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FOREIGN AID AND THE DOMESTIC COSTS OF SAHEL DEVELOPMENT PROJECTS

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TABLE OF CONTENTS

PREFACE		vi
INTRODUCTION		1
CHAPTER I -	Summary	5
CHAPTER II -	An Accounting Framework for Local and Recurring Costs	15
	An Accounting Model	23
	Applications of the Model	31
CHAPTER III -	Case Studies - Individual Countries	33
	Introduction	33
	The Model	34
	Project Simulations	36
	Analysis of Financial Flows	53
	Alternative Investment Patterns	63
CHAPTER IV -	Individual Projects	76
APPENDIX A -	Parameter Estimates	A1
	Introduction	A1
	Feeder Road Projects	A2
	Paved Road Projects	A5
	Telecommunications Projects	A6
	Agricultural Projects	A8
	Summary of Parameter Values	A11

INDEX OF TABLES

		Page
Table II-1:	Cost and Income Streams for Simulated Investment Program of $10 billion	18
Table III-1:	Niger - Aid and the Operating Budget	34
Table III-2a:	Sector Allocation of Total Investment Program by Country	38
Table III-2b:	Project Allocation of Simulated Investment Program by Country	39
Table III-3a:	Simulated Investment, Costs and Revenues - Feeder Road Project - Niger	42
Table III-3b:	Simulated Investment, Costs and Revenues - Paved Roads Project - Niger	43
Table III-3c:	Simulated Investment, Costs and Revenues - Telecommunications Project - Niger	44
Table III-3d:	Simulated Investment, Costs and Revenues - Polders Project - Niger	45
Table III-3e:	Simulated Investment, Costs and Revenues - Agricultural Development Project - Niger	46
Table III-3f:	Simulated Investment, Costs and Revenues - Livestock Projects - Niger	47
Table III-4:	Simulated Investment, Costs and Revenues - Niger Program	48
Table III-5:	Simulated Investment, Costs and Revenues - Senegal Program	49
Table III-6:	Simulated Investment, Costs and Revenue - Chad Program	50
Table III-7:	Simulated Investment, Costs and Revenue - Mali Program	51
Table III-8:	Simulated Investment, Costs and Revenue - Mauritania Program	52
Table III-9:	Growth and Budget Parameter Estimates - Sahel Countries	56

INDEX OF TABLES (continued)

Table III-10: Projected GDP and Government Revenue (Without Projects), Simulated Domestic Investment Costs and Net Recurring Costs for Club Program - Niger 58

Table III-11: Projected GDP and Government Revenue (Without Projects), Simulated Domestic Investment and Net Recurring Costs for Club Program - Senegal 59

Table III-12: Projected GDP and Government Revenue (Without Projects), Simulated Domestic Investment and Net Recurring Costs for Club Program - Chad 60

Table III-13: Projected GDP and Government Revenue (Without Projects), Simulated Domestic Investment and Net Recurring Costs for Club Program - Mali 61

Table III-14: Projected GDP and Government Revenue (Without Projects), Simulated Domestic Investment and Net Recurring Costs for Club Program - Mauritanie 62

Table III-15: Uneven Investment Allocations 63

Table III-16a: Simulated Investment, Costs and Revenue - Uneven Investment - Feeder Roads Project - Niger 65

Table III-16b: Simulated Investment, Costs and Revenue - Uneven Investment - Paved Roads Project - Niger 66

Table III-16c: Simulated Investment, Costs and Revenue - Uneven Investment - Telecommunications Project - Niger 67

Table III-16d: Simulated Investment, Costs and Revenue - Uneven Investment - Polders Project - Niger 68

Table III-16e: Simulated Investment, Costs and Revenue - Uneven Investment - Agricultural Development Project - Niger 69

Table III-16f: Simulated Investment, Costs and Revenue - Uneven Investment - Livestock Project - Niger 70

INDEX OF TABLES (continued)

Table III-17:	Simulated Investment, Costs and Revenue - Uneven Investment - Niger	71
Table III-18:	Simulated Investment, Costs and Revenue - Uneven Investment - Senegal	72
Table III-19:	Simulated Investment, Costs and Revenue - Uneven Investment - Mali	73
Table III-20:	Simulated Investment, Costs and Revenue - Uneven Investment - Chad	74
Table III-21:	Simulated Investment, Costs and Revenue - Uneven Investment - Mauritania	75
Table IV-1:	Project Investment	77
Table IV-2:	Additional Tax on Project Income Necessary to Finance Recurring Costs	79
Table IV-3:	Feeder Road Project	81
Table IV-4:	Paved Road Project	82
Table IV-5:	Polders Project	83
Table IV-6:	Agricultural Development Project	84
Table IV-7:	Total Five Projects	85
Table A1:	Feeder Road Project Parameters	A2
Table A2:	Cost per Kilometer of Feeder Roads	A3
Table A3:	Domestic Investment Costs - All Highway Projects	A3
Table A4:	Benefit/Investment Ratios and Growth Rates Feeder Road Projects	A4
Table A5:	Recurrent Costs - Paved Road Projects	A5
TAble A6:	Benefit/Investment Ratios and Growth Rates Paved Road Projects	A5
Table A7:	Telecommunications Projects	A7

INDEX OF TABLES (continued)

Table A8:	Polders Projects	A9
Table A9:	Livestock Projects	A10
Table A10:	Rural or Agricultural Development Projects	A11
Table A11:	Summary Table	A12

PREFACE

A common topic of discussion in development literature and among policy makers who are concerned with the allocation and use of foreign aid is that of "Absorptive Capacity." Included within this general term are a multitude of problems that range, for example, from the availability of skilled labor and managerial talent to limited infrastructure and transport networks. One aspect of absorptive capacity that is particularly important with respect to the activities of the Club du Sahel, however, is the problem of how to finance the recurring and local investment costs associated with externally supported projects.

At present each of the donor countries and organizations participating in the Club has somewhat different attitudes toward the financing of local investment and recurring costs. For example, with infrastructure projects, the United States and the World Bank have in the past tended to follow a policy of financing principally foreign exchange costs (which often are a majority of the total) and leaving the recipient to pick up the remainder. On agricultural projects they are more flexible in that they may finance a portion of the local investment but still none of the recurring.

The European Community and France, on the other hand, make virtually no distinction between local and foreign exchange investment costs. The Community and the French follow different courses, however, with respect to recurrent costs. The Community has a stated policy (from which occasional deviations occur) of not financing recurring costs. The French, on the contrary, sometimes finance considerable amounts of recurring costs either directly as part of a project budget or indirectly as part of more general budget support to the West African countries.

Even though projects may be quite independent from a technological point of view in terms of both real resources required and population served, they are all interdependent from a financial point of view. If any of the domestic costs or the recurrent costs are paid by the recipient government, the addition of one more project competes with all others for whatever funds may be available. By the same token, any government revenue generated by a new project theoretically becomes available for paying recurring costs on others as well as for itself. As a result, there are large advantages to be gained by looking at all projects within a country as an ensemble as well as evaluating them individually. Since the problem is one of cash flow, it is the total cash flow that is important as well as that of each project.

Given the potential magnitude of the recurring cost problem, and the degree to which domestic financing for one project competes with financing for all other projects, it seems essential that the participants in the Club du Sahel explore the need and possibilities for adopting a common attitude toward the financing of local and recurring costs and also examine some of the institutional and policy implications of financing with external funds, a portion of both the local investment and the recurring costs.

The primary objective of this study is to explore some of the characteristics of the recurring and local investment cost problem and in the process devise an appropriate accounting and economic framework for dealing with it. The framework and the associated methodology can be used to evaluate the magnitude of recurring costs, the linkages that exist among projects and budgets, and to analyze the effects of various policy choices upon the rather complex cost and income flows related to the expenditures and projects envisaged for the Sahel.

There are a wide range of issues related to the recurring cost problem that are broached only peripherally in this paper. Among them are the appropriate kinds and levels of taxes and service charges on project output, the general budgetary capacity of the Sahel countries, the nature of the organizational links through which data pertinent to recurring costs should be transmitted, the foreign exchange earnings potential of the countries, the foreign exchange component of recurring costs, the role of the central bank and the monetary system in handling external funding of recurring costs and in transmitting or dampening the inflationary effects of aid, and the relationship between recurring costs and the countries' ability to enter international financial markets and service debt costs. A thorough understanding of the recurring cost problem will involve looking at all of these.

Acknowledgement is due to USAID for the funding and support of the project in particular to David Shear and James Mudge for continued interest and encouragement. Thanks are also due to the Center for Research on Economic Development at the University of Michigan for the role they have played. Responsibility for error rests, of course, with the authors.

Charlottesville, Virginia April 1978

INTRODUCTION

Historically, project aid has been given to fund the foreign exchange portion of project capital costs. The host country has typically been expected to pay for the domestic resource costs associated with both initial investment and the recurring operating costs of the project.[1] When a small number of projects are contemplated and a small amount of domestic funding relative to the total budget is required, this system is acceptable. It assures that the host country is involved in and has a stake in the success of the project. When a large number of projects are undertaken and a large amount of foreign aid is being given, however, the financial requirements imposed upon the host country can be overwhelming. The result is likely to be either inflation as money is printed to cover deficits that can be

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[1] It is usually the case the donors finance only the foreign exchange portion of initial project investment costs. Agricultural projects, however, provide a notable exception at least for World Bank projects. This willingness to fund local costs may be explained by the fact that the ratio of foreign exchange costs to total costs is low for agricultural projects compared to highway or telecommunications projects. The following table gives the percent of total project costs (net of taxes and duties) which are foreign exchange and also the percent financed with external aid for a sample of World Bank agricultural projects.

	Projects		Livestock Projects				Agricultural or Rural Development Projects					
Project	1	2	1	2	3	4	1	2	3	4	5	6
Foreign exchange costs as a % of total costs	80%	40%	60%	51%	42%	49%	33%	50%	13%	49%	53%	56%
% of total costs which are foreign financed	100%	60%	78%	77%	78%	94%	89%	90%	82%	100%	79%	74%

financed in no other way; or the required resources may not be made available and projects will eventually die for lack of support.[1]

The importance of taking full account of the recurring and local investment cost requirements cannot be overemphasized. The specter of numerous finished but inoperative and deteriorating projects dotting the Sahelian horizon is not a pleasant one to contemplate and yet it is a very real possibility if policies are not adopted from the very beginning of the operation of the Club du Sahel to insure that the necessary local and foreign exchange funds are available to nourish all projects throughout their lives. This does not necessarily imply that local investment and recurring costs must be entirely aid supported. Many projects provide services for which user fees can be charged and virtually all projects generate income that can be taxed at one level or another. In addition, seignorage from normal monetary expansion may provide revenue. But even where government revenue is generated, there must be means of guaranteeing that the revenue is used to support the project. To accomplish such revenue allocation may require institutional arrangements that bypass the normal budget allocation procedures or call for the earmarking of revenue from particular sources.

In order that policy decisions about aid allocation or revenue diversion can be made, however, it is essential to devise a methodology that will permit an estimation of the magnitude of the problem. Only

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[1]A World Bank assessment of development projects in Upper Volta, for example, determined that the implementation ratio for development plans ranged between 48% and 77% for various sectors. One of the main reasons for the shortfalls was insufficient operating funds.

then can one analyze the impact of various policy alternatives both for donors with respect to selection, timing and financing of projects and for recipients with respect to the imposition of user fees and taxes. The methodology must be one which allows all the individual characteristics of projects, donors and recipients to be taken into account in order that both the economic and political elements that impinge on the Sahel investment program can be accomodated in the analysis.

The paper proceeds in the following way. Chapter I is a summary of the methodology proposed and the accounting model used. It also contains a brief statement of the results of simulating a hypothetical investment program and a list of recommendations about future directions of research. Chapter II contains a complete description of the methodology for analyzing recurrent costs and of the accounting framework that ties together the relationships among project investment, recurring costs, and government revenue. This framework is the basic model for estimating the magnitudes of cash flows linked to investment programs. The chapter also presents the results of a simulation that illustrates the dimensions of the financial flows related to a hypothetical $10 billion investment program for the Sahel region. At the end of the paper, an appendix to Chapter II provides parameter estimates for the model that apply to several different kinds of projects, including highways, telecommunications and agriculture.

Chapter III is an application of the model to all the Sahel Countries with the exception of Upper Volta. It illustrates how the model can be used to evaluate the impact of any Sahelian development program upon individual countries. Simulations are made of the

financial streams that are generated by each country's share of the hypothetical $10 billion investment program over 10 years. Chapter IV carries the analysis one step further and shows how the accounting model can be used to project and accommodate the cash flows associated with some specific projects. The ordering of these chapters is the reverse of the ordering of the steps that would be taken in using our methodology to estimate the recurring costs of an actual program or analyze policy choices. With an actual program one would start with individual projects and work up to the aggregate cash flows, both income and costs, associated with an entire program.

CHAPTER I

SUMMARY

An undertaking of the magnitude of the Club program for the Sahel can be expected to generate major displacements which will stretch thin in numerous places the fabric of the economies of the Sahel countries. Our findings indicate that this is certainly true with respect to one area--the financing of recurring and local project investment costs.[1] The results of our analysis indicate that the potential magnitude of these costs is significant and that the success of the Sahel development program may hinge upon adopting policies that are capable of solving the problems they pose.

We have constructed an accounting model (described fully in Chapter II) that can be used in two different ways to analyze local cost burdens and policies chosen to deal with them. First, it is capable of accepting information on all actual projects included in a particular development program. It permits this information to be aggregated on an annual basis by recipient country, by sector, by project type or any way that one wishes for analysis. The information can include projected cost streams, projected benefit streams and projected government revenues.

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[1]To avoid confusion we should define the concepts we are using. We initially divide the project costs along functional lines into two parts--investment and recurring. The recurring costs are typically either maintenance or operating costs. We specifically exclude from the definition of recurring costs any finance charges or loan repayments. These are policy determined and independent of project type. Investment and recurring costs are each further divided into local (or domestic) costs and foreign exchange costs. By local we mean payments that are made for domestic resources such as labor or locally produced inputs. Foreign exchange refers to anything that needs to be imported. We thus end up with four different cost components: external investment, local investment, foreign exchange recurring, and local recurring. The subjects of this paper are the local investment costs, the local recurring costs and the foreign exchange recurring costs. All are important.

Second, the model can simulate all of the important financial flows (local investment, recurring costs, government revenue and foreign exchange requirements) that are connected with any hypothetical level and temporal allocation of investment. In this case, alternative possible programs can be analyzed.

When using the model to forecast flows associated with actual projects, the information contained in the project evaluations (assuming that some have been done) can be included as input data. The output from the model then corresponds to what are presumably the best available estimates of actual flows. On the other hand, if no good data is available on actual projects or if the model is used to simulate flows for a hypothetical program, average parameters can be used that relate flows to initial investment.

It is the second use of the model that we illustrate in this paper and from which we draw our conclusions. The simulated cost and income streams are projected for a hypothetical $10 billion investment program spread over a period of ten years. Parameters for the simulation exercise were obtained by analyzing World Bank project evaluation studies. The project types examined include highways, telecommunications, agricultural and livestock projects.[1] The model was then used to simulate the financial flows associated with a particular investment program for the Sahel region and for each country with the exception of Upper Volta. Only the outcomes for the entire Sahel will be discussed in this chapter.

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[1]A complete description of the parameters is contained in Appendix A. We wish to emphasize that the parameters used in this study are <u>averages</u> of parameters from World Bank studies. Individual project parameters will almost surely differ from these averages but if a number of projects are involved, the average probably provides more reliable estimates of financial flows than would a single project parameter.

We examined the implications of a $10 billion investment program for the entire Sahel region spread equally over ten years.[1] The size of the investment program (including both aid and domestic investment) was used as a benchmark rather than the amount of foreign assistance. How much foreign assistance would be involved would depend upon the policies of donors, which we made no attempt to forecast. The simulations are thus related to a fixed size investment program rather than a fixed size aid program. The implications that can be drawn from the simulation exercise are as follows:[2]

1. The relative and absolute values of local investment and recurring costs are immense. For a $10 billion investment program, local investment costs would be $3.2 billion and recurring costs would be $3.6 billion for a total of $6.8 billion. The foreign exchange component of the investment portion of the program would also be $6.8 billion. Thus, if none of the local investment nor recurring costs were paid by donors, Sahel countries would need to provide domestic resources equal to the aid they were given. Of the internally funded $6.8 billion, approximately $2.5 billion could be expected to go for imported components of the recurring costs and require foreign exchange.

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[1]The details of the simulation results are contained in Chapter II. The allocation of investment among sectors was based on figures obtained from USAID. The model is described fully in Chapter II and the parameter estimates are contained in Appendix B.

[2]We wish to emphasize that the outcomes of the simulation depend entirely upon the assumptions made and the parameter estimates which are based on World Bank projects. Projection of actual income streams would require that data be collected for the entire menu of Sahel projects.

2. The average tax collection rate for the Sahel countries is 15 percent. If one assumes that at some point in the payments stream, the new income from the projects is taxed at this average, the government can expect to collect $2.3 billion of revenue from the income generated by the $10 billion investment. One can add to this $2.3 billion the potential seignorage on creation of money to satisfy the increased transactions demand. The seignorage totals $310 million so that estimated total potential domestic revenue attributable to the investment program is $2.6 billion. If all of this domestic income were applied against the $6.8 billion local and recurring costs, there would still remain $4.2 billion uncovered. The foreign exchange portion of this $4.2 billion would still amount to $2.5 billion.

3. Should donor countries decide to supply external assistance to cover the local investment costs, an additional $3.2 billion would be required, bringing the total aid contribution to $10 billion. The Sahel countries would then face recurring costs of $3.6 billion. Applying the estimated revenue of $2.6 billion to this figure would leave $1 billion uncovered. This is an amount that could conceivably be raised domestically with user charges or increased taxes.

4. The foreign exchange component of recurring costs could well be a significant part of the problem. In our simulation, foreign exchange costs amounted to $2.5 billion. Even if donor countries supply $3.6 billion in foreign exchange to cover domestic investment costs, foreign exchange would still present a thorny issue. The recurring costs extend well beyond the investment period and, in our case, over 60 percent of the foreign exchange costs would become payable after investment was completed.

To put some of these figures into perspective, we should note that the combined GDP of the six Sahel countries was about $3.2 billion and the government revenue was $483 million in 1974. The projected GDP for 1980 is $4.4 billion and government revenue without the projects is expected to be around $760 million.[1] The average annual local investment of $320 required by the aid program would thus be approximately 40 percent of the total 1980 government budgets without the projects and 7.3 percent of GDP. In addition, the average annual recurring costs are also equal to approximately 50 percent of the projected 1980 revenue.

An alternative source of revenue is the printing of money in excess of the amount required to accommodate real income growth. Any such attempt at money financed deficit spending, however, could have major effects on the price level. The total money supply in the six countries was approximately $643 million at the beginning of 1975. The figure has undoubtedly risen somewhat since but it is clear that attempting to finance an annual average of $680 million in local investment and recurring costs through money creation would create insupportable inflation.

It seems almost redundant to say that a large fraction of local investment and recurring costs probably must be included in the donor's aid package. But in accepting this conclusion, we are presented with a host of new problems. Giving aid for the purchase of domestic resources entails entirely different kinds of policies than does giving aid to pay for the foreign exchange costs of projects. Foreign exchange costs are virtually synonymous with project imports or technical

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[1]The projections are based on 1975 dollars and use growth rate estimates obtained from "Economic Considerations for Long Term Development in the Sahel," Center for Policy Alternatives, MIT Dec. 31, 1974, Annex 1 p. 124. See Tables III-10 through III-14 of this study for more complete details on the projections.

assistance requirements. In paying for these resources, the foreign exchange never need pass through the monetary institutions of the host country. The purchase of local labor and goods, on the other hand, requires local currency. If the aid is given in dollars or other foreign exchange, the dollars must be sold to the central bank which in turn sells them to importers or builds up foreign exchange reserves. Domestic resources can then be purchased with the local currency obtained from the central bank.

The institutional arrangements for giving such aid must be carefully worked out to ensure that the process is efficient, that the money flows where it should, and that exchange markets are not interferred with. It is also important that the aid, which has many similarities to domestic budget support, is handled in ways that are compatible both with the budgetary procedures of the country in which the project is located and with the policies of the regional and national financial institutions, particularly the central banks.

For example, since the central banks control all foreign exchange, there could be problems in allocating directly to a project or country, exchange that is meant to cover recurring costs. It may be necessary for a donor country to sell exchange to the bank and then distribute the counterpart local currency funds it receives either to the project or to the recipient country's treasury. Alternatively, given the difficulties of controlling budget allocations within countries, it may be advisable to dispense these funds directly from the central bank to

the project. This would provide a rationale and means for continuous monitoring of both the technical and financial aspects of the projects.[1]

In addition to selecting policies and institutions to dispense external support for local investment and recurring costs, it is essential to develop techniques to mobilize domestic resources as well. At some point all recurring costs must be borne by the recipient country and it is not only fair and sensible, but also economically efficient, that this be accomplished as rapidly as possible, provided that the means for raising revenue do not interfere with domestic growth and investment. The greater the share that can be borne by the Sahel countries, the larger the amount of investment a given amount of aid can support.

Analysis of the recurring and domestic investment costs comprises only a portion of the effort required to formulate appropriate policy to assure that these costs are covered. Additional effort must be devoted to analyzing both the initial budgetary capacity of each country and the nature and and recipients of the goods, services and cash flows produced by each project type. The budgetary capacity must be examined in order to estimate what portion of recurring costs can be covered by the host country and what policies will need to be adopted in order to do so. It is the gap between these two streams, the cash flow and the available government income, that must be covered by external funds. This paper is devoted principally to the first of these two problems and broaches the second only in a very limited way, using estimates of aggregate tax rates.

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[1]See Ch. V for a more complete discussion of this point.

It should be emphasized that the purpose of the study is primarily to develop a methodology to be used in analyzing a part of the problem of recurring costs. The findings discussed briefly above and more fully in the following chapters are highly preliminary and for the most part merely illustrative of the capabilities of the model we have developed. They are in no sense meant to be final figures. The numbers we have produced are not projections but the outcomes of simulations.

In spite of the preliminary nature of the work thus far, however, we feel there are several conclusions and recommendations that can be made.

1. A complete examination should be undertaken of the project evaluation documents for all major Sahel development projects completed or undertaken within the last five years as well as for those now budgeted for the future to determine first of all whether or not the recurring cost streams have been adequately taken into account in the evaluation process. Where data on domestic investment and recurring costs is available, it should be collected as part of the initial step in accumulating full information on the impact of these costs in individual countries. Where data is not available for particular projects, these gaps should be noted and steps taken to fill them. In some cases it may be possible to apply parameters derived from evaluation of other projects of a similar nature. In cases where no reliable parameter estimates are available, it may be necessary to seek information in the field from budget data for actual projects. There are almost certain to be some instances where there is neither data nor experience. In these cases, an informed estimate will need to be made and utilized until genuine data is available.

2. The responsible individuals in the various aid agencies in donor countries and organizations should be made aware of the importance of the problem and of the need for incorporating estimates of the recurring costs in all project evaluations that they undertake. They should be informed that such data is being collected centrally for evaluation and a contact point should be established for transmission of information in both directions.

3. A system should be established for monitoring all projects as they come on stream in order to establish a more reliable data base that reflects actual experience with recurring costs on a large variety of projects. In the future this data can be compared with the projections and used both to increase the accuracy of projected aggregate costs and to improve estimates made in future project evaluations.

4. An examination should be undertaken of the budgetary capacity of the individual countries in the Sahel to determine what fraction of local investment and recurring costs they are capable of supporting and under what circumstances. The examination should cover not only the current tax structure and institutions but look carefully at the potential of various project types to yield government revenue either through specific taxation of output or through the institution of user fees for rights to participate in the project.

5. There should be further examination of project evaluations in order to improve the reliability of parameter estimates already obtained and to include project types not yet covered such as health and education.

6. A complete study should be undertaken of the monetary and currency system of the African Currency Unions including a detailed analysis of the role of the central banks, the way in which they handle foreign exchange sales and purchases, their relationships to the budgetary process of each country, how the seignorage created by the system is allocated and how trade balances between countries are taken care of. Particular attention should be paid to the role of the Sahel countries within the much larger groups included in the currency unions.

7. An analysis should be made of the potential foreign exchange earnings for the Sahel and the claims on these earnings. Some preliminary missionary work should be begun to encourage future project analysis for the region to include an evaluation of potential foreign exchange earnings or savings from project output and to also estimate the foreign exchange portion of recurring revenue.

8. The model of this study should be expanded to enable it to comprehend the financial flows involved in loan repayments. Conditions of the aid to be given through the Club have as yet not been determined. If some of the aid involves repayment, particularly of foreign exchange, this will compete for funds to finance recurring and local investment costs. Repayment schedules cannot sensibly be laid out without taking potential conflicts into account.

9. Extensive evaluation must be undertaken of all policies and institutions that relate to the giving of aid designed as budget support. These will include among other things the desirability of tying aid, the merits of grants vs. loans, the setting up of safeguards to ensure that funds are used as intended, exchange rate policies, constraints that may be imposed on recipient countries as a condition to receive the aid, and the political implications of the central role played by the French franc in the African countries' monetary systems.

CHAPTER II

AN ACCOUNTING FRAMEWORK FOR LOCAL AND RECURRING COSTS

Each investment project is unique in terms of the kinds and amounts of resources required both during its construction and over its productive life. Although similar projects may have similar cash flows associated with them, they are almost never identical; and unrelated projects are likely to have quite disparate cost characteristics. Because the recurrent and local cost characteristics of projects can be so different, one must begin an examination of cost streams at the project level. One must know the amount and timing of cost streams and income flows for each project of any significant size in each country.

In order to assess the total impact of a particular investment program, however, one must be able to aggregate easily the cost and income flows associated with all projects and be able to match these against the budget capacity of the recipient countries. Accomplishing such aggregation requires an ability to identify, store, retrieve, and manipulate information quickly and accurately. With an investment program the size of that projected for the Sahel, where many countries and projects are involved, the only feasible solution is to use a computor for storage and manipulation of data and design an accounting model that is flexible and capable both of accepting actual detailed project data and of generating reasonable simulated figures where data gaps exist. Such a model can then be used both for analysis of actual numbers and for examining the outcomes of alternative policies and scenarios.

The main purpose of this chapter is to present and explain a model of the accounting relationships that exist between investment in a project and the various financial flows that are related to that investment. Before describing the model in detail, however, we shall discuss some of the results derived from a simulated $10 billion investment program. One should keep in mind throughout the following discussion that any numbers that are provided are essentially conjectural. We do not have complete information on the specific nature of all projects that will be included in the Sahel Development Program over the next ten years, nor do we know how much will be spent, nor what the temporal allocation of investment might be. We are fabricating a scenario which conforms as nearly as possible to current thinking, running it through the model and then examining the outcome. A different scenario would yield a different outcome.[1]

The benchmark foreign aid figure for Sahel development is $10 billion to be spent over ten years. For our purposes it is more useful to focus on a $10 billion <u>investment</u> program and let the value of aid that is associated with $10 billion in investment be a variable that depends upon the policies donors adopt with respect to the financing of local costs and recurring costs.[2] If these costs are paid for by recipient governments, the aid program is smaller than if they are externally financed. We have accepted the USAID figures on the allocation of the $10 billion of investment among various sectors of the economy.

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[1] In Chapter V we discuss how the model can be used to aggregate data from actual individual projects.

[2] Should the figures be of interest, it is a simple matter to scale the numbers we obtain so that they correspond to a $10 billion aid level and a given financing policy.

(The proportions used are shown in Table 2 of Chapter 3.) The vehicle for our discussion will be Table 1 which contains projected annual figures over a 14 year period for ten different variables: (1) Total investment, (2) Local investment, (3) Total recurring costs, (4) Total local and recurring costs, (5) Government revenue from project income, (6) Local investment and recurring costs net of government revenue, (7) Potential seignorage from money creation due to project income, (8) Local investment and recurring costs net of government revenue and seignorage, (9) Recurring costs net of government revenue and seignorage, and (10) the Foreign Exchange portion of recurring costs. We shall discuss the implications of the figures and the assumptions that underly each set.

Total investment (line 1) is the driving force behind all the figures in the table. Investment is assumed to take place at the rate of $1 billion per year for ten years. This assumption is obviously unrealistic from a practical point of view but it is sufficient as a basis for examining the dimensions of all the financial flows related to investment. Local investment (line 2) is 32 percent of the total or $320 million per year for the first ten years.[1]

Since it is assumed that projects require four years on average to complete, the recurring costs (line 3) do not begin until the fifth year of the period. Annual gross recurring costs (making no allowance for government revenues) are 6.6 percent of completed investment.[2] They increase each year by $66 million from the fifth to the fourteenth year when they stabilize at $660 million. These recurring costs include both local and foreign exchange costs.

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[1]This percentage is an average for all projects weighted by the fraction of total aid to be spent on them. See Table 2, Ch. III.

[2]This percentage is also a weighted average for all projects.

Table 1

COST AND INCOME STREAMS FOR SIMULATED INVESTMENT PROGRAM OF $10 BILLION

($Millions)

	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Totals
1. Total investment	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000					$10 Billion
2. Local Investment	320	320	320	320	320	320	320	320	320	320					3.2 "
3. Total recurring costs					66	132	198	264	330	396	462	528	594	660	3.63 "
4. Total local and recurring costs (2 + 3)	320	320	320	320	386	452	518	584	650	716	462	528	594	660	6.83 "
5. Total increase in GNP due to program investments					280	560	840	1120	1400	1680	1960	2240	2520	2800	
6. Government revenue from project income (.15 x 5)					42	84	126	168	210	252	294	336	378	420	2.31 "
7. Net local and recurring costs (4 - 6)	320	320	320	320	344	368	392	416	440	464	168	192	216	240	4.52 "
8. Seignorage from money creation due to project income					31	31	31	31	31	31	31	31	31	31	.31 "
9. Net Net local recurring costs (7 - 8)	320	320	320	320	313	337	361	385	408	413	137	161	185	209	4.21 "
10. Net recurring costs (9 - 2)					-7	17	41	65	88	93	137	161	185	209	1.0 "
11. Foreign Exchange portion of recurring costs (68% of 3)					45	90	135	180	224	269	314	359	404	449	2.469 "

Total investment = $10 billion

Total aid = 1. $6.8 billion if no local investment or recurring costs are supported
2. $10 billion if local investment but no recurring costs are supported
3. $11.1 billion if net net local investment and recurring costs are supported

Total net net local & recurring costs = $4.33 billion

Total local and recurring costs = $6.83 billion

The stream of domestic income produced by the projects (line 5) begins when the first set of investments is completed and presumably increases by $280 million per year as more investment comes on stream. Although the relationship between income and investment is derived directly from World Bank Project evaluation data, the capital output ratio implied by these figures is approximately 3.6 which is not an unreasonable number.

A portion of the total income is assumed to end up in the hands of the government (line 6) even without special taxes or fees. The average revenue collection rate for all the Sahel countries is 15%. This fraction is applied to the income stream produced by the projects to arrive at the government revenue figures. Government revenues grow until the fourteenth year where they stabilize at $420 million per year. These revenues are not specific to the projects, however, but enter into the government budget through the normal tax system. As a result, there is no assurance they would be used to pay the local investment or recurring costs unless special institutional arrangements were made. It is quite possible that some projects, particularly in agriculture, would produce income for the government either in the form of direct taxes or output or user fees charged for services. The degree to which such policies could augment the revenue stream of Table 1 is difficult to predict without a much more detailed analysis.

If all government revenue accruing from project income were applied against the local investment and recurring costs, the net cost stream would be as shown in line 7. There is one other potential source of

government revenue that should also be considered, seignorage from money creation (line 8). As the projects come on stream and income accrues to the participants, their demand for transactions balances can be expected to rise to accommodate their new income levels. The government can satisfy this demand by printing up money and exchanging it for goods and services. Since banks can also create money, the government must share this source of revenue with the banking system, with the government getting the seignorage on the issue of currency and bank reserves and the banks acquiring that on demand deposits net of reserves. In the Sahel countries, approximately half the money supply is bank money (demand desposits net of reserves) so that the government receives only half the total seignorage. The seignorage is calculated by multiplying the annual increase in income generated by the projects ($280 million per year) by the ratio of money to GNP in the Sahel area (.22) and dividing by 2. The figures are relatively small but not insignificant, remaining constant at $31 million throughout the period and amounting to $310 million in all. The problems attached to getting seignorage allocated to pay for recurring costs are much different from those connected with tapping government revenues. They do not enter directly into any government budget nor, in fact, are they even available to any individual country except insofar as the central bank permits the country to acquire them. Nevertheless, they do exist and policies governing their use can be an important aspect of the development program.

When government revenue and seignorage are subtracted from the total local and recurring costs, we arrive at the net burden imposed on the Sahel economies by the simulated investment program (line 9). It is evident, given the assumptions about government revenue, that the first ten years of the program pose by far the greatest financial burden. The net net local investment and recurring costs peak at the end of ten years at $413 million and then fall abruptly, as new investment ends, to $137 million before rising to $209 million, at the end of 14 years, where they stabilize. If donor countries were to pick up the tab for all local investment costs, all government revenues (including seignorage) could be applied against the recurring costs. The new recurring costs still not covered would be those shown on line 10 of the table. These figures are particularly interesting because they are relatively small. In the fifth year of the program they are actually negative. When they peak at the end of fourteen years, they stand at $209 million.[1] This is not a negligible figure and amounts to about 3 percent of a projected regional GDP of $7.2 billion.[2] If the project related revenue generated through the normal tax system can be 100% applied to the recurring costs, however, it seems reasonable to believe that most of this net recurring cost stream could be supported by a well planned system of charges for services from projects and direct taxes on output or an increase in the average aggregate revenue collection rate. Of course, this is a big if, but identification and adoption of policies to achieve these ends are an important aim of the entire Club program.

[1]If one were to eliminate the excess revenue from telecommunications projects (which by World Bank reckoning is extremely profitable) the net recurring cost figures would be about 25 percent higher. In this case, they would amount to 4 percent of projected GDP rather than 3 percent.

[2]The $7.2 billion is for 1991 in 1975 dollars and does not take into account the income generated by Club projects. It is based on growth projections contained in "Economic Considerations..." MIT, op. cit. p. 124.

There is one aspect of the recurring cost problem, however, that is obscured by the emphasis on the total figures--the foreign exchange requirements (line 10). These are derived in our example by assuming that the foreign exchange portion of recurring costs is the same as that in intial investment.[1] One cannot help but be struck by the potential magnitude of the foreign exchange requirements over time. They are invariably larger than the net recurring costs with the ratio slightly greater than 2 to 1. The implication is clear. Satisfying the net recurring cost requirement (line 9) with domestic resources may still leave projects starved for foreign exchange to purchase requisite imports. Thus, there may be a need for external support even though the government budget is adequate to cover these costs. The figures also point up the need to analyze the implications for foreign exchange earnings of investment in various kinds of projects. Virtually no analysis of this problem is currently being done in project evaluations.

We can summarize the implications of our exercise rather succinctly.

> First, the magnitude of total local and recurring costs is staggering. For a $10 billion investment program, the local investment and recurring costs would amount to $6.8 billion. The foreign exchange component of the investment program would also be $6.8 billion. Thus, if none of the local investment nor recurring costs were paid for with external assistance, the Sahel countries would be expected to furnish resources equal to the aid they were given. Of the internally funded $6.8 billion, approximately $2.5 billion would require foreign exchange.
>
> Second, if the average tax rate remains 15 percent and the estimates of growth in GNP due to the investment are at all valid, domestic revenue collection plus seignorage from money growth would furnish $2.5 billion. If all of this could be channeled to help pay the $6.8 billion, it would nevertheless leave a very healthy chunk of $4.2 billion uncovered. The foreign exchange requirement would be unaffected and still amount of $2.5 billion.

[1]There is no analysis in any project evaluations of the foreign exchange component of recurring costs. Thus, this parameter is conjectural.

Third, if donor countries decided to provide external assistance to cover the local investment costs, they would put up an additional $3.2 billion bringing the total aid contribution to $10 billion. This would leave the countries with $3.6 billion in recurring costs against which could be applied our estimated revenue of $2.5 billion. The remaining $1.1 billion is a figure that conceivably could be raised domestically with user charges or increased taxes but the feasibility of doing so depends upon the types of projects selected and the fiscal policies chosen.

Fourth, even with donor countries supplying $3.6 billion in foreign exchange to cover domestic investment costs, the specter of the exchange component of the recurring costs would will remain. In our simulation over 60 percent of these costs would become payable after the spigot of external support for local investment was shut off. Thus, the problem would be diminished as a result of the external funding of local investment but not eliminated.

An Accounting Model of Local Investments and Recurring Costs

In order to make explicit the relationships between project investment and various financial flows, and to identify the parameters for which estimates are required, we have deloped an accounting model which illustrates rather simply the problems of funding local investment and recurring costs. The model consists of several equations all related to investment in specific projects. The equations describe how recurrent costs, potential income changes, and domestically financed investment can be expressed as functions of total project investment costs. Since all variables in the model are dated and apply to a specific point in time, they all have a subscript to indicate the year in which costs are incurred or income received.

We shall begin by defining the following investment variables. Since there are a number of ways in which investment may be looked at, we need several variables:

(1-a)	I_{jt}	= investment in project j during period t
(1-b)	$I^d_{jt} = z_j I_{jt}$	= local resource portion of investment in project j in time t, z_j is the ratio of local to total investment
(1-c)	$I^f_{jt} = (1-z_j)\ I_{jt}$	= foreign portion of investment project j in time t
(1-d)	$I_t = \sum_{j=1}^{m} I_{jt}$	= total investment in all of m projects during period t
(1-e)	$I^d_t = \sum_{j=1}^{m} z_j I_{jt}$	= total local resource investment in time t
(1-f)	$I^f_t = \sum_{j-1}^{m} (1-z_j)\ I_{jt}$	= total foreign exchange investment in time t
(2-a)	$I_{jT} = \sum_{t=T-n}^{T} I_{jt}$	= total investment in project j over n years with project completed in year T
(2-b)	$I_{Tt} = \sum_{j=M_t} I_{jt}$	= value of total investment completed before year t. M_t is the set of all projects completed before year year t

The recurring costs typically begin while the project is still under construction and continue throughout its useful life. In specifying the equations, however, we assume they do not begin until after the project is finished since the early ones can be considered part of the

investment cost. The costs can be separated into two categories. The first category corresponds to routine maintenance costs. They are constant from one year to the next and tend to be linearly related to the size of the project. We can designate them $a_j I_{jt}$ where a_j is the ratio of recurring to project investment costs. The second category includes those which occur at less regular intervals and might correspond to major overhauls or refurbishing or equipment. We shall designate the ratio between these intermittent costs and investment as c_{jt} where c_{jt} may be zero in some years. The total recurring costs in year t associated with a project that is completed in any earlier year T then become:[1]

$$X_{jt} = a_j I_{jT} + c_{jt} I_{jT} \qquad t > T \tag{3}$$

The recurring costs in year t for all completed projects would be:

$$X_t = \sum_{j \varepsilon M_t} a_j I_{jT} + \sum_{j \varepsilon M_t} c_{jt} I_{jT} \qquad t > T \tag{3-a}$$

M_t is the set of projects completed before time t.

The projects will also generate an increase in aggregate income.[2] The time stream of income will be specific to each project type and may or may not be linear. As a result, we shall simply designate income from project j in the time t, ΔY_{jt}, as a function of investment and the time period.

$$\Delta Y_{jt} = f_j(I_{jT}, t) \qquad t > F \tag{4}$$

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[1] The recurring costs actually begin prior to completion of the project. These early costs are a linear function of investment undertaken up to that point. The parameter a_j is still applicable.

[2] If the project happens to be one that generates direct income for the government through sales of output or assessment of user fees, this revenue can easily be included in the model.

Total income from projects would be:

(5) $$\Delta Y_{jt} = \sum_{j \varepsilon M_t} f_j(I_{jT}, t) \qquad t > T$$

The government revenue that accrues as the result of increased income from the investment can be projected using one of two basic models. In the first, government revenue is generated solely as a function of increased GNP. If we assign the symbol s to the marginal aggregate tax rate, total government revenues ΔR_t that result from the project during time t will be:

(6) $$R_{jt} = s\Delta Y_{jt}$$

The second possibility is that there are specific taxes on fees that can be levied on output or services. In this case total project related revenues would be:

(7) $$R'_t = \Sigma s_j \, \Delta Y_{jt}$$

where s_j is the revenue collection rate specific for the project j. It is possible that both circumstances might occur; that there would be both specific taxes and a general increase in revenue.

There is also potential income from seignorage. This is available only once on an increase in the money supply that accompanies any new increment to income in a year. If k is the ratio of government money demanded to GNP, the seignorage w_t can be expressed as:[1]

(8) $$w_t = k(\Delta Y_t - \Delta Y_{t-1})$$

---

[1]Government money is defined as currency in the hands of the public plus reserves at commercial banks.

Another important variable is the foreign exchange component of recurring costs. If we let q_j be the ratio of foreign exchange to total recurring costs this can be written:

$$F_{jt} = q_j X_{jt} \tag{9}$$

For some applications of the model it may be useful to project the non-investment related income, government revenue or government expenditures. The foreign trade sector may be particularly important. These functions are easily modeled and do not need to be included here.

Project Related Deficits

There are number of problems that the model can now be used to analyze. One is how much of a net budget deficit is created by the implementation of a particular project. A second is what is the aggregate budget deficit that is generated by an entire menu of projects.

In order to look at the first of these two problems, we can label D_{jt} the net deficit in time t associated with project j. This project deficit will be equal to the sum of domestic investment resources plus recurring costs less government revenues. It is likely that either domestic investment or recurring costs and government revenues would be zero depending upon whether the project was completed or not. The deficit can be written as:[1]

$$D_{jt} = I_{jt}^{d} + X_{jt} - R_{jt} \tag{10}$$

This is the gap that must be filled from some source if the project is to be viable. There are a number of possibilities including foreign

[1]In the aggregate one would need to include seignorage but this does not accrue on a project basis.

aid, foreign borrowing, an increase in the effective tax rate, an increase in the income upon which taxes are collected or expansion of the money supply. It is a simple matter to solve for any one or combination of these variables to see what policy options are available. For example,

$$\sigma_{jt} = \frac{D_{jt}}{Y_t}$$

is the incremental increase in the average domestic tax rate that would be required to fund D_{jt}. Or, alternatively,

$$\alpha_{jt} = \frac{D_{jt}}{sY_t}$$

is the percentage increase in income that would be required to fill the gap.

To evaluate the aggregate budgetary effects of an entire aid program we need to sum over all projects. The program related net deficit is:

$$D_t = I_t^d + X_t - R_t \tag{11}$$

As with individual projects this budgetary gap can be filled in a number of ways, including aid, borrowing or higher taxes. The required incremental increase in the average domestic tax rate would be,

$$\sigma_t = \frac{D_t}{Y_t}$$

while the required percentage increase in domestic income would be,

$$\alpha_t = \frac{D_t}{sY_t}$$

The Entire Model

Having described each of the relationships involved in estimating project related costs we can now lay out the entire model both for a single project and for a program. The independent variables, equations, and parameteres relating to a single project are:

Model I

Project Related Deficit

Independent Variables:

Annual investment in project j	I_{jt}	$t = 1, N$

Equations

(1-b)	Local investment	$I^d_{jt} = z_j I_{jt}$	
(2)	Total investment	$I_{jT} = \sum_{T-n}^{T} I_{jt}$	$t > T$
(3)	Recurring costs	$X_{jt} = a_j I_{jT} + c_{jt} I_{jT}$	
(4)	Income generated	$\Delta Y_{jt} = f_j(I_{jt}, t)$	
(5)	Government revenue generated	$R_{jt} = s\Delta Y_{jt}$	
(9)	Foreign Exchange portion of Recurring Costs	$F_{jt} = q_j X_{jt}$	
(10)	Project related net deficit	$D_{jt} = I^d_{jt} + X_{jt} - R_{jt}$	

Parameters

z_j	proportion of local investment
a_j	proportion of continuous recurring costs
c_{jt}	intermittent recurring costs
f_j	functional relationship between investment and income
s	marginal tax rate on aggregate income
q_j	proportion of foreign exchange in total recurring costs

Model II

Program Related Deficit

Independent Variables:

I_{jt}; t - 1-K; j - 1, m	Annual investment in all projects

Equations

((1-e)	$I_t^d = \Sigma z_j I_{jt}$	Local investment
(2-b)	$I_{Tt} = \sum_j I_{jt}$ t T	Total investment in all projects completed before year t
(3-a)	$X_t = \sum_j X_{jt}$	Recurring costs
(4-a)	$\Delta Y_t = \sum_{j \in M_t} \Delta Y_{jt}$	Income generated
(6)	$R_t = s\Delta Y_t$	Government revenue generated
(8)	$w_t = k(\Delta y_t - \Delta Y_{t-1})$	Seignorage
(9)	$F = \Sigma q_j X_{jt}$	Foreign exchange portion of recurring costs
(11)	$D_t = I_t^d + X_t - R_t$	Program related net deficit

Parameters

same as Model I plus

k	Ratio of government money stock to GNP

Applications of the Model

Although the mathematical equations for the model are numerous, they represent some very simple relationships among the cash flows associated with projects. The formidable aspect of the problem is simply keeping track of and accounting for all of the multitude of projects and flows that the various donors will be generating throughout the life of the Sahel Development program. The mathematical model presented here and its computorized counterpart are nothing more than a means of handling this accounting problem so it becomes tractable. Once the figures can be managed easily, policy alternatives can be examined and financial monitoring can be undertaken to assure that all costs are planned for and that valuable facilities, once in place, are not allowed to deteriorate through lack of resources to support their operation.

The figures associated with each individual project are the numbers that we ultimately seek in attempting to analyze the impact of recurring costs. Obtaining these numbers will absorb a considerable amount of effort and in many cases may require examination of project budgets in the field. In the absence of actual project data, however, for the purposes of both demonstrating the model's capabilities and making some preliminary assessments of the magnitude of the recurring cost problem, we have run the model using some estimated financial parameters for certain classes of projects. The parameters are those associated with World Bank projects and were obtained by analyzing data from project evaluation studies.[1]

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The exercises done are thus in the nature of a simulation. We utilized what we gather is the best official guess about the size and distribution of the projected investment program for the Sahel over a ten year period, $10 billion, and attempted to determine what such a program implied both for the entire region, and for the individual countries. It is the results for the entire Sahel that are reported in the first part of this chapter. The results for the individual Sahel countries are discussed in Chapter III which also contains a complete description of the allocation of funds by project type. The parameters used in the simulations are derived and discussed in Appendix A.

The model can also be used to project recurring costs for individual projects and then to calculate the taxes or fees that would need to be collected from individuals who benefit from the project if the project were to be individually self sustaining. Some examples of this use of the model are contained in Chapter IV.

CHAPTER III

CASE STUDIES---INDIVIDUAL COUNTRIES

I. Introduction

Earlier we examined from a regional viewpoint the ongoing and local cost burdens for the entire Sahel that would accompany an investment program of $10 billion over ten years using certain assumptions about the allocation of investment. In this chapter we discuss the results of another simulation exercise, performed this time for the individual Sahel countries - Niger, Senegal, Chad, Mali and Mauritania.[1] We also investigate some of the components of the investment package for one country, Niger, and look at the flows associated with specific project types (although not individual projects) using the parameters and assumptions developed elsewhere in the paper. (A similar breakdown was performed for all other countries but the results are not presented here.) An estimate of the total size of flows that would be associated with the program in each country is then obtained by aggregating the flows for all types of projects assumed to be included in each country's share of a $10 billion program. The numbers used in this chapter are illustrative only but in using them we demonstrate the general methodology for applying the model and parameters to a specific country and specific project types.

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[1] Upper Volta is not included in the simulations because reliable data is unavailable for that country. Data may be available for Upper Volta later in 1978.

The countries of the Sahel region are already the recipients of large sums of foreign aid. For example, as shown in Table 1, aid receipts for Niger have recently been nearly equal to the budget revenues and expenditures. Even though aid is already flowing in at a relatively high rate, the estimated Club program could be nearly double the 1974 figure.

TABLE III-1
NIGER
AID AND THE CURRENT OPERATING BUDGET
('000's US $)

	69	70	71	72	73	74
Foreign Aid	44,444	30,777	41,778	47,111	54,222	76,444
Current Revenue	48,444	51,111	53,778	56,000	56,000*	
Current Expenditure	44,889	47,111	49,778	50,222	54,667*	

*estimate

As we shall demonstrate, the local and recurring costs associated with a long term aid level of this magnitude would surely strain the capacity of the governments to pay. But first we shall evaluate the financial flows that are associated with each Sahel country's share of a $10 billion investment program.

II. The Model

In Chapter II we developed an accounting model to use in analyzing the magnitude of local investment and recurring costs associated with foreign aid investment in the Sahel countries. It may be useful before presenting the results to briefly review the structure of that model:

1. The initial investment requires both foreign exchange and domestic resources. If I_{jt} is total investment in project j in year t, and z_j is the proportion of total costs which are domestic, domestic or local investment is given by:

(1) $$I^d_{jt} = z_j I_{jt}$$

2. Project investment generates a recurring cost stream and an income stream. The cost stream can be viewed as consisting of two components. The first is a constant or routine annual cost element that is a fixed proportion of project investment. The proportionality factor is a_j for project type j. The second cost is intermittent and occurs only in certain years. It is also proportional to investment and we designate it c_{jt}. In those years when there is no intermittent cost, c_{jt} is zero. Thus, the total recurring project costs, x_{jt}, associated with a project completed at time T, can be modeled as:

(2) $$x_{jt} = a_j I_{jT} + c_{jt} I_{jT}$$

3. The income stream generated by the project will be a function of the project investment and the time since project completion. The explicit functional form, however, is specific to the project type. The relationship in implicit form is:

(3) $$\Delta Y_{jt} = f_j(I_{jt}, t)$$

4. The income stream is important for our analysis because it provides tax revenue. If we assume that the marginal tax rate on income is equal to the average rate for a particular country and

designate the tax rate as s, the revenue that accrues to the government as a result of the project is:

$$R_t = s\Delta Y_{jt} \tag{4}$$

The parameters required for equations 1, 2 and 3 are specific to projects and are all given in the appendix. The average tax rates of equation 4 used in the simulation were the historical averages of the ratios of current revenue to national income for each country. The rate used was 12% for Niger, 20% for Senegal, 15% for Chad, 15% for Mali, and 22% for Mauritania.

III. Project simulations

In simulating the project-related flows for the Sahel countries, we used the same aggregate investment figure for the Sahel region that we stipulated earlier, $10 billion, and assume that it is it be spent in equal annual amounts.[1] In the absence of a firm estimate of how much of the $10 billion would be spent in each country, we have simply postulated that each country's share is equal to the ratio of that country's GDP to that of the total Sahel region in 1974. For Niger, this was 16.1 percent. Senegal's share of the investment would be 35.8 percent; Chad's--12.2 percent; Mali's--13.2 percent; Mauritania's--8.5 percent; and Upper Volta's--15.2 percent. Using the above proportions, investment in Niger would be approximately $161 million per year for each of the 10 years, a figure which is nearly three times Niger's government expenditures in fiscal year 1974/1975. Senegal's investment would be approximately

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[1]As described shortly the actual figures used were approximately 2/3 of the $10 billion total because of the absence of parameter estimates for some types of projects.

$358 million for each of the ten years, or about the same amount as its government expenditure in 1975. Chad's would be $112 million per year; Mali's would be $132 million; Mauritania's would be $85 million; and Upper Volta's would be $152 million.

To allocate the investment for each country among the various sectors, we used percentage shares contained in the 1977 USAID description of total Club investment in the Sahel. The percentages and dollar amounts for the Sahel countries are shown in Tables III-2a. The project types within each sector and the dollar amounts assumed invested in each types of project are given in Table III-2b. Since even rough estimates of the cost parameters are not available for some of the projects (the most important being the human resources and health sector), the simulations did not include the funds allocated to these sectors. Instead, the simulations were done using an investment package for each country that was approximately 2/3 the amounts listed in the paragraph above. Thus, the figures used in the simulations were $105 million in Niger, $236 million in Senegal, $56 million in Mauritania, $87 million in Mali, $74 million in Chad, and $100 million in Upper Volta. The cost and income flows associated with these levels of investment are not necessarily exactly 2/3 of the flows that would be associated with the total program since the projects that are not included could well exhibit much different ratios between investment and recurrent costs or income.

Table III-2a

SECTOR ALLOCATION OF TOTAL INVESTMENT PROGRAM BY COUNTRY

Sector	Proportion of total Club Program[1]	Annual Assumed Investment ($ millions)					
		Niger	Senegal	Chad	Mali	Mauritania	Upper Volta
Transport and Infrastructure	.21	33.81	75.9	23.5	27.7	17.9	31.9
Irrigated Agriculture	.25	40.25	89.52	38.0	33.0	21.3	38.0
Rainfed Agriculture	.11	17.71	39.39	12.3	14.5	9.4	16.7
Livestock	.09	14.49	32.24	10.1	11.9	7.7	13.7
Human Resources and Health	.23	37.03	82.34	25.9	30.4	19.6	35.0
Fishing	.02	3.22	7.14	2.2	2.6	1.7	3.0
Forestry	.03	4.83	10.73	3.4	4.0	2.6	4.5
Adaption of Technology	.02	3.22	7.14	2.2	2.6	1.7	3.0
Marketing and Price Policy	.04	6.44	14.31	4.4	5.3	3.4	6.0
Totals	1.00	161.00	358.00	112.0	132.0	85.0	152.0

[1]Source is USAID.

Table III-2b

PROJECT ALLOCATION OF SIMULATED INVESTMENT PROGRAM BY COUNTRY

Sector	Proportion of Total Club Program[1]	Project Type Within Sector[2]	Annual Investment Used in Simulations ($ millions) Niger	Senegal	Chad	Mali	Mauritania	Upper Volta
Transport and Infrastructure	.21	Feeder Roads	15.0	33.36	10.5	12.5	8.0	14.4
		Paved Roads	15.0	33.36	10.5	12.5	8.0	14.4
		Telecommunications	3.81	8.47	2.5	2.7	1.9	3.1
Irrigated Agriculture	.25	Polders	40.25	89.52	28.0	33.0	21.3	38.0
Rainfed Agriculture	.11	Rural or Agricultural Development	17.71	39.39	12.3	14.5	9.4	16.7
Livestock	.09	Livestock	14.49	32.24	10.1	11.9	7.7	13.7
Human Resources and Health	.23	*						
Fishing	.02	*						
Forestry	.03	*						
Adaptation of Technology	.02	*						
Marketing and Price Policy	.04	*						
Totals	1.00		106.26	236.34	73.9	87.1	56.3	100.3

*Parameters are not yet available for these projects.
[1]Source is USAID.
[2]These are project labels from evaluation studies.

Descriptions of the project types and values of the cost parameters associated with each are contained in the appendix and will not be repeated here. Tables III-3a to III-3f present the results of the simulations for the individual project types for Niger assuming total aid is given in equal installments over the ten-year period. Similar calculations were performed for each Sahel nation, but, for brevity, only the aggregate figures are presented for countries other than Niger. Although, in these simulations investment occurs only over ten years, the tables include cost and revenue figures for years 11 and 12 as well. The temporal flows are somewhat different from those presented earlier for the entire Sahel region. It is assumed here that projects are completed in one year and that recurring expenses and revenues begin the following year. Two other pieces of data are also left off these tables -- the foreign exchange component of recurring costs and the seignorage from money creation. The latter does not accrue to the individual country but must be allocated by the central bank. An estimate of the foreign exchange requirements could be obtained by multiplying the total recurring costs for each project by one minus the domestic cost ratio for the project (z_j).

Table III-4 gives the aggregate flows for the entire collection of projects financed by the $106-million-aid investment in Niger. Tables III-5 to III-8 provide similarly aggregated information for the other Sahel countries. One aspect of the aggregate flows requires clarification. For example, although the total aid to Senegal is over twice that to Niger, the total of project recurring costs minus the total of

project revenues is less for Senegal. This is due to the fact that Senegal's historical revenue collection rate is much larger than that of Niger (19.9% and 11.5%, respectively). Since the average tax rate is different in each country, the net recurrent cost flows are not the same proportion of investment in each case.

Table III-3a

SIMULATED INVESTMENT, COSTS AND REVENUES -- NIGER
Feeder Roads Project

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	15.0	3.3	0	0	3.3	0	0	0
2	15.0	3.3	.9	.9	4.2	3.6	.4	-.5
3	15.0	3.3	1.8	1.8	5.1	7.4	.8	-1.0
4	15.0	3.3	2.8	2.8	6.1	11.3	1.3	-1.5
5	15.0	3.3	4.9	4.9	8.2	15.4	1.8	-3.1
6	15.0	3.3	7.1	7.1	10.3	19.7	2.3	-4.8
7	15.0	3.3	9.2	9.2	12.4	24.2	2.8	-6.4
8	15.0	3.3	10.1	10.1	13.4	28.9	3.3	-6.8
9	15.0	3.3	11.0	11.0	14.3	33.8	3.9	-7.1
10	15.0	3.3	12.0	12.0	15.2	38.9	4.5	-7.5
11	0	0	12.0	12.0	12.0	38.9	4.5	-7.5
12	0	0	12.0	12.0	12.0	38.9	4.5	-7.5
SUMS	150.0	33.0	83.8	83.8	116.5	261.0	30.2	-54.7

Table III-3b

SIMULATED INVESTMENT, COSTS AND REVENUES -- NIGER
Paved Roads Project

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	15.0	3.3	0	0	3.3	0	0	0
2	15.0	3.3	.4	.4	.4	1.2	.1	-.2
3	15.0	3.3	.7	.7	4.0	2.6	.3	-.4
4	15.0	3.3	1.1	1.1	4.4	4.0	.4	-.7
5	15.0	3.3	1.5	1.5	4.8	5.5	.6	-.9
6	15.0	3.3	1.9	1.9	5.2	7.1	.8	-1.0
7	15.0	3.3	2.2	2.2	5.5	8.8	1.0	-1.2
8	15.0	3.3	2.6	2.6	5.9	10.7	1.2	-1.4
9	15.0	3.3	3.0	3.0	6.3	12.6	1.4	-1.5
10	15.0	3.3	3.4	3.4	6.7	14.7	1.7	-1.7
11	0	0	3.4	3.4	3.4	14.7	1.7	-1.7
11	0	0	3.4	3.4	3.4	14.7	1.7	-1.7
SUMS	150.0	33.0	23.6	23.6	56.4	96.6	10.9	-12.4

Table III-3c

SIMULATED INVESTMENT, COSTS AND REVENUES -- NIGER
Telecommunications Project

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	3.8	.7	0	0	.7	0	0	0
2	3.8	.7	.1	.1	.8	0	.4	.3
3	3.8	.7	.3	.3	.9	0	1.0	.7
4	3.8	.7	.4	.4	1.1	0	1.7	1.3
5	3.8	.7	.7	.7	1.4	0	2.6	1.9
6	3.8	.7	1.0	1.0	1.6	0	3.6	2.6
7	3.8	.7	1.3	1.3	2.0	0	4.8	3.5
8	3.8	.7	1.6	1.6	2.3	0	6.1	4.4
9	3.8	.7	2.0	2.0	2.7	0	7.6	5.5
10	3.8	.7	2.5	2.5	3.2	0	9.2	6.7
11	0	0	2.5	2.5	2.5	0	9.2	6.7
12	0	0	2.5	2.5	2.5	0	9.2	6.7
SUMS	38.0	7.0	14.9	14.9	21.7	0	55.4	40.3

Table III-3d

SIMULATED INVESTMENT, COSTS AND REVENUES -- NIGER
Polders Project

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	40.2	16.1	0	0	16.1	0	0	0
2	40.2	16.1	4.8	3.0	19.1	9.7	1.1	-1.9
3	40.2	16.1	9.7	6.0	22.1	19.3	2.2	-3.8
4	40.2	16.1	14.5	9.0	25.1	30.0	3.3	-5.6
5	40.2	16.1	19.3	12.0	28.1	38.6	4.4	-6.5
6	40.2	16.1	24.1	15.0	31.1	48.3	5.5	-9.4
7	40.2	16.1	29.0	18.0	34.1	58.0	5.7	-11.3
8	40.2	16.1	33.8	21.0	37.1	67.6	7.8	-13.2
9	40.2	16.1	38.6	23.9	40.0	77.3	8.9	-15.1
10	40.2	16.1	43.5	26.9	43.0	86.9	10.0	-16.9
11	0	0	43.5	26.9	26.9	86.9	10.0	-16.6
12	0	0	43.5	26.9	26.9	86.9	10.0	-16.6
SUMS	402.0	161.0	304.3	188.6	349.6	608.3	69.9	-118.9

Table III-3e

SIMULATED INVESTMENT COSTS AND REVENUES -- NIGER
Agricultural Development Project

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	17.7	10.3			10.3			
2	17.7	10.3	3.9	.9	11.2	9.6	1.1	.2
3	17.7	10.3	7.8	1.9	12.1	19.1	2.2	.3
4	17.7	10.3	11.7	2.8	13.1	28.7	3.3	.5
5	17.7	10.3	15.6	3.7	14.0	38.2	4.4	.6
6	17.7	10.3	19.5	4.7	14.9	47.8	5.5	.8
7	17.7	10.3	23.4	5.6	15.9	57.4	6.6	1.0
8	17.7	10.3	27.3	6.5	16.8	66.9	7.7	1.1
9	17.7	10.3	31.2	7.5	17.7	76.5	8.8	1.3
10	17.7	10.3	35.0	8.4	18.7	86.1	9.9	1.5
11	0	0	35.1	8.4	8.4	86.1	9.9	1.5
12	0	0	35.1	8.4	8.4	86.1	9.9	1.5
SUMS	177.0	103.0	245.6	58.8	161.5	602.5	69.3	10.4

Table III-3f

SIMULATED INVESTMENT, COSTS AND REVENUES -- NIGER
Livestock Projects

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COST PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	14.5	8.1	0	0	8.1	0	0	0
2	14.5	8.1	2.0	1.6	9.7	9.8	1.1	-.5
3	14.5	8.1	4.1	3.2	11.3	18.5	2.1	-1.0
4	14.5	8.1	6.1	4.7	12.9	27.8	3.2	-1.5
5	14.5	8.1	8.1	6.3	14.4	37.1	4.3	-2.1
6	14.5	8.1	10.1	7.9	16.0	46.4	5.3	-2.6
7	14.5	8.1	12.2	9.5	17.6	55.6	6.4	-3.1
8	14.5	8.1	14.2	11.1	19.2	64.9	7.5	-3.6
9	14.5	8.1	16.2	12.6	20.8	74.2	8.5	-4.1
10	14.5	8.1	18.2	14.2	22.3	83.5	9.6	-4.6
11	0	0	18.2	14.2	14.2	83.5	9.6	-4.6
12	0	0	18.2	14.2	14.2	83.5	9.6	-4.6
SUMS	145.0	81.0	127.8	99.5	180.7	584.6	67.2	-32.5

Table III-4

SIMULATED INVESTMENT, COSTS AND REVENUES
Total Niger Program

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	106.3	41.8		0	41.8	0	0	0
2	106.3	41.8	12.2	6.9	48.7	33.3	4.3	-2.7
3	106.3	41.8	24.3	13.9	55.7	66.9	8.7	-5.2
4	106.3	41.8	36.6	20.9	62.7	100.8	13.3	-7.6
5	106.3	41.8	50.1	29.2	70.9	134.9	18.1	-11.0
6	106.3	41.8	63.7	37.4	79.2	169.3	23.1	-14.4
7	106.3	41.8	77.2	45.8	87.6	204.0	28.2	-17.5
8	106.3	41.8	89.7	53.0	94.7	239.0	33.6	-19.4
9	106.3	41.8	102.1	60.2	102.0	274.4	39.1	-21.1
10	106.3	41.8	114.6	67.4	109.2	310.1	44.8	-22.6
11	0	0	114.6	67.4	67.4	310.1	44.8	-22.6
12	0	0	114.6	67.4	67.4	310.1	44.8	-22.6
SUMS	1063.0	418.0	799.7	469.5	887.3	2152.9	303.1	-166.7

Table III-5

SIMULATED INVESTMENT, COSTS AND REVENUES
Total Senegal Program

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	236.3	92.9		0	92.9		0	0
2	236.3	92.9	27.1	15.4	108.3	74.2	13.9	-1.5
3	236.3	92.9	54.2	30.9	123.8	148.9	28.2	-2.7
4	236.3	92.9	81.5	46.5	139.4	224.1	43.0	-3.5
5	236.3	92.9	111.5	67.9	157.8	300.0	58.3	-6.6
6	236.3	92.9	141.6	83.3	176.2	376.6	74.0	-9.3
7	236.3	92.9	171.8	101.8	194.8	453.7	90.1	-11.7
8	236.3	92.9	199.4	117.8	210.7	531.6	106.7	11.1
9	236.3	92.9	227.2	133.9	226.8	610.3	123.8	-10.0
10	236.3	92.9	255.0	150.0	242.9	689.7	144.4	-8.6
11	0	0	255.0	150.0	150.0	689.7	141.4	-8.6
12	0	0	255.0	150.0	150.0	689.7	141.4	-8.6
SUMS	2343.0	929.0	1779.3	1044.7	1973.8	4788.6	962.5	-82.2

Table III-6

SIMULATED INVESTMENT, COSTS AND REVENUES
Total Chad Program

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	73.9	29.1	0	0	29.1	0	0	0
2	73.9	29.1	8.5	4.8	33.9	23.2	3.7	-1.1
3	73.9	29.1	16.9	9.7	38.7	46.6	7.6	-2.1
4	73.9	29.1	25.5	14.5	43.6	70.2	11.6	-2.9
5	73.9	29.1	34.9	20.3	29.3	93.9	15.7	-4.6
6	73.9	29.1	44.3	26.1	55.1	117.9	19.9	-6.1
7	73.9	29.1	53.7	31.9	60.9	142.1	24.3	-7.5
8	73.9	29.1	62.3	36.8	65.9	166.5	28.8	-7.0
9	73.9	29.1	71.0	41.9	70.9	191.1	33.4	-8.4
10	73.9	29.1	79.7	46.9	76.0	216.0	38.2	-8.7
11	0	0	79.7	46.9	46.9	216.0	38.2	-8.7
12	0	0	79.7	46.9	46.9	216.0	38.2	-8.7
SUMS	739.0	291.0	556.3	326.7	617.3	1499.3	259.8	-67.0

Table III-7

SIMULATED INVESTMENT, COSTS AND REVENUES
Total Mali Program

(Millions of US $)

TIME PERIOD	PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	87.1	34.3	0	0	34.3	0	0	0
2	87.1	34.3	10.0	5.7	39.9	27.4	4.3	-1.4
3	87.1	34.3	20.0	11.4	45.7	55.0	8.7	-2.7
4	87.1	34.3	30.0	17.1	51.4	82.8	13.2	-3.9
5	87.1	34.3	41.1	23.9	48.2	110.9	17.9	-6.0
6	87.1	34.3	52.2	30.7	65.0	139.1	22.8	-7.9
7	87.1	34.3	63.3	37.6	61.8	167.7	27.7	-9.8
8	87.1	34.3	73.5	43.4	77.7	196.5	32.9	-10.6
9	87.1	34.3	83.7	49.3	83.6	225.6	38.1	-11.2
10	87.1	34.3	93.9	55.2	89.5	254.0	43.5	-11.7
11	0	0	93.9	55.2	55.2	255.0	43.5	-11.7
12	0	0	93.9	55.2	55.2	255.0	43.5	-11.7
SUMS	871.0	343.0	655.5	384.9	727.5	1770.0	296.2	-88.8

Table III-8

SIMULATED INVESTMENTS, COSTS AND REVENUES
Total Mauritania Program

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	56.2	22.1		0	22.1		0	0
2	56.2	22.1	6.4	3.7	26.8	17.7	4.1	.5
3	56.2	22.1	12.9	7.4	29.4	35.5	8.4	1.0
4	56.2	22.1	19.4	11.1	33.2	53.4	12.8	1.7
5	56.2	22.1	26.5	15.4	36.6	71.5	17.2	1.8
6	56.2	22.1	33.7	19.8	41.9	89.7	21.8	2.0
7	56.2	22.1	40.9	24.2	46.4	108.1	26.5	2.2
8	56.2	22.1	47.4	28.0	50.2	126.7	31.3	3.2
9	56.2	22.1	54.0	31.9	54.0	145.5	36.2	4.3
10	56.2	22.1	60.6	35.7	57.8	164.4	41.2	5.5
11	0	0	60.6	35.7	35.7	164.4	41.2	5.5
12	0	0	60.6	35.7	35.7	164.4	42.3	5.5
SUMS	563.0	221.0	432.3	248.7	469.8	1441.3	282.1	33.5

IV. Analysis of Financial Flows

In examining the financial flows for various project types shown in Tables III-3a to III-3f, it is readily apparent that only two types of projects, telecommunications and rural development, yield a positive stream of income to the government over time.[1] The others, given the general assumption about government revenue, all have negative flows.

The breakdown by project type permits an evaluation to be made of the level of service charges or specific taxes on output that would be required if recurring costs or local investment were to be paid for by the aid recipient. For example, in Niger, the livestock project recurring cost burden would be completely covered if, in addition to the normal tax collections, service charges equal to six percent of expected project income could be levied. For the polders projects, the rate would need to be 20 percent. Higher fees or taxes could help cover the recurring costs or projects which themselves have no marketable output. Whether or not such charges are feasible depends upon the specific project and the service or product involved. Further disaggregation of the system and analysis of individual projects would permit an evaluation of feasibility.[2]

Turning to the aggregate flows for Niger (Table III-4), we find much the same picture that we saw in examining the flows for the entire Sahel region. Consider the full twelve-year simulation period. The sum of government recurring costs plus local investment costs is $887 million.

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[1]This could be construed as an argument for letting private investors undertake development of the telecommunications industry.

[2]For an example of the kind of detailed analysis required see: W.F. Beazer and J.D. Stryker, "Financing Recurrent Government Expenditures for Livestock Development in Mali." Report prepared for the Government of Mali, May, 1976

The foreign exchange portion of the investment costs is $645 million. Thus, if donor countries pick up none of the local investment or recurring costs, Niger would be putting about 38 percent more resources into the program than the donors. The $887 million does not take into account the recurring costs that would extend beyond the twelve years. If the donors picked up the tab for all investment including domestic costs, the Niger government would need to fund recurring costs of $470 million. Government revenues derived from ordinary taxation of the increased income from projects might cover $303 million leaving a gap of $167 million. This would be an average of $14 million annually for twelve years or about 20 percent of the 1976 budget. Given the current low tax rate in Niger, it might be possible that Niger could cover this gap.

It should be remembered, however, that the simulation exercise comprises only 2/3 of the investment program projected for Niger. If the projects not included in the analysis, such as health and education, had parameters similar to or greater than those examined, the recurring and local investment cost burdens would be 50 percent greater for Niger than what we have projected. Paying for them entirely with domestic revenue would be a truly formidable task. In addition, the positive income streams associated with the telecommunications and rural development projects may well be overstated, since they depend upon assumptions made by the World Bank about the efficiency with which the projects will be operated and the prices at which services will be sold.

Table III-5 contains figures for Senegal. The sum of government recurring cost plus local investment costs over the ten-year period is $1.97 billion while the foreign exchange portion is $1.43 billion. Thus, if the donor countries pick up none of the local investment or the recurring costs, paying only foreign exchange costs, Senegal, like Niger, would be putting 38 percent more resources into the program than the donors.[1] If donors pay foreign exchange investment costs and domestic investment costs, the Senegalese government would need to raise $1.05 billion to cover recurring costs. With its relatively high revenue collection rate of 20 percent, the government might expect to extract $963 million as its share of project revenues, leaving only $82 million to be covered from other sources. This would be only $6.8 million annually or less than 3 percent of the 1976 budget. Keeping in mind that, as with Niger, the investment program is about 2/3 the projected total, finding the additional funds could still be something of a problem since the average tax rate is already high.

Chad and Mali present pictures similar to those for Niger and Senegal with uncovered deficits even if all domestic investment costs were picked up by donors. Only Mauritania appears to have any chance of handling its own recurring cost burden if investment is entirely aid financed. Its average revenue collection rate is the largest of the Sahel countries and the simulations indicate that the Club program might even generate a small budget surplus, even after paying recurring costs. This conclusion must be tempered by the caveats mentioned above, however.[2]

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[1] Since the cost parameters are the same for similar projects and the mix of projects is assumed identical for all countries, the relationships among investment, domestic costs and recurring costs will be the same for all countries. Only domestic tax rates differ.

[2] In addition, much of Mauritania's revenue derives from iron ore production. It is doubtful that the marginal collection rate on other income sources approaches the average.

Before leaving our examination of the output from the simulations, we shall present for comparison some projections of national income and government revenue for five Sahel countries over the period 1975-1985. These projections do not directly include any effects due to the Club program, but are based on projected growth rates contained in a 1974 MIT study of the Sahel.[1] These growth rates include the assumption that varying amounts of aid will be given in each country.

Government revenue independent of the Club program is projected as a function of income in each country and is equal to the historical ratio of revenue to GDP times GDP:

$$R_t = \alpha Y_t \tag{5}$$

The symbol α is the average ratio of revenue to GDP and is what we have referred to as the "average collection rate".

The parameters g, and α, and the initial observed value of GDP in 1975 (Y_o) for each country are given in Table III-9.

Table III-9

GROWTH AND BUDGET PARAMETER ESTIMATES

Country	Initial Income Y_o	Growth Rate g	Revenue Ratio α
	(Thousands of US $)		
Niger	560,000	.047	.12
Senegal	1,499,000	.05	.20
Chad	477,800	.025	.15
Mali	575,600	.045	.15
Mauritania	371,000	.05	.22

[1] "Economic Considerations..." MIT Op. cit., p. 124.

Tables III-10 to III-14 present projections of income and government revenue without projects as well as domestic investment associated with the Club program, total government recurrent costs and net recurrent costs for the program. These "net recurrent costs" assume that government revenue collected at the rates shown in Table III-9 on project income have already been applied to cover some of the project recurring costs and that domestic investment is funded with foreign aid. The net recurrent costs are what remain. The "Total Government Recurring Cost" figure assumes no government revenue is applied to these costs.

Government revenue without the projects rises consistently over time, but one must assume that demand for government services grows as well so that little of the increased revenue is likely to be available to service recurring costs.

Table III-10

PROJECTED GDP AND GOVERNMENT REVENUE (WITHOUT PROJECTS) AND SIMULATED DOMESTIC INVESTMENT COSTS AND NET RECURRING COSTS FOR CLUB PROGRAM

NIGER
(Millions U.S. $ - 1975 Prices)

FISCAL YEAR	GDP[1]	GOVERNMENT REVENUE[2]	DOMESTIC INVESTMENT[3]	NET RECURRING COSTS[3]	TOTAL GOVERNMENT RECURRING COS
1974/1975	560				
1975/1976	587	70			
1976/1977	614	74			
1977/1978	644	77	41.8		
1978/1979	674	81	41.8	2.7	10.4
1979/1980	706	85	41.8	5.2	20.9
1980/1981	740	89	41.8	7.6	31.4
1981/1982	775	98	41.8	11.0	43.8
1982/1983	811	97	41.8	14.4	56.1
1983/1984	850	102	41.8	17.5	68.7
1984/1985	890	107	41.8	19.3	79.5
1985/1986	932	112	41.8	21.1	90.3
1986/1987	977[4]	117	41.8	22.6	101.1

[1]The assumed real rate of growth of projected income from 1975 to 1987 is 4.7 percent. It is obtained from "Economic Considerations for Long Term Developments in the Sahel." Center for Policy Alternatives, MIT, December 31, 1974, Annex 1, p. 124. The assumptions underlying this rate of growth include foreign aid of $458 million during the period 1975-1987. This is nearly 30 percent of the total investment of $1.61 billion we have projected under the Club du Sahel Program.

[2].12 percent of GDP.

[3]See Table III-4. (These figures are 1.5 times those in cols. 2 and 8 of III-4 .) These are the domestic investment and net recurring costs that are derived from a simulated $1.61 billion investment program in Niger (Table III-2a). 1977/78 is assumed to be year 1 of the program.

[4]The projected annual addition to GDP by the end of the 10-year Club investment program is $465 million (Table III-4). Approximately 1/3 of this should already be included in the $977 million under the MIT assumptions (see note 1).

Table III-11

PROJECTED GDP AND GOVERNMENT REVENUE (WITHOUT PROJECTS) AND SIMULATED DOMESTIC INVESTMENT AND NET RECURRING COSTS FOR CLUB PROGRAM

SENEGAL
(Millions U.S. $ - 1975 Prices)

FISCAL YEAR	GDP[1]	GOVERNMENT REVENUE[2]	DOMESTIC INVESTMENT[3]	NET RECURRING COSTS[3]	TOTAL GOVERNMENT RECURRING COSTS
1974/1975	1499				
1975/1976	1573	315			
1976/1977	1653	330			
1977/1978	1735	347	92.9	0	
1978/1979	1822	364	92.9	1.5	23.1
1979/1980	1913	382	92.9	2.7	46.4
1980/1981	2008	402	92.9	3.5	69.8
1981/1982	2109	422	92.9	6.6	101.9
1982/1983	2215	443	92.9	9.3	125.0
1983/1984	2325	465	92.9	11.7	152.7
1984/1985	2442	488	92.9	11.1	176.7
1985/1986	2564	512	92.9	10.0	200.9
1986/1987	2692[4]	538	92.9	8.6	225.0

[1]The assumed real rate of growth of projected income from 1975 to 1987 is 5.0 percent. It is obtained from "Economic Considerations for Long Term Development in the Sahel", Center for Policy Alternatives, MIT, December 31, 1975, Annex 1, p. 124. The assumptions underlying this rate of growth include foreign aid in the amount of $809 million between 1975 and 1987. This is nearly 25 percent of the total projected investment under the Club program.

[2]20 percent of GDP .

[3]See Table III-5 (these figures are 1.5 times those in Cols. 2 and 8 of III-5). These are the domestic investment and net recurring costs associated with a simulated $3.58 billion investment program in Senegal (Table III-2b). 1977/78 is assumed to be year 1 of the program.

[4]The projected annual addition by the GDP at end of the 10-year Club investment program is $1035 million (Table III-5). Approximately 25 percent of this should be included in the $2692 million under the MIT assumptions (see note 1).

Table III-12

PROJECTED GDP AND GOVERNMENT REVENUE (WITHOUT PROJECTS) AND SIMULATED DOMESTIC INVESTMENT AND NET RECURRING COSTS FOR CLUB PROGRAM

CHAD
(Millions of U.S. $ - 1975 prices)

FISCAL YEAR	GDP[1]	GOVERNMENT REVENUE[2]	DOMESTIC INVESTMENT[3]	NET RECURRING COSTS[3]	TOTAL GOVERNMENT RECURRING COS
1974/1975	478				
1975/1976	490	73			
1976/1977	502	75			
1977/1978	515	77	29.1	0	
1978/1979	528	79	29.1	1.1	7.2
1979/1980	541	81	29.1	2.1	14.6
1980/1981	554	83	29.1	3.0	21.8
1981/1982	568	85	29.1	4.6	30.5
1982/1983	582	87	29.1	6.1	39.2
1983/1984	597	90	29.1	7.6	47.9
1984/1985	612	92	29.1	8.0	55.2
1985/1986	627	94	29.1	8.4	62.9
1986/1987	643[4]	96	29.1	8.7	70.4

[1]The assumed real rate of growth of projected income from 1975 to 1987 is 2.5 percent. It is obtained from "Economic Considerations for Long Term Development in the Sahel." Center for Policy Alternatives, MIT, December 31, 1974, Annex 1, p. 124. The assumptions underlying this rate of growth include foreign aid of $435 million during the period 1975-1987. This is nearly 40 percent of the $1.12 billion in investment we have projected under the Club Program.

[2]15 percent of GDP.

[3]See Table III-6 (these figures are 1.5 times those shown in cols. 2 and 8 of III-6). These are the domestic investment and net recurring costs that are derived from a simulated $1.12 billion investment program in Chad. (See Table III-2c for allocations among projects.)

[4]The projected annual addition to GDP by the end of the 10-year Club investment program is $324 million (1.5 times figures in Table III-6). Approximately 40 percent of this should already be included in the $643 million under the MIT assumptions (see Note 1).

Table III-13

PROJECTED GDP AND GOVERNMENT REVENUE (WITHOUT PROJECTS) AND SIMULATED DOMESTIC INVESTMENT AND NET RECURRING COSTS FOR CLUB PROGRAM

MALI
(Millions U.S. $ - 1975 Prices)

FISCAL YEAR	GDP[1]	GOVERNMENT REVENUE	DOMESTIC INVESTMENT[3]	NET RECURRING COSTS[3]	TOTAL GOVERNMENT RECURRING COSTS
1974/1975	576				
1975/1976	602	90			
1976/1977	629	94			
1977/1978	657	99	34.3	0	
1978/1979	687	103	34.3	1.4	8.6
1979/1980	718	108	34.3	2.7	17.1
1980/1981	750	113	34.3	3.9	25.7
1981/1982	784	118	34.3	6.0	35.9
1982/1983	819	123	34.3	8.0	46.1
1983/1984	856	128	34.3	9.8	56.4
1984/1985	895	134	34.3	10.6	65.1
1985/1986	935	140	34.3	11.2	74.0
1986/1987	977[4]	147	34.3	11.7	82.8

[1]The assumed real rate of growth of projected income from 1975 to 1987 is 4.5 percent. It is obtained from "Economic Considerations for Long Term Development in the Sahel," Center for Policy Alternatives, MIT, December 31, 1975, Annex 1, p. 124. The assumptions underlying this rate of growth include foreign aid of $314 million during the period 1975-87. This is nearly 25 percent of the $1.32 billion in investment we have projected under the Club program.

[2]15 percent of GDP.

[3]See Table III-7 (these figures are 1.5 times those shown in Cols. 2 and 8 of III-7). These are the domestic investment and net recurring costs that are derived from a simulated $1.32 billion investment program in Mali (see Table III-24 for allocation among projects). 1977-78 is assumed to be year 1 of the program in this table.

[4]Projected annual addition to GDP by the end of 10-year Club investment program is $382 million (1.5 times figures in Table III-7). Approximately 24 percent of this should be included in the $977 million under the MIT assumptions (see note 1).

Table III-14

PROJECTED GDP AND GOVERNMENT REVENUE (WITHOUT PROJECTS) AND SIMULATED DOMESTIC INVESTMENT AND NET RECURRING COSTS FOR CLUB PROGRAM

MAURITANIA
(Millions U.S. $ - 1975 prices)

FISCAL YEAR	GDP[1]	OVERNMENT REVENUE[2]		DOMESTIC INVESTMENT[3]	NET RECURRING COSTS[3]	TOTAL GOVERNMENT RECURRING COSTS
1974/1975	371					
1975/1976	390	86	84*			
1976/1977	409	90	87*			
1977/1978	429	94	90*	22.1	0	
1978/1979	451	99	94*	22.1	(0.5)	5.6
1979/1980	474	104	97*	22.1	(1.1)	11.1
1980/1981	497	109	101*	22.1	(1.7)	16.7
1981/1982	522	115	104*	22.1	(1.8)	23.1
1982/1983	548	121	108*	22.1	(2.0)	29.7
1983/1984	576	127	112*	22.1	(2.2)	36.3
1984/1985	604	133	117*	22.1	(3.3)	42.0
1985/1986	635	140	121*	22.1	(4.3)	47.9
1986/1987	666[4]	147	126*	22.1	(5.5)	53.6

[1]The assumed real rate of growth of projected income from 1975 to 1987 is 5.0 percent. It is obtained from "Economic Considerations for Long Term Development in the Sahel," Center for Policy Alternatives, MIT, December 31, 1974, Annex 1, p. 124. The rate of growth does not assume any outside development assistance.

[2]The first set of figures is 22 percent of GDP. 22 percent is the average historical government collection rate. The second set is 22 percent of $371million plus 15 percent of any increment above this. It assumes the marginal collection rate is 15 percent. This assumption may be closer to reality since much of Mauritania's government revenue comes from direct taxation of iron ore production.

[3]See Table III-8. (These figures are 1.5 times those shown in cols 2 and 8 of III-8). These are the domestic investment and net recurring costs that are derived from a simulated $850 million in investment program in Mauritania(See Table III-2e for allocation among projects).

[4]The projected annual addition to GDP by the end of the 10-year Club investment program is $246 million (1.5 times figures in Table III-8). None of this is included in the $666 million since MIT assumed no external assistance in their projections for Mauritania (see note 1).

V. Alternative Investment Patterns

The simulation results discussed earlier were derived under the assumption that investment always occurs in equal annual amounts. It is unlikely, however, that the $10 billion expenditure envisaged would be disbursed in equal yearly installments. In order to study the implications of other investment patterns, simulations were done using the investment schedule shown in Table III-15. Under this scenario, expenditures rise during the early period, level off and then diminish, yielding a temporal investment schedule similar to a bell curve.

Table III-15

Year	1	2	3	4	5	6	7	8	9	10
Proprotion of total investment	1/23	2/28	3/28	4/28	4/28	4/28	4/28	3/28	2/28	1/28

Simulations were performed for each Sahel country using the same total dollar amounts for the ten-year period as were used ealier. The annual investment payments, however, were not all equal, but were weighted as in Table III-15. Tables III-16a to III-16f give the results for the individual project types in Niger. Table III-17 shows the aggregate flows for all projects for Niger. The aggregate figures for the other Sahel countries are similar to those for Niger and are shown in Tables III-18 through III-21.

If one compares the results obtained from the uneven investment pattern (Tables III-16a to III-16f) with those from the equal investment pattern (Tables III-3a to III-3f), one finds some fairly major differences in the timing of the cost burden and income flows but relatively small differences

in the total values. The total flows for the uneven investment are slightly larger (either positive or negative) than those for the equal investment pattern because between the 5th and 10th year more investment is in place. The implication of this analysis is that the timing of investment can be used to influence the budgetary impact of any aid program. Investment in projects yielding net surpluses could be timed so as to offset negative flows associated with other projects. Alternatively, the timing and composition of a program could be adjusted to accomodate predictable movements in the government budget.

Table III-16a

SIMULATED INVESTMENT, COSTS AND REVENUE - NIGER
UNEVEN INVESTMENT
FEEDER ROADS PROJECT

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS
1	5.36	1.18	0	0	1.18	0	0	0
2	10.71	2.36	.33	.33	2.69	1.29	.15	-.18
3	16.05	3.53	1.00	1.00	4.53	3.97	.46	-.54
4	21.45	4.72	1.99	1.99	6.71	8.18	.94	-1.05
5	21.45	4.72	5.04	5.04	9.76	14.05	1.62	-3.42
6	21.45	4.72	8.08	8.08	12.80	20.19	2.32	-5.76
7	21.45	4.72	11.13	11.13	15.85	26.61	3.06	-8.07
8	16.05	3.53	12.46	12.46	15.99	33.31	3.83	-8.63
9	10.71	2.36	13.45	13.45	15.81	38.55	4.43	-9.02
10	5.36	1.18	14.12	14.12	15.30	42.21	4.85	-9.26
11	0	0	14.45	14.45	14.45	44.12	5.07	-9.38
12	0	0	14.45	14.45	14.45	44.12	5.07	-9.38
SUMS	150.03	33.01	96.50	96.50	129.50	276.59	31.81	-64.69

Table III-16b

SIMULATED INVESTMENT, COSTS AND REVENUE - NIGER
UNEVEN INVESTMENT
PAVED ROADS PROJECTS

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	5.36	1.18	0	0	1.18	0	0	0
2	10.71	2.36	.13	.13	2.49	.44	.05	-.08
3	16.05	3.53	.40	.40	3.93	1.39	.16	-.24
4	21.45	4.72	.80	.80	5.52	2.91	.33	-.47
5	21.45	4.72	1.34	1.34	6.06	5.07	.58	-.76
6	21.45	4.72	1.88	1.88	6.59	7.38	.85	-1.03
7	21.45	4.72	2.41	2.41	7.13	9.84	1.13	-1.28
8	16.05	3.53	2.95	2.95	6.48	12.47	1.43	-1.51
9	10.71	2.36	3.35	3.35	5.71	14.57	1.68	-1.67
10	5.36	1.18	3.62	3.62	4.79	16.06	1.85	-1.77
11	0	0	3.75	3.75	3.75	16.86	1.94	-1.81
12	0	0	3.75	3.75	3.75	16.86	1.94	-1.81
SUMS	150.03	33.01	24.38	24.38	57.39	103.85	11.94	-12.44

Table III-16c

SIMULATED INVESTMENT, COSTS AND REVENUE - NIGER
UNEVEN INVESTMENT
TELECOMMUNICATIONS PROJECTS

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	1.36	.24	0	0	.24	0	0	0
2	2.72	.49	.04	.04	.53	0	.15	.11
3	4.08	.73	.15	.15	.88	0	.56	.41
4	5.45	.98	.36	.36	1.34	0	1.34	.98
5	5.45	.98	.69	.69	1.67	0	2.59	1.89
6	5.45	.98	1.09	1.09	2.07	0	4.05	2.95
7	5.45	.98	1.55	1.55	2.53	0	5.72	4.17
8	4.08	.73	2.07	2.07	2.80	0	7.60	5.54
9	2.72	.49	2.50	2.50	2.99	0	9.17	6.67
10	1.36	.24	2.82	2.82	3.06	0	10.33	7.51
11	0	0	2.99	2.99	2.99	0	10.96	7.96
12	0	0	2.99	2.99	2.99	0	10.96	7.96
SUMS	38.11	6.86	17.25	17.25	24.10	0	63.42	46.17

Table III-16d

SIMULATED INVESTMENT, COSTS AND REVENUE - NIGER
UNEVEN INVESTMENT
POLDERS PROJECTS

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	14.37	5.75	0	0	5.75	0	0	0
2	28.74	11.50	1.72	1.07	12.56	3.45	.40	-.67
3	43.07	17.23	5.17	3.21	20.43	10.35	1.19	-2.02
4	57.56	23.02	10.34	6.41	29.43	20.68	2.38	-4.03
5	57.56	23.02	17.25	10.69	33.72	34.50	3.97	-6.73
6	57.56	23.02	24.15	14.98	38.00	48.31	5.56	-9.42
7	57.56	23.02	31.06	19.26	42.28	62.12	7.14	-12.11
8	43.07	17.23	37.97	23.54	40.77	75.94	8.73	-14.81
9	28.74	11.50	43.14	26.74	38.24	86.27	9.92	-16.82
10	14.37	5.57	46.59	28.88	34.63	93.17	10.71	-18.17
11	0	0	48.31	29.95	29.95	96.62	11.11	-18.84
12	0	0	48.31	29.95	29.95	96.62	11.11	-18.84
SUMS	402.58	161.03	314.01	194.69	355.72	628.03	72.22	-122.46

Table III-16e

SIMULATED INVESTMENT, COSTS AND REVENUE - NIGER
UNEVEN INVESTMENT
AGRICULTURAL DEVELOPMENT PROJECTS

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	6.32	3.67	0	0	3.67	0	0	0
2	12.64	7.33	1.39	.33	7.67	3.41	.39	.06
3	18.95	10.99	4.17	1.00	11.99	10.24	1.18	.18
4	25.33	14.69	8.34	2.00	16.69	20.48	2.35	.35
5	25.33	14.69	13.91	3.34	18.03	34.15	3.93	.59
6	25.33	14.69	19.48	4.68	19.37	47.83	5.50	.82
7	25.33	14.69	25.06	6.01	20.70	61.50	7.07	1.06
8	18.95	10.99	30.63	7.35	18.34	75.18	8.65	1.29
9	12.64	7.33	34.80	8.35	15.69	85.41	9.82	1.47
10	6.32	3.67	37.58	9.02	12.69	92.24	10.61	1.59
11	0	0	38.97	9.35	9.35	95.65	11.00	1.65
12	0	0	38.97	9.35	9.35	95.65	11.00	1.65
SUMS	177.14	102.74	253.30	60.79	163.53	621.75	71.50	10.71

Table III-16f

SIMULATED INVESTMENT, COSTS AND REVENUE - NIGER
UNEVEN INVESTMENT
LIVESTOCK PROJECTS

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	5.17	2.90	0	0	2.90	0	0	0
2	10.35	5.79	.72	.56	6.36	3.31	.38	-.18
3	15.50	8.68	2.17	1.69	10.38	9.93	1.14	-.55
4	20.72	11.60	4.34	3.39	14.99	19.85	2.28	-1.10
5	20.72	11.60	7.24	5.65	17.25	33.12	3.81	-1.84
6	20.72	11.60	10.15	7.91	19.52	46.38	5.33	-2.58
7	20.72	11.60	13.05	10.18	21.78	59.64	6.86	-3.32
8	15.50	8.68	15.95	12.44	21.12	72.90	8.38	-4.06
9	10.35	5.79	18.12	14.13	19.93	82.82	9.52	-4.61
10	5.17	2.90	19.57	15.26	18.16	89.44	10.29	-4.98
11	0	0	20.29	15.83	15.83	92.75	10.67	-5.16
12	0	0	20.29	15.83	15.83	92.75	10.67	-5.16
SUMS	144.93	81.16	131.89	102.87	184.03	602.90	69.33	-33.54

Table 17

SIMULATED INVESTMENT, COSTS AND REVENUE
TOTAL NIGER PROGRAM
UNEVEN INVESTMENT

((Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	37.93	14.91	0	0	14.91	0	0	0
2	75.87	29.83	4.34	2.47	32.30	11.90	1.52	-.95
3	113.70	44.70	13.06	7.45	52.15	35.88	4.69	-2.76
4	151.95	59.73	26.18	14.95	74.69	72.10	9.63	-5.32
5	151.95	59.73	45.48	26.75	86.49	120.80	16.49	-10.27
6	151.95	59.73	64.83	38.62	98.35	170.08	23.61	-15.01
7	151.95	59.73	84.25	50.54	110.27	219.71	30.99	-19.55
8	113.70	44.70	102.02	60.80	105.50	269.80	38.63	-22.17
9	75.87	29.83	115.35	68.53	98.35	307.63	44.55	-23.98
10	37.93	14.91	124.28	73.72	88.63	333.12	48.64	-25.08
11	0	0	128.76	76.32	76.32	346.00	50.75	-25.58
12	0	0	128.76	76.32	76.32	346.00	50.75	-25.58
SUMS	1062.81	417.80	837.32	496.47	914.28	2233.12	320.23	-176.25

Table 18

SIMULATED INVESTMENT, COSTS AND REVENUES
TOTAL SENEGAL PROGRAM
UNEVEN INVESTMENT

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	84.37	33.17	0	0	33.17	0	0	0
2	168.74	66.34	9.66	5.50	71.84	26.48	5.61	.11
3	252.88	99.41	29.06	16.57	115.98	79.82	17.14	.57
4	337.96	132.86	58.22	33.26	166.11	160.37	34.89	1.63
5	337.96	132.86	101.14	59.51	192.36	268.89	59.26	-.25
6	337.96	132.86	144.20	85.89	218.75	378.31	84.28	-1.61
7	337.96	132.86	187.39	112.41	245.26	488.70	109.97	-2.44
8	252.88	99.41	226.90	135.24	234.65	600.10	136.33	1.09
9	168.74	66.34	256.56	152.42	218.76	684.24	156.56	4.14
10	84.37	33.17	276.42	163.96	197.13	740.95	170.41	6.46
11	0	0	286.39	169.76	169.76	769.60	177.52	7.76
12	0	0	286.39	169.76	169.76	769.60	177.52	7.76
SUMS	2363.83	929.27	1862.34	1104.26	2033.53	4967.05	1129.47	25.22

Table 19

SIMULATED INVESTMENT, COSTS AND REVENUES
TOTAL MALI PROGRAM
UNEVEN INVESTMENT

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	31.09	12.23	0	0	12.23	0	0	0
2	62.19	24.46	3.56	2.03	26.49	9.78	1.53	-.50
3	93.20	36.66	10.71	6.11	42.77	29.50	4.68	-1.44
4	124.55	48.99	21.46	12.26	61.26	59.27	9.54	-2.72
5	124.55	48.99	37.29	21.95	70.94	99.38	16.24	-5.71
6	124.55	48.99	53.16	31.68	80.67	139.83	23.14	-8.54
7	124.55	48.99	69.08	41.45	90.44	180.64	30.25	-11.21
8	93.20	36.66	83.61	49.84	86.50	221.83	37.55	-12.28
9	62.19	24.46	94.51	56.14	80.61	252.95	43.18	-12.97
10	31.09	12.23	101.81	60.37	72.60	273.92	47.04	-13.34
11	0	0	105.46	62.50	62.50	284.52	49.02	-13.48
12	0	0	105.46	62.50	62.50	284.52	49.02	-13.48
SUMS	871.17	342.67	686.11	406.83	749.50	1836.13	311.18	-95.65

Table 20

SIMULATED INVESTMENT, COSTS AND REVENUES
TOTAL CHAD PROGRAM
UNEVEN INVESTMENT

((Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	26.38	10.37	0	0	10.37	0	0	0
2	52.76	20.75	3.02	1.72	22.47	8.29	1.33	-.39
3	79.07	31.09	9.09	5.18	36.28	24.99	4.09	-1.09
4	105.68	41.56	18.20	10.40	51.96	50.21	8.36	-2.04
5	105.68	41.56	31.63	18.62	60.17	84.19	14.24	-4.38
6	105.68	41.56	45.09	26.87	68.42	118.45	20.30	-6.57
7	105.68	41.56	58.60	35.16	76.72	153.02	26.55	-8.61
8	79.07	31.09	70.94	42.29	73.39	187.90	32.99	-9.31
9	52.76	20.75	80.21	47.66	68.41	214.25	37.94	-9.72
10	26.38	10.37	86.41	51.26	61.63	232.01	41.35	-9.91
11	0	0	89.52	53.07	53.07	240.98	43.10	-9.97
12	0	0	89.52	53.07	53.07	240.98	43.10	-9.97
SUMS	739.15	290.66	582.23	345.29	635.95	1555.26	273.35	-71.95

Table 21

SIMULATED INVESTMENT, COSTS AND REVENUES
TOTAL MAURITANIA PROGRAM
UNEVEN INVESTMENT

(Millions of US $)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUE MINUS COSTS
1	20.08	7.90	0	0	7.90	0	0	0
2	40.1	15.79	2.30	1.31	17.10	6.31	1.48	.17
3	60.19	23.67	6.91	3.95	27.61	19.02	4.52	.58
4	80.44	31.63	13.85	7.92	39.55	38.22	9.19	1.27
5	80.44	31.63	24.07	14.17	45.80	64.08	15.58	1.41
6	80.44	31.63	34.32	20.45	52.08	90.16	22.12	1.67
7	80.44	31.63	44.59	26.77	58.40	116.48	28.83	2.06
8	60.19	23.67	53.98	32.20	55.86	143.03	35.69	3.49
9	40.16	15.79	61.03	36.28	52.07	163.09	40.94	4.66
10	20.08	7.90	65.75	39.02	46.92	176.61	44.53	5.51
11	0	0	68.12	40.40	40.40	183.44	46.37	5.97
12	0	0	68.12	40.40	40.40	183.44	46.37	5.97
SUMS	562.61	221.21	443.06	262.86	484.07	1183.89	295.63	32.77

CHAPTER IV

INDIVIDUAL PROJECTS

In our initial discussion of the accounting model that has been developed, we indicated that it could be used in two fundamentally different ways. One is to simulate potential investment programs based on hypothetical scenarios about the total amount of investment and the amounts allocated to different project types. This is what was done in Chapter II and III. The other is to examine the financial flows associated with actual projects using as data for the model information in project evaluation documents. Once the economic analysis of any project has been done it is possible to feed the data into the model and obtain estimates of the financial flows associated with it. The flows associated with any number of actual projects can be aggregated and the total budgetary and resource requirements compared to what is available. If there appear to be any problems, adjustments are possible. As a result, the model can be used as part of the process of selecting an optimal project/investment/financing mix.

To illustrate the procedure, data was obtained from the evaluation studies for five different World Bank projects. The projects have been undertaken in recent years or are currently planned for the Sahel. Table 1 identifies the projects by type and shows the dollar investments and the year in which they are assumed to be expended. The temporal allocation of investments for each project corresponds to that in the planning document. The only adjustment we have made is to assume that all projects begin in year 1.

Table IV-1
Project Investment ('000's US $)

Project Type	Year	1	2	3	4	5	6
Feeder Roads		4617	1954	1923	0	0	0
Paved Roads		3708	3708	0	0	0	0
Polders		3676	5583	2293	1448	0	0
Agricultural Development		5289	3596	4316	0	0	0
Livestock		957	1559	1441	1435	1090	0

Tables IV-3 through IV-7 present the financial flows associated with each of the five projects over a twelve-year period. In calculating government revenues, it was assumed that the projects were carried out in Niger and an average tax rate of 11 percent was used to calculate government revenues. If fees were charged for project services or if specific taxes were collected on the income generated, a collection rate for each project could be used in the model.

The financial streams for all five projects are aggregated and shown in Table IV-8. Such a table could be obtained for any number of projects and the budgetary impact of varying the project mix could be examined. For example, according to the World Bank evaluations, agricultural development projects yield a budgetary surplus. When such an agricultural project is combined with other projects, the surplus from one project could theoretically be used to help cover the deficits of other projects. Telecommunications projects also presumably earn a profit so that their income would be available to finance such things as feeder roads.

In projecting potential government revenue we have thus far used the simplifying assumption of a single tax collection rate for each country. An alternative means of dealing with the spectre of recurring costs is to attack the problem at the project level. In some cases specific taxes or levies could be applied to project income to generate sufficient revenues to wholly or partially offset the recurrent cost stream. Road-use or gasoline taxes might be used for this purpose in the case of feeder roads or paved roads projects. Agricultural production taxes or, perhaps, well-use fees could be applied in agricultural development or irrigation projects. Of course, head or weight gain taxes could be used for livestock projects. Careful analysis of individual projects will be helpful in designing project-related taxes or fees which could be used to generate revenues to cover recurrent costs. Perhaps this is the level at which the problem of recurrent costs can best be approached. Certainly, on equity grounds alone, it is not implausible to expect those benefiting most from a project to share the costs of its continuing operation.

Looking at each project individually, it is easy to calculate the additional tax which, if levied in some manner upon project income, would eliminate the gap between project recurring costs and project revenue collected at the current average tax rate. The tax rate required for each project can be obtained by dividing the sum of net uncovered recurring costs by the total project income stream. Table IV-2 presents these rates for the projects in Tables IV-3 through IV-7.

Table IV-2
Additional Tax on Project Income Necessary to Finance Recurring Costs

Project Type	Additional Tax Rate (percent)	Total Tax Rate[a] (percent)
Feeder road	17.4	27.4
Paved Roads	9.5	20.5
Polders	19.5	30.5
Agricultural Development	-1.7	9.3
Livestock	5.6	16.6

[a]The total tax rate is the additional tax plus the current average tax ate of 11 percent that is already incorporated in calculating government revenues.

Using the aggregate figures from Table IV-8 for income and uncovered recurring costs, it is also possible to calculate the additional average tax rate which, if applied to the income from each of the projects, would eliminate the program deficit. This rate is 6.9 percent.

The estimates in Table IV-3 of the additional tax that would be required if all recurring costs were to be covered for each project are calculated under the assumption that the average tax of 11 percent rate will also be imposed on the income stream somewhere along the line. In reality, the average tax rate may not be imposed and it may be infeasible to collect directly enough revenue to cover the costs. Analysis of each project and of the situation in which output or services from the project are being produced and the way in which they are channelled through the economy should, however, result in estimates of what might feasibly be collected. These estimated feasible tax rates could be included in the model to produce a more accurate picture of potential government revenue.

In addition, the model can also be expanded to accomodate information and projections about the governments budgetary position exclusive of the impact of the projects so that a comprehensive picture of resource requirements and availabilities would be obtainable.

In developing the model and illustrating its capabilities we have gone from a level of total aggregation to a level of total disaggregation. At the level of regionwide and countrywide aggregation we were attempting to simulate the income streams associated with a hypothetical program. At the level of complete disaggregation we were looking at the flows that result from actual projects and discussed how particular fees and direct taxes might be calculated. One further application of the model, which we have alluded to earlier, would be to include all individual projects and the actual flows and investment timing associated with them to provide a complete accounting framework for analysis of a total actual program. In a sense this will take us full circle, back to a level of total aggregation, but this time using reality rather than hypothetical figures. It is this use of the model that in the long run may prove most valuable in providing information for making decisions.

Table IV-3
Feeder Road Project
(Thousands of dollars)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS*
1	4617	1015	0	0	1015	0	0	0
2	1954	429	286	286	716	1108	127	-158
3	1923	423	407	407	830	1648	189	-217
4	0	0	526	526	526	2226	256	-270
5	0	0	526	526	526	2326	267	-259
6	0	0	526	526	526	2431	279	-247
7	0	0	1206	1206	1206	2540	292	-914
8	0	0	1206	1206	1206	2654	305	-900
9	0	0	1206	1206	1206	2774	319	-887
10	0	0	526	526	526	2899	333	-193
11	0	0	526	526	526	3029	348	-178
12	0	0	526	526	526	3165	364	-162
SUMS	8494	1868	7471	7471	9340	26803	3082	-4389

*This column is the difference between government revenues (at 11 percent of income) and recurring costs. Domestic investment costs are assumed to be financed externally.

Table IV-4
Paved Roads Project
(Thousands of dollars)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS *
1	3708	815	0	0	815	0	0	0
2	3708	815	92	92	908	307	35	-57
3	0	0	185	185	185	656	75	-109
4	0	0	185	185	185	700	80	-104
5	0	0	185	185	185	747	85	-99
6	0	0	185	185	185	797	91	-93
7	0	0	185	185	185	851	97	-87
8	0	0	185	185	185	908	104	-80
9	0	0	185	185	185	969	111	-73
10	0	0	185	185	185	1034	118	-66
11	0	0	185	185	185	1103	126	-58
12	0	0	185	185	185	1177	135	-50
SUMS	7416	1631	1946	1946	3578	9254	1064	-882

*This column is the difference between government revenues (at 11 percent of income) and recurring costs. Domestic investment costs are assumed to be financed externally.

Table IV-5
Polders Project

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS*
1	3676	1470	0	0	1470	0	0	0
2	5583	2233	441	273	2506	882	101	-172
3	2293	917	1111	688	1606	2222	255	-433
4	1448	579	1386	859	1438	2772	318	-540
5	0	0	1560	967	967	3120	358	-608
6	0	0	1560	967	967	3120	358	-608
7	0	0	1560	967	967	3120	358	-608
8	0	0	1560	967	967	3120	358	-608
9	0	0	1560	967	967	3120	358	-608
10	0	0	1560	967	967	3120	358	-608
11	0	0	1560	967	967	3120	358	-608
12	0	0	1560	967	967	3120	358	-608
SUMS	13000	5200	15418	9559	14759	30836	3546	-6013

*This column is the difference between government revenues (at 11 percent of income) and recurring costs. Domestic investment costs are assumed to be financed externally.

Table IV-6
Agricultural Development Project

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS*
1	5289	3067	0	0.	3067	0	0.	0
2	3596.	2085	1163	279	2364.	2856	328	49
3	4316	2503	1954	469	2972	4797	551	82
4	0	0	2904	697	697.	7128	819	122
5	0	0	2904	697	697	7128	819	122
6	0	0	2904	697	697	7128	819	122
7	0	0	2904	697	697	7128	819	122
8	0	0	2904	697	697	7128	819	122
9	0	0	2904	697	697	7128	819	122
10	0	0	2904	697	697	7128	819	122
11	0	0	2904	697	697	7128	819	122
12	0	0	2904	697	697	7128	819	122
SUMS	13201	7656	29256	7021	14678	71810	8258	1236

*This column is the difference between revenues (at 11 percent of income) and recusrring costs. Domestic investment costs are assumed to be financed externally.

Table IV-7
Livestock Project
(Thousands of Dollars)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS*
1	957	535	0	0	535	0	0	0
2	1559	873	133	104	977	612	70	-34
3	1441	806	352	274	1081	1610	185	-89
4	1435	803	553.	432	1235	2532	291	-140
5	1090	610	754.	588	1199	3450	396	-191
6	0	0	907	707	707	4148	477	-230
7	0	0	907	707	707	4148	477	-230
8	0	0	907	707	707	4148	477	-230
9	0	0	907	707	707	4148	477	-230
10	0	0	907.	707	707	4148	477	-230
11	0	0	907	707	707	4148	477.	-230
12	0	0	907	707	707	4148	477	-230
SUMS	6482	3629	8147	6355	9984.	37245	4283	-2071

*This column is the difference between government revenues (at 11 percent of income) and recurring costs. Domestic investment costs are assumed to be financed externally.

Table IV-8
Total Five Projects
(Thousands of Dollars)

TIME PERIOD	TOTAL PROJECT INVESTMENT	DOMESTIC INVESTMENT COSTS	PROJECT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS	GOVERNMENT RECURRENT COSTS PLUS DOMESTIC INVESTMENT COSTS	PROJECT INCOME STREAM	GOVERNMENT REVENUES	REVENUES MINUS COSTS*
1	18247	6905	0	0	6905	0	0	0
2	16400	6437	2117	1036	7473	5766	663	-373
3	9973	4650	4010	2025	6676	10935	1257	-768
4	2883	1382	5556	2700	4083	15360	1766	-934
5	1090	610	5931	2965	3575	16773	1928	-1036
6	0	0	6083	3084	3084	17625	2026	-1057
7	0	0	6763	3763	3763	17788	2045	-1717
8	0	0	6763	3763	3763	17960	2065	-1698
9	0	0	6763	3763	3763	18140	2086	-1677
10	0	0	6083	3084	3084	18330	2107	-976
11	0	0	6083	3084	3084	18529	2130	-953
12	0	0	6083	3084	3084	18740	2155	-928
SUMS	48593	19986	62240	32354	52341	175950	20234	-12120

*This column is the difference between government revenues (at 11 percent of income) and recurring costs. Domestic investment costs are assumed to be financed externally.

APPENDIX A

PARAMETER ESTIMATES

I. INTRODUCTION

Chapter II describes in detail the accounting model we have developed for keeping track of the numerous projects encompassed by the Sahel program and for analyzing the budgetary impact of local investment and recurring costs. If the model is to be used for simulating the outcomes of large investment programs, there are a number of parameters for which values must be estimated for each project type. The parameteres define the technical relationships between various financial flows and the amount of investment. The relationships that were measured are: (1) that between recurring costs and total investment, (2) that between project-induced aggregate income and total investment, and (3) that between local investment costs and total investment. The following are the equations for which parameter estimates are required:

(A-1) $X_{jt} = a_j I_{jT} + c_{jt} I_{jT}$ recurring costs

(A-2) $\Delta Y_{jt} = f_j(I_{jT}, t)$ project income

(A-3) $I^d_{jt} = z_j I_{jt}$ domestic investment

Variable Definitions

X_{jt} = recurring costs for project j in time period t

I_{jT} = total investment in project j with project completed in year T

ΔY_{jt} = project income in year t

I^d_{jt} = domestic investment in project j, year t

I_{jt} = total investment in project j in year t

There are three parameters and one functional relationship that must be obtained if the model is to be used to provide any quantitative projections. The parameters are the continuous recurring cost parameter, a_j; the intermittent cost parameter, c_{jt}; and the ratio of local investment costs to total investment, z_j. The functional relationship is that between income and investment. The data were taken from World Bank Project Appraisal Reports. The project types for which parameters were estimated are the following:

1. Feeder or rural roads projects
2. Paved roads projects
3. Telecommunications projects
4. Agricultural projects
   a. polders projects
   b. livestock projects
   c. agricultural or rural development projects

II. FEEDER OR RURAL ROADS PROJECTS

A. Recurrent Costs

Table 1 presents estimates of a_j and c_{jt} for five World Bank rural or feeder road improvement projects and the average for all projects. Both the continuous cost parameters, a_j, and the intermittent cost parameter, c_{jt}, are measured as a percentage of total investment costs. In order to obtain an estimate of total recurring costs for a given year, it would only be necessary to multiply the total investment by the sum of a_j, which is invariant over time, and c_{jt}. The column headed "year" in the table refers to the number of years after the project is completed.

TABLE 1

Recurrent Costs
Feeder or Rural Roads Improvement Projects

Project	1	2	3	4		5	Average
				A*	B**		
a_j	.14	.028	.098	.048	.024	.02	.062
year[1]	c_{jt}	c_{jt}	c_{jt}	c_{jt}		c_{jt}	c_t
T+1	0	0	NA	0		0	.0
T+2	0	.013	-	0		0	0
T+3	.12	.013	-	0		.07	0
T+4	0	.013	-	0		.07	.08
T+5	0	.013	-	0		.07	.08
T+6	0	0	-	0		.07	.08
T+7	0	0	-	.12		0	0
T+8	0	0	-	0		0	0

*A-standard road (more than 4000 tons/yr)
**B-standard road (1700-4000 tons/year)
[1]T is the completion date for project investment

There are relatively large differences in the parameters. The amount and kinds of materials and equipment needed to improve feeder or rural roads varys considerably with the particular project and the pre-project road condition. These differences become evident when one examines the specific costs/km for various feeder road improvement projects shown in Table 2. If one matches the cost/kilometer of Table 2 with the recurring cost parameters

of Table 1, it becomes apparent that those projects with the highest recurrent costs generally have the lowest costs/km for improvement. This is in line with intuition in that the greater the extent of improvement (at least for feeder roads), the lower, one may expect, will be the maintenance costs.

TABLE 2

Cost per Kilometer of Feeder or Rural Road Improvement - by Project[1]

Project	1	2	3		4		5
Road Type[2]			A	B	A	B	
Costs/km of Improvement	$1676	NA	$3092	$1225	$4800	$2400	$2453

[1]In 1974 prices (if costs were given in some other year, they were corrected to reflect 1974 prices)
[2]Roads not labeled by type are assumed B-standard

The important numbers from Table 1, for the purpose of projecting future cost streams, are the averages in the right-hand column. In making our estimates of the recurring cost streams associated with given amounts of investment in feeder roads, these parameters were used. In looking at specific projects, the actual ratios for those projects would be used, rather than the averages from Table 1.

B. Domestic Investment Costs

Most of the equipment and materials used in road construction in the Sahel must be imported. As a result, the local cost ratio is rather small. The ratios of domestic investment costs to total project investment costs (net of taxes and duties) for World Bank highway projects are given in Table 3.

TABLE 3

Domestic Investment Costs
All Highway Projects

Project	1	2	3	4	5	6	7	8	9	10	11
z_j	.29	.24	.27	.22	.16	.14	.25	.24	.22	.15	.25

Average z_j = .22 Standard deviation = .05

The average avlue of .22 was used in feeder-road and paved-road project simulations as an estimate of z_j.

C. Income Streams

In estimating the income streams for projects we have assumed that the benefits as measured by the cost benefit analysis contained in the evaluations are an approximation of income. The benefits of rural or feeder roads projects derive primarily from reduced vehicle operating costs. The project analyses include an assumption that the benefits increase over time in accordance with projected growth in road use. They thus become an increasing proportion of total initial investment and conform to the following algebraic relationship:

$$B_{jt} = b(1+d)^{t-1} I_{jT} \qquad \text{(A-4)}$$

Table 4 gives the values of b and d as estimated from World Bank Projects. The parameter d is the projected rate of growth and the parameter b is the ratio of benefits to total investment as of the first year the project is functioning.

TABLE 4

Benefit/Investment Ratios and Growth Rates
Rural or Feeder Road Projects

	b (benefit ratio)	d (growth rate)
Project 1	.21	.055
2	.18	.04
3	.31	.023
4	NA	NA
5	.25	.06
Means	.24	.045

A rather tenuous assumption must be made to redefine these benefits as aggregate income. Since the cost saving really represents a reduction in fuel consumption, spare parts and labor, the monetary value of project benefits corresponds to a freeing of foreign exchange or other resources. If we assume that these freed resources, particularly exchange, have alternative uses, the measured benefits do, in fact, reflect an increase in national income of equal amount.[1] Thus, for feeder roads the unspecified income relationship A-2 can be written explicitly as:

$$\Delta Y_{jt} = b(1+d)^{t-1} I_{jt} \qquad \text{(A-5)}$$

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[1]The reader is warned that this assumption may or may not be accurate. The benefit stream for different projects may vary significantly in magnitude from the induced income stream. The assumption that they are equal, however, gains credibility if one is considering a large "portfolio" of projects. This is an area that requires considerably more analysis.

III. PAVED ROADS PROJECTS

A. Recurrent Costs

The recurrent costs for a paved road project are primarly routine maintenance costs that remain nearly constant from one year to the next. As a result, the intermittent costs reflected in c_{jt} are zero for all periods.

Table 5 gives the value of a_j, the continuous recurring cost parameter, for fourteen paved-road construction projects and an average for the fourteen. This average value from Table 5 was used in the simulations to generate the recurrent cost stream for paved road projects.

TABLE 5

Recurrent Costs
Paved Road Projects

Project	1	2	3	4	5	6	7	8	9	10	11	12	13	14
a_j	.073	.03	.043	.025	.011	.022	.025	.019	.032	.014	.014	.014	.016	.016

Average a_j = .025

B. Domestic Investment Costs

The ratio of domestic investment to total investment coses (z_j) for paved roads is the same as that used for feeder roads projects. The value is .22.

C. Income Stream

Benefits from paved roads projects derive from the same sources as for those for feeder roads projects, reduced vehicle operating and maintenance costs. Again, the assumption is made that the project benefit stream equals the project-induced income stream. Thus, equation A-6 represents the income stream associated with a paved roads project.

(A-6) $$Y_{jt} = b(1+d)^{t-1} I_{jt}$$

A small sample of World Bank paved roads projects was abailable from which to estimate values for the parameters b and d. The results are presented in Table 6 The average values from Table 6 were used in project simulations.

TABLE 6

Benefit/Investment Ratios and Growth Rates
Paved Road Projects

	b (benefit ratio)	d (growth rate)
Project A	.087	.055
Project B	.079	.078
	Average = .083	Average = .067

IV. TELECOMMUNICATIONS PROJECTS

A. Recurrent Costs

Estimates of the recurrent cost parameters a_j and c_{jt} for telecommunications projects were obtained using data from recent World Bank telecommunications projects in the Sahel. The intermittent costs of telecommunications projects, reflected in c_{jt}, are a linearly increasing proportion of project investment. For telecommunications projects the recurrent costs are in large measure the costs of running a telephone company. These operating costs increase over time as demand for connections and service rises. The values of the recurrent cost parameters are given in Table 7 for four projects. The average values for the four projects were used in generating recurrent cost streams for telecommunications projects.

B. Domestic Investment Costs

Domestic costs are a relatively low proportion of telecommunications projects. Most of the equipment and technology are imported. The domestic investment fraction, z_j, for four projects is given in Table 7. The average for the four projects is .18.

C. Income Stream

As discussed earlier, the net impact on the government budget of project costs depends upon the amount of government revenue generated. For most project types the revenue is estimated by first estimating the project-induced national income stream and then applying a country-specific revenue collection rate. The telephone service that is produced by telecommunications projects, however, is sold directly to consumers. As a result, given that the project is owned by the government, all the revenues accrue directly to the government. The relationship between revenues and investment is similar to that between recurring costs and investment. Part of the revenue is a constant ratio of initial investment and part increases linearly over time. We can let w_j represent the constant proportion parameter and l_{jt} be the increasing proportion. The revenue stream, R_{jt}, can then be written as:

$$R_{jt} = w_j I_{jT} + l_{jt} I_{jT} \tag{A-7}$$

The l_{jt} increase over time for the same reason costs do. There are new connections and increased usage which means increasing revenue. Table 7 goves estimates of w_j and l_{jt} acquired from a small sample of World Bank projects. The average values from Table 6 are used in revenue stream simulations for telecommunications projects.

Although we have not attempted to evaluate the accuracy of the World Bank estimates to determine whether they correspond to historical experience, we can point out some implications of the formation they have used. Since the recurring costs, x_{jt}, and revenues, R_{jt}, have both been estimated as functions of total investment, it is a simple matter to estimate the implied rate of return on investment. Let π_{jt} be the rate of return in period t on total initial investment.

Table 7

TELECOMMUNICATIONS PROJECTS

Project	Project 1	Project 2	Project 3	Average
a_j	.013	.027	.048	.029
		c_{jt}[1]		
T+1	0	0	0	0
T+2	.01	.006	.016	.011
T+3	.02	.012	.032	.022
T+4	.03	.018	.048	.033
T+5	.04	.024	.064	.044
T+6	.05	.030	.080	.055
T+7	.06	.036	.096	.066
T+8	.07	.042	.112	.077
z_j	.18	.16	.20	.18
w_j	.112	.132	.092	.112
		l_{jt}[3]		
T+1	0	0	0	0
T+2	.037	.020	.061	.039
T+3	.074	.040	.122	.078
T+4	.111	.060	.183	.117
T+5	.148	.080	.244	.156
T+6	.185	.100	.305	.195
T+7	.222	.120	.366	.234
T+8	.259	.140	.427	.273

[1]The c_{jt} can actually be represented by the formulation $c_j(t-1)$ where c_j is constant and t represents the years since project completion. The c_j's used in Table 6 for projects 1, 2, and 3 are .010, .006, and .016, respectively.

[2]T is the completion data for project investment.

[3]The l_{jt} in TAble 6 are derived using the formulation $l_j(t-1)$. The l_j's used in Table 6 for projects 1, 2, and 3 are .037, .020, and .061, respectively.

$$\pi_{jt} = \frac{R_{jt} - X_{jt}}{I_{jT}} = w_j + l_{jt} - a_j - c_{jt}$$

$$= w_j - a_j + (l_j - c_j)(t-1)$$

$$= .112 - .029 - (.039 - .011)(t-1)$$

$$\pi_{jt} = .083 - .028\ (t-1)$$

The rate of return thus increases continuously over time and is always positive. It is quite possible that this formulation overstates the profitability of telecommunications investments and as a result, overstates their contribution to government income in our simulations.

V. AGRICULTURAL PROJECTS

Agricultural projects can be divided into three subcategories:

1. Polders Projects
2. Livestock Projects
3. Rural or Agricultural Development Projects

Polders projects are generally devoted to improving and expanding irrigated agriculture in and around polders and other delta areas. Livestock projects are designed to assist cattle production and often include activities designed to improve livestock marketing, meat processing, and veterinary services. Rural or agricultural development projects are composite programs covering livestock, training, rainfed agriculture, irrigated agriculture, and/or agricultural transport.

Estimation of parameters for agricultural projects poses somewhat different problems than does estimation of infrastructure parameters. With road construction and telecommunications, the incidence of recurring costs falls almost exclusively on the government. This is not the case, however, for agricultural projects. To varying degrees, a significant part of the recurring costs of such projects fall directly on the individual farmer or farm unit. Hence, the total recurrent cost stream generally overstates the government cost burden. In order to calculate the government cost stream, it is necessary to introduce a new parameter, g_j, which is the ratio of government supported recurrent costs to total recurrent costs.

Estimating the project income stream and potential government revenues for agricultural projects also presents problems that are different from those associated with infrastructure projects. With infrastructure, it is impossible to specify who receives the income and in what form. As a result, government revenue is estimated simply by applying an average revenue collection rate to the income stream. Agricultural projects, however, usually produce income for identifiable groups of people and generally raise the output of specific kinds of crops or products such as livestock. In many cases, the taxes applicable to the incremental output are different from the average tax rate for the country. In addition,

there can be direct charges to the beneficiaries such as water charges to farmers in the case of irrigation projects. If one can specify projects, and the products they affect, one should certainly take into account the tax rates and charges that apply to those products. Unfortunately, the tax rates, charges, and degree of collectability vary widely both across different agricultural products and across different countries. Thus, in a general analysis, such as this one, these differences must be ignored and the same methodology that was used to estimate government income from infrastructure projects will be used in agriculture. The increment in national income is projected and the average revenue collection rate is applied to this income. This methodology may understate the true revenue potential.

The project income stream is assumed equal to the project benefit stream. For agricultural projects, however, this assumption is truly justified since the value of the estimated benefit stream in the World Bank evaluations is measured as the incremental crop and livestock production valued at market prices. As a result, the calculated benefits are identical with the project-related increment in national income.

1. Polders Projects

A. Recurring Costs

In common with the paved roads projects, polders projects (and agricultural projects in general) have little in the way of intermittent recurring costs. Hence, all recurring costs can be reflected in the constant proportionality factor a_j of equation B1 with c_{jt} equal to 0 for all t. Table 8 gives the estimates of a_j from two World Bank polders project reports. As described in the previous section, the project recurring cost stream overstates the government cost burden. The proportion of recurring costs which accrue as direct costs to the government[1] (g_j) are also shown in Table 8.

TABLE 8

Polders Projects

Parameter	Project 1	Project 2	Average
a_j	.16	.07	.12
g_j	.61	.62	.62
z_j	.59	.20	.40
b_j	.33	.15	.24

[1]In polders projects the project is generally run under the auspices of a specific agency or government-owned enterprise. All direct project revenues and costs are then channeled through this intermediary. However, for our purposes it is assumed that the government administers the project directly.

B. Domestic Investment Costs

Generally a larger proportion of total investment costs are spent on local technology, labor, and other resources in agricultural projects than in infrastructure projects. Hence, the proportion of domestic costs, z_j, is higher for agriculture projects. Table 8 gives the values of z_j for the two polders projects surveyed.

C. Income Stream

The estimated income stream (= benefit stream) for polders projects is similar to the estimated recurrent cost stream, being comprised solely of a constant proportion of project investment[1] and given by:

(A-8) $$\Delta Y_{jt} = b_j I_{jt}$$

Table 8 presents estimates of b_j from World Bank reports. The average values of a_j, g_j, z_j, and b_j from Table 8 were used in subsequent project simulations and analysis.

2. Livestock Projects

The recurrent-cost-stream, domestic-investment-cost-stream, and income-stream formulations for livestock projects are assumed to be the same as those for polders projects. Table 9 presents, as in the case of polders projects, all requisite parameter estimates and their averages from a sample of World Bank livestock project evaluations.

TABLE 9

Livestock Projects

	Project 1	Project 2	Project 3	Averages 4
a_j	.14	.06	.22	.14
g_j	.90	.65	NA	.78
z_j	.49	.61	.58	.56
b_j	.75	.55	.61	.64

[1]This is not strictly appropriate since full benefits are not viewed as being realized until several years after project completion. The complications involved in modeling the benefit stream so as to incorporjate an initial period after project completion when benefits are not fully realized is thought unnecessary for two reasons. First, the data are not sufficiently reliable and one runs the risk of trying to do too much with too little. Second, the periods over which benefits are realized are generally long (up to 50 years) so the compromise over a few initial years is not too damaging. As calculated, the b_j's represent an averaging process with the years of full benefit realization receiving the most weight. Refinements can easily be made when actual project data is used.

3. Rural or Agricultural Development Projects

The recurring cost, domestic-investment-cost, and income aspects of rural or agricultural development projects follow the same format as the previous agricultural projects. Table 10 presents the estimated values of a_j, g_j, z_j, and b_j and their averages from a sample of World Bank agricultural or rural development projects.

TABLE 10

Rural or Agricultural Development Projects

	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Average
a_j	.04	.43	.39	.29	.08	.14	.22
g_j	NA	.16	.46	.25	.25	.10	.24
z_j	.51	.44	.50	.47	.87	.67	.58
b_j	.19	.68	1.03	.48	.43	.40	.54

VI. SUMMARY OF PARAMETER VALUES

In order for the reader to make comparisons easily among parameters for different kinds of projects, we have assembled in Table 11 the relevant parameters for all projects. In looking at the figures it is obvious that the composition of an aid program can exert a major influence on the level and timing of local investment and recurring costs.

Table 11

SUMMARY TABLE

	Feeder Roads Projects	Paved Roads Projects	Telecommunications Projects	Polders Projects	Livestock Projects	Rural or Agricultural Development Projects
Recurrent cost parameters						
a_j	.062	.025	.029	.12	.14	.22
g_j				.62	.78	.24
c_{jt}						
T+1*	0	0	0	0	0	0
T+2	0	0	.011	0	0	0
T+3	0	0	.022	0	0	0
T+4	.08	0	.033	0	0	0
T+5	.08	0	.044	0	0	0
T+6	.08	0	.055	0	0	0
T+7	0	0	.066	0	0	0
T+8	0	0	.077	0	0	0
Domestic investment costs parameters						
z_j	.22	.22	.18	.40	.56	.58
Income stream parameters						
b_j	.24	.083		.24	.64	.54
d_j	.045	.067				
Direct revenue stream parameters						
w_j			.112			
l_{jt}						
T+1			0			
T+2			.039			
T+3			.078			
T+4			.117			
T+5			.156			
T+6			.195			
T+7			.234			
T+8			.273			

*T is the completion date for initial project investment.