ABSTRACT

A MACROECONOMIC MODEL FOR THE EVALUATION OF THE IRRIGATION IMPACTS OF THE PA MONG PROJECT ON THE ECONOMY OF SOUTH VIETNAM

By

Vu Quoc Thuy

Due to interdependence among the various aggregates of the economy, economic implications of large-scale development projects usually differ from the initial impact. This study has attempted to construct a macroeconomic model for South Vietnam which can be used to estimate the overall impact of public projects, and to apply this model to a specific case, namely, the implementation of the Pa Mong project to control the flow of the Mekong River.

The model is a combination of two analytical techniques: the input-output approach and the Keynesian technique of income determination. The economy is divided into five main sectors -- household, business, government, financial and foreign. In the input-output submodel, the business sector is further broken down into agriculture, manufactures and services sectors. There are 21 equations in the model, including definitional equations, functional equations and identities. Regression methods were used to estimate most of the functional equations.

By using the model to evaluate the Pa Mong project, it is possible to estimate not only the project output requirements, but also its economic implications under various alternative financing policies. From the investigation it was found that a macroeconomic model is very useful in project evaluation and development planning. The study also shows that South Vietnam will benefit greatly from the operation of the reservoir at Pa Mong, and that the Vietnamese government should contribute to the Mekong Basin development program, both in human and natural resources. The size of these contributions depends largely on the financing policy adopted.

Finally, this study proves the importance of a detailed input-output model for planning purposes, and emphasizes the necessity of improving the methods of collecting and reporting statistical data in South Vietnam.

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INTRODUCTION

A. Need for the Study

One of the world's largest rivers, the Mekong, is Southeast Asia's most substantial natural resource. Each year, an average of more than 475,000 million cubic meters of water flow, almost completely unutilized through the Mekong Delta into the South China Sea. More than 30 million people are now living in the Lower Mekong Basin, which covers more than 600,000 square kilometers and comprises almost all of Laos and the Khmer Republic, one-third of Thailand and two-fifths of the Republic of South Vietnam.

According to recent research by the United Nations, the Mekong River, if fully harnessed, could improve inland navigation for 1,000 miles, produce 150 billions of kilowatt-hours of hydro-electric power, provide enough water to irrigate nearly three million hectares of cultivable land during the dry season, and most importantly, provide the foundations for a future economic "commonwealth" in Indochina.[1]

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[1] United Nations, Report on Indicative Basin Plan -- A Framework for the Progressive Development of the Water Resources of the Lower Mekong Basin, prepared by the Committee for Co-ordination of Investigation of the Lower Mekong Basin, 1970.

However, the most striking aspect of the Mekong is not the size of the river, nor its potential, but the extent to which this resource has not been utilized. So far, only 0.3 percent of the hydro-electric potential of the river is being exploited. No bridge has ever crossed the Lower Mekong at any point, and only a fraction of the cultivated land in the region is irrigated. In short, the Lower Mekong has been a giant asleep -- an immense source of power production, irrigation, navigation and flood control, but a source virtually unutilized.

Realizing these tremendous potentials for development, the four riparian countries (the Khmer Republic, Laos, Thailand, and South Vietnam), with the assistance of the United Nations, formed the Committee for Coordination of Investigations of the Lower Mekong Basin (also called the Mekong Committee) in 1957. Composed of representatives from each of the four countries, this committee operates under the auspices of the United Nation's Economic Commission for Asia and the Far East (ECAFE) and is serviced by its Secretariat.

The main function of the Mekong Committee is to promote, coordinate, supervise and control the planning and investigation of the water resources development projects in the Lower Mekong Basin. This Mekong Scheme has received support from several countries and organizations.[2]

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[2]By 1963, participants in addition to the four riparian states were Australia, Canada, India, Japan, New Zealand,

The viability of the Mekong scheme is also enhanced by the recent pledge of the United States to contribute to the rehabilitation of Indochina. In short, all these facts contribute to insure the viability and desirability of the Mekong scheme.

In 1970, after more than a decade of investigation, the Mekong Committee published the Report on Indicative Basin Plan.[3] This report summarized the findings of the studies conducted thus far on potential projects in the basin, and proposed several alternative sequences for their implementation.

Ten possible mainstream projects were identified by the Mekong Committee for long-range implementation: Pa Mong, Delta Development Phase I and Phase II, Sambor, Interconnecting Transmission Lines, Stung Treng, Nam Theun No. 2, Ban Koum, High Luang Prabang, and Oil-Fired Thermal 400 Megawatts. These projects are all still at the investigation stage, with the exception of the Pa Mong project for which feasibility studies have been completed and updated.

Pakistan, Great Britain, the United States, the Republic of China, France, West Germany, Iran, Israel, Italy, the Netherlands, the Philippines, the Bureau of Technical Assistance, the World Bank, the International Labor Organization, the Food and Agriculture Organization(FAO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Health Organization, the Ford Foundation, the Asia Foundation, and a number of private companies.

[3] Op. cit.

The estimated costs of the whole program are about \$11 billion in U.S. dollars, spreading over a period of 30 years, with Pa Mong alone costing around 1.2 billion.

B. Objectives of the Study

For South Vietnam, the impacts of these upstream projects on its economy are direct and straightforward. The Mekong Delta is Vietnam's granary, and upstream water storage areas are necessary for full development of the delta. With its population increasing at an annual rate of 2.6 percent, South Vietnam will have nearly 30 million people to feed by the end of this century. This alone will require about nine million tons of paddy per year, nearly twice the actual annual production.

Faced with the growing demand for food, increasing the productivity of the delta is therefore crucial for the country. The best way to attain this goal is to provide year-round water control. The construction of upstream water storage areas on the Mekong is the first step in this direction.

However, due to the magnitude of the investment involved and the limited financial capacities of the four riparian countries, many experts on the Mekong Basin share the belief that the proposed long-range program appears too ambitious, and it is more realistic to expect, at best, only one mainstream project to be completed in the next decade, the Pa Mong project.

An analytical examination of the impact of the Pa Mong project, therefore is necessary to determine to what extent the Vietnamese economy will benefit from this project, and how much South Vietnam will be able to contribute to the project costs without overstraining the country's resources. Consequently, the main purpose of this study is to design a macroeconomic model which can help to evaluate the impact of irrigation on the different sectors of the economy where major changes are envisioned and where the effects can be quantitatively estimated.

More specifically, the objectives of this study are: (1) to review briefly the various approaches to the problem of project impact evaluation; (2) to formulate a macroeconomic model for South Vietnam which can provide an analytical framework for evaluating large-scale projects such as the development of the Mekong River at Pa Mong; (3) to estimate, with the help of the macroeconomic model, the implications of the Pa Mong project on the various macro variables of the economy; and finally, (4) to advance some general policy recommendations, which will help South Vietnam benefit fully from the project.

With these objectives in mind, Chapter II will consider the various techniques available for public project evaluation. Chapters III and IV will describe the model and estimate the equations of the model. The application of the model to the Pa Mong project will be presented in Chapter V.

The summary of the findings, together with a discussion of the limitations of the model will be presented in Chapter VI.

CHAPTER II

THEORETICAL APPROACHES TO PROJECT IMPACT EVALUATION

Large-scale development projects, such as the Pa Mong scheme, usually generate two types of impact on an economy: the primary impact of changes in income directly related to the project, and the secondary impact of economic changes resulting from the repercussion of the primary impact on the rest of the economy. An example of primary impact is the increase in household income generated by the project investment expenditures. The secondary impact would be those economic activities which result from the re-spending of the initial increase in income. While estimation of the primary impact is rather straightforward, evaluation of the secondary impact, due to its ambiguous nature, is often quite difficult.

In the past two decades, several approaches have been proposed to appraise the economic implications of development projects. The most important will be presented and discussed briefly in this chapter, namely, the Keynesian multiplier approach, the comparative projection approach, the input-output approach, and the intersectoral flows analysis.

A. The Keynesian Multiplier Approach

The pure Keynesian multiplier is particularly useful in measuring the "induced" income effects of an exogenous change in household income generated by the impact of a project. However, the Keynesian multiplier has the one obvious shortcoming of being an aggregate demand multiplier. For the multiplier effects to be felt fully without being partially absorbed through inflation, aggregate supply must either be very elastic or it must shift (as a result of the project) by the same amount as does aggregate demand. Unless one has reason to believe that one of these aggregate supply conditions is being met, multiplier analysis will overestimate the project's secondary effects.

Furthermore, for the full value of the increase in income payments to represent real changes in income to the recipients, the opportunity costs of those factors must have been close to zero, so that the outputs which result from the project do not simply substitute for other products in the market. Thus, the conditions under which the full multiplier effects of a public investment in a water resource project would constitute a net change in real income are fairly specific and limiting, and one should be very careful when using the Keynesian multiplier analysis.

B. The Comparative Projection Approach

Formalized by John E. Pearson, the comparative projection concept is a fairly simple one.[1] As its title

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[1]John E. Pearson, A Study of the Economic Impact of

indicates, the approach utilizes comparative analyses of similar areas (one area having a public project, the other not) in an attempt to estimate the differences in income which redound to the advantage of the project region. The approach represents an attempt to apply the "controlled experiment" approach of scientific investigation in this case, the "without-project" group represents the "control group". If a systematic pattern of differences exists, and if that pattern cannot be logically explained by some other "uncontrolled variables," the cause of the difference is assigned to the existence of the public project.

The main shortcoming of the comparative projection approach is the failure to establish logical links between the project and the process of economic growth. It is understandable that a project which provides water to a water deficient area might be accepted axiomatically as a determinant of economic growth. Nevertheless, this does not eliminate the necessity for a sound theoretical foundation.

Furthermore, one should be wary of the comparative projection approach as a means of estimating secondary project impact. The comparative growth rates are not developed from the same areas, but rather from comparable areas in which the lack of a project is the only difference between them.

Water Impoundment Through the Development of a Comparative Projection Model, Technical Report No. 8 Texas A and M University: Water Resource Institute, (1967).

In reality, comparable areas can seldom be found. Differences in industrial mix, community size and local consumption and investment propensities can cause income multipliers from seemingly similar areas to differ considerably.

C. The Input-Output Approach

The input-output model is a system of linear equations which depict the interindustry flow of goods and services at a given point in time.[2] The basic unit of the input-output model is the transaction or flow table in which the rows (or columns) describe the sales (or purchases) of one sector to (or from) other sectors.

From the transaction table, two other tables can be derived: the technical coefficient or direct requirements table and the interdependence coefficient or direct and indirect requirements table. The technical coefficient table gives the breakdown of each dollar of gross output by each sector and describes the value added or flow as input to other sectors. The interdependence coefficient table describes the input requirements, both direct and indirect, which result from each dollar of gross output by each sector. Detailed derivation of these tables will be given in the next chapter.

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[2]For a detailed description of the input-output technique, see Wassily W. Leontief, The Structure of American Economy, 1919-1939, 3rd ed. (New York: Oxford University Press, 1960).

The disaggregation in the input-output model allows one to compute many multipliers rather than a single average multiplier. A multiplier for each industrial sector can be computed. Thus, if the incidence of the impact is known, the multiplier effects can be estimated with more accuracy than is possible with the more aggregative models. The most widely used input-output multipliers are the output multipliers. These show the direct and indirect changes in gross output stimulated by a one dollar change in demand for each industrial sector. They are obtained by summing the entries in the vector of direct and indirect requirements per dollar of sales for the industry in question.

However, while output multipliers can yield valuable information about relative sectoral interdependence, they can be misleading when used to estimate the income effects because the sectors having the lowest value-added-per-dollar-of-sales tend to be those having the greatest sectoral interdependence. In other words, the larger the output multiplier, the smaller the income effect will be for the sector in question.

Moreover, the main weakness of the static input-output approach lies in the abstraction from the time sequence of production and exchange[3]: the technological relationships

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[3]Robert Dorfman, "The Nature and Significance of Input-Output," Review of Economics and Statistics (May 1954), pp. 120-134.

in the matrix of requirements are assumed not only to hold for all levels of output, but to remain constant over time as well. Furthermore, since the multiplier techniques also include the round-after-round expansions, the input-output multiplier not only abstracts from time in dealing with the direct relationships, it also further abstracts from time in handling the rounds of expansion.[4]

In spite of its weaknesses, the input-output technique, by allowing detailed analysis of sectoral interdependence, still constitutes the most effective tool to evaluate the secondary impact of public projects.

D. The Intersectoral Flows Analysis

This analysis differs only slightly from input-output analysis in that only data on sales by each sector is collected, while the input-output approach records data on both sales and purchases. The result is a noticeable reduction in data collection cost; but, in exchange, a valuable means of cross checking is lost.

Proponents of the intersectoral flows analysis[5] have argued that, for a completely closed region (i.e., no

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[4]It should be noted that these criticisms apply only to the static input-output model, not the dynamic model. For a presentation of the dynamic input-output model, see Wassily Leontief et al., Studies in the Structure of the American Economy, Chap. 3 (New York: Oxford University Press, 1953).

[5]Lee Hansen and Charles Tiebout, "An Inter-Sectoral

trading with the outside world), this approach would yield basically the same information as the input-output approach when all the internal sales data is brought together. Consequently, this approach is capable of being put to most of the same analytical uses as input-output analysis, and also shares most of its limitations and problems.

However, in addition to the weaknesses common to input-output analysis mentioned in the preceding section, the intersectoral flows analysis presents two main, inherent shortcomings. First, it ignores imports, since trading with the outside world is not included in the data collection process. Consequently, this approach could not be applied to an open economy. Second, the data collection process of the intersectoral flows analysis does not allow one to estimate the value added coefficients for the producing sector. If no further additions are made to the basic data, only an output requirements matrix actually develops. As mentioned earlier, this proves not to be particularly helpful for secondary impact evaluation purposes, in which one is more likely to be interested in "income" than in "output" generation.

Flows Analysis of the California Economy," Review of Economics and Statistics Vol. 45 (November, 1963, pp. 409-418). Also see R.J. Kalter, Estimating Local Secondary Impacts of Water-Based Recreation Investment Using Inter-Industry Analysis (Madison: University of Wisconsin Press, 1967).

CHAPTER III

THE DESIGN OF THE MACROECONOMIC MODEL

A. General Aspects of the Model

A model which could serve as an analytical tool for evaluating the impacts of the Pa Mong project on the South Vietnamese economy will be described briefly here. As discussed in the previous chapter, a number of models can serve that purpose, each having its own advantages and shortcomings which cannot be fully appraised without taking into consideration all the constraints surrounding the specific study that each model was intended to serve.

In this study, where outside constraints are so numerous, two approaches instead of one have been used to increase the analytical power of the model, namely, the input-output approach and the Keynesian multiplier approach.[1] Thus, this model has two parts: the first estimates the project output requirements, and the second evaluates the project implications on the various aggregates of the economy.

The direct and indirect income effects are obtained with the help of a consolidated input-output model which

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[1] John Maynard Keynes, The General Theory of Employment, Interest, and Money (New York: Harcourt, Brace and World Inc., 1936).

aggregates the South Vietnamese economy into six sectors: agriculture, manufactures, services, primary input, imports, and final demand. A further breakdown, especially of the producing sectors, is desirable, but not feasible due to the absence of relevant data.

This input-output model is the "open" type because consumption, investments, and exports are lumped together in the final demand sector and are exogenous to the requirements matrix. Consequently, it excludes the induced income effect of respending by households.

One way of incorporating this induced income effect is to close the model by making the household sector endogenous to the system, and then derive the "type II" income effect. However, this solution is not adopted for two reasons: (1) it requires the additional assumption of linear homogeneity of consumption, an assumption rejected by most empirical studies, which have found that households have the tendency to vary their consumption patterns as income changes; (2) data on the final demand sectors, particularly those dealing with investment and household consumptions, is insufficient.

As a result, the open input-output technique in the second stage of the model will be supplemented by a Keynesian type national income determination model which allows the initial impacts of the project to have further expansionary effects on the economy via the Keynesian multiplier. Since the main purpose of this model is to evaluate the aggregate demand effects and not those generated by intersectoral requirement relationships, the producing sectors (agriculture, manufactures and services) will be consolidated into one single sector, while the final demand sector is disaggregated into four different sectors (household, government, financial, and foreign).

Through the combination of these two types of models, it is possible to gain more insight into the economic implications of the development project.

The main problem of using the multiplier technique to estimate the impacts of a public project is that the aggregate supply must either be perfectly elastic or it must shift by the same amount as does aggregate demand for the multiplier to have its full effect on the economy. This condition, though operationally very limiting, is present in South Vietnam.

Looking first at supply conditions, South Vietnam still has vast areas of fertile land, most left fallow during the dry season for lack of irrigation water. Thus, once water is made available from the upstream reservoirs on the Mekong, food supply could be increased in a relatively short period.

Moreover, due to the lack of water during the dry season, farmers are usually underemployed half of the year. Since they constitute more than 80 percent of the total population, a major and inexpensive source of labor is ready to be tapped.

Furthermore, South Vietnam is keeping more than one million men under arms due to the war. However with the future demobilization program, most of them will return to civilian life. This surge in the labor supply will allow the economy to face any increase in aggregate demand generated by the project. Theoretically, there is ample room for aggregate supply to expand, and consequently, the full multiplier effects can be expected to represent a net change in the real income of the economy.

However, the supply of labor in South Vietnam is not unlimited, and to remain on the conservative side, the expansionary effects of the Keynesian multiplier will be checked by a constraint represented by the full employment of the labor force.

It should also be noted that this model is not dynamic, but comparatively static in nature. It yields a comparison of the value of the economic changes brought about by the project, but does not reveal anything about the time paths of the change.

B. The First Stage of the Model: The Input-Output Relationships

An aggregate input-output table will be formulated which will serve as the foundation for the first stage of the model.

As mentioned earlier, the first step to measure the total effect a project will have on the entire economy is to estimate its direct and indirect effects. The direct effects of the project are relatively simple to ascertain, but indirect effects are not as easily measured. For example, the initial effect of the Mekong project is an increase in the income of people in the agricultural sector. The indirect effects of the new project are the new businesses in the region and the resulting increased employment opportunities. These indirect effects arise as farmers demand additional services and industrial inputs; thus, the service and manufacture industries will hire additional people. The reverberations will continue until the economy adjusts completely to the initial change.

One analytical device used to measure the direct and indirect effects of a change in the economy is the input-output model which, thanks to the pioneering works of Wassily W. Leontief, has become a powerful tool in measuring the inter-relationships of industries and sectors within the economy.[2]

The input-output model being used here has three basic parts: (1) a transaction of flow table, (2) a set of technical or direct coefficients, and (3) a set of interdependence or direct and indirect coefficients. The flow table is

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[2]Wasilly W. Leontief, "Quantitative Input-Output Relations in the Economic System of the United States," Review of Economics and Statistics, Vol. 18 (August, 1936), pp. 105-125. Also see Wassily W. Leontief, The Structure of American Economy, 1919-1939, op. cit.; Wassily W. Leontief, Input-Output Economics (New York: Oxford University Press, 1966); H. B. Chenery and P.G. Clark, Interindustry Economics (New York: Wiley & Sons, 1959).

the base of the model. The technical and interdependence coefficients are derived directly from it.

1. <u>The Flow Table</u>

To build the flow table, the Vietnamese producing sector is broken down into three sectors: agriculture, manufactures, and services. A greater division of the producing sector is desirable to provide more analytical insight, but is not feasible considering the shortage of available data. Each sector consists of a set of relatively homogenous industries and produces a certain amount of output which is used within the sector, purchased by the other sectors, or purchased for final demand.

In addition to these producing sectors, three other sectors are distinguished, namely, the primary input sector, the foreign sector and the final demand sector. The primary sector indicates the value of primary services used for the producing and final demand sectors, and includes all types of income such as wages, transfers, interest payments, profits, rents, etc.

The transactions of the economy can be presented as a system of equations:

$$O_a = x_{aa} + x_{am} + x_{as} + V_a \qquad (3.1)$$

$$O_m = x_{ma} + x_{mm} + x_{ms} + V_m \qquad (3.2)$$

$$O_s = x_{sa} + x_{sm} + x_{ss} + V_s \qquad (3.3)$$

$$Y = Y_a + Y_m + Y_s + Y_D \qquad (3.4)$$

$$M = M_a + M_m + M_s + M_D \qquad (3.5)$$

Where 0_a = gross output of the agricultural sector.

0_m = gross output of the manufactures sector.

0_s = gross output of the services sector.

Y = total value added or income.

M = total imports.

x_{aa}, x_{am}, x_{as} = purchases of agricultural inputs by the agricultural sector itself, manufactures sector and services sector.

x_{ma}, x_{mm}, x_{ms} = purchases of manufactured input by the agricultural sector, the manufactures sector itself and the services sector.

x_{sa}, x_{sm}, x_{ss} = purchases of services by the agricultural sector, the manufactures sector and the services sector itself.

Y_a , Y_m , Y_s , Y_D = purchases of primary inputs by the agricultural sector, the manufactures sector, the services sector and the final demand sector.

M_a , M_m , M_s = intermediary inputs imported by the agricultural, manufactures and services sectors.

M_D = imports by the final demand sector.

V_a , V_m , V_s = purchases of agricultural, manufactured and service outputs by the final demand sector.

An outlined form of the transaction table may help to explain the system of the equations (Table 1). It should be noted that all the variables are in value terms.

The input-output or flow table (Table 1) provides a systematic account of the sales and purchases of each sector. Reading across each row indicates the sales of that sector while reading down each column indicates the purchases of that sector. In the first row of the input-output, output of the agricultural sector is 0_a. Of this output, x_{aa} is purchased by the agricultural itself, x_{am} is purchased by the manufactures sector, x_{as} is purchased by the services sector, and V_a is the amount distributed to the final demand sector. The inputs of each sector are summarized in that sector's column.

Reading down the first column, the agricultural sector requires x_{aa} of its own output, x_{ma} of the industrial sector, x_{sa} of the services sector, Y_a of primary inputs and M_a of imported inputs.

The producing sectors (agriculture, manufactures and services) are assumed endogenous to the system while the remaining sectors (final demand, foreign and primary input)

TABLE 1

CONSOLIDATED INPUT-OUTPUT

Output / Input	Agriculture	Manufactures	Services	Final Demand	Total Output
Agriculture	x_{aa}	x_{am}	x_{as}	V_a	0_a
Manufactures	x_{ma}	x_{mm}	x_{ms}	V_m	0_m
Services	x_{sa}	x_{sm}	x_{ss}	V_s	0_s
Primary Input	Y_a	Y_m	Y_s	Y_D	Y
Imports	M_a	M_m	M_s	M_D	M
Total Input	0_a	0_m	0_s		

are considered exogenous. Therefore, the model is an open input-output model and assumes that constant input-output coefficients hold only for the endogenous producing sectors.

A closed input-output model assumes all sectors to be endogenous and all input-output coefficients to be constant. This assumption is quite strong and lacks empirical evidence, especially concerning the coefficients of the final demand sector. For this reason, no attempt is made to close the input-output model, but instead the open system is supplemented with a Keynesian model of national income determination.

2. The Technical Coefficients

The technical coefficients are derived from the transaction table and indicate the input requirements per unit value of output.[3] These are derived by assuming that the relationship between the input purchases of a sector and the level of the output of that sector is linear.[4]

The technical coefficient table illustrates the breakdown of each unit value of output and describes its flows to various sectors for inputs. For any sector j, the technical coefficient t_{ij} can be mathematically expressed in the following form:

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[3] Wassily Leontief, The Structure of American Economy 1919-1939, Op. cit., pp. 204-205.

[4] Harold O. Carter, "Input-Output -- Uses and Problems

$$t_{ij} = \frac{x_{ij}}{0_j} \qquad (3.7)$$

Where 0_j is the sectoral output of sector j, and x_{ij} its purchases of input from sector i. The money spent on various inputs in the course of obtaining one unit value of output of sector j is represented by t_{ij}.

The technical coefficients are defined as follows:

$$t_{aa} = \frac{x_{aa}}{0_a} ; \quad t_{am} = \frac{x_{am}}{0_m} ; \quad t_{as} = \frac{x_{as}}{0_s}$$

$$t_{ma} = \frac{x_{ma}}{0_a} ; \quad t_{mm} = \frac{x_{mm}}{0_m} ; \quad t_{ms} = \frac{x_{ms}}{0_s}$$

$$t_{sa} = \frac{x_{sa}}{0_a} ; \quad t_{sm} = \frac{x_{sm}}{0_m} ; \quad t_{ss} = \frac{x_{ss}}{0_s}$$

$$t_{ya} = \frac{Y_a}{0_a} ; \quad t_{ym} = \frac{Y_m}{0_m} ; \quad t_{ys} = \frac{Y_s}{0_s}$$

$$M_a = \frac{M_a}{0_a} ; \quad M_m = \frac{M_m}{0_m} ; \quad M_s = \frac{M_s}{0_s}$$

Table 2 expresses the inter-sectoral flows in terms of technical coefficients.

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in Regional Analysis," Regional Economic Development, Proceedings of the Methodology Workshop (Denver, 1966) pp. 56-84.

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TABLE 2

FLOW TABLE WITH TECHNICAL COEFFICIENTS

Input from	Output to: Agriculture	Manufactures	Services	Final Demand	Total Output
Agriculture	$t_{aa} x\ 0_a$	$t_{am} x\ 0_m$	$t_{as} x\ 0_s$	V_a	0_a
Manufactures	$t_{ma} x\ 0_a$	$t_{mm} x\ 0_m$	$t_{ms} x\ 0_s$	V_m	0_m
Services	$t_{sa} x\ 0_a$	$t_{sm} x\ 0_m$	$t_{ss} x\ 0_s$	V_s	0_s
Primary Inputs	$t_{ya} x\ 0_a$	$t_{ym} x\ 0_m$	$t_{ys} x\ 0_s$	Y_D	Y
Imports	$m_a x\ 0_a$	$m_m x\ 0_m$	$m_s x\ 0_s$	M_D	M
Total Inputs	0_a	0_m	0_s		

3. Interdependence Coefficient Table

The interdependence coefficient, often referred to as the direct and indirect coefficient, indicates not only the direct but also indirect output requirements per unit of output delivered to final demand.

The calculation of the interdependence coefficients includes taking the technical coefficients in matrix form and subtracting it from an identity matrix. The inverse of the resulting matrix provides a set of interdependence coefficients. It should be noted that the interdependence coefficients could only be computed for the endogenous sectors of the model because the inversion process requires that the technical coefficient matrix be square.

The mathematical procedure is as follows:
First, the technical coefficients are introduced in the equations (3.1), (3.2), and (3.3) which become:

$$0_a = t_{aa}0_a + t_{am}0_m + t_{as}0_a + V_a \tag{3.8}$$

$$0_m = t_{ma}0_a + t_{mm}0_m + t_{ms}0_s + V_m \tag{3.9}$$

$$0_s = t_{sa}0_s + t_{sm}0_s + t_{ss}0_s + V_s \tag{3.10}$$

Rewriting these equations in matrix form:

$$\begin{bmatrix} 0_a \\ 0_m \\ 0_s \end{bmatrix} = \begin{bmatrix} t_{aa} & t_{am} & t_{as} & 0_a \\ t_{ma} & t_{mm} & t_{ms} & 0_m \\ t_{sa} & t_{sm} & t_{ss} & 0_s \end{bmatrix} + \begin{bmatrix} V_a \\ V_m \\ V_s \end{bmatrix}$$

In matrix notation, it would read as:

$$0 = AO + V \qquad (3.11)$$

which may be transformed into:

$$V = 0 - AO$$

$$V = IO - AO$$

$$V = (I - A)\,0 \qquad (3.12)$$

The identity matrix I is inserted to solve the dimensionality problem. When I is inserted, it does not change the equation, but factors out 0 because (I-A) is then defined.

The matrix (I - A) is known as the "Leontief Matrix" and has the special properties of the diagonal elements being positive, while the remaining elements are negative or zero.

Premultiply both sides of equation (3.12) by $(I - A)^{-1}$:

$$(I - A)^{-1}(I - A)\,0 = (I - A)^{-1} V$$

$$0 = (I - A)^{-1} V \qquad (3.13)$$

The matrix $(I - A)^{-1}$ is called the interdependence coefficient matrix and each of its elements, e_{ij}, indicates the amount of production from sector i necessary to sustain a final demand of one unit in sector j. In short, the interdependence table or direct - indirect requirements table is simply the inverse of the Leontief matrix (I - A).

4. The Import Requirement and Output Requirement Equations

Once the matrix $(I - A)^{-1}$ is calculated for the input-output model, it will be possible to estimate the output requirement equations. The derivation procedure is described in what follows.

Denote the elements of $(I - A)^{-1}$ by e_{ij}'s, then in the three-sector model:

$$\begin{bmatrix} O_a \\ O_m \\ O_s \end{bmatrix} = \begin{bmatrix} e_{aa} & e_{am} & e_{as} \\ e_{ma} & e_{mm} & e_{ms} \\ e_{sa} & e_{sm} & e_{ss} \end{bmatrix} \begin{bmatrix} V_a \\ V_m \\ V_s \end{bmatrix}$$

Thus, the direct-indirect output requirements for producing V_a, V_m and V_s are:

$$O_a = e_{aa} V_a + e_{am} V_m + e_{as} V_s \qquad (3.14)$$

$$O_m = e_{ma} V_a + e_{mm} V_m + e_{ms} V_s \qquad (3.15)$$

$$O_s = e_{sa} V_a + e_{sm} V_m + e_{ss} V_s \qquad (3.16)$$

By making use of the technical coefficients of Table 2, it is possible to estimate the amount of imports of intermediary inputs necessary for the production of V_a, V_m, and V_s:

$$M_a = m_a O_a = m_a (e_{aa}V_a + e_{am}V_m + e_{as}V_s) \qquad (3.17)$$

$$M_m = m_m O_m = m_m (e_{ma}V_a + e_{mm}V_m + e_{ms}V_s) \qquad (3.18)$$

$$M_s = m_s O_s = m_s (e_{sa}V_a + e_{sm}V_m + e_{ss}V_s) \qquad (3.19)$$

The equations (3.14), (3.15), (3.16), (3.17), (3.18), and (3.19) summarize the first part of the model. V_a, V_m, and V_s are defined as the bill of goods for final demand; O_a, O_m, and O_s, the sectoral output requirements necessary to satisfy these demands; and M_a, M_m, and M_s, the required imports of intermediary inputs.

C. The Second Stage of the Model: The Equations for National Income Determination

The first stage of the model has been built and the output requirement equations have been derived. The stage is now ready to develop the second stage, i.e., the Keynesian model of national income determination. This section is divided into three parts: part one contains the general considerations which should be taken into account in the building of the Keynesian macro model; part two constructs the second stage of the model; and part three explains how the model could be used to evaluate the economic implications of the project.

1. General considerations

a. Selection of the Variables

Economic relations usually involve a whole gamut of variables. It would be extremely difficult, if not impossible, to take all these variables into account, especially in the case of South Vietnam where not much data is available. As a result, only a relatively few variables will be mentioned in this study.

Since the model in this study is intended to serve as a tool for project evaluation at a macro level, and since adequate data of a microeconomic nature is not available, only aggregate variables will be included in the model.

The variables of the Keynesian submodel are measured at the market prices of 1960, which is the base year adopted by the National Institute of Statistics of Vietnam. Due to empirical and computational difficulties, prices are not endogenous variables of the system.

b. Sector Division

To provide information about the structure and functions of the economic system, it is necessary to split the economy into various sectors so that the internal relationships among these sectors can be observed. It should be mentioned that many different kinds of sector breakdowns are possible, and that different forms of economic problems will require different types of sector breakdowns.

For this reason, no social accounting system could claim competence to embrace all aspects of economic activity with similar thoroughness for the use of policy makers. Consequently, any system will be admissible as long as it has a coherently determined plan for the analytical presentation of economic aggregates so that there is some interdependence among them.

In the case of South Vietnam, a functional sector breakdown will be used (i.e., the sectors are classified according to the function of the transactions rather than the nature of the individual or agency involved in the transaction). For example, a farmer is considered in the producing sector whenever he acts in his role as a producer. This same farmer, however, will be considered in the consuming sector with respect to all transactions concerning his consumption activities.

The model splits the economy into five main sectors: household, government, financial, foreign, and producing.

The household sector is concerned with the activities of individual households in their role as private consumers. The income of the household sector is in the form of wages, interest, rent, profits, and dividends. This income is either consumed in both domestic and foreign commodities, saved, or paid as taxes to the government. Because the household sector constitutes a major part in the use of resources, it is important to keep it as a separate sector.

The government sector could be regarded as delimiting a special section of the economy, performed by the government. For the sake of clarity, it should be kept separated from the household sector. Because the government usually takes the main responsibility for economic development, it is better to separate that sector from the household sector to see how much and in which direction it can affect the economy.

It should also be noted that by following the criterion of functional sector breakdown, business activities of the government will be recorded in the producing sector but the rest of the government activities, i.e., those related to tax collections and public consumption in general, will be recorded in the government sector.

The financial sector does not refer to a single sector; but is used instead to record all those transactions or residual items that enter the other current accounts, but do not have a balancing entry in any of the other accounts.

South Vietnam, like most of its neighbors in Southeast Asia, is an agricultural country which needs foreign currency to import capital goods, and in which foreign aid and foreign loans play a crucial role in economic development. Consequently, the model will be an open one and the foreign sector will consolidate the transactions between the various domestic sectors and the rest of the world. The residual item on this account (net foreign borrowing and foreign aid) is important from a developmental policy point of view, since it shows the extent to which the country can depend on foreign countries in its development.

Because the model being used is a combination of the multiplier model and an input-output model, the production sector has a special feature. It was split into three separate industries in the input-output submodel, namely, agriculture, manufactures and services, to evaluate the direct and indirect output changes generated from interindustry feedback. However, in the Keynesian submodel all productive activities are aggregated into one production sector. The concern here lies in estimating the induced income effects, and no distinction is made on how the different activities contribute to the total income.

It should be noted that the sector division adopted in this second stage is simply a restructuring of the one used in the preceding input-output table. The producing industries are consolidated into one production sector while the final demand sector is disaggregated into four separate sectors.

A wider sector division than the one just chosen -- although very useful in the project evaluation by allowing for more insight into interindustry feedbacks -- was not considered because in addition to the increased complexity of the model, there are insuperable difficulties with respect to the data requirements of such division.

c. Method of Estimation

The ordinary least squares method will be widely used in estimating the parameters of the behavioral equations. It is recognized that this method of estimation does not have the desirable property of large sample consistency of more sophisticated estimation techniques.[5]

However, in this study there is no gain from the consistency of high powered statistical techniques due to the serious limitation of the data sample size. Besides, the degrees of freedom of each estimating equation, which are

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[5]For example, indirect least square, three-stage least squares, full information likelihood estimation, and limited information estimation provide large sample consistency.

already few, will unavoidably be reduced by using other methods.

In addition, it should be noted that as a result of more than two decades of internal struggles, major institutional changes were taking place which make it difficult to judge if the changes in the data reflect technical and economic changes alone or also changes in the institutional structure of the economy. For all these reasons, no attempt will be made to use sophisticated econometric techniques, but rather the simple linear regression method will be utilized.

The process of estimation will depend mainly on the economic data available for the period 1960 to 1970. The data, however, was in current prices, and to estimate the parameters from these data will mean that the estimates reflect price changes as well as technological and behavioral changes. One way of eliminating the effects of price changes is to estimate all the values of the relevant variables in term of the base year prices (1960). The price deflators of different macroeconomic variables are those currently used by both the National Institute of Statistics of Vietnam and the National Bank of Vietnam.[6]

d. Symbols

Throughout this model, economic variables will be represented by symbols with the following meanings:

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[6]Republic of Vietnam, National Institute of Statistics of Vietnam, Statistical Yearbook of 1971, Chapter V.

A_F = Net foreign aid and foreign loan

C_H = Total household consumption of both domestic and imported commodities

C_h^d = Household consumption of domestic commodities

C_g = Public consumption of domestic commodities

I = Gross investment

I_d = Investment expenditures on domestically produced goods and services

M_c = Imported commodities for final consumption

M_i = Imports of inputs for the production sector

Y = Gross national income

M_K = Imports of investment goods

R_g = Current budget net revenue

S_h = Household savings

S_g = Savings of the government sector

V_a = Output of the agricultural sector for final demand

V_m = Output of the industrial sector for final demand

V_s = Output of the services sector for final demand

X = Total exports

M_a = Imports of intermediary inputs by the agricultural sector

M_i = Imports of intermediary inputs by the manufactures sector

M_s = Imports of intermediary inputs by the services sector

O_a = Output requirement in the agricultural sector

O_m = Output requirement in the manufactures sector

O_s = Output requirement in the services sector

With the general properties of the model decided upon and the sector division specified, construction of the model can begin.

2. Design of the Multiplier Submodel

The following submodel is the Keynesian type and has fifteen equations and seven exogenous variables.

a. Definitional Equations

These equations will provide the accounting relationship among the different sectors in the model. It is important that these accounting equations be satisfied in order for the model to have internally consistant solutions. One of the neat ways of deriving these equations is to build a matrix of the national income accounts where each row and column of the same order contain the receipts and payments of one sector respectively; and each sector has one row and one column. The payments from one sector to another are shown where the column of one sector intersects the row of the other. A national income matrix which satisfies the sector division used in this model appears in Table 3.

There are several general considerations about the national income matrix that have to be kept in mind.

First, the matrix shows the rather trivial fact that in every sector total receipts equal total payments. This,

TABLE 3

NATIONAL INCOME MATRIX

Payments / Receipts	Production Sector	Household Sector	Government Sector	Financial Sector	Foreign Sector	Total Receipts
Production		C_h^d	C_g	I^d	X	Business Revenues
Household	Y					Y
Government		R_g				R_g
Financial		S_h	S_g		A_F	I
Foreign	M_i	M_c		M_K		Total Imports
Total Payments	Business Expenditures	Y	R_g	I	Total Exports	

as already explained, helps to insure the internal consistency of the model.

Second, because the sectors are represented in a consolidated form, the intrasectoral transactions will cancel each other out. As a result, cells at the intersection of rows and columns of the same sectors, i.e., those cells lying on the diagonal of the matrix, will have zero entries.

For the sake of simplicity and to conform to the functional sector division criterion adopted in this model, corporation savings and business tax payments will not be recorded in the production sector but rather in the household sector.

Third, in the foreign sector, all net borrowings are assumed to accrue to the government. This is a reasonable assumption in the case of Vietnam since the government takes the main responsibility for the process of development and nearly all of the foreign aids and loans are channeled via government agencies. Furthermore, no distinction was made between foreign aid and foreign loans since the major part of Vietnam's foreign assistance comes in the form of aid.

Lastly, in South Vietnam several big industrial establishments are government owned and the profits generated in these establishments are either invested internally or are provided for investments in other industrial establishments according to the government's investment plan. From the accounting point of view, these savings should therefore be included in government savings. However, because the functional sector breakdown separates transactions with respect to their functions rather than the nature of individuals performing these transactions, retained profits in public companies, like their counterparts in private corporations, will be included in household savings. Government savings shown in the matrix will include only savings in the current government budget.

There is an analytical advantage in restricting government savings to those shown in the budget because it will reveal how much the government can save in its current budget due to the implementation of the project. Also, it has been stressed by Ursula Hicks that by revealing the contribution of the government to national savings (or dissavings), the domestic budget deficit (or surplus) is one of the key variables with great economic significance.[7]

From the matrix, the following accounting equations could be easily identified.

Gross national income (Y) (or gross national product at factor cost) is defined as total income generated from the production sector of the economy. It should be noted that productive activities of foreign firms are recorded in the production sector according to the criterion of sector division.

A portion of (Y) is saved (S_h) or serves as tax payments to the government (R_g); the remaining is consumed (C_H):

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[7]Ursula Hicks, Development Finance: Planning and

$$Y = S_h + R_g + C_H \qquad (3.20)$$

As mentioned earlier, household savings (S_h) include retained profits for public and private companies, and pensions and insurance fund accumulations with the government.

Total consumption goods (C_H) consist of commodities produced domestically (C_h^d) and imported goods and services (M_c):

$$C_H = C_h^d + M_c \qquad (3.21)$$

The current budget revenue (R) is either consumed on goods and services (C_g), or saved (S_g):

$$R_g = C_g + S_g \qquad (3.22)$$

Total investment expenditures (I) are either spent on goods and services produced domestically (I_d), or spent on capital imports (M_k):

$$I = I_d + M_k \qquad (3.23)$$

These total investment expenditures (I) must equal the sum of household savings (S_h), government saving (S_g), and net foreign loans and aids (A_F). This condition is represented by the following accounting equation:

$$I = S_h + S_g + A_F \qquad (3.24)$$

Control (New York: Oxford University Press, 1965), Chapter 8.

Finally, the foreign sector also requires equality between inflows and outflows of foreign exchanges. Since the outflows of foreign exchanges consist of all imports while the inflows are the sum of exports and foreign aids and loans, the following equation must be satisfied:

$$M_i + M_k + M_c = X + A_F \qquad (3.25)$$

where:

M_i = Imports of agricultural intermediary inputs

M_c = Imports of consumption commodities

M_k = Imports of investment goods

X = Total exports

A_F = Net foreign aid and loans

b. Behavioral Equations

The preceding equations, though necessary to provide the model with its internal consistency, are not sufficient to make the model determinate. To determine the values of the variables involved, additional independent conditions need to be stipulated, which could either be exogenous variables that are determined outside the multiplier model or behavioral equations that may reflect behavioral and/or technical relationships between different economic transactions.

It should be mentioned that the system will be determined whether one depends heavily on exogenous variables or on behavioral equations. A system relying more heavily on behavioral equations is, however, a better one since it permits greater play for the contribution of economic theory. Nevertheless, the use of more or less behavioral equations may not simply be a matter of choice but of necessity since the quantification of some behavioral equations prove to be unfeasible, given the availability of relevant data and the state of economic knowledge.

(1.) Domestic Current Revenue (R_g)

The revenues of the government of Vietnam include both budgetary and extrabudgetary receipts. Budgetary receipts may be grouped into five main categories: (1) foreign aid, (2) advances from the National Bank, (3) custom duties, (4) domestic taxes, and (5) receipts from government agencies. The last three items -- customs duties, domestic taxes and receipts from government agencies -- constitute in the model the domestic current budget revenue of the government (R_g).

Foreign aid and advances from the National Bank are not included in the definition of (R_g) because they have been taken into account in the foreign and financial sectors. Moreover, it should also be noted that foreign aid and loans not only provide direct support of the budget through the generation of counterpart funds, but also give rise to a large portion of taxes on imports. Therefore, these import duties should be regarded as indirect aid, different from taxes on domestically financed imports.

However, since these two types of import duties are inextricably related, no attempt will be made to separate the former from (R_g) and the result will be a slight over-estimation of the performance of the government.

A relationship between current government revenue and the level of gross national product could be assumed as follows:

$$R_g = x_o + x_1 Y \qquad (3.26)$$

where x_1 may be considered the government aggregate tax rate.

(2.) Household Consumption

The Keynesian consumption concept is the basis for the specification of this equation. Therefore, private consumption (C_H) is hypothesized to be a function of disposable income ($Y-R_g$). Consequently:

$$C_H = c_o + c_1(Y-R_g) \qquad (3.27)$$

where C_H = Total household consumption

Y = Gross national income

R_g = Current budget revenue of government

c_1 = Marginal propensity to consume

c_o = Constant term (intercept)

(3.) Imports of Consumption Goods (M_c)

Since these imports increase the aggregate supply of goods and services available and help the economy to meet increases in aggregate demand, it is natural to assume that there exists a relationship between total consumption (both public and private) and the amount of consumption goods imported:

$$M_c = m_{co} + m_{c1} C_H \qquad (3.28)$$

M_c = Imports of consumption goods

(4.) Imports of Intermediate and Primary Inputs (M_i)

Imports of intermediate and primary inputs such as raw cotton, paper pulp, fertilizer, coal, and crude oil are closely related to the level of activity of the economy, and consequently could be assumed to be a function of the gross national income. The functional relationship between the two can be derived from the input-output table[8] and has the following form:

$$M_i = m_i Y \qquad (3.29)$$

where M_i = Imports of intermediate and primary inputs

Y = Gross national income

(5.) Imports of Capital Goods (M_K)

South Vietnam is still far from producing at home all the capital goods required for its economic development, especially manufactured equipment and machinery. A large portion of investment goods must be imported from abroad and, consequently, it is realistic to assume that imports of capital goods (M_K) are a function of total investment (I). Thus,

$$M_K = m_{ko} + m_{k1} I \qquad (3.30)$$

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[8] Due to the lack of time-series data on M_i, regression methods will not be used here.

Where M_K = Imports of capital goods

I = Private investments

(6.) The Investment Function

Private investment (I) is defined in this model as the amount of capital goods (equipment, construction and inventories) purchased by the private sector. The motives for investment are multiple,[9] as are the theories on investment behavior.[10]

In this study, it is assumed that the determinant factor influencing investment decisions is the entrepreneur's expectations of profits[11] since a rise in profits indicates improvement in business conditions. This calls for expansion

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[9]The pressures of demand on capacity, expectations, technological change and innovation, population growth, the desire to keep or increase one's share of the market, and the cost and availability of external funds are examples of motives for investment.

[10]See M.K. Evans, Macroeconomic Activity: Theory, Forecasting and Control (New York: Harper & Row, 1969); Robert Eisner, "Investment Fact and Fancy," American Economic Review (May, 1963), pp. 237-246; D.W. Jorgenson, "Capital Theory and Investment Behavior," American Economic Review (May, 1963), pp. 247-273; Trygve Haavelmo, A Study in the Theory of Investment (Chicago: University of Chicago Press, 1960); J.R. Hicks, Capital and Growth (New York: Oxford University Press, 1965); Paul Samuelson, "Interactions Between the Multiplier Analysis and the Principle of Acceleration," Review of Economics and Statistics, Vol. 21 (May, 1939); David Smith, "Empirical Evidence on the Acceleration Principle, Review of Economic Studies (June, 1964).

[11]J.S. Duesenberry, Business Cycles and Economic Growth, (New York: McGraw-Hill Book Co., 1958) Chapters 4 & 5. Also see Michal Kalecki, Theory of Economic Dynamics (London: George Allen & Unwin, Ltd., 1954) Chapters 6-12.

of capacity and enhances the state of business confidence. Because profits and the level of income are highly correlated, the investment demand equation could be formulated:

$$I = i_o + i_1 Y \qquad (3.31)$$

Where I = Private investment

Y = Gross national income

For the sake of simplicity, it is assumed there is no lag involved in the investment decisions.

C. Exogenous Variables

In addition to the accounting and behavioral equations mentioned previously, the model also contains exogenous variables which influence the system without being influenced by it.[12] These variables are mainly concerned with exports and government expenditures.

Since the country's exports (X) depend on a number of variables such as relative price, quality of the product, commercial policy, and future markets, and because all of these are extremely difficult to predict, this variable is therefore assumed to be exogenous:

$$X = \bar{X} \qquad (3.32)$$

Most of the government's decisions on expenditures are politically motivated, and therefore economically unpredictable. As a result, variables concerning the government

[12] Jan Tinbergen, On the Theory of Economic Policy (Amsterdam: North Holland Publishing Co., 1955), pp. 6-8.

sector are usually considered to be exogenous to the system. Thus:

$$C_g = \bar{C}_g \qquad (3.33)$$

The Keynesian submodel which has been developed defines the structure of the Vietnamese economy in terms of 12 variables within a system of 12 endogenous equations. This submodel is therefore determinate.

d. <u>The constraint</u>

This model allows us to derive the overall income multiplier and to estimate the total income effects of the project. However, as already mentioned, in order to avoid overestimating the impacts of the Mekong projects, a ceiling on the expansionary effects of the Keynesian multiplier will be set, represented by the "potential capacity limit" dY*. This limit, defined as the full employment productive capacity of the economy, is equal to the difference between the income which could be generated if all resources are fully employed, and the actual income. (This concept is similar to the full employment budget surplus concept in public finance.) Any multiplier effect in excess of this upper limit dY* will be either absorbed by price inflation or "exported" abroad via the increase in imports, without any real effect on the aggregate supply side of the economy.

Since cultivable lands are available and imports of capital goods could be financed by foreign aids and loans, we shall assume in the case of South Vietnam, for the sake of simplicity, that the potential capacity limit dY^* is mainly determined by the supply of labor available. The limit dY^* will now be derived.

The total demand for labor depends on the output of the economy and on the rate of increase in average labor productivity. Obviously, an increase in average labor productivity will have a negative impact on the demand for labor (i.e., the faster the rate of increase of labor productivity, the less employment needed). Consequently, the demand for labor could be represented:

$$L_t^d = \frac{Y_t}{P_t} = \frac{Y_t}{P_o(1 + p)^t} \qquad (3.34)$$

Where L_t^d = Total demand for labor at any time (t)

P_o, P_t = Average labor productivity at time (o) and (t) respectively.

P = Annual increase in the average labor productivity

t = Time period

The total supply of labor is assumed to be equal to:

$$L_t^s = L_o (1 + s)^t \qquad (3.35)$$

Where L_s = Supply of the labor force

L_o = Labor force of the base year

s = Rate of growth of the labor force

t = Time period

The full employment condition in the labor market requires that the supply of the labor force be totally absorbed:

$$L_t^d = L_t^s \quad \text{or}$$

$$\frac{Y_t}{P_o(1 + p)^t} = L_o (1 + s)^t \qquad (3.36)$$

At any period (t), the income level ($\overline{Y}_t$) which could be generated at full employment is therefore:

$$\overline{Y}_t = L_o (1 + s)^t P_o (1 + p)^t \qquad (3.37)$$

On the other hand, since the actual income level at any period (t) is represented by:

$$Y_t = Y_o (1 + g)^t \qquad (3.38)$$

Where Y_o is the income level at the base year and (g) refers to the average rate of growth of income (in the absence of any development project).

Then, the potential capacity limit of the economy in any period (t) is obtained by substracting (Y_t) from $\overline{Y}_t$:

$$\overline{Y}_t - Y_t = L_o (1 + s)^t P_o (1 + p)^t - Y_o (1 + g)^t \qquad (3.39)$$

It should be noted that if $\overline{Y}_t - Y_t = 0$ (i.e., the economy is at full employment), then $dY^* = 0$ and the entire multiplier effect will be either absorbed by inflation or exported abroad via the increase in imports.

In short, the constraint to the model could be stated in the following form:

$$d\,Y \leq dY^*$$

Where $dY^* = L_o\,(1 + s)^t\,P_o\,(1 + p)^t - Y_o\,(1 + g)^t$ (3.40)

D. <u>The Working of the Model</u>

Before going further, it is important to note that since we are dealing with public projects, the investment expenditures are assumed to originate from the government sector. Consequently, the model will have an additional identity:

$$dC_g = dV_a + dV_m + dV_s$$

Where dC_g represents the increase in government expenditures and $dV_a + dV_m + dV_s$ represents the bill of final goods generated by the public project. As a result, the model used in this study could be represented by the following system of equations:

1. <u>Equations of the simultaneous system</u>

1. $Y = S_h + R_g + C_H$
2. $C_H = C_h^d + M_c$
3. $R_g = C_g + S_g$
4. $I = I_d + M_K$
5. $I = S_h + S_g + A_F$
6. $M_i + M_K + M_c = X + A_F$
7. $R_g = x_o + x_1 Y$

8. $C_H = c_o + c_1 (Y - R_g)$

9. $M_c = m_{co} + m_{c1} (C_H)$

10. $M_i = m_i \; Y$

11. $M_K = m_{ko} + m_{k1} \; I$

12. $I = i_o + i_1 Y$

2. <u>Equations outside the simultaneous system</u>

13. $0_a = e_{aa} V_a + e_{am} V_m + e_{as} V_s$

14. $0_m = e_{ma} V_a + e_{mm} V_m + e_{ms} V_s$

15. $0_s = e_{sa} V_a + e_{sm} V_m + e_{ss} V_s$

16. $M_a = m_a 0_a$

17. $M_m = m_m 0_m$

18. $M_s = m_s 0_s$

19. $dC_g = dV_a + dV_m + dV_s$

3. <u>Exogenous variables</u>

20. $X = \bar{X}$

21. $C_g = \bar{C}_g$

22. $V_a = \bar{V}_a$

23. $V_m = \bar{V}_m$

24. $V_s = \bar{V}_s$

4. <u>Model constraint</u>

25. $dY \leq dY^*$

26. $dY^* = L_o (1 + s)^t P_o (1 + p)^t - Y_o (1 + g)^t$

The economic impacts of the public project could be evaluated from the model by solving for the endogenous variables in terms of the parameters and exogenous variables which are affected by the project.

One way of doing this is to put the system of simultaneous equations in matrix form:

$$Z \times E = V \qquad (3.42)$$

Where Z is the vector of the coefficients.
There are 12 endogenous variables, so the size of the Z is 12 x 12.

E = Vector of the endogenous variables with the size 12 x 1

V = Vector of exogenous variables, sixe 12 x 1

The solution for E is obtained by multiplying both sides of equation (3.42) by the Z^{-1}. Thus:

$$E = Z^{-1} V \qquad (3.43)$$

Once the numerical values of the parameters are known, equation (3.43) could be easily solved. However, to have a better insight into the working of the model, the Keynesian multiplier shall be derived using the conventional procedure of substitution.

From the equations of the previously stated simultaneous system, Y is expressed:

$$Y = S_h + R_g + C_H$$

Substituting for S_h and C_H from equation (6) and (9) respectively:

$$Y = I - S_g - A_F + R_g + c_o + c_1 (Y - R_g) \quad (3.44)$$

But from equation (6)

$$A_F = M_i + M_K + M_c - \bar{X}$$

and from equation (3)

$$S_g = R_g - \bar{C}_g$$

and from equation (12)

$$I = i_o + i_1 Y$$

Substituting these values for A_F, S_g and I into equation (3.44) it becomes:

$$Y = i_o + i_1 Y + I_g + \bar{C}_g + c_o + c_1 Y - c_1 R_g - M_i - M_K - M_c + \bar{X} \quad (3.45)$$

By repeating this procedure of substitution, an equation in which Y is a function solely of the exogenous variables and parameters can be achieved:

$$Y = P\left[i_o (1 - m_{k1}) + c_o (1 - m_{c1}) - c_1 x_o (1 - m_{c1}) - m_{ko} - m_{co} + \bar{C}_g + \bar{X}\right] \quad (3.46)$$

Where P refers to the Keynesian multiplier of the model and has the value:

$$P = \frac{1}{1-c_1-i_1+c_1x_1+m_i+m_{k1}i_1+m_{c1}c_1-m_{c1}c_1x_1} \quad (3.47)$$

By taking the total differential of Y with respect to those exogenous variables affected by the project, it is possible to estimate the project impact on national income. The same procedure could be repeated for the other endogenous variables of the model, such as foreign aids and loans, investment, imports, and consumption. By the same token, the import and output requirements necessary for the project's implementation also could be estimated (i.e., by taking the total differential of 0_a, 0_m, 0_s, M_a, M_m and M_s with respect to V_a, V_m, and V_s). It should be noted that because the developmen- projects are public projects, the investment expenditures are assumed to originate from the government sector.

CHAPTER IV

ESTIMATION OF THE COEFFICIENTS OF THE EQUATIONS

A. The Input-Output Coefficients

1. The Flow Table

Appendix 1 gives a detailed explanation on the construction of the flow table for the South Vietnamese economy. The results of the computations are listed in Table 4.

TABLE 4

CONSOLIDATED FLOW TABLE FOR 1970
(In billions of Vietnamese piasters, 1970 constant prices)

Input \ Output	Agriculture	Manufactures	Services	Final Demand	Total Output
Agriculture	47.321	30.743	.222	351.721	430.007
Manufactures	10.321	16.670	14.190	147.020	188.201
Services	22.211	10.578	77.508	250.867	361.164
Primary Inputs	309.866	76.943	257.292	160.316	804.417
Imports	40.288	53.267	11.952	95.234	200.714
Total Input	430.007	188.201	361.164	1,005.154	1984.503

Source: See Appendix 1

Note: Because the imports of intermediary inputs are not netted out from the final demand sector, the total of this sector is in excess of the total of the primary input sector by the amount of these imports.

The flow table presents the dispersion of each sector's output among the purchasing and final demand sectors. Each row represents the value of goods or services sold by the producing sector to the purchasing sectors represented by the columns. Reading across the first row of Table 4, for example, the agricultural sector sold 47.3 billion piasters worth of goods to farmers within that sector, 30.7 billion piasters worth to the manufactures sector, 0.2 billion piaster worth to the services sector, and 351.7 billion piasters worth to the final demand sector.

The entries in each column of Table 4 represent the input structure of each producing or consuming sector. Using the second column as an illustration, the manufactures sector purchased 30.7 billion piasters worth of goods from the agricultural sector, 16.6 billion piasters worth from its own firms and 10.5 billion piasters worth from the services sectors. It also paid 76.9 billion piasters for taxes, profit, rent, wages and salaries, and imported about 53 billion piasters of intermediary inputs.

2. The Technical Coefficients

The technical coefficients in Table 5 show the direct purchases of each sector from every other sector, per unit of output. The technical coefficient shows only the first round effects of a change in output of one sector on the sectors from which it purchases goods and services. It should be noted that because flexibility of consumer behavior

TABLE 5

TECHNICAL COEFFICIENTS OF THE SOUTH VIETNAMESE ECONOMY, 1970

	Agriculture	Manufactures	Services
Agriculture	.1100	.1634	.0006
Manufactures	.0240	.0888	.0393
Services	.0520	.0560	.2146
Primary Input	.7206	.4088	.7124
Imports	.0934	.2830	.0331
Total	1.0000	1.0000	1.0000

Source: Appendix 1.

is assumed[13], technical coefficients associated with the final demand sector are subject to continual change and will not be computed. Therefore, the technical coefficients are relevant only for the producing sectors.

By considering a particular column, for example column one, the technical coefficients can be interpreted. If the agricultural sector increases its output by 1 piaster, it will buy .11 piasters worth of goods in its own sector, .024 piasters worth from the manufactures sector, .052 piasters worth from the services sector, .72 piasters worth from the primary input sector, and .09 piasters worth from the imports sector.

3. <u>Direct-Indirect Requirement Coefficients or Interdependence Coefficients</u>

The interdependence coefficients can now be computed. First, from Table 5, the technical coefficient matrix A is derived:

$$A = \begin{bmatrix} .110 & .1634 & .0006 \\ .024 & .0888 & .0393 \\ .052 & .056 & .2146 \end{bmatrix}$$

Then the Leontief matrix (I - A) is computed.

$$(I - A) = \begin{bmatrix} .89 & -.1634 & -.0006 \\ -.0240 & .9112 & -.0393 \\ -.0517 & -.0562 & .7854 \end{bmatrix}$$

---

[13]Flexibility is used in the sense that the mix of household purchases does not remain the same as income varies.

The interdependence coefficients are obtained by inverting the Leontief matrix (I - A):

$$(I - A)^{-1} = \begin{bmatrix} 1.1297 & .2032 & .0110 \\ .0331 & 1.1066 & .0554 \\ .0767 & .0926 & 1.2779 \end{bmatrix}$$

The interdependence coefficients are represented in Table 6.

TABLE 6

INTERDEPENDENCE COEFFICIENTS

FOR THE SOUTH VIETNAMESE ECONOMY, 1970

	Agriculture	Manufactures	Services
Agriculture	1.1297	.2032	.0110
Manufactures	.0331	1.1066	.0554
Services	.0767	.0926	1.2779

The interdependence coefficients indicate the total change in output requirements as a result of a one piaster change in final demand in a sector. The total change includes the direct effect as well as all indirect effects resulting from the initial one piaster change.

For illustrative purposes, consider a one piaster change in demand for agricultural products. The first column of Table 5 shows that this would <u>directly</u> change intra-sectoral transaction by .11 piasters. However, as the agricultural sector changes its own output, the amount of purchases from other sectors also will change. As the amount of purchases from other sectors changes, each sector will change its own output to meet the new demand. These sectors, in turn, will change their purchases from every other sector, including the agricultural sector. This secondary change in the agricultural sector is referred to as the <u>indirect</u> effect. The interdependence coefficients in Table 6 indicate the combined direct and indirect effects.

Consequently, the total output requirements for producing V_a units of agricultural products, V_m units of industrial commodities and V_s units of services could be estimated by substituting the coefficients of equations (3.14), (3.15), and (3.16) with their numerical values given in Table 6. Thus, the output requirement equations of our model are obtained:

$$0_a = 1.1297\ V_a + .2032\ V_m + .0110\ V_s \qquad (4.1)$$

$$0_m = .0331\ V_a + 1.1066\ V_m + .0554\ V_s \qquad (4.2)$$

$$0_s = .0767\ V_a + .0926\ V_m + 1.2779\ V_s \qquad (4.3)$$

The import requirements for producing V_a, V_m, and V_s also could be derived, using the technical coefficients of Table 5:

$$M_a = .0934\ O_a = .1055\ V_a + .0189\ V_m + .0010\ V_s$$

$$M_m = .2830\ O_m = .0093\ V_a + .3131\ V_m + .0156\ V_s$$

$$M_s = .0331\ O_s = .0025\ V_a + .0030\ V_m + .0422\ V_s \qquad (4.4)$$

Where M_a, M_m and M_s are imports of intermediary inputs by the agriculture, manufactures, and services sectors.

B. Estimation of the National Income Equations

Before going into the details of the estimation of the parameters of the behavioral equations, it should be stressed again that, for reasons mentioned earlier, the ordinary least squares method will be used in this process instead of more sophisticated econometrics techniques. It is also noted that all the data used in the estimation of the parameters is in constant 1960 prices, and that the deflators used are the ones adopted by the National Bank of Vietnam and the National Institute of Statistics of Vietnam.

1. Estimation of the Current Budget Revenue Equation

Current budget revenue (R_g) includes tax payments plus any other net transfers from the private sector to the public sector. It is to be noted that foreign aids and loans, especially direct U.S. aid to the government, are not included in R_g since by the nature of the sector division adopted for this model, they are credited to the foreign sector.

Table 7 presents the data related to the current budget revenue R_g compared to gross national income for the

10-year period from 1960 to 1970. From this data, the ordinary least squares method gives the result:

$$R_g = -430.6 + \underset{(.0376)}{.127}\,Y \qquad R^2 = .5590 \qquad (4.5)$$

2. Estimation of the Consumption Function

Data on household consumption is provided by the National Institute of Statistics in Vietnam and is illustrated in Table 8 together with the data on disposable income $(Y-R_g)$. From this data, the consumption for the Vietnamese economy is satisfactorily obtained as:

$$C_H = 7{,}294 + \underset{(.0776)}{.802}\,(Y - R_g) \qquad R^2 = .9223 \qquad (4.6)$$

Where C_H = Total household consumption (including imported goods)

$Y - R_g$ = Disposable income

From equation (4.6) it can be seen that the marginal propensity to consume for the Vietnamese economy is not excessively high compared to other countries of the region.[14] Therefore, it seems clear that the heavy inflationary pressures on prices which have been plaguing the Vietnamese economy during recent years is not due to the high private consumption rate, but rather to the rapid increase in public defense expenditures.

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[14] The marginal propensity to consume estimated by Chenery and Watenable for Southeast Asia is around .77; See Hollis B. Chenery, Towards a Strategy for Development Co-operation with Special Reference to Asia. (Proceedings of a Conference on Asian Development held by the Netherlands Economic Institute, Rotterdam Universitaire Press, 1967).

TABLE 7

CURRENT BUDGET REVENUE AND GROSS NATIONAL INCOME
AT CONSTANT 1960 MARKET PRICE
FROM 1960 TO 1970
(in millions of Vietnamese piasters)

	Current Budget Revenue (R_g)	Gross National Income (Y)
1960	10,417	81,928
1961	11,175	81,684
1962	10,740	89,326
1963	10,645	89,990
1964	11,256	99,064
1965	12,146	107,966
1966	12,784	108,487
1967	14,374	110,673
1968	13,517	105,804
1969	11,119	110,183
1970	17,502	117,539

Sources: United States Agency for International Development -- Office of Joint Economic Affairs, <u>Vietnam Economic Bulletin</u>, 1968.

National Institute of Statistics of Vietnam, <u>Vietnam Statistical Yearbook 1970</u>.

National Bank of Vietnam, <u>National Revenue of Vietnam</u>, 1971.

3. Estimation of the Consumption Import Function

The consumption import function illustrates the relationship between imports of commodities for consumption and total domestic consumption. Data on these variables is given by Table 9, and the estimated econometric equation has the form:

$$M_c = -11{,}771 + .295\,(C_H) \qquad R^2 = .9175$$
$$\qquad\qquad\qquad(.0294) \qquad\qquad\qquad (4.7)$$

Where M_c = Imports of consumption goods

C_H = Total household consumption

It can be seen from equation (4.7) that the marginal share of imported goods in household consumption is quite high (.295), especially for a country such as South Vietnam where exports are only a small percentage of the national income (roughly 2 percent). It is high because of the way in which the U.S. government channels its economic aids to South Vietnam. Through its aid mission, the U.S. government provides the government of South Vietnam with a supply of dollars which can be sold to Vietnamese importers in exchange for piasters. The dollars thus acquired are spent in foreign markets for goods imported into Vietnam. The piasters paid by importers for the aid dollars are placed in a deposit account to the credit of the Vietnamese government and are called counterpart funds.

With the war and the resulting increase in defense expenditures, the government has found itself relying more

TABLE 8

TOTAL HOUSEHOLD CONSUMPTION, DISPOSABLE INCOME AND IMPORTS OF CONSUMPTION GOODS FROM 1960 TO 1970 AT CONSTANT 1960 MARKET PRICE
(in millions of Vietnamese piasters)

	Total Household Consumption (C_H)	Disposable Income ($Y - R_g$)	Imports of consumption goods (M_c)
1960	63,721	71,511	7,261.3
1961	63,048	70,169.2	6,963.8
1962	68,349	77,923.6	9,185
1963	72,389	79,450	9,321.1
1964	76,431	81,181.9	10,026.2
1965	84,272	95,999.2	11,717.6
1966	77,900	95,686.3	10,900
1967	86,979	96,381.1	13,602.7
1968	80,718	92,287	11,781
1969	88,876	99,064	16,325.9
1970	88,186	100,093.4	14,406

Source: National Bank of Vietnam
National Institute of Statistics of Vietnam

and more on these foreign aids to cover its budget deficit, calling for increases in imports in order to generate more counterpart funds and import tax revenues.

Faced by the competition of cheap, imported commodities and the economic uncertainty created by political instability, the private sector has become more and more reluctant to venture long run investments and, in particular, to import capital goods. The result is a slowing of the growth rate of domestic industries and an increasing dependence of the economy on imported goods to satisfy its consumption needs. This behavior of the economy is reflected in the high marginal propensity to import. Unless the government finds some measure to correct this trend, a large portion of foreign aid not only will be wasted in unproductive consumption activities, but it also will represent a serious retarding factor to the growth of local industries.

4. Estimation of the Import Function for Intermediate and Primary Inputs

Imports include intermediate and primary inputs used in the production sector, such as petroleum, cement, plaster, iron, coal, fertilizers, insecticides, and raw cotton.

The import function for primary and intermediate inputs can be derived directly from the input output technical coefficients of Table 5:

From the technical coefficient table one can write:

$$M_a = .0934\ O_a = \frac{.0934}{.7206}\ Y_a = .130\ Y_a$$

$$M_m = .2830\ O_m = \frac{.2830}{.4088}\ Y_m = .690\ Y_m$$

$$M_s = .0331\ O_s = \frac{.0331}{.7124}\ Y_s = .046\ Y_s \qquad (4.8)$$

Where M_a, M_m, M_s = Imports of primary and intermediate inputs by the agricultural, manufactures and services sectors respectively.

O_a, O_m, O_s = Gross outputs of the agricultural, manufactures and services sectors.

Y_a, Y_m, Y_s = Income generated from the three sectors.

From the flow table (Table 4) the income share of each sector can be estimated:

$$Y_a = .3898\ Y$$

$$Y_m = .0957\ Y$$

$$Y_s = .3198\ Y \qquad (4.9)$$

Since the total import of primary and intermediate inputs (M_i) by the whole production sector is defined as:

$$M_i = M_a + M_m + M_s \qquad (4.10)$$

the import function of primary and intermediate inputs can be obtained by substitution for M_a, M_m, and M_s their respective values in terms of Y:

$$M_i = (.130)\ (.3898)\ Y + (.690)\ (.0957)\ Y + (.3198)\ (.046)\ Y$$

$$M_i = .1314\ Y \qquad (4.11)$$

5. Estimation of the Investment Function

As previously mentioned, decisions on public investment usually are politically motivated and are therefore excluded from the induced investment function which attempts to illustrate only the behavior of the private sector. Table 9 shows the variations in the private investment level from 1960 to 1970 compared to gross national income.

From this data, the investment function is estimated:

$$I = -25438 + \underset{(.0665)}{.378}\, Y \qquad R^2 = .7825 \tag{4.12}$$

Where I = Private investment

Y = Gross national income

6. Estimation of the Capital Import Function

Table 9 provides data on the imports of capital goods which are composed mainly of heavy equipments such as electrical and textile machinery, engines, aircrafts, tractors, and trucks. Also illustrated in Table 9 is the data on total investment.

From these data, the ordinary least squares method gives the following equation:

$$M_K = -2{,}127 + \underset{(.0543)}{.481}\, (I) \qquad R^2 = .8949 \tag{4.13}$$

Where M_K = Imports of capital goods

I = Private investment

TABLE 9

IMPORTS OF CAPITAL GOODS AND TOTAL GROSS CAPITAL FORMATION FROM 1960 TO 1970 AT CONSTANT 1960 MARKET PRICE (in millions of Vietnamese piasters)

	Imports of Capital Goods (M_K)	Total Gross Capital Formation (I)
1960	1,711.1	9,057
1961	1,558.1	5,946.5
1962	1,810.2	7,417
1963	1,528.9	5,844
1964	1,735.8	10,242
1965	1,809.9	11,970
1966	6,009.4	17,481
1967	8,175.5	19,329
1968	4,298.9	12,529
1969	7,740.4	19,460
1970	6,674.4	18,659

Sources: National Institute of Statistics, Vietnam Statistical Yearbook, 1968, 1969, 1970, 1971.

United States Agency for International Development -- Office of Joint Economic Affairs, Vietnam Annual Statistical Bulletin, No. 12, December, 1969.

7. Estimation of the Constraint dY*

To evaluate the constraint dY*, four parameters need to be estimated: (1) the average productivity of labor (P), (2) the annual growth rate of the labor productivity (p), (3) the growth rate of the labor force (s) and, (4) the rate of growth of gross national income (g).

In 1960 and 1966, the Ministry of Labor conducted two surveys of employment in industrial and commercial establishments, and in 1960 a census was also undertaken of the agricultural population in 27 provinces. The results of these surveys are summarized in Table 10.

These results show that the employment rate of the population was about 37 percent. Since the unemployment rates in 1960 and 1966 were around 4 percent and 1 percent respectively,[15] the labor force actually employed was 4,998,700 people in 1960 and 6,643,949 in 1966.

The average productivity of labor in 1960 (P_{60}) and 1966 (P_{66}) is obtained by dividing gross national product by the corresponding working labor force:

$$P_{60} = \frac{81,928,000,000}{4,998,700} = 16,389 \text{ piasters/man labor}$$

and $$P_{66} = \frac{108,478,000,000}{6,043,949} = 17,949 \text{ piasters/man labor}$$

Assuming the productivity of labor to grow linearly over time, then its annual growth rate (p) could be derived

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[15] Development and Resources Corporation, Labor Employment and Skill, (New York: 1969), p. 23.

TABLE 10

DISTRIBUTION OF LABOR AND GROSS PRODUCT
BY SECTOR IN 1960 AND 1966

	1960	1966
	People	
Total Population	14,072,000	16,500,000
Total Labor Force	5,207,000	6,105,000
Agriculture sector	4,234,000	4,245,000
Manufactures sector	178,000	305,000
Services sector	486,000	466,000
Government sector (public administration and armed forces)	309,000	1,010,000
U.S. Sector (excluding construction)		80,000
	Million Piasters (At constant 1960 market prices)	
Gross National Product	81,928	108,487
Production sector (agriculture, manufactures and services)	70,347	78,839.7
Government sector	11,581	21,570.3
U.S. sector		8,077

Source: Joint Development Group, The Post War Development of the Republic of Vietnam: Policies and Programs, Vol. 1, (Saigon: 1969), p. 127.

Vietnam Statistical Yearbook 1970, National Institute of Statistics.

from the equation:

$$P_{66} = (1 + p)^t P_{60} \qquad (4.14)$$

Where P_{60} and P_{66} refer to the average productivity in 1960 and 1966, respectively, and (t) is the time interval between these two years (i.e., six). Solving equation (4.14) for (p):

$$P = \sqrt[6]{\frac{P_{66}}{P_{60}}} - 1 = .0152$$

Similarly, the growth rate (g) of gross national income and the growth rate (s) of the total labor force could be estimated from the following equations:

$$Y_t = Y_o (1 + g)^t \qquad (4.15)$$

$$L_t = L_o (1 + s)^t \qquad (4.16)$$

Where Y_o and Y_t refer to the level of gross national income; and L_o and L_t refer to the level of the total labor force at times (o) and (t), respectively.

From the data in Tables 7 and 10:

$$g = \sqrt[10]{\frac{Y_{70}}{Y_{60}}} - 1 = .036$$

and $$s = \sqrt[6]{\frac{L_{66}}{L_{60}}} - 1 = .0268$$

The upper limit to the expansionary effect of the income multiplier (i.e., dY*) could be estimated by replacing the parameters by their numerical values in the constraint equation, thus:

$$dY^* = P_o (1 + p)^t L_o (1 + s)^t - Y_o (i + g)^t$$

Where

p = .0152 (annual growth rate of labor productivity)

s = .0268 (annual growth rate of the total labor force)

g = .036 (annual growth rate of gross national income)

L_o = 9,570,800 (total labor force of the base year)[16]

P_o = 20,308 (labor productivity at the base year)

Y_o = 186,148 (gross national income at the base year)

So, dY^* = 241.300 billion piasters (4.17)

C. Solution of the Model

By substituting the parameters of the behavioral equations with their numerical values and by putting the exogenous variables into appropriate places, the 26 equations of

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[16]The Mekong projects are expected to be ready to operate in 1983; consequently, 1983 is selected to be the base year of our model and therefore:

$$L_o = L_{66} (1 + s)^t$$
$$= 6,105,000 (1.0268)^{17} = 9,570,800 \text{ people}$$
$$P_o = P_{66} (1 + p)^t$$
$$= 17,949 (1.0152)^{17} = 20,308 \text{ piasters/man labor}$$
$$Y_o = Y_{70} (1 + g)^{13}$$
$$= 117,539 (1.036)^{13} = 186,148 \text{ million of piasters at 1960 market prices}$$

the model can be reduced to 21 equations:

1. Equations of the simultaneous system

1. $Y = S_h + R_g + C_H$
2. $C_H = C_H^d + M_c$
3. $R_g = \bar{C}_g + S_g$
4. $I = I_d + M_K$
5. $I = S_h + S_g + A_F$
6. $M_i + M_K + M_c = \bar{X} + A_F$
7. $R_g = -430.6 + .127\ Y$
8. $C_H = 7{,}294 + .802\ (Y - R_g)$
9. $M_c = -11{,}771 + .295\ C_H$
10. $M_i = .1314\ Y$
11. $M_K = -2{,}127.2 + .481\ I$
12. $I = -25348 + .378\ Y$

2. Equations Outside the Simultaneous System

13. $O_a = 1.1297\ \bar{V}_a + .2032\ \bar{V}_m + .0110\ \bar{V}_s$
14. $O_m = .0331\ \bar{V}_a + 1.1066\ \bar{V}_m + .0554\ \bar{V}_s$
15. $O_s = .0767\ \bar{V}_a + .0926\ \bar{V}_m + 1.2779\ \bar{V}_s$
16. $M_a = .1055\ \bar{V}_a + .0189\ \bar{V}_m + .0010\ \bar{V}_s$
17. $M_m = .0093\ \bar{V}_a + .3131\ \bar{V}_m + .0156\ \bar{V}_s$
18. $M_s = .0025\ \bar{V}_a + .0030\ \bar{V}_m + .0422\ \bar{V}_s$

19. $d\bar{C}_g = d\bar{V}_a + d\bar{V}_m + d\bar{V}_s$

20. $dY \leq dY^*$

21. $dY^* = 241.300$

There are 12 endogenous variables and 12 equations in the system of simultaneous equations. Therefore, the system of simultaneous equations can be written in matrix form:

$$Z \times E = V$$

Where Z is the square (12 x 12) matrix of coefficients of endogenous variables, E is the column vector of endogenous variables, and V is the column vector of exogenous variables and constant terms.

Each endogenous variable can be solved in terms of exogenous variables and constant terms in matrix form:

$$E = Z^{-1} V$$

The simultaneous system in matrix form is illustrated in Table 11.

It is now obvious that the most important tool for solving the system is the inverse matrix Z^{-1}. Each element in a particular row of the inverse matrix is a multiplier for the endogenous variable of that row on the corresponding element in the vector V, and a given endogenous variable is equal to the sum of the products between (1) those elements of the matrix Z^{-1} in the same row as the endogenous variable and (2) the corresponding element in the column vector V.

If an exogenous variable appears in many elements of vector V, the marginal change of an endogenous variable due

TABLE 11

THE SYSTEM $E = Z^{-1} V$

$$
\begin{bmatrix} Y \\ S_h \\ S_g \\ R_g \\ C_H \\ C_h^d \\ M_c \\ M_K \\ M_i \\ I \\ I_d \\ A_F \end{bmatrix}
=
\begin{bmatrix}
2.456 & 0.0 & 2.456 & 0.0 & -2.456 & 2.456 & -1.485 & 1.768 & -2.456 & -2.456 & -2.456 & 1.274 \\
-.657 & 0.0 & .343 & 0.0 & -.343 & .343 & -.367 & -.753 & -.343 & -.343 & -.343 & .178 \\
.312 & 0.0 & -.688 & 0.0 & -.312 & .312 & .811 & .224 & -.312 & -.312 & -.312 & .162 \\
.312 & 0.0 & .312 & 0.0 & -.312 & .312 & .811 & .224 & -.312 & -.312 & -.312 & .162 \\
1.801 & 0.0 & 1.801 & 0.0 & -1.801 & 1.801 & -1.929 & 2.296 & -1.801 & -1.801 & -1.801 & .935 \\
1.296 & -1.0 & 1.296 & 0.0 & -1.296 & 1.296 & -1.389 & 1.653 & -2.296 & -1.296 & -1.296 & .673 \\
.504 & 0.0 & .504 & 0.0 & -.504 & .504 & -.540 & .643 & .496 & -.504 & -.504 & .262 \\
.446 & 0.0 & .446 & 0.0 & -.446 & .446 & -.270 & .321 & -.446 & -.446 & .553 & .713 \\
.323 & 0.0 & .323 & 0.0 & -.323 & .323 & -.195 & .232 & -.323 & .677 & -.323 & .167 \\
.928 & 0.0 & .928 & 0.0 & -.928 & .928 & -.561 & .668 & -.928 & -.928 & -.928 & 1.482 \\
.482 & 0.0 & .482 & -1.0 & -.482 & .482 & -.291 & .347 & -.482 & -.482 & -1.482 & .769 \\
1.273 & 0.0 & 1.273 & 0.0 & -1.273 & .473 & -1.005 & 1.197 & -.273 & -.273 & -.273 & 1.142
\end{bmatrix}
\begin{bmatrix} 0 \\ 0 \\ \bar{C}_g \\ 0 \\ 0 \\ \bar{X} \\ -430.6 \\ 7,294 \\ -11,771 \\ 0 \\ 2,127.2 \\ -25,438 \end{bmatrix}
$$

to a unit increase in that exogenous variable will be equal to the sum of the appropriate multipliers of the inverse matrix.[17]

For the purpose of project evaluation, take the total differential of each of the equations of the model; dc_o, di_o, dx_o, dm_{co} and dm_{ko} are shift parameters used to illustrate the effects on the endogenous variables of exogenous changes in consumption, investment, tax schedule and imports.

$$dY = 2.456\ (d\bar{C}_g + d\bar{X} - dm_{co} - dm_{ko}) - 1.485\ dx_o + 1.768\ dc_o + 1.274\ di_o \qquad (4.18)$$

$$dS_h = .343\ (d\bar{C}_g + d\bar{X} - dm_{co} - dm_{ko}) - .367\ dx_o - .753\ dc_o + .178\ di_o \qquad (4.19)$$

$$dR_g = .312\ d\bar{C}_g + .312\ (d\bar{X} - dm_{co} - dm_{ko}) + .811\ dx_o + .224\ dC_o + .162\ di_o \qquad (4.20)$$

$$dC_H = 1.801\ (d\bar{C}_g + d\bar{X} - dm_{co} - dm_{ko}) - 1.929\ dx_o + 2.296\ dc_o + .935\ di_o \qquad (4.21)$$

$$dM_c = .504\ (d\bar{C}_g + d\bar{X} - dm_{ko}) + .496\ dm_{co} - .540\ dx_o + .643\ dc_o + .262\ di_o \qquad (4.22)$$

$$dM_K = .446\ (d\bar{C}_g + d\bar{X} - dm_{co}) + .553\ dm_{ko} - .270\ dx_o + .321\ dc_o + .713\ di_o \qquad (4.23)$$

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[17] For a comprehensive explanation, see Daniel B. Suits, "Forecasting and Analysis with an Econometric Model," American Economic Review, Vol. 52, No. 1 (March, 1962), pp. 104-132.

$$dM_i = .323\,(d\bar{C}_g + d\bar{X} - dm_{co} - dm_{ko}) - .195\,dx_o + .232\,dc_o + .167\,di_o \qquad (4.24)$$

$$dI = .928\,(d\bar{C}_g + d\bar{X} - dm_{co} - dm_{ko}) - .561\,dx_o + .668\,dc_o + 1.482\,di_o \qquad (4.25)$$

$$d0_a = 1.1297\,d\bar{V}_a + .2032\,d\bar{V}_m + .011\,d\bar{V}_s \qquad (4.26)$$

$$d0_m = .0331\,d\bar{V}_a + 1.1006\,d\bar{V}_m + .0554\,d\bar{V}_s \qquad (4.27)$$

$$d0_s = .0767\,d\bar{V}_a + .0926\,d\bar{V}_m + 1.2779\,d\bar{V}_s \qquad (4.28)$$

$$dM_a = .1055\,d\bar{V}_a + .0189\,d\bar{V}_m + .0010\,d\bar{V}_s \qquad (4.29)$$

$$dM_m = .0093\,d\bar{V}_a + .3131\,d\bar{V}_m + .0156\,d\bar{V}_s \qquad (4.30)$$

$$dM_s = .0025\,d\bar{V}_a + .0030\,d\bar{V}_m + .0422\,d\bar{V}_s \qquad (4.31)$$

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CHAPTER V

APPLICATION OF THE MODEL FOR EVALUATING THE IRRIGATION IMPACTS OF THE PA MONG PROJECT ON THE ECONOMY OF SOUTH VIETNAM

In Chapters III and IV, a model has been constructed which could be used as a framework for project impact evaluation. The stage is now ready for a more detailed examination of the Pa Mong project and its impacts on the Vietnamese economy.

It should be noted that the quantification of all possible impacts of the project is extremely difficult, if not impossible, due to the scarcity of available data. Consequently, in this chapter only the irrigation impact[1] of the Pa Mong project on sectors of the economy where major changes are envisioned and can be quantitatively estimated will be attempted to be measured.

The first part of this chapter deals with the primary impacts of the Pa Mong project, i.e., the estimation of the project implementation costs. The second part will discuss

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[1]The other possible impacts of the project are discussed separately in Appendix 3.

how the project's initial impacts affect the various aggregates of the economy.

A. Implementation Costs of the Pa Mong Project

Though rainfall in the Mekong Delta is quite heavy during the wet season, there is not much rain during the rest of the year. Rice cultivation, which accounts for more than 90 percent of the productive activities of the delta, is limited to a single crop per year planted at the onset of the monsoon in May or June. As a result, most of the agricultural labor force is idle during the dry season, the main cause of underemployment in the delta.[2]

The operation of the immense water storage at Pa Mong will help to relieve the shortage of irrigation water and will allow delta farmers to double crop an area of rice land amounting to 1,161,350 hectares[3] which now remains fallow half the year.

As mentioned in Appendix 2, the Pa Mong project, after completion, will increase dry season flow of the Mekong river by 2,085,000 litres/sec. Given a water requirement of

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[2]See James B. Hendry, A Study of a Vietnamese Rural Community, Economic Activity (Saigon: Michigan State University Advisory Group, 1959) p. 91.

[3]The total land area of the Mekong Delta is about 3.75 million hectares. After allowing for waterways, villages, roads, etc., about 1.85 million net hectares are suitable for agricultural production from the standpoint of fertility. In 1967, just under 1.70 million hectares were under cultivation, 1.56 million hectares in rice and the balance

one litre/sec/ha for rice cultivation,[4] the above increase in the river low flow is more than adequate to irrigate the estimated 1,161,350 hectares of rice land during the dry season.

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in other crops. During the dry season, the area of rice land is further reduced by incursions of saline water which extensively affects the coastal areas of the delta. The following table illustrates the repartition of cultivable rice land among the different provinces of the delta.

Estimated Delta Rice Lands not Affected by Salinity Intrusion during the Dry Season (1971)

Province	Area in ha.	Province	Area in ha.
An Giang	180,000	Kiến Phong	97,000
Ba Xuyen	70,300	Kiến Tường	24,000
Châu Đốc	125,000	Long An	56,000
Chương Thiện	36,600	Phong Dinh	115,000
Định Tường	132,000	Vĩnh Bình	66,450
Kiên Giang	45,000	Vĩnh Long	97,000
Kiến Hòa	58,000	Sa Đéc	59,000
TOTAL:	1,161,350 ha.		

Source: Areas are estimated on the basis of isohaline contours drawn by Sherwood M. Gangliano and W.G. McIntire in their Reports on the Mekong River Delta, Technical Report No. 57, Louisiana State University Coastal Studies Institute, Baton Rouge, 1968, p. 32.

[4]The figure includes both conveyance loss and losses due to evapotranspiration. See the Development and Resources Corporation, Mekong Delta Development Program -- Appraisal Report, 1969, p. IV.2.

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According to a study conducted by the Development and Resources Corporation,[5] the cropping of one hectare of rice land requires the following investment expenditures:

Expenditures on services:	38,021 piasters
Expenditures on agricultural inputs:	1,442 "
Expenditures on industrial inputs (including fertilizers, insecticide, water pump, etc.)	9,558 "

Consequently, the development of 1,161,350 hectares of rice land will necessitate an annual investment of 1.675 billion piasters in agricultural products, 11.100 billion in manufactured goods, and 44.415 billion in services.

Thus,

$$d\overline{V}_a = 1.675$$

$$d\overline{V}_m = 11.100$$

$$d\overline{V}_s = 44.415$$

Furthermore, since this is a public project, these expenditures are assumed to originate from the government sector. Consequently: $d\overline{C}_g = d\overline{V} + d\overline{V} + d\overline{V} = 57.190$ billion piasters

B. Project Output Requirements

As mentioned in the previous section, to fully profit from the irrigation benefits of the Pa Mong project, the

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[5] *Ibid.*, Table 7, p. 35.

government must increase its annual expenditures by 57.19 billion piasters, allocated among the various commodities as follows: 1.675 billion for agricultural products ($d\bar{V}_a$), 11.100 billion for manufactured goods ($d\bar{V}_m$), and 44.415 billion for services ($d\bar{V}_s$). By substituting $d\bar{V}_a$, $d\bar{V}_m$ and $d\bar{V}_s$ with their respective values in the equations (4.26), (4.27), (4.28), (4.29), (4.30), and (4.31), it is possible to estimate the output requirements of the Pa Mong project:

Increase in agricultural output:

$$dO_a = 1.1297\ d\bar{V}_a + .2032\ d\bar{V}_m + .0110\ d\bar{V}_s = 4.635 \text{ billion piasters}$$

Increase in industrial output:

$$dO_m = .0331\ d\bar{V}_a + 1.1006\ d\bar{V}_m + .0554\ d\bar{V}_s = 14.731 \text{ billion piasters}$$

Increase in output of the services sector:

$$dO_s = .0767\ d\bar{V}_a + .0926\ d\bar{V}_m + 1.2779\ d\bar{V}_s = 57.914 \text{ billion piasters}$$

To satisfy these output requirements, the producing sectors of the economy will have to increase their annual imports of intermediary inputs by the following amounts:

$$dM_a = .1055\ d\bar{V}_a + .0189\ d\bar{V}_m + .0010\ d\bar{V}_s = .432 \text{ billion piasters}$$

$$dM_m = .0093\ d\bar{V}_a + .3131\ d\bar{V}_m + .0156\ d\bar{V}_s = 4.168 \text{ billion piasters}$$

$$dM_s = .0025\ d\bar{V}_a + .0030\ d\bar{V}_m + .0422\ d\bar{V}_s = 1.916 \text{ billion piasters}$$

It should be noted that because the equations (4.26), (4.27), (4.28), (4.29), (4.30), and (4.31) are outside the system of simultaneous equations, the project output requirements are independent of the policy adopted by the government to finance the Pa Mong project, and consequently, they will remain the same for all financing alternatives examined in the next section.

C. Evaluation of the Irrigation Impact of the Pa Mong Project under Alternative Financing Policies

In the preceding sections the output and import requirements of the Pa Mong project have been discussed. The stage is now ready for examining, by means of the model developed in Chapters III and IV, how these project expenditures will affect the different economic aggregates such as income, consumption, investment, and imports.

It should be noted that the irrigation impacts of the Pa Mong project will depend to a large extent on how the implementation costs are financed. Since at the present time, it cannot be predicted with any accuracy the most probable mode of financing those costs, a number of assumptions about possible alternatives will be made and their economic implications examined. Tracing the implications of several alternatives, it is hoped to bracket the range of possible outcomes and at the same time, to show the different policy problems involved.

In a developing country like South Vietnam, a development project could be financed in four different ways: (1) by increasing taxes, (2) by deficit financing, (3) by borrowing from abroad and (4) by recurring to foreign aid. A combination of two or more alternatives could be adopted; however, since the policy mix cannot be guessed accurately, these combination alternatives will not be discussed here.

The methodology developed in the previous chapters will now be used to explore the implication of these alternative assumptions.

1. First Alternative: The Implementation Costs of the Pa Mong Project are Financed by Taxation

When the government increases taxes in order to finance the project costs, the equation for government revenue may shift upward, or the marginal propensity to tax may increase, or both may happen. If the marginal propensity to tax i.e., the coefficient x_1 of Y in equation (4.27) changes, the inverse matrix Z^{-1} will be changed accordingly. However, when the change of tax policy consists of an increase in the lump sum, (or "head" or "poll") tax, only the intercept (x_o) of the equation (4.27) will increase, and consequently, the matrix Z^{-1} will remain unchanged. For the sake of simplicity, the government is assumed to adopt this latter mode of tax increase. As a result, irrigation impacts of the Pa Mong project will bring about the following changes to the exogenous variables of our model: both government expenditures and taxes will increase by the same amount of the project investment expenditures, i.e., 57.19 billion piasters. Thus:

$$d\bar{C}_g = 57.190$$

$$dx_o = 57.190$$

a. <u>Effect on Income</u>

The impact on Y of the Pa Mong project could be estimated by substituting $d\bar{C}_g$ and dx_o with their respective values in equation (4.18) which becomes:

$$dY = 2.456\ d\bar{C}_g - 1.485\ dx_o = 55.531 \text{ billion piasters}$$

Since the above figure is within the limit set up by the model constraint, (i.e., $dY^* = 241.300$ billion) it is safe to conclude that this represents an increase in real national income.

b. <u>Effects on Other Economic Aggregates</u>

By the same token, the irrigation impact of the Pa Mong project on other economic variables could be estimated by substituting $d\bar{C}_g$ and dx_o with their respective values in the equations (4.19), (4.20), (4.21), (4.22), (4.23), (4.24), (4 25), (4.26), (4.27), and (4.28).

Change in household saving (dS_H):

$$dS_H = .343\ d\bar{C}_g - .367\ dx_o = -1.372 \text{ billion piasters}$$

Change in government revenue (dR_g):

$$dR_g = .312\ d\overline{C}_g + .811\ dx_o = 64.224 \text{ billion piasters}$$

However, since the government has to finance the project costs from its tax revenues, the net increase in R_g will be only 7.034 billion piasters, (i.e., 64.224 - 57.190 = 7.034).

Change in household consumption (dC_H):

$$dC_H = 1.801\ d\overline{C}_g - 1.929\ dx_o = -7.320 \text{ billion piasters}$$

Change in imports of consumption goods (dM_c):

$$dM_c = .504\ d\overline{C}_g - .540\ dx_o = -2.058 \text{ billion piasters}$$

Change in imports of capital goods (dM_K):

$$dM_K = .446\ d\overline{C}_g - .270\ dx_o = 10.065 \text{ billion piasters}$$

Change in imports of intermediary inputs (dM_i):

$$dM_i = .323\ d\overline{C}_g - .195\ dx_o = 7.32 \text{ billion piasters}$$

Change in business investment (dl):

$$dl = .929\ d\overline{C}_g - .561\ dx_o = 21.045 \text{ billion piasters}$$

2. Second Alternative: Financing through Foreign Aid

Since the project is financed through foreign assistance, and since there is no obligation to pay back the foreign aid, the cost side of the project could be disregarded. Consequently, the initial project impacts are reduced to:

$$d\overline{C}_g = 57.19 \text{ billion}$$

By substituting $d\overline{C}_g$ by its value in the equations (4.18), (4.19), (4.20), (4.21), (4.22), (4.23), (4.24), and (4.25), the following increases in the magnitude of the economic aggregates are obtained:

Increase in income:

$$dY = 2.456\ d\bar{C}_g = 140.458 \text{ billion piasters}$$

Increase in household saving:

$$dS_H = .343\ d\bar{C}_g = 19.616 \text{ billion piasters}$$

Increase in tax revenue:

$$dR_g = .312\ d\bar{C}_g = 17.843 \text{ billion piasters}$$

Increase in household consumption:

$$dC_H = 1.801\ d\bar{C}_g = 102.999 \text{ billion piasters}$$

Increase in import of consumption goods:

$$dM_c = .504\ d\bar{C}_g = 28.823 \text{ billion piasters}$$

Increase in imports of capital goods:

$$dM_K = .446\ d\bar{C}_g = 25.506 \text{ billion piasters}$$

Increase in imports of intermediary inputs:

$$dM_i = .323\ d\bar{C}_g = 18.472 \text{ billion piasters}$$

Increase in induced investment:

$$dl = .929\ d\bar{C}_g = 53.129 \text{ billion piasters}$$

3. Third Alternative: Financing Through Foreign Loans

Since the government is obligated to repay the foreign debts, domestic taxes will have to be increased by an equivalent amount to provide the government with the necessary additional income. The economic impact of the project will therefore be similar to the alternative of tax financing discussed previously.

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For illustrative purposes, let assume that the foreign loan belongs to the "soft" category and the annual repayment only amounts to 20 percent of the loan (i.e., 57.19 x .20 = 11.44 billion). Consequently, the project will bring about the following effects on the exogenous variables of the model:

$$d\bar{C}_g = 57.19$$

$$dx_o = 11.44$$

By substituting these values back into the equations of the model, it can be seen that the total income Y will increase by 118.391 billion piasters, from which 15.418 billion will go to household savings, 8.566 billion to the government and 58.865 to household consumption. However, since the foreign debt is paid out of tax yield, the government revenue will have a net loss of 2.874 billion piasters (8.566 - 11.44 = -2.874). Also as a result of the project, private investment will increase 29.805 billion piasters, from which 16.001 billion will be spent on imported capital goods and 16.242 billion on imported intermediary inputs. The household sector will import an equivalent amount of 22.646 billion.

4. Fourth Alternative: By Deficit Financing

By adopting this mode of financing, the government has two alternatives, either to borrow from the National Bank or to borrow from the public.

Since the cost of printing money is negligible and there is no interest payment involved, the effect of borrowing from the National Bank is the same as if the project is financed through foreign aid, the economic implications of which have been already discussed in the second alternative.

In the second case, assuming that people do not hoard their savings, borrowing from the public will reduce exogenously the investment of the private sector by an amount equal to the project cost (57.19 billion piasters). Consequently, the project will have the following effects on the model:

$$d\overline{C}_g = 57.19$$

$$dx_o = -57.19$$

By substituting these values back into the equations (4.18), (4.19), (4.20), (4.21), (4.22), (4.23), (4.24), and (4.25), the following results are obtained:

Increase in income (Y):

$$dY = 2.456\ d\overline{C}_g + 1.274\ di_o = 67.598 \text{ billion piasters}$$

Increase in household saving (S_H):

$$dS_H = .343\ d\overline{C}_g + .178\ di_o = 9.436 \text{ billion piasters}$$

Increase in public revenue (R_g):

$$dR_g = .312\ d\overline{C}_g + .162\ di_o = 8.578 \text{ billion piasters}$$

Increase in household consumption (C_H):

$$dC_H = 1.801\ d\overline{C}_g + .935\ di_o = 49.526 \text{ billion piasters}$$

Increase in imports of consumption goods (M_c):

$$dM_c = .504\ d\overline{C}_g + .262\ di_o = 13.839 \text{ billion piasters}$$

Decrease in imports of capital goods (M_K):

$$dM_K = .446\ d\bar{C}_g - .713\ di_o = -15.269 \text{ billion piasters}$$

Increase in imports of intermediary inputs (M_i):

$$dM_i = .323\ d\bar{C}_g + .167\ di_o = 8.921 \text{ billion piasters}$$

Net decrease in private investment (I):

$$dI = .928\ d\bar{C}_g + 1.482\ di_o = -31.683 \text{ billion piasters}$$

CHAPTER VI

CONCLUSION: SUMMARY OF THE FINDINGS AND RECOMMENDATIONS FOR FURTHER RESEARCH

This study began with the overall objective of developing a macroeconomic model for South Vietnam which could be used to assess the overall irrigation impacts of the Pa Mong project on the economy. This was pursued by attempting to fulfill a set of objectives:

1. Surveying and evaluating the current approaches regarding project impact evaluation.

2. Identifying the elements in the first objective which could be forged into an economic model which, by using available secondary data could be applied to all or most public development projects.

3. Applying the model to a specific public project, namely, Pa Mong.

4. Appraising the practicality of the model for planning purposes and advancing some general policy recommendations.

The first objective was met in Chapter II in which four general approaches to project impact evaluation were identified: (1) the Keynesian multiplier approach, (2) the comparative projection approach, (3) the input-output approach and (4) the intersectoral flows analysis. It was found that the input-output technique, in spite of some limitations, still constitutes the most effective tool for public project impact analysis.

The second objective was met in Chapters III and IV. The theoretical aspects of the model were discussed in Chapter III and the estimation of the parameters was presented in Chapter IV. The model used was a combination of the input-output and the Keynesian multiplier techniques. Through this combination, it was possible not only to estimate the output requirements of the project, but also its impacts on the various aggregates of the economy.

The third objective was met in Chapter V which contains a discussion on the economic implications of the project irrigation benefits under alternative financing policies.

Objective four will be dealt with in the remaining part of this chapter.

A. Summary of the Findings

1. First, the present study revealed that as a result of the Pa Mong project, the annual output of the services sector will have to be increased by 57.914 billion piasters. Since the services sector in South Vietnam employs a large number of unskilled laborers, the project will undoubtedly help to alleviate the chronic unemployment

situation of the Vietnamese economy. Moreover, the Pa Mong project will also require an annual increase of 4.635 billion piasters in agricultural products, and 14.731 billion piasters in manufactured commodities. Considering the perennial shortage of skilled labor in the manufactures sector, adequate training programs should be set up without delay to increase the supply of skilled labor and to avoid any possible bottleneck in this sector.

2. To satisfy the output requirements of the Pa Mong project, the agriculture sector will have to import .432 billion piasters of intermediary inputs; the manufactures sector, 4.168 billion; and the services sector, 1.916 billion. These imports will impose quite a heavy burden on the country's balance of payments. Measures should therefore be taken to generate the necessary amount of foreign exchanges, such as trade policy aiming at encouraging exports and/or reducing imports.

3. This study revealed that the Vietnamese economy will greatly benefit from the operation of the Pa Mong reservoir. Gross national income will increase by an annual amount ranging from 55.531 to 140.458 billion piasters, depending on the mode of financing the project. The increase in

national income is largest when the project is financed through foreign aid or borrowing from the national bank, and smallest when financed through taxation.

4. Financing the project through taxation has a redistribution effect on the various sectors of the economy; household consumption and savings will be reduced by 7.320 billion and 1.372 billion piasters, respectively, while the government sector experiences a net increase of 7.034 billion, and the investment sector 21.045 billion piasters. Since this mode of financing will require the population to reduce consumption, measures should be taken to allocate the tax burden equitably among the various income groups to avoid social injustice.

5. Due to the high propensity to import of the economy, an important share of the project benefits will leak out of the country. The annual increase in imports for consumption purposes may be as high as 28.823 billion piasters. As a result, the government should start a policy of import restriction, particularly on imports of consumption commodities. This policy may prove difficult to implement considering that a large

portion of government revenues come from import duties; however, this sacrifice should be made if the policy makers desire the economy to fully benefit from the project.

6. Finally, as this analysis demonstrates, the Vietnamese economy will greatly benefit from the operation of the Pa Mong reservoir and South Vietnam should contribute to the Mekong Basin development program -- both in manpower and natural resources. However, there is no unique answer to the question of how much these contributions should be, since these are functions of the benefits received, which, in turn, depend to a large extent on the project financing policy selected.

B. Model Appraisal and Suggestions for Further Studies

From limited statistical data, a macroeconomic model for public project impact evaluation has been constructed. Although this model consists of only 21 equations, which may be too few to adequately represent the whole economy, it has proved to be potentially useful for analysis and planning.

The model has been applied to a specific case, the Pa Mong irrigation project, to illustrate how the model can be used for project impact evaluation. However, the model developed is far from being operationally perfect and still presents theoretical drawbacks, the most important of which will be discussed here.

First, the input-output part of the model is too aggregated. There is no disaggregation beyond the sectoral level to the individual industry, and as a consequence, the analytical power of this technique is greatly reduced. A greater sector division will be needed if we demand more insight and accuracy from the results of the model.

Second, another limitation of the model stems from its omission of the money market. The reason advanced was the relatively low degree of "monetary awareness" among the Vietnamese people, especially those living in the countryside. The banking system is not widely developed in South Vietnam, and noneconomic factors often play a crucial role in business decision-making. With the economy becoming more sophisticated, and if the data conditions allow, the money market, in the future, should be incorporated in the model to provide a better insight into the financing aspect of the development project.

A third limitation of the model can be found in its neglect of the effect of time. Although project evaluation is more interested in estimating the magnitude of the change in output, it is also important to know the process of adjustment in production and the time required to reach the new equilibrium. If the adjustments are slow, the gap between demand and supply is difficult to fill rapidly. Before equilibrium is reached, final demand may divert its course so that the expected effect will not materialize. Moreover, if production does not respond quickly enough to the increase in final demand, prices will rise, and some measures may be required to prevent the possible inflation. All these dynamic implications should be taken into account in project evaluation, and it is therefore desirable to conduct empirical as well as theoretical research on the adjustment processes of the economy.

Another dynamic aspect of production left out by this study is the impact of capital formation. In addition to final demand, it was generally found that output in one period is actually affected by the outputs in the previous periods, and the neglect of this intertemporal link in production may give biased projections. The need for a dynamic input-output model is therefore unquestionable since it would provide a powerful tool for project analysis. Although different dynamic models incorporating capital formation have been developed by various people, an empirically applicable model is still in the early stage of development.[1]

A final word should be said about the rigidity of the input-output coefficients of the model. As shown elsewhere, the results of intertemporal comparisons of production structure reveal that technology does change over time.

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[1]For specific models, see Wassily W. Leontief et al., Studies in the Structure of the American Economy, op. cit.; Robert Dorfman, Paul Samuelson and Robert Solow, Linear Programming and Economic Analysis (New York): McGraw-Hill Book Co., 1958; Anne P. Carter, "Application of Input-Output

How valid, then, is the assumption of fixed technical coefficients? To answer this question, many studies have been conducted to test the stability of the input-output coefficients over time. Leontief compared three U.S. tables for 1919, 1929 and 1939 and found that between 1919 and 1929 only about one-fifth of the coefficients varied less than 20 percent and about one-sixth varied more than 50 percent. Between 1919 and 1939, only a third varied less than 20 percent and a quarter varied 50 percent.[2] However, a test with Japanese input-output tables for 1951 and 1954 revealed that more than three-fourths of the coefficients varied less than 20 percent during the period.[3] A study by Cumberland, on the other hand, revealed that some coefficients showed definite stability and others showed a definite time trend.[4] Thus, it seems that the stability of the input-output coefficients depends largely on the characteristics of the economy in question and on the particular pattern of technical

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Analysis," Proceedings of the International Conference on Input-Output Techniques, (Netherlands: North Holland Publishing Co., 1970), Vol. 2, Chapter I.

[2]Wassily Leontief et al., Studies in the Structure of the American Economy, op. cit.

[3]Japan, Ministry of International Trade and Industry Research and Statistics Division, Interindustry Analysis for the Japanese Economy, 1957.

[4]J.H. Cumberland, "Examples of Variations in the Behavior of Critical Material Input Coefficients," Interindustry Item No. 17 (Washington, D.C.: U.S. Bureau of Mines, 1952).

change undergone in each specific period.

However, it is possible to reduce the error of input-output projections caused by the fixed proportion assumption by updating the input-output coefficients frequently. One way of doing this was proposed by Ann Carter.[5] She estimated the technical change in each sector from its investment rate, and then updated the technical coefficient according to the magnitude of the technical change. The applicability of this approach is yet to be tested, but it did represent a step forward in improving the reliability of the input-output technique.

To sum up, in spite of its shortcomings, the economic model developed in this study has proved to be potentially useful in project impact analysis. It is the first such model of South Vietnam and may be of great help in choosing among alternative development programs. However, it should be emphasized that regardless of improvements in the evolution of planning models, policymakers cannot escape making value judgments, and political decisions are still required. The planning model furnishes no more than a systematic way of trying to coordinate decisions and to improve uncoordinated ones. It should be considered as a focus and not a substitute for decision-making.

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[5] Anne P. Carter, Structural Change in the American Economy, (Cambridge: Harvard University Press, 1970).

APPENDICES

APPENDIX 1

METHODS AND SOURCES USED FOR THE CONSTRUCTION OF THE CONSOLIDATED INPUT-OUTPUT TABLE

The consolidated input-output model of South Vietnam consists of three endogenous sectors (agriculture, manufactures and services) and three exogenous sectors (primary input, import and final demand). A greater sector division though desirable, is not feasible for the time being, due to the shortage of statistical data.

Each of the endogenous sectors is a set of relatively homogenous industries, and produces a certain amount of output which is used within the sector, purchased by other sectors, or purchased for final demand.

A. Sources of Information

Most information sector transactions is from data published by the National Bank of Vietnam[1] and the National Bureau of Statistics.[2] Concerning the agricultural sector, information is also based on a special study on the Vietnamese rural economy entitled The Rural Income and Expenditure

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[1]National Bank of Vietnam, Office of Statistics and National Revenue, National Revenue of Vietnam 1970, February, 1973.

[2]National Institute of Statistics, Vietnam Statistical Yearbook 1970-1971, op. cit.

TABLE 12

THEORETICAL REPRESENTATION OF THE CONSOLIDATED INPUT-OUTPUT TABLE

Output to / Input from	Agriculture	Manufactures	Services	Final Demand	Total Output
Agriculture	x_{aa}	x_{am}	x_{as}	V_a	0_a
Manufactures	x_{ma}	x_{mm}	x_{ms}	V_m	0_m
Services	x_{sa}	x_{sm}	x_{ss}	V_s	0_s
Primary Input	Y_a	Y_m	Y_s	Y_D	Y
Imports	M_a	M_m	M_s	M_D	M
Total Input	0_a	0_m	0_s		

Where 0_a = Gross output of the agricultural sector

0_m = Gross output of the manufactures sector

0_s = Gross output of the services sector

Y = Total value added or income

M = Total imports

x_{ij} = Output of the i sector purchased by the j sector.

Sample Survey (RIES).[3] Additional data also was obtained from the working papers published by the Joint Development Group.[4]

B. The Agriculture Sector

1. Total Output of the Agricultural Sector (0_a)

Agricultural output was defined as the value of all agricultural commodities produced in 1970, plus the value of government payments and the rental value received by farmers. The list of agricultural commodities and their respective values are given in Table 13.

TABLE 13

AGRICULTURAL OUTPUT

	Quantity (in metric tons)	Value (in million piasters)
Paddy	5,715,500	206,006.150
Corn	31,435	987.059
Vegetables	217,550	7,396.700
Soy bean	7,455	691,824
Mungo bean	11,096	1,650,936

[3]This survey, conducted by Dr. Robert H. Stroup of the University of Kentucky, and under the auspices of the U.S. Agency for International Development, is the first known attempt to secure basic data for the Vietnamese agricultural sector. The RIES covered 2,910 households from 97 hamlets throughout the country. Its immediate purpose was to collect statistics to be used in establishing consumer income and expenditure patterns in the rural areas of South Vietnam.

[4]The Joint Development Group studied the economic

TABLE 13 (Continued . . . .)

	Quantity (in metric tons)	Value (in million piasters)
Manioc	215,710	2,372.810
Potatoes & Yam	241,270	5,001.436
Banana	203,635	6,984.680
Pineapple	33,325	1,392.985
Other fruit	235,705	19,987.784
Peanuts	32,185	1,689.712
Sesame	235	40.537
Coconut	74,624	4,089.395
Sugar canes	335,720	2,605.187
Rubber	33,000	897.600
Coffee	3,925	1,561.365
Tea	5,545	1,641.320
Cocoa	25	4.145
Pepper	410	132.512
Tobacco	8,420	2,476.322
Jute	250	13.825
Cotton	40	3.060
Ramie	5	.725
Mulberry	1,575	393.750
Kapok	810	47,709

and technical planning for the long-range future of Vietnam, with particular emphasis upon the post-war period. The group was comprised of Vietnamese experts, headed by Dr. Vũ Quốc Thúc and American advisors supplied by the Development and Resources Corporation, a private firm headed by David E. Lilienthal.

TABLE 13 (Continued . . . .)

	Quantity (in metric tons)	Value (in million piasters)
kenaf	80	3.320
Livestock		92,052.00
Fishery products		60,970.
Forestry		1,793.
TOTAL		430,007

Source: National Bank of Vietnam, Office of Statistics, National Revenue of Vietnam, 1970. Table 1, p. 17.

Table 13 shows that in 1970 the total value of the agricultural sector was 430.007 billion piasters, and consequently:

$$0_a = 430.007$$

2. Expenditure of the Agricultural Sector for Industrial Inputs (x_{ma})

Data on the expenditures of the agricultural sector for industrial inputs (x_{ma}) was not available for 1970, but from the information provided by the Rural Survey of Income and Expenditures,[5] it is estimated that the agricultural sector spends about 2.5 percent of its total output for the

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[5]Robert H. Stroup, Rural Income and Expenditure Sample Survey of Vietnam (Washington: Agency for International Development, 1967), Table 18.

domestic produced inputs such as inorganic fertilizers, insecticides, machinery, etc. This relatively small percentage reflects the very low degree of mechanization in the rural sector, which still relies heavily on human labor and draft animal as the main sources of power.

In terms of 1970 output, these expenditures amounted to 10.321 billion piasters. Thus:

$$x_{ma} = 10.321$$

3. Expenditures for Agricultural Inputs (x_{aa})

Also from the rural survey, it is estimated that approximately 11 percent of the total value of agricultural output is spent in the sector to purchase inputs produced in the sector such as seeds, cattle and poultry feeds, manure, and draft animals.[6] In term of 1970 output, this amounts to 47.301 billion piasters. Consequently:

$$x_{aa} = 47.301$$

4. Expenditures for Imported Inputs (M_a)

From the data published by the National Bureau of Statistics,[7] it is estimated that in 1970, the agricultural sector spent close to 40.288 billion piasters to import such inputs as pesticide, insecticide, fertilizer and manufactured

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[6] Robert H. Stroup, Rural Income and Expenditure Sample Survey of Vietnam, op. cit., Table 18.

[7] National Institute of Statistics, Vietnam Statistical Yearbook 1970, Chapter IX.

commodities. Thus:

$$M_a = 40.288$$

5. Expenditures for Primary Inputs (Y_a)

By definition, these inputs include all types of income generated from the agricultural sector, i.e., rents, wages, profits and taxes. In 1970, total expenditures by the agricultural sector for primary inputs were estimated at 309.866 billion piasters.[8] Thus,

$$Y_a = 309.866$$

6. Expenditures for Inputs from the Services Sector (x_{sa})

Expenditures for inputs from the services sector include mainly transportation costs, marketing costs paid to intermediaries and miscellaneous services fees.

Data on these outlays is not available. However, in an input-output table total receipts should equal total expenditures. Therefore, these service costs which have been incurred by the agricultural section could be calculated by substracting the total amount of expenditures for inputs other than services from the total sectoral receipts (i.e., 0_a). As a result:

$$x_{sa} = 0_a - x_{aa} - x_{ma} - M_a$$

Where x_{sa}, x_{ma}, and x_{aa} are expenditures for services, manufactured inputs and agricultural inputs, respectively.

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[8] *Ibid*.

M_a = Import of agricultural inputs

0_a = Total output of the agricultural sector

By solving the equation:

x_{sa} = 22.231

C. The Manufactures Sector

1. Total Output of the Manufactures Sector (0_m)

The manufactures sector is defined according to the classification used by the National Bureau of Statistics, and includes the industries shown in Table 14.

TABLE 14

MANUFACTURES SECTOR

Industry	Value of Production in 1970 (in million piasters)
Mining and quarrying	1,804.19
Salines	1,025.00
Sugar	5,225.65
Bakery and confectionery	6,181.37
Fish sauce and soy sauce	4,677.89
Vegetable oil	160.00
Rice mill	5,539.16
Canned food	4,577.64
Alcohol & alcoholic products	1,589.38
Soft drinks and ice	15,615.00
Tobacco	14,958.00

TABLE 14 (Continued . . . .)

Industry	Value of Production in 1970 (in million piasters)
Textile & clothing	21,731.6
Furniture	932.36
Rubber	1,367.96
Aluminum	817.40
Plastic	6,597.30
Tanning	85.65
Footwear	1,905.81
Ceramic	1,109.4
Paper	3,044.39
Matches	437.74
Cosmetic	2,502.08
Painting	395.78
Chemical	203.12
Printing	3,270.00
Mechanical & metallurgical products	5,460.79
Glassware	713.17
Junk building	27.14
Water & Electricity	8,758.62
Pharmaceutical	17,499.00
Cement	1,688.54
Construction	35,150.00
Miscellaneous	13,149.57
TOTAL	188,200.00

Source: National Bank of Vietnam, Office of Statistics, National Revenue, 1970.

From Table 14, it can be seen that in 1970, total output of the manufactures sector was worth 188.2 billion piasters, and consequently:

$$O_m = 188.2$$

2. Expenditures for Agricultural Inputs (x_{am})

Agricultural inputs consist mainly of products used as raw materials in agriculture-related industries, such as canned food, soft drinks, tobacco, rubber, and sugar refining. From the informations provided by the Bureau of Statistics of the National Bank, it was estimated that in 1970, the manufactures sector spent about 30.743 billion piasters for the purchase of agricultural inputs,[9] thus,

$$x_{am} = 30.743$$

3. Expenditures for Industrial Inputs (x_{mm})

Industrial inputs are the intermediate goods used by the industrial sector for production. They include mineral products, products of chemical industries, machinery, base metals and articles of base metal. From data published by the National Bureau of Statistics,[10] it was found that in

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[9] According to the report on national income for 1970, published by the National Bank, the total value of agriculture products used as intermediary inputs in 1970 amounted to 78.270 billion piasters. By substracting from this figure the amount of agricultural inputs going into the service sector (x_{as} = .226 billion) and the agricultural sector (x_{aa} = 47.301 billion) the value of agricultural inputs demanded by the manufactures sector is obtained, (i.e. x_{am} = 30.743 billion)

[10] National Institute of Statistics, Vietnam Statistical

1970, an estimated 16.670 billion piasters worth of industrial products was consumed within the manufactures sector as intermediate inputs. Thus:

$$x_{mm} = 16.670$$

4. Expenditures for Primary Inputs (Y_m)

Expenditures for primary inputs are the contribution of the industrial sector to the national income, and is defined here so as to include wages, profits, dividends and taxes. In 1970, the total outlays by the manufactures sector for primary inputs amounted to 76.943 billion piasters.[11] Consequently:

$$Y_m = 76.943$$

5. Expenditures for Imported Intermediate Inputs (M_m)

Data for expenditures on imported intermediate inputs is provided by the National Bureau of Statistics[12] and the U.S. Agency for International Development.[13] The inputs include raw materials, products of chemical and metallurgical industries, artificial resins and plastic materials, cellulose and synthetic rubber, wood and wood products, base metals

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Yearbook 1970, Chapter VI.

[11]This figure is based on data published by the National Bureau of Statistics and by the Center for Industrial Development.

[12]National Institute of Statistics, *op. cit.*, Chapter VII.

[13]U.S.Agency for International Development, Bureau for Supporting Assistance, *Vietnam Economic Data*, November, 1972.

and articles made of base metals.

An estimated 53.267 billion piasters were spent in 1970 for importing intermediate inputs, therefore:

$$M_m = 53.267$$

6. Expenditures for Services (x_{sm})

Data for these expenditures on services is not available. However, it could be estimated in the same way as for the agricultural sector, i.e., using the relationship:

$$x_{sm} = 0_m - x_{am} - x_{mm} - M_m$$

Where 0_m = Total industrial output

M_m = Imports of intermediate imports

x_{am} = Agricultural inputs expenditures

x_{mm} = Industrial inputs expenditures

In 1970, the value of x_{sm} was found to equal 14.190 billion piasters.

D. The Services Sector

1. Total Output of the Services Sector (0_s)

The services sector is defined according to the classification adopted by the Bureau of Statistics of the National Bank (see Table 15).

Table 15 shows that the 1970 total output of the services sector is 361.164 billion piasters.

$$0_s = 361.164$$

TABLE 15

OUTPUT OF SERVICES SECTOR

Activity	Value of Output in 1970 (in billion piasters)
Trade (wholesale & retail)	212.674
Transport	
by railways	.530
by road	41.090
by sea	.068
by inland waterways	.732
by air	3.001
Private education	4.001
Medical services	3.228
Banking & insurance	14.942
Housing	14.773
Miscellaneous services	65.715
TOTAL	361.164

Source: National Bank of Vietnam, National Revenue of Vietnam 1970, Tables 4, 5, & 6.

2. <u>Expenditures for Agricultural Inputs (x_{as})</u>

According to the National Institute of Statistics, the contribution of the agricultural sector to the services sector in 1970 was .226 billion piasters.[14] This figure represents the estimated value of horses, oxen, and buffalo which were used for public transportation. Consequently:

$$x_{as} = .222$$

3. <u>Expenditures for Manufactured Inputs (x_{ms})</u>

No data was available on expenditures for manufactured inputs. However, according to the National Bank, in 1970, the amount of industrial products used as intermediary inputs by all sectors of the economy amounted to 41.181 billion piasters.[15] Consequently, by substracting from this figure the amounts of manufactured inputs consumed by the agricultural sector (i.e., x_{ma}) and the manufactures sector itself (i.e., x_{mm}), it is possible to estimate the value of the industrial inputs demanded by the services sector. Thus:

$$x_{ms} = 41.181 - x_{ma} - x_{mm}$$

$$= 14.190 \text{ billion piasters.}$$

4. <u>Expenditures for Services Inputs (x_{ss})</u>

Also from the Office of Statistics of the National Bank, the total value of services used as intermediary inputs

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[14] National Institute of Statistics, <u>Vietnam Statistical Yearbook 1970</u>, Chapter IV.

[15] National Bank of Vietnam, Office of Statistics, <u>Op. cit.</u>, p.23.

in the production process in 1970 was estimated at 110.297 billion piasters. The amount of services consumed by the services sector itself can be derived:

$$x_{ss} = 110.297 - x_{sa} - x_{sm} = 77.508 \text{ billion piasters.}$$

5. Expenditures for Primary Inputs (Y_s)

In 1970, the services sector contribution to gross national income was estimated at 257.292 billion piasters. Therefore:

$$Y_s = 257.292$$

6. Expenditures for Imported Inputs (M_s)

No exact information was available on imported inputs. However, since by definition the total receipts must equal the total outlays for any sector of the input-output table, it is possible to estimate M_s by deducting expenditures for all other inputs from the total output of the services sector:

$$M_s = 0_s - x_{as} - x_{ms} - x_{ss}$$

$$= 11.952 \text{ billion piasters}$$

E. The Consolidated Input-Output Table

From the results obtained above, it is possible to construct a consolidated input-output table for the Vietnamese economy in 1970.

TABLE 16

SOUTH VIETNAM: CONSOLIDATED INPUT-OUTPUT FOR 1970

(in billion Vietnamese piasters)

Output / Input	Agriculture	Manufactures	Services	Final Demand	Total Output
Agriculture	47.321 (.1100)	30.743 (.1634)	.222 (.0006)	351.721	430.007
Manufactures	10.321 (.0240)	16.670 (.0888)	14.190 (.0393)	147.020	188.201
Services	22.211 (.0520)	10.578 (.056)	77.508 (.2146)	250.867	361.164
Primary Inputs	309.866 (.7200)	76.943 (.41)	25.7292 (.7124)	160.316	804.417
Imports	40.288 (.0934)	53.267 (.2830)	11.925 (.0331)	95.234	200.714
Total	430.007	188.201	361.164	1005.154	1984.503

Notes: The values are in billion piasters at 1970 constant prices. The figures in parentheses represent the corresponding technical coefficients.

F. The Direct and Indirect Income Effects

In Chapter IV, the interdependence coefficients were estimated for the South Vietnamese economy. The stage is now set for the evaluation of the direct and indirect income effects, which by definition measure the total change in income throughout the economy resulting from a one unit change in output in a sector.[16]

The direct income effects are given by the row primary input of Table 6. The agriculture sector has the largest direct income effect of .72; then comes the services sector with .71, and finally the manufactures sector with .41. The difference among the direct effects of the various sectors is largely the result of the nature of the sector. A labor-intensive sector, such as the agricultural and services sectors, will spend more for wages and salaries than a capital intensive sector such as the manufactures sector.

The direct and indirect income effects measure the total change in income as result of a one piaster change in output. This effect is evaluated by considering how the output in each sector changes as a result of an initial change in final demand, and how the change affects income. For example, from Table 6 it can be seen that a one piaster change in final demand for agricultural products will change output

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[16]For a detailed discussion see Werner Hirsch, "Interindustry Relations of a Metropolitan Area," Review of Economics and Statistics, Vol. 41 (November, 1959), pp. 360-369.

in that sector by 1.12 piasters. Since the primary input sector receives 72 cents of every piaster change in output, an initial change of 1 piaster will cause agricultural income to change by .813 piaster (i.e., 1.12 x .72 = .813).

The initial change of one piaster in final demand for agricultural products will cause a direct and indirect output change of .0331 piasters in the manufactures sector. From the direct effect, .408 of every piaster change in output goes to the value added (or primary input) sector. Thus, the income of the manufactures sector changes by .0156 piasters. Similarly, the income of the services sector changes by .054 piasters as the result of a one piaster change in output of the agricultural sector. Total direct and indirect income effects of a one piaster increase in final demand for agricultural products is equal to the sum of all the income changes, or .8826.

The direct and indirect income effects could be mathematically derived by using the equation:

$$0 = (I - A)^{-1} V$$

Replacing the matrix $(I - A)^{-1}$ by its value given in Table 6:

$$\begin{bmatrix} 0_a \\ 0_m \\ 0_s \end{bmatrix} = \begin{bmatrix} 1.1297 & .2032 & .0110 \\ .0331 & 1.1066 & .0554 \\ .0767 & .0926 & 1.2779 \end{bmatrix} \begin{bmatrix} V_a \\ V_m \\ V_s \end{bmatrix}$$

If the agricultural sector increases its output by ΔV_a piasters, the manufactures sector by ΔV_m, and the services sector by ΔV_s, then the output increase in each sector will be:

$$\Delta 0_a = 1.1297\Delta V_a + .2032\Delta V_m + .011\Delta V_s$$

$$\Delta 0_m = .0331\Delta V_a + 1.1066\Delta V_m + .0554\Delta V_s$$

$$\Delta 0_s = .0767\Delta V_a + .0926\Delta V_m + 1.2779\Delta V_s$$

The resulting increases in sectoral income level are:

$$\Delta Y_a = (.7206)\Delta 0_a = .8141\Delta V_a + .1458\Delta V_m + .0079\Delta V_s$$

$$\Delta Y_m = (.4088)\Delta 0_m = .0135\Delta V_a + .4524\Delta V_m + .0226\Delta V_s$$

$$\Delta Y_s = (.7124)\Delta 0_s = .0546\Delta V_a + .0660\Delta V_m + .9104\Delta V_s$$

The total income generated (ΔY) is obtained by summing all the above sectoral income increases:

$$\Delta Y = \Delta Y_a + \Delta Y_m + \Delta Y_s$$

$$\Delta Y = .8822\Delta V_a + .6642\Delta V_m + .9409\Delta V_s$$

The above equation shows the direct and indirect income effects generated throughout the economy when the output is increased by ΔV_a piasters in the agricultural sector, by ΔV_m piasters in the manufactures sector, and by ΔV_s piasters in the services sector.

To estimate the total effects of a one piaster change in each sector, we set successively:

1. $\Delta V_a = 1$, $\Delta V_m = 0$, $\Delta V_s = 0$

2. $\Delta V_a = 0 , \Delta V_m = 1 , \Delta V_s = 0$

and 3. $\Delta V_a = 0 , \Delta V_m = 0 , \Delta V_s = 1$

The indirect income effect is obtained by substracting the direct effect from the total effect.

TABLE 17

THE DIRECT AND INDIRECT INCOME EFFECTS

	Direct income effects	Indirect income effects	Direct and indirect income effects
Agricultures	.7026	.1616	.8822
Manufactures	.4088	.2554	.6642
Services	.7124	.2285	.9409

From Table 17 we see that the manufactures sector has the highest indirect effect, and the agricultural sector the lowest indirect effect. The reason is that activity in the manufactures sector depends quite heavily on the other sectors in the economy; whereas, the agricultural sector has appreciably less interaction with the other sectors. This partially reflects the dualistic nature of the Vietnamese economy.

APPENDIX 2

GENERAL FEATURES OF THE MEKONG DELTA AND OF THE PA MONG PROJECT

A. The Mekong Delta

The Lower Mekong Basin covers more than 600,000 square kilometers, comprising almost the whole of Laos and the Khmer Republic, one-third of Thailand and two-fifths of the Republic of Vietnam. It is inhabited by a population of 30 million, representing about half the total population of these four countries. In comparison to most of the other Asian river basins, the Lower Mekong Basin is not densely populated, so that the resources of land, forests, and water are relatively plentiful.

All four riparian countries, while possessing nascent industrial sectors, display dominantly agricultural economies in which the production of a single wet season rice crop is the most significant element. Four-fifths of the basin's population is employed in agriculture, obtaining an average per capita income between 90 and 150 United States dollars per year. It is estimated that by the year 2000, the population of the basin will reach 62 million, and the total population of the four riparian countries, 134 million. It is, therefore, imperative to increase food production at least 3 percent annually, the same annual rate as population growth. Historically, food production increases are obtained by expanding the cultivated area, which now is about ten million hectares (or 15 percent of the total basin). However, further increases in production will be progressively more difficult to obtain by this method. The best solution lies in the increase in agricultural productivity, which requires as basic condition, year round control of the water supply.

With respect to possible control and use of water, the Lower Mekong Basin may be divided into four parts: the hill area, the plateau, the Mekong Plain and the Mekong Delta.

The hill area, with an altitude higher than 200 meters above mean sea level, comprises the entire region in the northern part of Laos. It is covered with forest, but with patches of land cleared for the cultivation of rice or dry crops for local consumption.

The plateau, with an elevation of 100 to 200 meters, consists mostly of the Korat plain of Thailand. It is composed chiefly of sandstone, and the soil is not very fertile.

The Mekong Plain comprises a flat area in Cambodia, having an elevation below 100 meters. It is located between the Cambodian-Laotian border in the north and a line running approximately through Kompong Cham in the south. Along both banks of the Mekong, strips of land varying from one to a few kilometers in width have been cleared for the cultivation of various dry crops. The western part of the plain forms the basin of the Great Lake and is open for rice cultivation.

The most extensively cultivated areas are found near Battambang, the paddy center of Cambodia, where the streams running into the lake have been utilized for irrigation.

The Mekong Delta, the vast alluvium built up by the river, is a triangle with its apex at Phnom Penh and its base on the South China Sea coast at the mouth of the Mekong. It covers an area of 49,520 square kilometers, 26 percent being in Cambodia and 74 percent in South Vietnam. Apart from isolated rock knolls, such as the Seven Mountains in South Vietnam, the relief is so flat that every year during the wet season flood waters overflow the river bank and turn the whole delta into a vast swamp.

Except in its southwest corner which is covered with mangrove, and in the Plain of Reeds where the oil is toxic to the crops, the vast area of the delta is mostly under paddy cultivation, and rice fields cover nearly 90 percent of all cultivable lands.

The hydrologic regime of the river reflects the alternating dry and wet monsoon climate of the Lower Basin: the river begins to rise each year in May, reaching its highest elevation toward the end of the southwest monsoon rainy season (in August or September). During the dry northeast monsoon season until May, it falls.

The magnitude of difference between flows during the dry and wet season is indicated by the flow at Kratie in Cambodia. There, the average low flow is as little as 1,764 cubic meter/sec compared to an average flood flow of

52,000 cubic meter/sec, and an average flow of 14,166 cubic meter/sec.

The moisture deficiency of the dry season imposes a powerful restriction upon crop production. During the dry months, most of the cultivable land, with the exception of that along the main water channels, is left fallow. The problem is worse in the coastal areas, which in addition to insufficient water, are affected by salinity intrusion which impairs the quality of surface and ground waters, and spoils the lands by leaving saline deposits in the soil. On the other hand, the annual flood is, up to certain levels, beneficial in the delta. Farmers have adjusted their methods of cultivation and crop varieties to the rising flood so that within limits, it does little damage, and even facilitates cultivation. However, severe floods do cause considerable damage to crops and property. For instance, the 1960 flood caused damage to the delta lowlands amounting to $34 million.

However, in spite of all its problems, the Mekong Delta remains one of the richest rice growing areas in the region, and potentially one of the most productive agricultural areas in Asia. Moreover, the Mekong and its tributaries constitute by far the largest known indigenous source of energy in the Lower Mekong Basin. If fully exploited,it could satisfy the demand for electric power of the four basin countries for years to come.

The Pa Mong and Sambor projects are the first major steps in exploiting the mighty Mekong River for the benefits of those living in its basin.

B. The Pa Mong Project

1. General Features

The Pa Mong project area lies on both sides of the Mekong where the river forms the boundary between Northeast Thailand and Northwest Laos. The Pa Mong dam site is about 20 kilometers upstream from Vientiane, Laos, and about 1600 kilometers above the mouth of the Mekong River.

The Pa Mong project occupies a key position in the development of the Mekong Basin. It can provide direct irrigation of extensive areas in Laos and Northeast Thailand, and generate large amounts of hydro-electric power. Because of its upstream location and immense storage capacity, it also can eliminate the overflow in the river valley from Pa Mong down to the confluence with the Mun River and can reduce the flood flows in the delta. Moreover, the release of reservoir storage during the dry season can supply water for irrigation of the vast deltaic area of the Khmer Republic and Vietnam, as well as reduce salt water intrusion in the coastal region.

Pa Mong's potential impact on the development of the basin was recognized in the early stages of planning and provision was made for comprehensive investigation of the project by a United States Bureau of Reclamation team under an agreement concluded between the Mekong Committee and the United States Government. The bureau team began investigations in 1963. An interim report[1] on the Pa Mong project was published in 1968. A feasibility report[2] on the first stage was released in 1970 and a report covering the later stages of development of the project was released at the end of 1972.[3] Investigative work undertaken to date includes field surveys; extensive topographic mapping; foundation and geological exploration; land classification; drainage; and sociological and economic studies; and the preparation of feasibility designs and estimates for the main project features.

Initial (Stage I) development would include providing mainstream and tributary storage; installing 4,800 megawatts of hydro-electric generating and transmission line capacity; and developing irrigation facilities for 43,000 hectares in Laos and Thailand. Statistical data on the project is presented in Table 18.

The key element of the project is the immense reservoir that would be created by constructing dams on the Mekong and its tributaries, the Nam Mong and Nam Lik. The reservoir would extend upstream from the main dam site about

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[1]United States Department of Interior, Bureau of Reclamation, Pa Mong: Stage I Interim Report (Washington, D.C., 1968).

[2]Ibid., Pa Mong Project: Stage I Feasibility Report, 1970.

[3]Ibid., Pa Mong Project: Stage II Feasibility Report, 1972.

20 kilometers above Vientiane to the possible Sayaboury project. Auxiliary dams would be needed on the Nam Mong and Nam Lik rivers to contain the reservoir at the proposed headwater level. In addition, earthfill dikes would be required at several locations on low portions of the reservoir rim.

The principal project features to be undertaken during Stage I include the Pa Mong dam and power plant, the Nam Lik and Nam Mong dams, the reservoir rim dikes, transmission lines, and irrigation systems.

Pa Mong would be a concrete gravity structure, 1,360 meters long and 115 meters above the stream bed. The proposed crest elevation was selected following studies of four alternative dam heights, the lowest considered being 76 meters. The center section of the dam would contain a gated spillway capable of discharging a probable maximum flood of 36,000 cubic meter/sec (with allowance for surcharge). A four-unit, 2,400 megawatt power plant would be located on each side of the spillway in the non-overflow abutment sections. Stage I development would provide for 4,800 megawatts of power. River outlet works consisting of six conduits having a total discharge capacity of 700 cubic meters/sec would be located in the middle of the spillway section. An outlet for irrigation in Laos would be located through the non-overflow left abutment section of the dams; this would have a maximum capacity of 80 cubic meters/sec. A tunnel located about 500 meters upstream from the dam would deliver 16 cubic meters/sec for the initial phase of irrigation in Northeast Thailand.

The Nam Lik dam, 69 kilometers north of Vientiane, would be a double-curvatured, three-centered, thin arch concrete structure rising 93 meters above the streambed. Crest length would be 435 meters. Two high-pressure gates having a combined discharge capacity of 35 cubic meters/sec would be located in the center section of the dam. Two penstocks through the dam would be provided for a future power plant. There would be no spillway as all tributary floods could be absorbed in the reservoir. A road across the crest of the dam would provide access to both sides of the river.

The Nam Mong dam would be about 55 kilometers west of Udorn. It would be a rolled earthfilled structure, 170 meters high with a crest length of 2,030 meters, giving access across the valley. An outlet works through the right abutment would permit release to irrigation canals and to the Nam Mong River.

Lengthy transmission lines would be required to connect the power plant with existing facilities at load centers. Initially, a 115-kilovolt line would be constructed to Udorn, two 500-kilovolt lines to Bangkok, two 230-kilovolt branch lines to other centers in Thailand, and a 115-kilovolt line to Vientiane.

Initial irrigation facilities would include outlet works at the main dam, a 1,200-meter tunnel in the first section of main canal and lateral and drainage systems to provide irrigation for about 11,400 hectares in Laos. The tunnel through the right abutment at the Pa Mong dam site, together with the Huai Mong diversion dam below the Nam Mong dam and associated canals, laterals and drains, would serve approximately 31,600 hectares in Thailand. Water distribution and drainage systems would be provided to supply water to individual farms in the irrigated area. Additional pump irrigation might be developed as power becomes available.

Engineering and geologic investigations, supported by laboratory testing and analysis, indicate it is structurally feasible to create a reservoir with a gross capacity of 107,400 million cubic meters at a normal high water surface of elevation of 250 meters above mean at sea level. About 77,868 million cubic meters would be available as effective storage for power generation, irrigation, and flood control. An estimated 24,550 families in Thailand and 19,900 families in Laos would have to resettle because of the inundation of land within the reservoir area. The effective storage of the reservoir would normally be empty or nearly empty at the end of the dry season and full at the end of the rainy season. Using part of the effective storage, it would be possible to reduce the 100-year flood peak from 26,600 cubic meters/sec to 15,600 cubic meters/sec, enough to keep the flow of the river within its banks from below the dam site to the Mun River confluence, and at the same time materially reduce the flood flow in the delta.

Effective storage would increase the minimum dry season flow at Vientiane from 836 to 2,921 cubic meters/sec[4] or by 2,083 cubic meters/sec which would greatly improve the firm power production of all projects downstream.

The increase in minimum flow amounting to 2,085 cubic meters/sec would provide a supply for dry season irrigation in the delta and help to combat saltwater intrusion. Navigation also would be materially improved during the low water period.

TABLE 18

SALIENT FEATURES OF PA MONG AS AN ISOLATED PROJECT

1. Purposes served	power, navigation, flood control, irrigation
2. Dam	
Type	concrete gravity
Height above foundation	115 m
Crest length	1,360 m
Spillway capacity	36,000 cubic meters/sec
3. Reservoir	
Normal water level above mean sea level	250 m
Minimum water level above mean sea level	220 m

[4]Based on flows during April, 1958, the driest period in a record of 57 years (1913-1969).

TABLE 18 (Continued . . . .)

	Drainage area	305,422 km^2
	Area	3,846 km^2
	Gross storage capacity	107,400 km^3
	Effective storage capacity	76,868 million m^3
4.	<u>Power plant</u>	
	Rated head	63.5 m
	Number of units	8
	Total installed capacity	4,800 megawatts
	Firm power	2,215 megawatts
	Average annual generation	24,335 megawatt hours
5.	<u>Irrigation</u>	
	Maximum monthly diverted flow	55 m^3/sec
	Total area served	43,000 ha
6.	<u>Navigation</u>	
	Increase in minimum monthly flow	2,085 m^3/sec
7.	<u>Flood control</u>	
	Reduction of 100 year flood	11,000 m^3/sec
	Agricultural land protected	148,000 ha
8.	<u>Costs</u> (including interest during construction)[a]	
	Dam and reservoir	575 million U.S.Dollars
	Power plan aid equipment	491 million " "
	Irrigation facilities (in Northeast Thailand & Laos)	85 million " "

TABLE 18 (Continued . . . .)

Total project costs	1,151 million U.S. Dollars

[a]Excluding transmission costs

Source: United Nations, Committee for the Coordination of Investigations of the Lower Mekong Basin (Khmer Republic, Laos, Thailand and Republic of Vietnam), Report on Indicative Basin Plan -- A Proposed Framework for the Development of Water and Related Resources of the Lower Mekong Basin, 1970.

APPENDIX 3

DISCUSSION ON OTHER POSSIBLE IMPACTS OF THE PA MONG PROJECT ON SOUTH VIETNAMESE ECONOMY

In the previous chapters, an attempt has been made to estimate the irrigation impacts of the Pa Mong project on the Vietnamese economy. However, besides increasing the agricultural production, the Pa Mong project will generate other benefits which will accrue to the delta as development progresses. Consequently, this appendix will provide a qualitative approach to these possible impacts which, due to the lack of relevant data, are too difficult to be measured quantitatively.

A. Effects on Flood Level

During the summer of 1967, a study program was undertaken by Kreiss, Davis and Cutler to analyze the hydraulic responses of the Mekong delta to various schemes of water control.[1] One of the main questions addressed dealt with the effectiveness of large upstream storage reservoirs in reducing floods to the extent required to prevent heavy and

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[1]Joint Development Group, Program for Analysis of Mekong River Hydraulics with Particular Reference to the Delta, prepared by A.B. Cutler, D.E. Davis and R.F. Kreiss, Working Paper No. 20 (Saigon: 1967).

widespread flooding in the delta. The analytical tool used for this study was the mathematical model of the Mekong Delta which has been prepared by SOGREAH (Societe Grenobloise d'Etudes et d'Application Hydrauliques) for the Mekong committee.[2] This model, installed in a computer in Bangkok, simulates hydraulics behavior in the delta at various flow conditions of the river. The study found that the operation of 60 billion cubic meters of flood control storage at Pa Mong would not significantly change the areal extent of flooding in the delta, but would reduce flood depths in some areas. However, the flood depth in 25 percent of the areas still is more than one meter.

As mentioned in Appendix 2, the annual flooding of the delta usually does little damage to the area because the agricultural techniques have been adapted to the prevailing water conditions. Three distinct systems of rice culture are used, each adapted to the natural conditions prevailing in different parts of the delta. In the upper part of the delta, annual flooding of vast areas requires the use of floating rice which is capable of growing at a rate and to a height sufficient to keep the heads above water as the flood rises. In the middle part of the delta, where flooding is not a serious problem but drainage of local rainfall is poor,

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[2]United Nations, Committee for the Coordination of Investigations of the Lower Mekong Basin, Report on Indicative Basin Plan, op. cit., p. V.87; and Development and Resources Corporation, Mekong Delta Development -- Appraisal Report, op. cit.

rice is transplanted twice in an effort to develop plants tall enough to survive under high water levels in the growing field. This type of rice culture is called the double-transplant system. Single transplanted rice is grown in the lower delta where flooding and poor drainage are less serious problems.

The upstream reservoir at Pa Mong could not completely eliminate inundation of the delta, but could reduce flood depth, and, most importantly, prevent any sudden increase in flood level which could submerge the rice plants and extensively damage the crops. Moreover, it should be noted that an inverse relation exists between rice yield and the flood level in the delta. An increase in rice production could be expected as the result of the regulating effect of the Pa Mong reservoir.

The total benefits of reducing flood damage are impressive and may reach billions of piasters, but unfortunately, due to their extremely complex nature, no attempt has been made in this study to quantify them.

B. Navigation Improvement Benefits

Throughout the history of the Mekong Delta, waterways have been the dominant mode of transportation. The entire population of the delta is water oriented and the major towns, with few exceptions, have grown up around strategic junctions between waterways. In addition to the main channels of the Mekong and Bassac rivers, there are some 2,400 kilometers of navigable canals in the delta.

However, during the dry season the inland water traffic is reduced considerably by the low water level in the canals which hampers the operation of deep-draft barges. The Pa Mong reservoir, by increasing the dry season flow of the Mekong River, will considerably facilitate the delta waterway transportation system.

Studies have shown that where large volumes of bulk commodities are available for regular haul, as is the case for rice between the delta and Saigon, inland waterway transportation is traditionally much cheaper than highway transportation. Presently, for example, the cost of barge transport between the delta and Saigon is estimated to be only one-fifth of the cost of truck transportation. Transportation rates, of course, are now distorted by wartime conditions; but the basic relationship between the two modes in the delta is roughly similar to that elsewhere in the world.

In short, substantial movement of freight by barge will remain in the future. In particular, rice production in the delta will continue to be dependent upon the inland waterway system, as will much of the backhaul traffic in fertilizer and agricultural inputs. Moreover, as the economic level of the delta rises, there will be an ever-increasing demand for all kinds of consumer goods to be supplied to the delta from industrial centers or from abroad.

Considering the future of the delta waterway transportation, it can be easily seen that the operation of the upstream reservoir at Pa Mong will greatly improve the dry season inland navigation in the delta, and will permit important savings in transportation costs. If these navigation benefits can be quantified, they will surely enhance the attractiveness of the Pa Mong project.

C. Reduction in Salinity Intrusion

As mentioned in Appendix 2, the coastal area of the Mekong Delta has been affected by dry salinity intrusion. Most of the incursions of saline water are caused by tidal fluctuations of the South China Sea and the Gulf of Thailand. These cause flow reversals during the dry season in numerous waterways connected to the lower ridges of the rivers and the ocean. The release of upstream water at Pa Mong, by increasing the dry season flow of the Mekong River, will prevent saline water from penetrating too far inland.

The saline encroachment which affects nearly one-third of the lands of the Mekong Delta causes two problems: (1) domestic and irrigation water sources, both surface and ground supplies, are degraded, and (2) the land turns saline. As a result, farmers have to wait a month or more after the beginning of the rainy season before planting to allow the rain to wash the salt from the soil. Farmers must also harvest early before salt water again intrudes at the outset of the dry season. The release of upstream water at Pa Mong to increase the dry season flow of the Mekong River will prevent saline water from penetrating too far inland. The degradation of land and water supply will be reduced considerably, permitting a longer rice growing season. The result will be higher yield and, most importantly, improved living conditions for the farmers of the coastal areas.

Although these benefits are difficult to assess quantitatively, they are important and deserve to be taken into consideration in estimating the economic impacts of the Pa Mong project.

APPENDIX 4

QUANTITATIVE PROJECTIONS OF RICE PRODUCTION NEEDS FOR SOUTH VIETNAM

To support the assumption that a market exists for the additional rice produced, it is essential to estimate the future needs of South Vietnam for this staple cereal.

In 1969, a study of projected needs for agricultural production in the delta was conducted by the Development and Resources Corporation for the government of South Vietnam.[1]

In its estimate of requirements for domestic consumption, the Development and Resources Corporation made the following assumptions:

First, the population of South Vietnam will increase at the rate of 2.6 percent per year. On this basis, population in 1980 would be 24 million, and by 1990, more than 30.6 million. Estimates of domestic needs for agricultural products are based on this rate of population growth.

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[1] Development and Resources Corporation, Projected Needs for Agricultural Production in the Delta, 1970-90, October, 1969, supplement to Appraisal Report Mekong Delta Development Program, October, 1969.

Second, income will continue to increase moderately, but not rapidly. South Vietnam is expected to remain basically an agricultural nation with perhaps 60 to 70 percent of its population classified as agricultural as late as 1990.

Third, diets will change with increasing incomes and emphasis on better balance in food consumption. Trends already under way in South Vietnam will likely result in these relative shifts among food products:

Cereals (rice, wheat, etc.)	Down slightly
Starchy food (sweet potatoes, manioc)	No change
Beans and oils	Up moderately
Sugar	No change
Fruits	Up moderately
Vegetables	Up Substantially
Animal products (meat and egg)	Up slightly
Fish products	Up moderately

Rice is now, and will continue to be, the most important single item in the Vietnamese diet. Consumption of rice per capita will likely decline slightly as rising incomes lead to an increased use of substitute foods.

The estimated quantities of certain major crops required for domestic needs are listed in Table 19.

The projections made by the Development and Resources Corporation show that although per capita consumption in rice decreases slowly over time (from 325 kilogram per capita

TABLE 19

ESTIMATED DOMESTIC REQUIREMENT AND PER CAPITA DISAPPEARANCE FOR CERTAIN AGRICULTURAL CROPS IN SOUTH VIETNAM

Crops	1980		1990	
	Per Capita Disappearance (kilogram)	Domestic Needs (metric tons)	Per Capita Disappearance (kilogram)	Domestic Needs (metric tons)
Rice	310.0	7,440,000	300.0	9,189,000
Manioc	25.0	600,000	25.0	766,000
Sweet potatoes	20.0	480,000	20.0	613,000
Peanuts	3.0	72,000	3.5	107,000
Soy beans	1.0	24,000	1.5	46,000
Vegetables	23.0	552,000	40.0	1,225,000
Corn & Sorghum	3.0	150,000	3.0	200,000

Notes: Disappearance includes amount used for seed, shrinkage in marketing, damage by rodents and insects, etc. The disappearance rates reflects anticipated changes in the diet of the Vietnamese people with a daily intake of 2,000 to 2,200 calories.

Source: Development and Resources Corporation, Projected Needs for Agricultural Production in the Delta, (1970-1990) October, 1969.

in 1970 to 300 kilogram in 1990) South Vietnam will still require 9,189,000 tons in 1990 for its domestic needs. This represents a net increase of about 5 million tons over the amount of rice produced in 1971 (4,871,000 tons). This additional requirement for rice must be satisfied either by improving production or by importing rice from abroad. It is safe to conclude that there exists an effective demand for rice in the near future, and the government has a strong motive to implement the Pa Mong project. However, it has been recognized that full irrigation benefits of the Pa Mong project will be achieved only with a massive agricultural program to help the delta farmers expand production. Suggestions will be made which may contribute to the establishment of such a program.

A. Agricultural Research and Farmer Education

To take full advantage of the project, the implications of the increase in irrigation water will need to be examined and a determination will need to be made of the best means of field preparation and water utilization for a second rice crop. Optimum soil and water management practices, as well as the possibility of introduction high yielding rice varieties (e.g., I.R.8 and I.R.5)[2] will also need to be identified.

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[2]Two high yielding rice varieties used for the Green Revolution.

These determinations will require a great deal of research, but more importantly, once these optimum solutions are identified, several million farmers will have to be educated in their use. A program of research and extension is therefore central to planning the implementation of the Pa Mong project.

Experimental stations and pilot farms should be increased to train manpower and to provide accurate data on crops and farming practices. These pilot farms should be located in various parts of the delta, and should serve as focal points for instructing large groups of farmers. Agricultural technicians in these pilot farms should work in close contact with the farmers, instructing them in the use of new technique and demonstrating the value. The manpower needs for staffing these farms are very great. Large numbers of highly trained and experienced agriculture specialists and engineers will be required. Current estimates of the availability of such manpower indicate a serious short fall. Heavy emphasis, must, therefore, be placed upon improving education in agriculture at all levels, and in preparing students as carriers for extension agents and farm managers and operators.

B. Marketing Policy

Marketing facilities should be improved to handle the increase in agricultural production efficiently and at minimal losses.

1. Distribution of Physical Inputs

Seeds, fertilizers, insecticides, herbicides, and equipment, and their ready availability at fair prices are essential elements of the increase in agricultural production. However, surveys conducted by the Stanford Research Institute[3] showed that the farmer is served by a very inadequate marketing system, and that an unsatisfied demand for farm supplies exists, varying considerably from one type of input to another. In 1968, the demand for rental tractors and insecticide sprayers was only 16 percent satisfied, while the demand for water pumps was only 21 percent satisfied. Only a third of the farmers are getting all the improved rice seeds they want and only 57 percent of the farmers are having their fertilizer requirements met. Improvement in the distribution of agricultural inputs is, therefore, crucial to the success of the Pa Mong project because it depends extensively on the delta farmers obtaining the necessary inputs at reasonable prices.

2. Marketing of Project Output (rice)

The entire fabric of the rice marketing industry is permeated with innumerable instances of avoidable waste. The local market for rice is composed of thousands of merchants

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[3]Stanford Research Institute, Land Reform in Vietnam, (Melo Park, Calif. 1968) Summary Volume, p. 186.

and middle men, each severely limited in his operation by a lack of capital and a limited knowledge of the market in which he operates. There is a high turnover of people in this business and inefficiencies are high. Losses are estimated to be as high as 20 percent of total production. Reducing these losses could have the same effect on the economy as an increase in production. Reduction of waste will also benefit consumers by reducing prices and/or increasing consumption.

C. Credit Policy

The availability of adequate credit to farmers on reasonable terms is also among the major facilitating factors needed in any effort to increase agricultural production. There is a need to assess the amount of credit required to orderly increase agricultural production. Consideration should be given to the amount of short term credit needed to carry enterprises through the production season. Care must be exercised in establishing credit procedures so that they may remain simple while providing some degree of control over the use of the funds.

D. Price Policy

It is not unusual for patterns of production to be altered markedly in response to established price policies or activities which affect the formation of such prices. Consequently, there is a need to identify public and private pricing policies and institutional arrangements which might have an impact upon the development of agriculture in the delta. Policy makers should also determine the nature of the pricing and market structure for agricultural commodities produced within the delta and assess the impact which such structure might have upon the allocation of regional resources and markets.

E. Land Reform

Economic growth is dependent on far more than input-output relationships, costs and returns. In most endeavors, powerful institutional factors modify the basic economic relationships which prevail. Among the foremost of these factors are rural land holding and tenure patterns. It is not unusual for patterns of production to be altered markedly in response to established land holding institutions which affect the farmer's incentive to produce. Unless a farmer is in secured possession of his land, he will be reluctant to make the necessary investments to improve his farming techniques and increase production. This leads to the necessity of an extensive land redistribution program to insure each farmer an equitable share of the fruit of his efforts and to eliminate the outdated land holding systems which have degraded the peasant from a factor of production to a mere tool for land exploitation.

In conclusion, if South Vietnam is going to benefit fully from the irrigation impacts of the Pa Mong project, top priority should be given to the agrarian reform in the delta. Defined as an integrated program to reorganize the institutional framework of agriculture to facilitate social and economic progress, this agrarian reform must include not only the redistribution of land and the regulation of rents and wages, but also the institution of a functioning farm credit system, cooperatives and agricultural education.

In conclusion, the economic analysis presented in this study shows that quantitative techniques can be used to evaluate large-scale public projects in South Vietnam. It is hoped this study will induce more quantitative research, both at macro and micro levels, of the economic implications of the Mekong Development scheme for the countries of the Indochinese Peninsula.

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