed his study of the behavior of aggregate output shares, "Development Patterns: A Simulation Model"* . Through the use of input-output analysis coupled with cross-section regressions for the final demands of the three major sectors of the economy, he has incorporated existing hypotheses about structural change into a general equilibrium model. Taylor found that the correspondence between the model's predictions and the results of cross-section regressions for sector shares was qualitatively good. The methodological approach, in fact, may be as important as the substantive conclusions. Taylor concludes that multi-sectoral general equilibrium studies will play an increasing role in both the theoretical and empirical analysis of development. He feels that the alternative to this approach -- a series of partial investigations, for example, or benefit-cost studies on an industry basis -- cannot account for all the necessary developmental interactions.

Several points stand out from the results of Taylor's simulation, which are verified by the cross-sectional analysis discussed below. (a) Import substitution as a vehicle of industrialization is much more important in large countries than in small. (b) Manufactured exports are a very important component of industrialization in the small country, directly and indirectly being responsible for about 27% of industrial output as opposed to 12% in a large country. (c) Large countries show a declining elasticity of manufacturing value added with respect to per capita income, while small countries show an approximately constant elasticity. In addition, the following predictions about the behavior of the primary and service sectors were tested and verified. (d) The primary share in large countries lies at a considerably lower level than the share in small countries and the gap shows a slight tendency to narrow as income increases. (e) The primary production share in both types of countries declines at an increasing rate with income, representing the combined effect of falling domestic demands, import substitution, and the growth of manufactured exports. Hollis Chenery and Lance Taylor, in "Development Patterns: Among Countries and Over Time"* use time series data and cross-country comparisons to test whether or not there are uniform patterns of change in the structure of production as income levels rise. The study, a continuation

of work discussed in the last report, has three major sections (a) the estimation of multiple regression equations describing intercountry growth patterns for major sectors and country groups; (b) a comparison of postwar changes in each group of countries as compared to the historical patterns of advanced countries; and (c) an analysis of twelve industry sectors, designed to provide a disaggregated view of production patterns. In considering variation among countries, Chenery and Taylor find that three development patterns emerge from experiments with the pooled data. The first is the "large country" pattern, where, in addition to income and size, the share of capital in GNP was shown to be a significant variable. For "small industry-oriented countries", the variation of production shares with income was similar to the large country pattern; however, the shares of primary and manufactured exports had a greater explanatory effect than the capital share. Finally, the pattern of development was outlined for "small primary-oriented" countries and showed a much slower growth of industry than the other two groups. Chenery is now working on a more general model of industrialization designed to explain the factors that produce these different patterns.

b) Location of Pakistan Industry

The major focus of Gustav Papanek's work on industrial location was reported in the previous report. He has now

completed the revisions on "Industrial Location in Pakistan"* , which entailed some additional quantitative analysis of the time phasing of investment decisions. Included in this study is an assessment of the reasons for the extraordinary growth of Karachi industry and an evaluation of cost differentials by region. Revision of this paper has not altered his most significant finding, i.e. that the location of the powerful central government played a major role in location decisions after 1947. Government policies designed to affect location, and such factors as infrastructure facilities and market location had far less of an impact. This paper will appear in Development Policy -- The Pakistan Experience, the second volume in the Development Policy series.

c) Migration and Growth

The question of migration is one which has been raised in many contexts in the development process. Lorene Yap has begun an analysis of the contribution of rural-to-urban migration in Brazil's post-war economic growth. The complete study will entail a theoretical model of migration in a developing country and an empirical verification on the basis of the Brazilian experience. The conceptual framework considers the growth effects of migration in terms of its impact on investment and on labor productivity in the various sectors of the economy. It will also view the service sector, the main source of employment for new migrants, as the means by which new

recruits into the urban labor force become potentially employable by the manufacturing sector. Because some of the relationships postulated in the model are not empirically quantifiable, the model is being simulated, using representative values, in order to derive relationships which can then be tested empirically for Brazil.

F. AID AND TRADE

a) Aid Strategy

Gustav Papanek has completed revisions on his paper "Changes in Aid Strategy"*. As mentioned in the previous report, Papanek argues against the proliferation of multinational agencies and suggests that in the short run, the use of "harder" credit and debt roll-overs are both inevitable and desirable. For the long run, Papanek places great emphasis on international monetary reform and increased international liquidity. This paper will appear in Spanish in Colombia as part of a series of books based on seminars sponsored by the Colombian Planning Agency, the National University, and the OAS.

b) Trade and Development

The "two-gap" methodology developed by Hollis Chenery, is integral to two current studies of trade and development by Luis Landau and David Felix. In addition, Chenery and Strout have prepared a reply to a critique of this type of planning model by J.C.H. Fei and Gustav Ranis.

"Gapmanship and the Future of the Less Developed Countries"*, a study by David Felix, analyzes the behavioral and policy implications of the two-gap model as applied to underdeveloped areas characterized by having a "mixed economy". A major implication of the model, Felix argues, is that if the foreign trade gap is chronically dominant, the economy will also have a chronic excess of ex-ante savings over realizable investment. As a result, the economy's output bounces between a ceiling set by the capacity to import and a floor set by a "deflationary" savings-investment adjustment. Felix also discusses various aspects of import substitution and export promotion. He argues that to restore steadier and more rapid economic growth, it is necessary to reorient industrial investment away from consumer import substitution through the "socializing" of export risk and through the control of the home-consumer demand mix.

Felix is also doing a quantitative analysis of Argentine industrial exporting in the post-war period which tests empirically some ideas in the above-mentioned paper. He expects to complete a draft paper reporting his findings by the end of the summer.

Luis Landau's research has been concerned with the general area of savings in Latin American countries. Preliminary to his analysis, Landau collected extensive data and prepared recent national accounts time series on a comparable basis for all the Latin American countries.

These time series were then used to estimate savings functions and other structural parameters. In addition, he has made projections of foreign aid requirements until 1972 for each Latin American country.

The Fei-Ranis critique, "Foreign Assistance and Economic Development Revisited", raised questions as to the "validity and operational usefulness" of the two-gap model used to analyze the role of external assistance in economic development. Fei and Ranis are pessimistic as to the possibility of detecting historical periods in which a given combination of constraints predominated. The latter reply^{*}, however, that although the concept of a phase is central to their analysis, the presumption of a given sequence of phases is not. The likelihood of a particular sequence arose from having examined a large number of projections from the model. In the opinion of Chenery and Strout, such countries as India, Pakistan, Turkey, and Brazil, there was in fact a shift from a phase dominated by the absorptive capacity to one dominated by the supply of foreign capital. Finally, while the authors agree with Fei and Ranis as to the difficulties of estimation in empirical verification, in their view the available evidence for many countries can be better interpreted on the basis of the two-gap hypotheses than by assuming equilibrium adjustments.

c) Foreign Exchange and Protection

In many countries, the exchange rate alone does not maintain equilibrium in the balance of payments; import restrictions are used as well. Such a situation implies a continuous disequilibrium in the foreign exchange market and causes the exchange rate to be a poor indicator of the scarcity of foreign exchange. In consequence, its use in the evaluation of investment projects will lead to misallocation of resources. Daniel Schydrowsky has continued his work on the theory and measurement of an appropriate shadow price for foreign exchange for investment planning and produced computations for 48 countries based on 1965 data. A revised note on the subject is entitled "On the Choice of a Shadow Price for Foreign Exchange"*. His study develops a more appropriate price for foreign exchange and compares this with previously suggested derivations of such a shadow price.

Stephen Guisinger has been studying the theoretical and empirical problems encountered in measuring effective rates of protection in a developing country. In contrast to nominal protection which considers only the impact of tariffs on the value of final goods, effective protection measures the percentage change in the value added per unit of final output for an industry as the economy moves from free trade to protected-trade "equilibrium." One of the more controversial issues arising from empirical results is the appearance of negative value added.

Guisinger, in "Negative Value Added and the Theory of Effective Protection"* shows the concept is neither economically meaningless nor does it need to be explained by assumptions about extreme inefficiency in production or monopoly pricing.

A second study by Stephen Guisinger, under the general direction of Gustav Papanek, is concerned with estimating effective rates of protection in Pakistan. Assumptions about the prices of non-traded goods, the over-valuation of the exchange rate and the substitutability of primary for intermediate inputs are varied systematically in order to determine how the set of effective rates is altered both in relative and absolute terms. The most reasonable set of effective rates will be used to test a number of hypotheses about the effects of the Pakistani tariff system. For example, do labor or capital intensive industries receive the greater amount of protection? What is the relation between the growth rate and the amount of protection each industry receives?, and Do highly protected industries have strong backward and forward linkages?

e) Future Plans

William Steel has begun research on the structure of protection and the choice among foreign exchange-saving- and earning industries in Ghana. During the 1960's, industrial investment decisions in Ghana have been distorted by import licensing, tariffs, taxes, special

concessions, and other policies of the Nkrumah government designed to defend the balance of payments and to establish domestic industries within a socialist framework. Ghana's industrial capacity has more than doubled since 1960 but less than half of this capacity is currently being utilized. Because of Ghana's large foreign debt and stagnant export earnings, the foreign exchange shortage is likely to remain the most significant constraint on its economic growth over the next decade. One of the most important problems facing the present government, therefore, is to allocate foreign exchange efficiently among existing firms in order to increase the level of production. Steel will first analyze the structure of protection in Ghana to determine its effects on incentives and resource allocation and to investigate possibilities for rationalizing it. This will involve study of import duties, taxes and subsidies, import licensing and price controls, and will lead to calculation of effective rates of protection for Ghana's industries. In order to compare industries according to their relative efficiency in using imports, Steel plans to calculate for each major industry the cost in terms of domestic resources of saving a unit of foreign exchange. This calculation will require collection of cost data directly from the 90 or so firms which produce 80-90 percent of Ghana's manufactured output, and will also involve estimates of

indirect foreign exchange inputs and of the opportunity cost of domestic resources. In addition to calculating effective rates of protection and domestic costs of saving foreign exchange, he will derive the exchange rates at which each industry would be competitive with imports and will discuss the conditions under which each measure provides the appropriate basis for making economic decisions.

G. PLANNING MODELS AND TECHNIQUES

a) Planning Models Involving Economies of Scale

Investment planning in Korea, as in other less-developed economies, is typically carried out through the analysis of individual projects considered more or less in isolation from one another. But the application of benefit-cost investment criteria is questionable where industries are linked through the use of intermediate products and when future product prices depend upon the set of projects selected for investment. Larry Westphal has continued his work on an optimizing model for investment planning in Korea in a paper entitled: "Multi-Sectoral Project Analysis Using Mixed Integer Programming"* Building on the results of the Chenery and Westphal study, "Economics of Scale and Investment Over Time"*, he has stressed the necessity for placing project analysis within a multi-sectoral, intertemporal setting in the case of large projects whose investment cost is likely to be over two or three percent of total investment. Two projects of major concern -- a petrochemicals plant and

an iron and steel mill -- are included in the model with economies of scale. He has found that investment in the two projects is most sensitive to the timing of foreign capital inflows, being profitable only if there is sufficient financing to build the plant as well as simultaneously provide its using and supplying facilities.

Westphal has also focused on the relative merits of single and multi-period models for investment planning. Based on the Korean data, he has found that a single period, balanced growth model gives results very close to those of the multi-period model except in the case of industries with economies of scale. Since single period models are more easily erected and solved than multi-period models and can also include more sectors, this appears to be an important conclusion.

b) Nonlinear Planning Models

Since the previous report, David Kendrick and Lance Taylor have successfully applied a gradient algorithm for solving nonlinear control theory problems to a four sector model of the Korean economy.^{2/} In so doing, they have discovered that it is not much more expensive to solve rather general nonlinear optimizing planning models than to solve the more restrictive linear optimizing models. Thus it appears feasible now to use nonlinear production functions, welfare functions, and export earning functions in dynamic multi-sectoral

^{2/} Portions of this work were also supported by the National Science Foundation.

optimizing models for development planning.

These results are discussed in two papers "Numerical Solution of Nonlinear Planning Models" , and "A Dynamic Nonlinear Planning Model for Korea"* . In the former, Kendrick and Taylor summarize some of the recent advances in the formulation of algorithms for the solution of optimal control problems, and demonstrate the feasibility of applying them to the solution of a moderately complex economic planning model. They also report on the results of experiments designed to analyze progression to a position of optimal growth.

The second paper concentrates on the formulation and interpretation of the solutions to a four sector model of the Korean economy (agriculture, heavy industry, light industry and services). The model maximizes a welfare function over a thirty year period subject to constraints in the form of distribution relations, production functions, absorptive capacity functions, foreign exchange constraints, and initial and terminal capital stock and foreign debt constraints.

Kendrick and Taylor conclude that it is now possible to solve models with four or more sectors, and, with the introduction of current advances in computer technology, with ten or more sectors. In addition, their analysis has permitted them to make a number of statements concerning the comparative advantages of a control theory approach as opposed to the linear programming technique used in many formal planning models.

H. OTHER CONTRACT ACTIVITIES

In addition to the substantive studies already described, a number of other AID/Harvard activities were carried out under contract auspices. On several occasions, faculty members have briefed AID officials and consultants en route to overseas missions. This has occurred most often in the case of Pakistan and India, but also for Colombia, Korea, Ghana and Indonesia. In addition to these general briefings, a delegation from AID visited Harvard for a contract review on May 23rd. Following an administrative discussion, three substantive seminars were held on Korea, Patterns of Development, and Educational Planning. A similar review is being planned for Washington during the Fall term.

I. SUMMARY

It is clear that research during the last seven months has covered a wide range of topics; it may be less clear, however, how all of these activities fit together. On the latter point several summary comments may be in order.

First, the listing of projects under individual headings, which has been done for ease of exposition, should not cloud the fact that the research has been quite concentrated with regard to key countries (Pakistan, Colombia, India and Korea); key sectors (education, transportation and agriculture); and key policies (inflation, industrialization, foreign exchange and fiscal policy). Second, the last seven months has seen a major increase in the amount of comparative work. Studies have been

completed to compare India and Pakistan (in agriculture and trade), to compare development patterns across many countries, and to transfer lessons and models developed in one country to others, e.g. the simulation models from Colombia to Pakistan. Finally, it should be stressed that the field/Cambridge, theory/policy interactions which were originally foreseen have proved very fruitful. We believe the increased flow of ideas and information between Cambridge and the field has been extremely beneficial to both groups. We also believe that, because of these interactions, we have been able to complete a substantial amount of useful research at relatively low cost.

Part II.

A. PERSONNEL

Table I indicates the senior personnel whose research has been supported under the contract. During the seven months under review, 22 faculty members devoted approximately 68 man-months to research under this contract, thus bringing the total input from June 1967 through June 30, 1968 to 133 man-months.^{3/} This 13 month total (plus the two-month pre-contract period) compares with the 130 man-months approximated in the original contract proposal.^{4/} It should also be noted that the 133 man-month figure cited above does not include the advanced graduate students who are working on a number of the projects.

^{3/} As anticipated in the original proposal, the salary of several members was paid from other sources, with research support provided by this contract.

^{4/} The proposal actually called for 162 man-months for the first 18 months. Because the contract started later than originally planned, the reporting periods do not coincide with the original proposal.

At the close of the Harvard fiscal year on June 30th, a number of personnel changes took place that will somewhat alter work under the contract. David Cole departed for Indonesia to join the DAS project there, Richard Bird became Associate Professor at the University of Toronto, and Lance Taylor took leave for a year to join the MI project in Chile. During the Fall term, Willem Bussink and Thomas Hexner, both currently with the DAS project in Pakistan, will return to Cambridge and will be included in the contract, as will Donald Hoerr, presently an advisor with the DAS project in Malaysia. Also to be included will be Thomas Weiscopf, Assistant Professor of Economics, who has been in India the past two years, and Arthur MacEwan, Instructor in Economics, who has been in Pakistan the past two years.

Table 1. SENIOR RESEARCH PERSONNEL
Approximate Portion of Time Committed: December 1, 1967 -
June 30, 1968.

<u>Name</u>	<u>Percent</u>
Richard Bird	38
Samuel Bowles	50
Dorris Brown	00 ***
Hollis Chenery *	25
David Cole	75
Walter Falcon	50
David Felix *	50
Lester Gordon	25
Carl Gotsch	50
Morton Grossman *	75
David Kendrick	25
David Kresge	35 **
Richard Mallon	75
John Meyer *	10
Gustav Papanek	33
Paul Roberts	16
Daniel Schydrowsky *	10
Marcelo Selowsky	50
Joseph Stern	50
Mahlon Strazheim	17
Lance Taylor	25
John Thomas	<u>75</u>

Approximate total: 68 man-months

* Own salary financed from other sources.

** Through November only.

*** On leave for 3 months.

B. EXPENDITURE

Preliminary expenditure data through June 30th are given in Table II. The pattern is roughly the same as indicated for the man-month data. For the period October 1, 1967 through June 30, 1968, approximately \$307,503 was spent, making a total expenditure for the first 13 months (plus two pre-contract months) of about \$452,156. (These numbers are approximate magnitudes and are for general information only. An "official" tabulation will be provided at a later date by Harvard's Office for Research Contracts. Since \$577,882 was originally budgeted for the first 18 months, it can be seen that the expenditure pattern is almost exactly on schedule. In addition, the line items in Table II also show a close correspondence to the original proposal.

There is every indication, therefore, that the project is proceeding as scheduled.

Walter P. Falcon,
Cambridge, Massachusetts.
July 25th, 1968.

Table II.

CONTRACT EXPENDITURES

April 5, 1967 - June 30, 1968

	(4 months plus 2 "precontract" months) <u>4/5-9/30/67</u> *	(9 months) <u>10/1/67-6/30/68</u>	<u>Total</u>
Senior Research Staff	\$ 47,379.96	\$ 94,695.47	\$142,075.43
Research Assistance	39,375.40	52,031.42	91,406.82
Secretaries, Clerical Staff	11,846.68	15,066.44	26,913.12
Computer Use	6,792.00	52,076.68	58,868.68
Supplies, Telephone, Postage, etc.	6,233.26	16,728.79	22,962.05
Travel	506.75	1,112.22	1,618.97
	<hr/>	<hr/>	<hr/>
Subtotal:	112,134.05	231,711.02	343,845.07
Overhead	32,518.88	75,792.32	108,311.20
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TOTAL:	\$ 144,652.93	\$ 307,503.34	\$452,156.27

* Per last progress report