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9. ABSTRACT

The work reported here was conducted in Caracas from 1963 through 1966 by the Simulmatics Corporation, working in collaboration with the Universidad Central de Venezuela and CORDIPLAN, the Venezuelan government planning agency. A series of models of the Venezuelan economy was formulated for use in studying the nation's development strategy by means of computer simulation. With this technique, alternatives can be compared in a way that offers guidance to policymakers without impeding their use of judgment and intuition in making planning decisions. The principles of simulation are briefly presented and then illustrated by a detailed plan for a policy study. The analysis and experiments to be conducted are explained. The study plan is not just a hypothetical illustration; it is based on the actual situation in Venezuela and the capabilities of the model (V-2A) developed for use in such studies. The authors recommend that CORDIPLAN carry out this plan. Further sections of the report review the development of various simulation models considered, and explain their differences; summarize problems encountered and the work done in analyzing statistics; describe uses to which the Model V-2 was put in helping CORDIPLAN in its economic planning activities; present details of the abstract model; and present recommendations for future simulation activities in Venezuela.

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Prepared by
THE SIMULMATICS CORPORATION
Cambridge/New York/Washington

DYNAMIC MODELS FOR SIMULATING

THE VENEZUELAN ECONOMY

prepared by The Simulmatics Corporation

for

Centro de Estudios del Desarrollo (CENDES),
Universidad Central de Venezuela

and

the Agency for International Development,
United States of America

July 1966

revised September 1966

Dedicated

to the memory of

JORGE AHUMADA

and his hopes for the usefulness

of research in overcoming poverty and conflict

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CORRECTIONS

Dynamic Models for Simulating
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p. 22, line 6: after "conditions" insert "to ascertain whether the conclusions are contingent on the conditions"

p. 54, Eq. 11 : change CPW7 to CPW6

p. 60, Eq. 33 : in three terms after the multiplication sign should be enclosed in parentheses

p. 86, Eq. 79 : change ZCA6 to CZA6

p. 92, line 10: after "and" insert "since the latter influences the wage rate, which in turn affects PZD,"

p. 219 : items 02, 03, 04, should read "Market-oriented agriculture ..." etc.

p. 226 : footnote should read: "Price in parentheses replaces other when i = 71 to 99

p. 231, line 8 : brackets misplaced; should enclose (RREND(9) - RBj) instead pf on the first term

CHAPTER 1

THE SIMULMATICS - CENDES PROJECT

1.1 Summary

A series of models of the Venezuelan economy have been formulated for use in studying the nation's development strategy by means of computer simulation. With this technique alternatives can be compared in a way that offers useful guidance to policy makers without impeding their use of judgment and intuition as other elements in making their decisions. The principles of simulation are briefly presented below, and are then illustrated by a detailed plan for a policy study, with explanation of the analysis as well as of the experiments to be made. The study plan is not just a hypothetical illustration. It is based on the actual situation in Venezuela and on the capabilities of the model that has been made ready for use in such studies (Model V-2A). It is recommended that CENDES and CORDIPLAN carry out this plan as part of their joint program of simulation work.

Following the background on the simulation approach and its intended application in a particular study, Section 1.4 of this chapter reviews the development of the different models in the course of the Simulmatics-CENDES project for simulating the Venezuelan economy and explains what their

differences are. It also summarizes the problems encountered and the work done in analyzing statistics and establishing the numerical content of the models (a subject that is covered more fully in Chapter 3).

Section 1.5 describes uses to which Model V-2 was put to help CORDIPLAN in its economic planning work. Chapter 1 then closes with recommendations for future simulation activity in Venezuela.

The succeeding chapters present the detailed abstract formulation of Model V-2A, the numerical work whereby its quantitative content was established, and the abstract formulation of Model V-3, the more detailed general model.

The work on which this report is based was carried out in Caracas between August 1963 and July 1966 by The Simulmatics Corporation in collaboration with the Centro de Estudios del Desarrollo (CENDES) of the Universidad Central de Venezuela, using the computer facilities of the Departamento de Cálculo Numérico of that University.* Liaison was maintained with officials of the Oficina Central de Coordinación y Planificación (CORDIPLAN), the government planning agency, who helped define the objectives and provided some of the necessary data. A member of the CORDIPLAN staff was attached to our group

during the last phase of the work. Other assistance in connection with statistical data was given by officials in the Banco Central de Venezuela and the Ministerio de Minas e Hidrocarburos. The principal funds for the project were provided to the University--which contracted most of the work to The Simulmatics Corporation--by the United States Agency for International Development.*

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* Under Project Agreement GMA-1-63.

1.2 The Simulation Approach

The value of simulation as a technique for studying questions of development policy lies in the flexibility it offers for experimenting with different combinations of instruments and with different assumptions about external conditions or even about the economic system itself. This flexibility is needed because the problems to be studied concern a dynamic system--an economy--which is undergoing changes in internal structure, external conditions, and policies, and whose quantitative characteristics are not accurately known. The nature of the system is such that its various elements interact in complicated ways. Different policies cannot be judged separately because their effects may not be independent. Neither can policies be judged by their immediate impacts, because in the longer run cumulative indirect effects may completely alter the outcome. To study development strategies for such a system obviously requires a versatile technique.

The flexibility inherent in simulation is a consequence of its fundamental nature as an experimental "try and see" method combined with the use of an electronic computer so that a large number of experiments can be tried. It is

not necessary to make a single set of assumptions about the economy and probable future conditions, as has often been done in planning, without knowing how much the results would be affected by changing any of the assumptions. Instead, a search can be made for strategies that are beneficial under a variety of alternative hypotheses.

Neither is it necessary, as in more traditional mathematical techniques, to decide in advance on a formula for judging the merits of the results and then to solve for the unique combination that is optimal under the arbitrary standard thus chosen. Instead, alternative results can be compared and judged in terms of the full array of relevant variables--national income, price indexes, foreign exchange reserves, and others. The factors that cannot be expressed in the mathematical formula can still be considered in applying judgment to the comparisons of alternative policies and their calculated outcomes.

The basic approach of simulation was originally developed in connection with physical problems, such as those of electricity, aeronautics, and hydraulics. In those fields, the processes to be studied are often simulated by means of physical models--scaled-down electrical networks, wind tunnel models, and scale models of rivers and harbors. As the systems to be investigated grew more complex, and as new fields not amenable to physical

modeling came to be studied, the same sort of experimental approach was applied to mathematical rather than physical models. Thus the subject of experiments in an economic system simulation is a "dynamic model" composed of equations, decision rules, and numerical information from which the timewise response of the system to different externally imposed conditions can be derived.

The variables in the model include such things as investment, capital stocks, current outputs of different goods, prices, incomes, tax revenues, imports, exports, and so on, many of them subdivided into several categories. The equations and instructions describe how to determine the different variables from the numerical data supplied, and how to calculate the changes in the whole set of variables from one point in time to another. All of this is expressed in the form of a computer program, which is a set of detailed instructions to the computer for carrying out all of the calculations and keeping track of the results. The most difficult and time-consuming part of the operation of simulating an economic system is establishing the concrete numerical simulation model and getting it ready for the experimental investigation.

Given the program and the necessary numerical information, the computer carries out a series of calculations for all of the dependent variables at one point in time. Then it

calculates the changes that would take place over a short time interval and arrives at a whole new set of values for the variables corresponding to the end of the time interval. The time interval used in the experiments here was one-twentieth of a year, and the process was repeated for every twentieth of a year until a duration of several years (10 or more in many tests) had been covered. In this way, the evolution of the system is traced out for one particular set of circumstances. This operation is referred to as a run. The process of making a run was repeated several hundred times in the course of developing and tuning up the models, as described later on. A study of policy alternatives may also require several hundred runs so that many different variations can be tried independently and in combinations and their separate and combined effects assessed. How the simulation approach is used is illustrated below in the explanation of a policy study to be made with a model developed in this project.

1.3 Design for a Simulation Study

Conventionally, when simulation is not used, the formulation of a national economic development plan often starts from an estimate of the feasible rate of growth of the economy and proceeds to projections of the corresponding output from each of various sectors and the investment required in each to provide the necessary capacity. The calculations are usually done entirely in real terms, ignoring any effects of price trends, and the levels of both private and government investment in each sector are postulated. In this process it may be found that the tentative plan requires an impractically large flow of one or more resources, either in terms of physical production or as overall domestic savings or foreign exchange inflow. In that event a new formulation of the plan must be tried, possibly requiring a reduction in the assumed overall rate of growth.

Planners accustomed to working in these terms are naturally prone to think of simulation simply as a means of carrying out the same process more efficiently and testing a few more alternatives--both alternative assumptions about coefficients or exogenous variables and alternative government investment plans. This, indeed, is one valid

way of using a simulation model, and one of the models developed in this project (Model V-2) has been used in this way to help CORDIPLAN study the effects of variations in the assumptions underlying the 1965-68 National Plan.*

A different way of using simulation--a way that makes more effective use of the special characteristics of the method--is illustrated here through a description and discussion of a plan for an investigation to be carried out with Model V-2A. What is presented below is not only an illustration of the approach. It is at the same time a concrete recommendation for action to be carried out by CENDES and CORDIPLAN**.

The proposed study starts from the premise that the

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* See Section 1.5.

**It had been intended earlier that such a study as this would be carried out as part of the Simulmatics-CENDES project. However, the price and investment functions in Model V-2 were found unsuitable for this sort of investigation, and development and tuning up of a model with satisfactory functions for these important variables (Model V-2A) was not completed until the end of Simulmatics' participation in the work.

feasible rate of development of a country like Venezuela may be limited by the generation of inflation and by balance-of-payments pressure associated with the growth of imports as investment is stepped up and income grows. If there is neither inflation nor a balance-of-payments problem, it should be possible to increase investment (and thereby the rate of growth) on the basis of deficit financing, up to the point where one problem or the other makes its appearance. If there is a balance-of-payments problem without inflation, imports can be restricted until the restriction begins to cause domestic price increases. Conversely, if there is inflation with a favorable balance of payments, encouragement of increased imports of appropriate kinds should inhibit the upward price trend. Thus, whichever problem appears first, it may be possible to continue increasing investment while adjusting import restrictions until both inflation and the balance of payments become limiting.

The basic idea of the study is to experiment with different ways of working up to those limits, including using policies that are aimed at pushing back the limits themselves. Since the private nonpetroleum sector is significant in Venezuela's development, it is important to have in the simulation a reasonably good representation

of the aggregate behavior of private investors in that sector. And since incipient inflation is to be a criterion, a reasonably realistic price function is clearly a necessity. It was primarily to meet the needs for those two behavioral functions that Model V-2A was developed to supplant Model V-2.

The coefficients of Model V-2A have been adjusted to make the characteristics of the model correspond to those inferred from history for the economy. They are to be kept at the same values for at least the initial experiments (or if they were found to have trends, the trends may be extrapolated.) Exogenous variables, such as the volume and price of oil exports, will be projected on a "best guess" basis; alternative projections will be tried later on. In the first series of runs, several different levels and rates of growth of government investment will be exogenously applied to the system, and for each case, the evolution of the system over a period of ten to fifteen years will be simulated and recorded. (Although the standard planning period used by the Venezuelan government is four years, for study purposes a longer period should be used. Results will be recorded for intermediate years or even shorter intervals if desired, not just for the terminal year.)

Out of the several dozen variables that are recorded each time, special attention in these runs will be given to

the time paths of:

gross national income

the balance-of-payments surplus or deficit on the current account*

public sector revenues and expenditures

the general price index.

If the postulated government investment programs cover a wide enough range, the following results should be found:

1. Higher levels and rates of growth of government investment will result in higher levels and rates of growth of gross national income and real disposable income per capita, although the relationships may not prove to be linear.

2. With the lowest government investment program, the balance of payments will show a surplus throughout the period. With higher rates of increase of government investment, the surplus will diminish in the course of the run, and turn into a deficit with the most rapidly increasing government investments, the deficit will appear early and grow quite large.

3. The general price index should be reasonably stable**

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* or, with an assumption about capital inflow as an exogenous variable, it could be the overall surplus or deficit that is observed.

** i.e: changing no more than one or two percent per year.

for all rates of increase of government investment up to some critical point, beyond which more intensive investment may be expected to have increasingly inflationary effects.

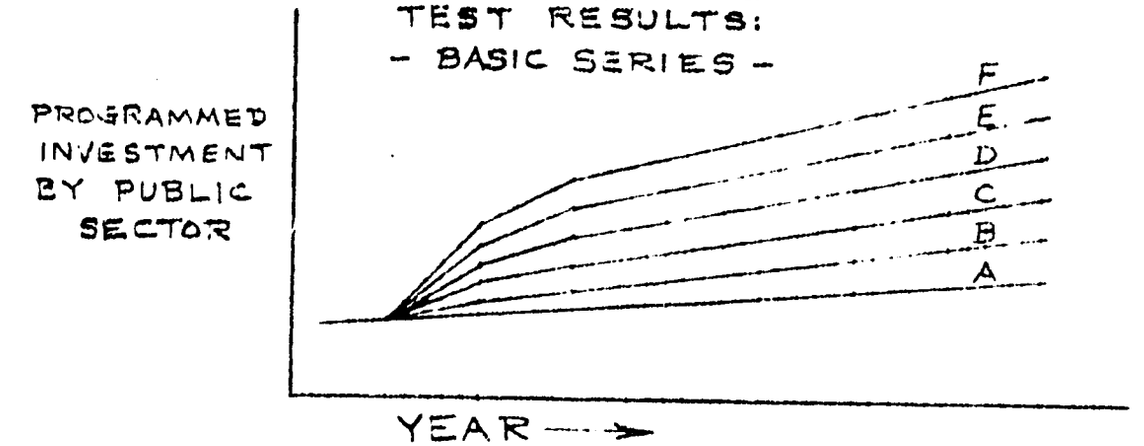
The results might appear graphically as shown in Figure 1-1.

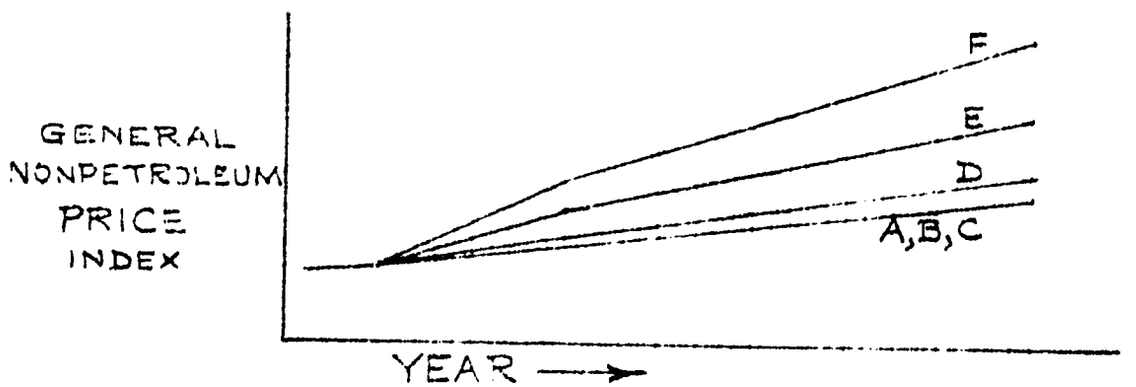
This first series of runs is not expected to provide very much guidance for policy making. It is intended as a base or reference line from which to explore in several dimensions. Certain things are to be noted before proceeding as a matter of defining the problem. In particular, the points where inflation and the balance-of-payments deficit pass acceptable limits will need to be observed. (This implies arbitrary definitions of "acceptable limits," but the definitions used at this stage need not be final; they can be reconsidered later if desired.)

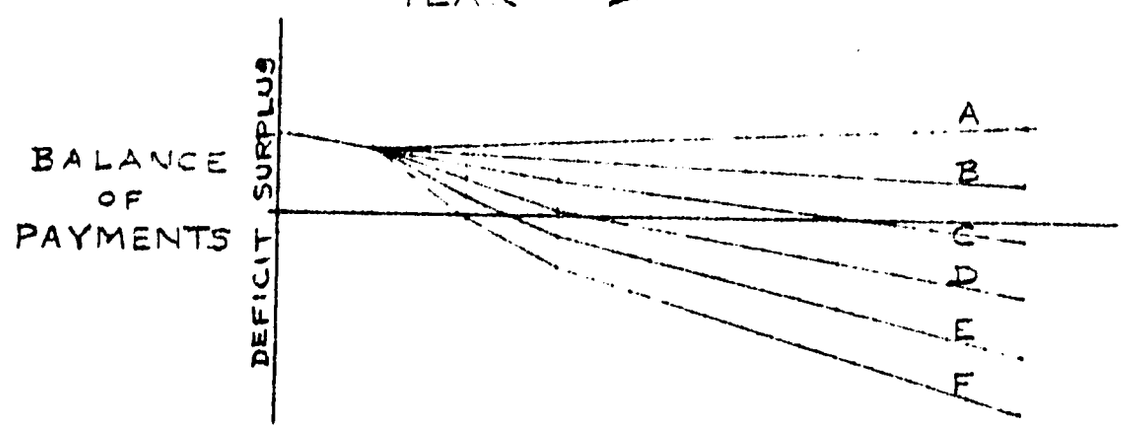
A convenient way of condensing the results to facilitate comparisons with subsequent runs is to make "cross-plots" as shown in Figure 1-2. These graphs are derived from those of Figure 1-1 as follows:

For each of the runs, the proportionate rate of increase of the price index is measured from the second graph in Figure 1-1, and the proportionate rate of increase of per capita disposable income is measured from the fourth graph; plotting one of these rates of

FIG. I-1
HYPOTHETICAL
TEST RESULTS:
- BASIC SERIES -







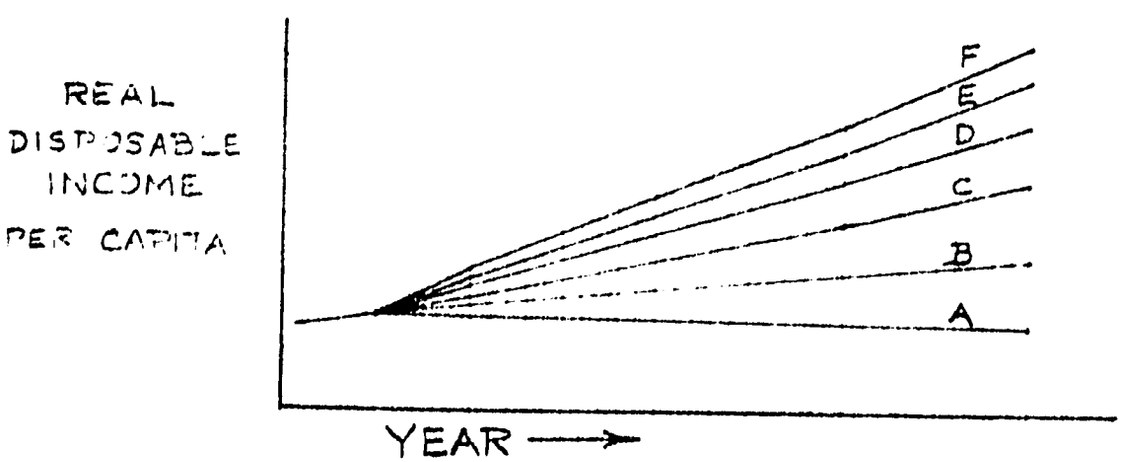
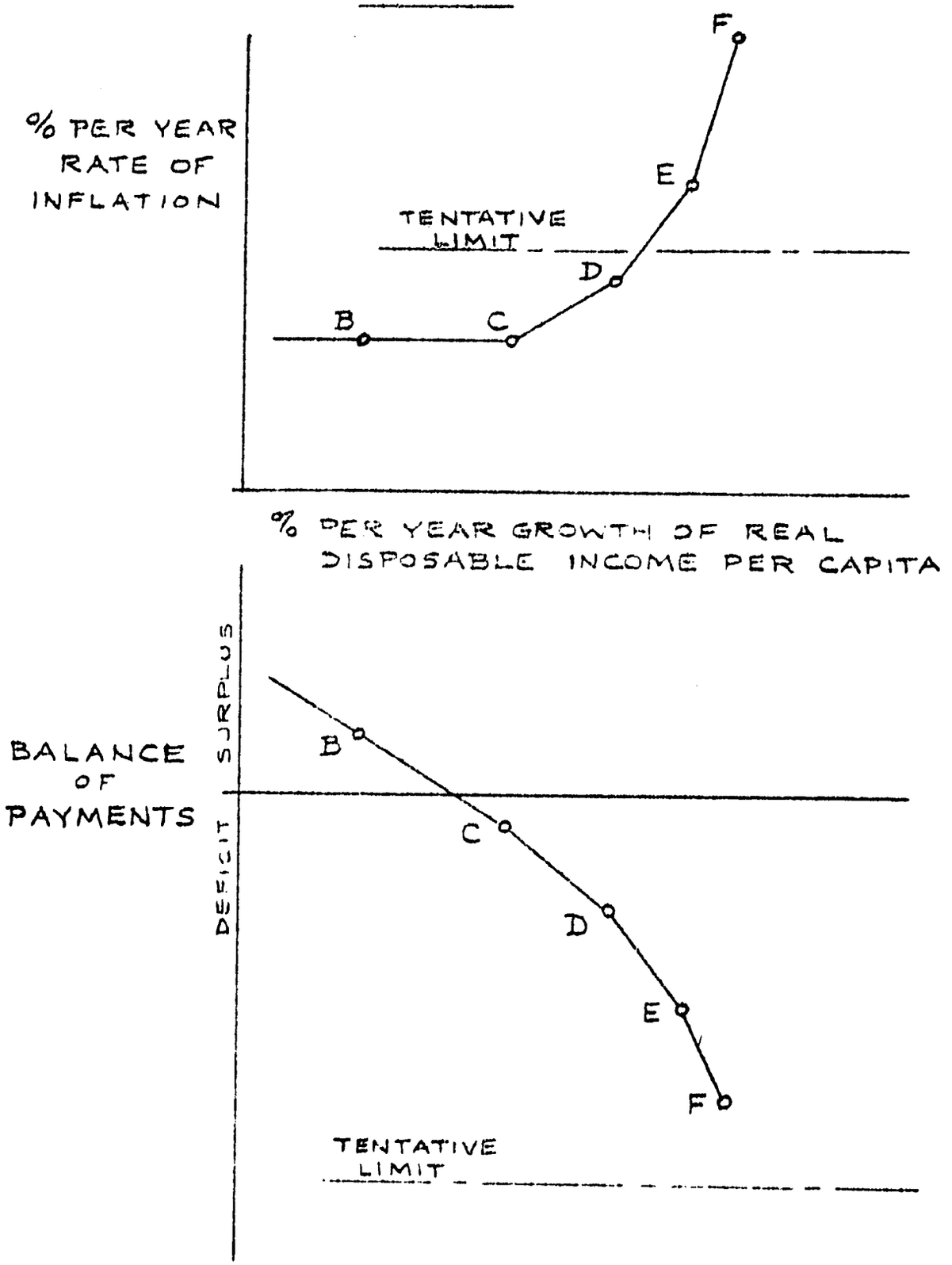


FIG. 1-2
BASIC SERIES
SUMMARIZED



increase against the other results in the upper graph of Figure 1-2. Also, as a crude but convenient indicator of the balance-of-payments prognosis, the surplus or deficit in one selected future year is plotted against the rate of increase of per capita disposable income, producing the bottom panel of Figure 1-2. The correspondence between points in the two parts of Figure 1-2 and the lines in Figure 1-1 from which they are derived is indicated by letters in both figures, each letter corresponding to one run. In the end, when final conclusions are being drawn, it will be desirable to compare selected runs in terms of their full time histories, as in Figure 1-1, but the process of selecting the runs to be compared in more detail and of drawing some preliminary conclusions can be done much more quickly in terms of information summarized as in Figure 1-2.

After the first set of runs has been made and the results graphed as shown above, the graphs may show that the range covered was too narrow or too broad, and some additional runs may be made to extend the range or to fill in an interval with some intermediate cases. This will complete what we shall refer to as "the basic series." Then the next step in the study can be taken.

What the next step is will depend on whether the foreign exchange problem or the inflation problem is deemed more critical at this point. Sooner or later both should receive attention, so

for the sake of concreteness, it will be assumed that the inflation problem is to be addressed first. If in the course of the study, it seems better to "start on the other foot," the sequence of tests can be changed without changing the basic approach of the investigation.

As the starting point for this next step, a run is to be selected from the first series at a rate of growth of government investment that produces more inflation than has been decided on as a limit--perhaps four or five percent per year above the acceptable rate of price increase. Let us assume that the run chosen is "F" in the graphs. Then, with all other parameters and exogenous variables kept the same as in this reference run, a new series of three or four runs will be made with successively higher values of the coefficient that represents the effective rate of direct taxes on petroleum earnings, PPTX.

Clearly, increasing this coefficient will increase the surplus or reduce the deficit of the public sector account. It will also have some favorable effect on the balance of payments* by reducing the volume of after-tax profits that can be remitted abroad. But whether it will have an effect on the trend of the price level, and

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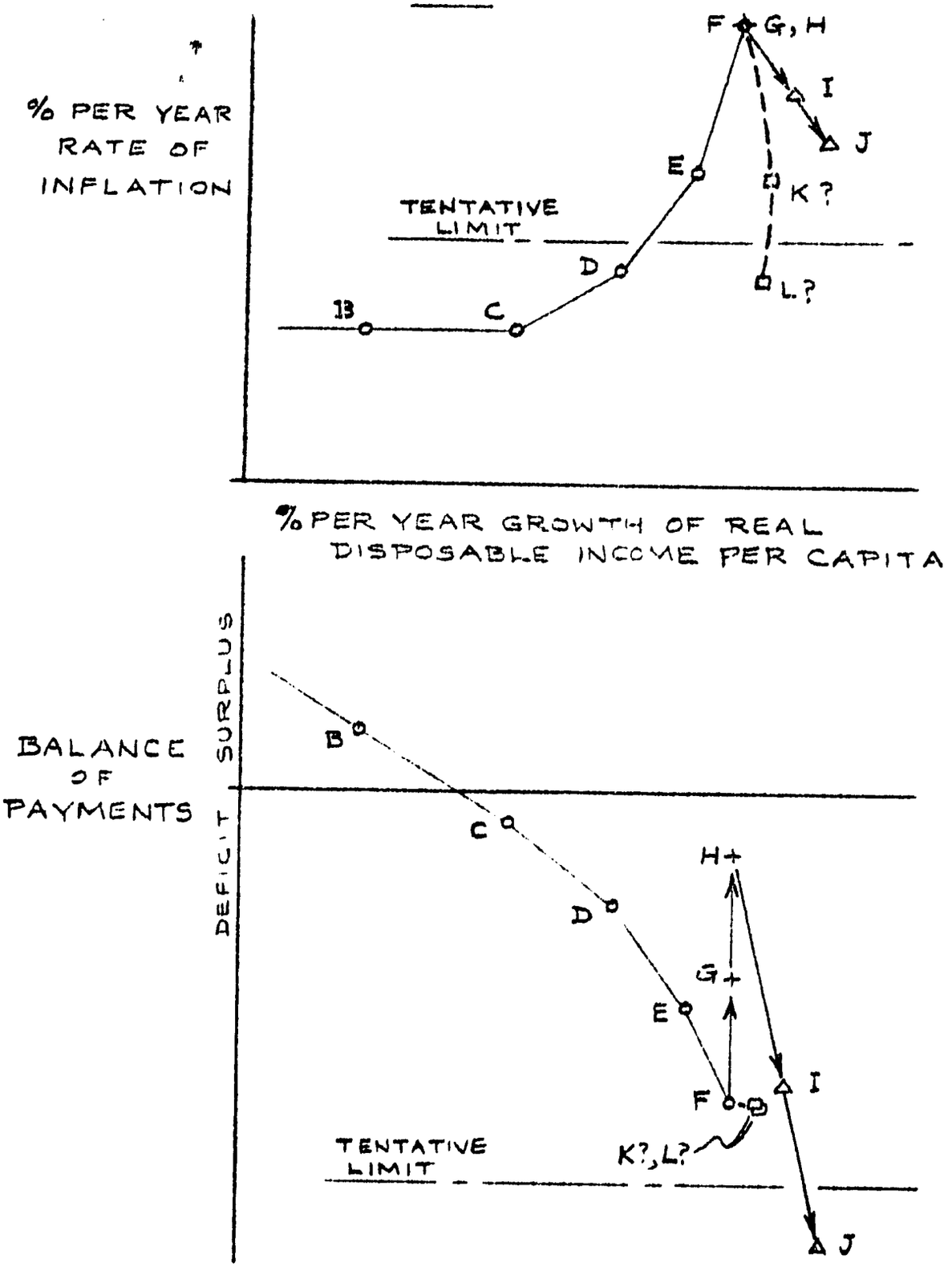
* --assuming the change in tax rate does not cause petroleum companies to change their production or investment plans. It would be worth a few tests to see how much of a change in petroleum operations could take place before the benefit was wiped out.

if so, how much, remain to be observed. (It is assumed for this step in the analysis that government expenditures have been planned and fixed, independently of the variation in revenue, and that an increase in revenue is simply added to surplus or used to reduce borrowing that would otherwise have been necessary.)

The results of this "petroleum tax series" of runs, graphed in the same summarized form as the "basic series" in Figure 1-2, might appear as point F, G, and H of Figure 1-3. (Run F is common to the two series.) If, indeed, it turns out as described above, that changing the petroleum tax has a significant effect on the balance of payments but not on inflation, another experiment will now be tried. Starting from a run with a high petroleum tax coefficient--Run H in Figure 1-3--import coefficients will be raised (or their downward trend arrested) to represent a relaxation of import restrictions. The coefficients may be raised all together for some test, selectively for others. In this way it may be possible to achieve a reduction in inflationary pressure in return for giving up part of the improvement that was previously realized in the balance of payments. This effect might appear as indicated by points I and J in Figure 1-3.

Following this group of runs with increased petroleum tax and liberalized imports, another set will be made restoring the petroleum

FIG. I-3
ADDITIONAL
SUMMARIZED
RESULTS



tax coefficient and import coefficients to their original values, and varying all three coefficients that represent direct taxes on individual incomes and nonpetroleum profits. The reference run for this series is the same as for the petroleum tax series, Run F of Figure 1-2 and 1-3. Initially, all three coefficients (PPTY, PGTY, and PNTY) are to be changed simultaneously. Later, if it is believed desirable, they may be varied separately.

Inasmuch as these taxes directly reduce disposable income, one effect of increasing them will be a reduction in consumers' demand, and probably in the rate of growth of gross national income in current prices. At the same time the inflationary tendency should be reduced, so that it is not certain whether real national income will grow faster or slower than before. If it grows faster, there might be, in the long run, a net gain in real disposable income, even though the immediate impact of the tax increase reduces it. Thus caution must be exercised in drawing conclusions from the summary graphs, and due thought will have to be given to the implications of the time period chosen for summary comparisons. It will also be necessary to consider whether economic performance is better indicated by the growth of national income or of disposable income, since a change in taxes will alter the relation between

the two. Runs from this "direct nonpetroleum tax" series might appear in Figure 3 as indicated by points K and L, but the location of these points is more difficult to foresee than the others.

The relative location of the points in the various series thus far described will suggest tentative conclusions that should be further investigated, either by more detailed comparisons of the full time series generated by relevant runs (as in Figure 1-1), or in some cases by additional runs with different combinations of coefficients.

At this stage answers might be apparent to some of the following questions:

1. To what extent are taxes on the petroleum sector and direct nonpetroleum-sector taxes interchangeable for financing a development program?

2. How large an effect would an increase in petroleum sector taxes have on the balance of payments and on inflation, if it did not affect petroleum production or investment?

3. What proportionate increase in imports would damp inflation to the extent of making a one percent per year difference in the price trend?

4. If direct nonpetroleum taxes are used to inhibit inflation, how effective are they?--is the growth of real national income accelerated or retarded?--will real disposable

income get up to, or surpass, the level it would have attained without the tax change? and if yes, then what?

When tentative conclusions have been reached on these and other similar questions, the pairs or groups of runs whose comparison indicates the conclusions will be repeated various times with changes in different assumed conditions that present themselves. Similar re-comparisons will be made with systematic changes in coefficients of the model, to learn whether the conclusions are sensitive to the estimates of any coefficients and, if so, which ones.

Further related questions will suggest themselves, some of which can be answered by appropriate tests with Model V-2A. Other questions--such as the income-distribution ramifications of the changes in disposable income due to direct tax changes--wil require a more disaggregated model such as Model V-3.

1.4 The Development of the Venezuela Models (Models V-2, V-2A, V-3)

Up to this point we have discussed the general idea and nature of simulation and specified how it should be used for a study of certain policy parameters. This section is concerned with what was done in the course of the project to create a simulation model suitable for studies like the one that is specified, and to design another model for future investigations at a more detailed level. It describes some of the practical problems that were encountered and how they influenced the evolution of the models.

The first phase of the work had two related objectives; 1.) to formulate a model (V-1) with five or six sectors, some of which would include relatively complicated relationships for capital, investment, pricing, and employment of different grades of manpower; 2.) to compile and analyze statistical data on the Venezuelan economy as a basis for determining the quantitative characteristics of the model. As work progressed in the statistical field, the model formulation was repeatedly altered in an effort to make it correspond better with what was being learned about the economy. However, it was found that there were no relevant statistics for many of the relations that were postulated and that some of the historical data were extemely dubious.

It was no surprise that data on capital gestation periods or on production functions did not exist, or that there was no way to estimate the effect of non-land agricultural investment on yields. It was disappointing to learn that work that had been under way several years earlier on an input-output table had been abandoned because of data problems, and that the recent survey of family budgets could not provide the information that we wanted on income- and price-elasticities of demand for major categories of goods. The greatest difficulty of all, however, arose from inconsistencies and implausible behavior of some of the main macroeconomic variables in the historical accounts.

We were aware before we started that the historical data were not considered very accurate. However, consistency was deemed more important than accuracy, and we had been assured that in spite of the unreliablility of absolute magnitudes the data on different variables in the national income accounts, balance of payments, etc., were all internally consistent. After starting to use these data, however, we soon found major inconsistencies not only between data from different sources but even within a given report. Therefore a great deal more time and effort than had been planned were devoted to assembling data from various sources, analyzing it, and attempting to eliminate inconsistencies that were found in it.

In the course of seeking help from the staff of CORDIPLAN and various other experts and agencies toward solving the data problems, it became evident that there was an acute difficulty in getting across to other people the basic ideas of what we were doing and what sort of information would be helpful to us. Moreover, there was a lack of motivation for others to aid the project, since productive results seemed so remote, and there were misgivings--both within the project staff and outside of it--about the inconvenience of using a model (V-1) which would be too complex to process with the limited computer facilities available to CENDES and CORDIPLAN. (The original plan called for the computer work to be done in New York.)

With all these considerations in mind, it was decided, after considerable work had been done on the first model (V-1) to set it aside temporarily and to carry through an exercise, using local facilities, with a simplified model. It was felt that a demonstration of the approach, on a simplified basis and with the communication advantages of using local facilities, would be a valuable supplement to our not-very-effective verbal explanations.

Some other benefits were expected from this operation,

as well. For one thing, our own staff would undoubtedly gain further understanding from the experience. For another, it would provide a test of the feasibility of doing useful economic-system simulation work with a machine as small as the IEM 1620 of the Central University. Members of the staff of the Departamento de Cálculo at the University were eager to participate in this experiment and hoped to demonstrate that we had underestimated the capabilities of their equipment and perhaps also of their programmers.

At the time of this decision, it was expected that the simpler, "global" model (designated V-2) would be used only briefly and that attention would then be returned to the completion of Model V-1. But the experience with Model V-2 eventually led to a change in these plans.

The initial formulation of the new model was rather quickly accomplished, being largely a matter of omitting, simplifying, and aggregating parts of the V-1 formulation, although some new functions had to be devised where relations had not yet been worked out for Model V-1. Programming and running the model, however, uncovered problems whose importance had previously been underestimated. Aside from some more or less mechanical problems, having to do with record-keeping and testing for errors, it was demonstrated that programming a model

that was tentative and subject to evolution should be done with a considerably different approach than programming a straightforward and routine data-processing operation. Efficiency in terms of processing time and use of storage locations, which had been paramount in the previous training of programmers, had to be compromised in favor of understandability, ease of trouble-shooting, and flexibility for modifications. The difficulty of communicating this philosophy to those who had been trained differently was compounded by the difference in our spoken languages.

The question of feasibility was favorably answered, nevertheless. It was found that the IBM 1620 (with 60,000 digits of internal storage and none external) could process a model somewhat more complex than the early V-2. Later, when external disk storage was added, considerably more complexity could be handled conveniently, as in Model V-2A.

A different sort of problem that was revealed once the simulation was operating more or less properly was another level of inconsistency in the historical data. Whereas we had been concerned, up to this point, with figures that failed to check in an accounting sense, we now became aware that even when the accounts were made to balance there were inconsistencies in an economic-theory

sense. The relative variations indicated by the data for cetain theoretically interdependent variables could not be reproduced by the model except by introducing behavioral assumptions that were extremely hard to justify. At one stage abrupt year-to-year variations were being postulated in the consumers' savings coefficient, investors' behavior coefficients, import coefficients, and other parameters in an effort to reproduce the "history" of investment, national income, consumption, and imports. Although most of these coefficients were still variable in the final version of the model and of "history", some of the variations indicated in the early work were erratic and unexplainable. Using the simulation as a test of theoretical consistency, some data series were eventually rejected and others modified to improve their relations with data that were believed more reliable. A notable example is the re-estimation of the history of nonpetroleum investment to make it more consistent with the history of national income and of imports of machinery and building materials. Details of this problem and its resolution are given in Chapter 3.

While the global model was thus being used as a learning device and as a tool for evaluating data, a strong interest developed in seeing it applied to actual problems that were of interest to CORDIPLAN in the formulation of development policy

and of a national economic plan. This interest, once accepted, led to a need for improving the model to make it more realistic and reliable than its original purpose had required. Unfortunately, we did not recognize for some time just how much the early model needed to be changed, and we tried to bring it up to the new standard of performance by a succession of minor changes and numerical adjustments. At each step it was feared that any major reformulation, such as was considered from time to time, would open the door for too many programming errors, which would take too long to discover and correct. The result of this caution, far from saving time, was to delay the development of a model that would be adequate for studies like that described above (Section 1.3). The initial global model (V-2) was modified in one way or another and reprogrammed thirty-three times--sometimes to correct errors; other times to reformulate equations--before it was decided that a major reformulation was required to make the price and investment functions work satisfactorily.

In preparation for the new formulation, several partial models were devised and used to test alternatives and to adjust numerical parameters, as described in Chapter 3. Finally Model V-2A was formulated. In this version, imported goods were disaggregated into four categories and new behavioral functions were included

for private investment and prices in the nonpetroleum sector. To avoid some of the difficulties previously encountered, these functions were programmed with newly-devised provisions for trying out alternative relationships and for using a more direct approach to the process of tuning up or adjustment of numerical coefficients. Even with these provisions, the adjustment of the model--involving, as it did, the new behavioral functions and several new import coefficients--required more than 50 runs over a period of several months. The adjustment was quite successful, as shown by the close agreement of simulation results and history in Chapter 3 (Figures 3-1 through 3-5), and Model V-2A is now ready for application to policy design studies, such as that described earlier in this report.

From the beginning of the project, another important objective had been to develop a model that would be more disaggregated, give more attention to subgroups in the population and their relative incomes, and deal with financial aspects of investment and other decisions. This model was also to feature a generalized formulation that would make it adaptable to other countries. Originally this general model was to evolve from Model V-1 by an increase in the number of sectors and the elaboration of the financial relationships. When V-1 was shelved, the advanced model had to be planned as a new formulation rather than as a product of evolution. The generalized

model, designated V-3, has been formulated in abstract terms, and its equations are presented in Chapter 4.

Unlike the previous model, Model V-3. was designad from the start for a high degree of disaggregation in various dimensions, but with provision for operating simplified versions of the model with the same computer program. The number of production sectors may eventually be as high as 25, but will probably be only about five in the initial experiments. Different occupational and income groups can be accounted for, but may be consolidated if other parts of the model are to be tested before the data on these subdivisions are ready.

Besides the provisions for extensive disaggregation, Model V-3 incorporates important relations that were omitted from Model V-2A, such as a detailed representation of the financial system and its interconnections with the production and use of economic goods and services.

Obviously Model V-3 is not designed to be within the limits of practicability for the IBM 1620, nor within the constraints of available data. It is designed, rather, with the expectation that both of these limits will be overcome. The University has already decided to acquire bigger and more modern computing facilities. CORDIPLAN has indicated its intention to concentrate the efforts of its economic planning group for the next year or

two on statistical studies designed to meet the requirements of Model V-3. CENDES will carry on the work of refining and adjusting the model to fit the statistical data as it becomes available. Thus, Model V-3 as it now stands is not an end product but is the beginning of a major continuing program of simulation work.

1.5 The Use of Model V-2 in Connection with National Planning Studies

While the statistical studies were in progress and the evolution of Model V-2 was taking place, questions were occasionally raised by the economic planning staff of CORDIPLAN about the capabilities of the simulation, and from time to time specific problems were suggested to us for possible investigation. We were always interested in learning whatever we could about the questions faced by the planning staff to guide us in defining the objectives of our work, and we were always anxious to give them whatever help we could. Unfortunately, the problems of data analysis and model development, described above, prevented us from having an ideally suitable model ready when the questions were brought to us, and thereby precluded our being as helpful as we would have liked to be.

Model V-2A, the model that would have been most appropriate for these purposes, was not tuned up and ready to use until the end of the project, in July 1966. During 1964 and 1965, while Model V-2 was operating, the functions for determining private nonpetroleum investment and price behavior had not been made to give satisfactory results. Hence it was never possible to use Model V-2 for the sort of policy study described in Section 1.3, where the behavior of private investors plays a

part in the endogenous dynamics of the system and where inflation is an important criterion of the results. Thus no program of runs that was carried out during the period of Simulmatics work in Venezuela was an investigation of the sort that makes full use of the potentialities of simulation.

Nevertheless, there are ways of using a simulation, short of the ideal investigation, that can be helpful to development planners, and for some of these purposes it is not essential that the behavioral functions be included as part of the model. A number of different tests were made with Model V-2 that CORDIPLAN found useful, in which both private investment and prices in the nonpetroleum sector were projected independently and programmed into the simulation as exogenous data. What the tests provided were macroeconomic projections similar to those normally made without a simulation but in this case computed by machine according to a model that automatically satisfied the multiplier relation and import coefficient, and kept all of the interrelated variables consistent. The process facilitated the making of projections so that a larger number of them could be made and used for comparing the effects of alternative assumptions.

One systematic series of tests* was made to determine

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* Model V-2, Runs 1052 through 1076

the effects of a change in the assumed rate of increase in petroleum exports, the effects of changing the rate of increase of government investment, and the extent to which government investment would have to be modified to compensate for a change in petroleum export if it occurred. Since the model was not capable of indicating inflation or changes therein, the effects (and the "trade-off" of government investment for petroleum exports) had to be assessed in terms of the government budget deficit and foreign exchange reserves.

Since these experiments were made with some rather arbitrary numbers and with a far-from-perfect model, the results were considered to be preliminary, and no formal report was prepared. To illustrate the nature of the investigation, however, some indications based on an analysis of the results are given below. These statements are subject to change when new tests are made with Model V-2A:

1. If the rate of growth of petroleum exports by volume were higher by one percent per year (e.g. 5% per year instead of 4% per year), all other conditions, including government spending, remaining as before, the government budget surplus would be increased (or deficit reduced) by about 500 million bolivars per year at the end of seven years, and the foreign exchange deficit during that time would be lower by about 500 million dollars.

2. A one-percent-per-year change in the trend of the price of

petroleum exports would affect the government budget about equally to a change of the same proportion in the volume of petroleum exports. However, the effect on the foreign exchange position would be only half as great for a change in the price trend as for a corresponding change in volume.

3. A one-percent-per-year addition to the rate of increase of government investment, if matched by an equal change in private nonpetroleum investment, would result in an increment to the government budget deficit, at the end of seven years, of about 230 million bolivars, and the foreign exchange deficit would be increased by about 180 million dollars.

4. The effect of a change in government investment on the budget deficit, as stated above, is only slightly altered by changing the assumption specified for private nonpetroleum investment. However, the effect on the foreign exchange position would be cut in half if the trend of private investment remained unchanged instead of changing with the government investment trend.

5. Assuming that changes in government investment would be matched by changes in private nonpetroleum investment, maintenance of a given budget position in the face of a one-percent-per-year change in the trend of petroleum exports would require changing the rate of increase of government investment by 2.2 percent per year. For example, if the rate of growth of petroleum exports was assumed to

be 5 percent per year instead of 4 percent per year, then the rate of increase of government investment could be boosted from x percent per year to x + 2.2 percent per year with the same resulting budget deficit or surplus. In this event, the foreign exchange deficit over a seven year period would be reduced by about 120 million dollars.

6. Under the conditions stated above, if the foreign exchange position were to be maintained instead of the budget position, then the rate of increase of government investment could be raised by 2.8 percent per year for a one percent per year increase in the trend of petroleum exports. This would increase the budget deficit by about 250 million bolivars per year at the end of seven years.

Of course, none of the "conclusions" stated above take into account the possible repercussions of changes in price trends that might be associated with the changes specified, and somewhat different results for the foreign exchange gap might come out of the newer model in which imports are disaggregated. The arbitrary assumptions about private investment should also be borne in mind, as well as the arbitrary choice of a seven-year period and of the criteria used for making comparisons.

In addition to this systematic series of runs, more limited spot comparisons were made from time to time to get numerical estimates in answer to specific questions such as the following:

Starting from a plan previously worked out in detail, what

change in total imports, year by year, would result from a proposed change in the schedule of overall government investment?

and:

How much would government revenues and domestic output be affected, year by year, by an assumed change in the trend of the import coefficient, taking into account the substitution of domestic output for imports, and the corresponding change in tax base for direct taxes as well as the change in base for tariff revenues?

Here, again, the answers were subject to limitations imposed by the shortcomings of Model V-2, and by the necessity for making some arbitrary assumptions to make up for the lack of endogenous functions. Model V-2A should provide better answers to such questions. Nevertheless, it was felt that the indications derived from tests with Model V-2 were better than could be obtained by any except the most laborious of hand calculations and that such tests were therefore a step in the right direction.

1.6 Recommendations to CENDES and CORDIPLAN

CENDES and CORDIPLAN have made clear their intentions of continuing jointly to work with simulation for planning and policy studies. It is hoped that the following recommendations will contribute to the effectiveness of that endeavor.

1) It is recommended that the study described in Section 1.3 be carried out in the near future using Model V-2A.

2) It is recommended that other studies, similarly organized, be carried out with Model V-2A from time to time as other questions are raised. Further evolution of the model may be desirable, according to the problems addressed.

3) It is recommended that studies be undertaken soon to develop the behavioral functions that will be required for any future model, including V-3. There is a need for a set of functions to represent private investment decisions in different sectors, as influenced by financial markets and by import protection and other instruments of allocation policy. Also needed are a consumption function that takes credit into account and allocates expenditure among various categories of goods, import functions that can respond to relative price changes as well as to quota limits and production decision functions that take inventory policies into account. In developing such functions, experiments with partial models will be almost indispensable. Possibly also Model V-2A can be trans-

formed into a test vehicle for some of these purposes.

4) It is recommended that a simplified version of Model V-3 be programmed, quantified, and tested as soon as the expansion of computer facilities permits (or sooner, going abroad for facilities) in order to gain experience with this sort of model and to learn what needs to be done in terms of data collection and analysis to make it operational.

CHAPTER 2

THE GLOBAL MODEL, V-2A -- ABSTRACT RELATIONS

2.1 The Overall Scheme

In this section the main outlines of Model V-2A are described and a general picture is presented of the relations among the various parts. In the rest of the chapter the particular relationships are more fully explained, both verbally and in terms of equations. Special relations and instructions that were included in the computer program for the purpose of tuning up the model or providing for alternative relations are not included in the basic model description.

In terms of its abstract relations, the model of the economy is essentially a combination of many pieces of economic theory and qualitatively observed phenomena that are well known to economists in general. Although there are some features that are not often encountered except in isolated partial relations, most of them should not be difficult to understand, so long as the reader is prepared for the fact that many limitations that apply to conventional mathematical

economic models have been removed. In a simulation almost any kind of relation that can be specified without ambiguity can be represented.

Two aspects of the dynamics of the model, nevertheless, may require some special attention on the part of readers accustomed to the conventional ways of describing and representing economic processes. First, most variables are conceived of as varying continuously through time rather than being determined once for each year.* Second, several important relations represent dynamic processes of adjustment that do not necessarily bring about a static equilibrium under dynamic conditions, although they may work toward it. The model can be better understood if these two ideas are borne in mind while the description is read.

The producing subdivisions of the model are the petroleum sector, the public sector (producing general services but not including state enterprises) and all nonpetroleum enterprises (both state and private). These are designated as Sectors P, G, and N, respectively. Each sector encompasses both current output and capital formation. These activities are complemented by a consumption function, import functions, national

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* The model is explained in terms of this continuous-process idealization. Although the computer program only approximates it, the approximation is very close.

income accounts, and the foreign payments account.

Three of the four principal exogenous variables in this model, which are programmed to vary with time, impinge on the petroleum sector. They are the quantity and price of petroleum exports and the level of investment in petroleum. These primary variables, in addition to making direct contributions to national and territorial income in the petroleum sector, are also the bases of the principal revenue of the government. The time-varying flow of government investment expenditures is the fourth of the most important exogenous variables for the model. It contributes to the demand for nonpetroleum goods and services, both directly in the form of government purchases, and indirectly by creating income from which consumption is financed. In addition, the investment component of government expenditures augments the productive capacity of the nonpetroleum sector.

Petroleum exports, price, and investment are treated as exogenous because they are necessarily influenced by many factors determined in other countries or in international markets. In projections for policy studies, different time variations are to be tried, in order to cover a range of possibilities within which more precise prediction is

impossible. Government expenditure is exogenous for a different reason. It is a policy variable and will be assigned alternative time variations for investigation of its effects.

The functioning of the petroleum sector is only slightly affected by the state of the rest of the economy. It is assumed that domestic sales of petroleum products are proportional to nonpetroleum output, but since domestic sales are only a fraction of exports, they can vary considerably without having much relative impact. The price level in the nonpetroleum economy affects the cost of goods and services purchased locally, but again, this effect does not weigh very heavily because of the small magnitude of local purchases relative to value added.

The public sector represents the service activities of the national, state, and municipal governments and of those autonomous government institutes which do not act as business enterprises. It is linked to the other sectors through the revenues it receives from taxes, tariffs, and multiple-exchange-rate profits, and through its use of goods and services purchased from the rest of the economy. In addition, its payroll is a source of income.

Demands for nonpetroleum goods and services include the demand by the petroleum sector and by the public sector for

inputs to current production and to capital formation, demand from abroad for exports, demand by consumers, and demand by the domestic nonpetroleum sector itself for intermediate and capital goods. The demand for nonpetroleum exports is exogenous and relatively small; the other components are endogenously determined. Consumers' demand is proportional to disposable income, smoothed and lagged.

Each of the components of demand listed above is met partly from imports and partly from the domestic nonpetroleum enterprise sector (Sector N). For most of these compenents the ratio of imports to total demand was postulated exogenously with a trend determined from a study of the historical data. For some components this import ratio--or its trend--changed significantly at certain times in the past where such changes could be explained either by events exogenous to the model or by changes in government policy (such as the import substitution policy which began to take effect about 1959).

For consumer goods, a function was postulated and programmed into the model whereby relative prices of imports and domestic goods could be made to determine the consumer goods import ratio endogenously. It was also possible, however, to eliminate this price sensitivity. In fact, that has been done in all of the runs to date with Model V-2A because of the impossibility of evaluating the parameters directly and the lack of time for tuning up the function and making sensitivity

tests on it. After more pressing problems are solved, perhaps the users of the model can carry on a study of the characteristics and effects of this function. The overall ratio of imports to domestic supply is, of course, determined by the variations of the import ratios assumed for the various components and by the relative magnitudes of the different categories of demand.

There are two important behavioral functions in the nonpetroleum sector besides total consumers' demand and the consumers' import function, mentioned above. They are the investment function and the price function.

Private gross real investment in the nonpetroleum sector is determined by a linear combination of terms proportional to the following variables:

Replacement requirements

Rate of growth of real gross territorial product (accelerator)

Total petroleum sales

Real investment by the government

The relation between current output and normal capacity (smoothed and lagged).

The replacement, accelerator, and capacity terms are included on the basis of well established theoretical considerations. Petroleum sales are included because they are given much attention in Venezuela as an indicator of business prospects. Real investment by the government is thought to stimulate private investment by providing complementary "infrastructure."

The price index for the products of the nonpetroleum sector is a weighted average of the price indexes for agricultural and nonagricultural products. Agricultural prices, being sensitive to the weather, import policies, selective price controls, and other factors that could not be accounted for in the model, are exogenous. The nonagricultural price index is affected by direct costs of intermediate inputs and labor and by import competition, financial conditions, taxes, and the rate of growth of demand. The price index itself affects the cost of intermediate goods (some of which are intrasectoral products) and labor costs (through the pressure to raise wages when the cost of living rises). Thus there is a "multiplier effect" whenever anything acts to change the price level.

The computer program for the simulation incorporates specific equations for all of the relations described above, with numerical values for all coefficients and exogenous quantities. It also includes many accounting and definitional equations. As the passage of time is simulated, the values of the variables in the system change step by step in accordance with the specified relations. The course of their evolution depends on the time paths that are assumed for the exogenous variables and coefficients. Some of these exogenous variations represent assumed or estimated trends, others represent government policy.

An investigation of development strategy will involve simulating various time paths of current and capital expenditure by

the public sector, together with many combinations of the coefficients (either constant or changing through time) representing the following·

a. effective rates of taxes on petroleum operations, on personal incomes in each sector (combined with business income in sector N), and on output·

b. effective rates of tariff and other customs charges on each of four categories of imports (imports for the petroleum sector and capital, intermediate and consumer goods for nonpetroleum uses);

c. exchange rates for the petroleum sector and for different import and export categories.

d. import ratios in different categories.

It is assumed that the government's foreign trade policy can alter the historically observed trends in the import ratios, but only within limits. The alternative projections of these ratios will represent judgment about the possible range of effects of policy within behavioral and technological limits.

2.2 Particular Relations and Equations

This section elaborates more exactly the relations that have been mentioned above. Some readers may feel that this is the essence of the matter--just what they have been looking for. Others will prefer to skip the details. The latter may as well go directly from this point to Chapter 3. If they find later on that they need more specific definition of some relations, they can refer back to this section and, for the meanings of symbols, to Section 2.3.

The detailed specification of relations, of course, requires the use of many equations, with a large number of code symbols to represent the various quantities involved. Each symbol is defined where it is first encountered, and is also included in an alphabetical dictionary in Section 2.3. The first part of the dictionary section explains some of the principles underlying the system of code symbols.

For convenience in finding particular relations or subdivisions of the model the equations and explanations in this section are grouped as follows:

2.21 Petroleum Output, Inputs and Costs

In the overall description of the model above, it was pointed out that three of the most important exogenous variables in the whole system pertain to petroleum. They are represented in the equations by:

QPW	Quantity of petroleum and products exported.	quants/year
PPW	Price of petroleum and products in world market.	Million$/quant ($/barrel)*
ZPKG	Gross rate of formation of real fixed capital in the petroleum sector. (Real gross investment)	caps/year**

At no time that we are aware of has output been limited by productive capacity; hence, exports are determined either by external demand or by decisions outside the scope of the model. The price is determined in international markets. And since the major oil companies operating in Venezuela are subsidiaries of international companies, their investment decisions are at least as dependent on factors outside of Venezuela as on internal

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* A "quant" of petroleum is defined as one million barrels. The international value of exports is expressed in millions of U.S. dollars. Thus the price, PPW, defined to be in units of million dollars per quant, is the same as the price in dollars per barrel.

** A "cap" is an artificial unit invented to make it easier to distinguish real stocks and real investment from their financial counterparts. It is a quantity of real capital worth one million Bolivares at 1957 prices.

considerations. Thus, it would not be feasible to make any of these variables endogenous in a model of the Venezuelan economy alone.

Other exogenous variables related to the petroleum sector (Sector P) are:

PWNW	World Price for goods imported by Sector P	Million$/quant
FPGCW	Flow of payments for concessions.	Million$/year
PPD	Price of petroleum products in the domestic market.	Bs/barrel

The first of these is exogenous because it is determined in external markets. The second represents a special event that occurred during 1956 and 1957; if it should occur again (which is not expected) it would be a matter of policy and negotiation. The last item above is set by government decree.

The product of the first two exogenous variables mentioned, of course, gives the dollar value of the petroleum exports, and multiplication by the exchange rate applicable to petroleum converts it to the Bolívar value:

1.	VPWW = QPW x PPW	Million$/year
2.	VPW = PWW1 x VPWW	Million Bs/year

The other variables affect the petroleum sector from outside its own limits, although they are internal to the model as a whole. Thus they are endogenous for the simulation of the complete system, but are exogenous from the viewpoint of the petroleum sector considered alone.

They are:

PZD	Price of domestic nonpetroleum nonagricutural goods	Million Bs/quant
QNQE	Gross real output of the domestic nonpetroleum sector. (Sector N)	quant/year*

QPN, the quantity flow of petroleum products sold domestically, is assumed to be proportional to this last variable. This is a crude approximation, but quite satisfactory for the relatively small magnitude involved.

The quantity flow and the corresponding value flow are:

3. QPN = APN x QNQE quant/year

4. VPN = PPD x QPN Million Bs/year

and the value flow for external and internal sales combined is:

5. VPQ = VPN + VPW Million Bs/year

The petroleum companies have revenue from other sources than sales of their output (e.g., return on investments in nonpetroleum activities). It was found that it could be adequately approximated as a fixed ratio to the revenue from sales. Hence their total revenue is given by:

6. VPQT = CPVQ x VPQ Million Bs/year

In quantity terms, the domestic and foreign sales are summed up:

7. QPQE = QPN + QPW quants/year

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* A quant of nonpetroleum product unlike a quant of petroleum, is defined as one million Bolívares worth at 1957 prices.

This may be compared at any time with nominal capacity, or potential production, which is taken as proportional to the stock of real capital:

8. QPQK = CPQK x SPK quants/year

The inputs of goods and services required from outside of the petroleum sector are first determined without distinction between those imported and those produced in the nonpetroleum part of the domestic economy. This distinction is made afterward.

The study of historical statistical data showed that the goods and services for current production, as well as total labor inputs, could be accounted for more consistently as a function of potential output (i.e., capacity) rather than actual output. This conclusion agrees with the qualitative observation that maintaining the facilities of a partially idle oil field or refinery in readiness to produce is not much different than using them for full production.

It was also determined that the ratio of inputs to potential output had declined steadily throughout the historical period studied, presumably because of increasingly efficient technology. Thus the flow of real inputs for current production (not including labor) is:

9. QNPE = ANP x QPQK quants/year

where the coefficient ANP decreases exogenously with time. (Note that the units of ANP are quants of N product per quant of P product and that the two kinds of quants are different.)

The quantity flow of inputs required from outside of Sector P for capital formation is approximated as a constant ratio to real investment:

10. QNPK = BNPK x ZPKG quants/year

These two flows of inputs are supplied partly from the output of domestic Sector N and partly from direct imports by Sector P. The ratio of imports to total supply is programmed as a separate exogenous time series for each of the two flows (CPW6, CPW8). The combined flow of imports (QWNP1) and the combined flow of domestic purchases (QNPQE) are thus given by the following equations:

11. QWNP1 = CPW7 x QNPE + CPW8 x QNPK quants/year

12. QNPQE = (1 - CPW6) x QNPE + (1 - CPW8) x QNPK quants/year

During 1956 and 1957, when the oil boom was accelerating to its climax, the government sold large new concessions to the oil companies. In the same two years, imports by the petroleum sector were considerably higher than could be accounted for by Equation 11 without implausible values of its coefficients. Presumably some sort of unusual stockpiling was taking place in anticipation of exploiting the concessions. Whatever the explanation, it is clear that conditions were abnormal in those two years. To account for the observed level of imports, the normal flow of imports, determined by Equation 11, is increased by a term proportional to the normal flow and to the concession payments. The increment and the total flow are, respectively:

13. QWNP2 = CWP x FPGCW x QWNP1 quants/year

14. QWNP = QWNP1 + QWNP2 quants/year

In all of the historical period except 1956 and 1957, FPGCW is equal to zero, and QWNP, therefore, is the same as QWNP1 of Equation 11.

In order to determine costs, profits, and taxes, all of the relevant variables have to be expressed in terms of the national currency. In the beginning of the petroleum sector description above, two prices were listed as variables from outside of the sector. PZD, the price applicable to domestic purchases, is the price of the nonagricultural component of production of Sector N. It may be either determined in the price function (see Section 2.27) or programmed exogenously. The exogenous world price of imports for Sector P, PWNW, has to be converted from foreign to domestic currency units and marked up to include customs charges. This involves:

PWW1 the exchange rate for Sector P — Bs/$

and PPT2 the customs revenue coefficient — nondimensional

Both of these factors are constant over long periods but are subject to change as instruments of policy. The relation (an identity) for the price of imports in domestic units is:

15. PWN1 = PWNW x PWW1 x (1 + PPT2) — Million Bs/quant

The cost of nonlabor inputs for current operations is then determined from the corresponding quantity flow by weighting the two prices, PWN1 and PZD, according to the import ratio and its complement, thus:

16. VNPE = [CPW6 x PWN1 + (1 - CPW6) x PZD] x QNPE — Million Bs/year

Two additional approximations are introduced at this point. The historical data on costs show that it is sufficiently accurate to assume that the direct labor cost for current production stays in a fixed proportion to the cost of nonlabor inputs. With this assumption the total direct cost is:

17. VQPE = CPVE x VNPE Million Bs/year

in which CPVE > 1.0. Further, the total labor cost for both production and capital-formation activities is approximated as proportional to VQPE:

18. YP6G = CPVG x VQPE Million Bs/year

As implied by the symbol used, this concept is equivalent to the total value added by labor or the income of labor in national-income terms for the petroleum sector.

2.22 Petroleum Investment, Incomes and Taxes.

It is necessary to distinguish the quasi-physical concepts of real investment, attrition, and the corresponding stock of physical capital from the accounting concepts of investment, depreciation, and the book value of assets. The physical capital concept is the one to which production capacity and hence direct inputs are related. The accounting concepts are necessary for calculating profits and hence taxes. Although the two concepts of gross investment are directly related through a price index*, the same is not true of the two stock concepts nor of physical attrition and accounting depreciation.

Real gross investment--perhaps more accurately described as gross capital formation--is exogenous, as mentioned previously. It is symbolized as ZPKG, and is a "flow" concept, in the sense that it is the time rate of additions of new capital to the stock; its units are caps per year. The corresponding stock is designated SPK (in caps). Attrition, corresponding to the rate of decline of old productive capacity, is assumed to be proportional to the existing stock. Hence net real capital formation and the resulting stock are determined as follows:

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* except in years of concession payments, as explained later.

19. ZPKN = ZPKG - CPZN x SPK caps/year

20. $SPK = SPK_o + \int_o^t ZPKN\ dt$ caps

The value of investment expenditures has already been implied above in terms of the inputs of goods and services (Equations 10 and 15) and the cost of labor (Equations 16, 17, and 18). For goods and services, partly domestic and partly imported, the expenditure flow is:

21. VNPK = (CPW8 x PWN1 + (1 - CPW8) x PZD) x QNPK Million Bs/year

and for labor the expenditure is*:

22. V6PK = YP6G - (CPVE - 1) x VNPE Million Bs/year

Ordinary gross investment in current value flow terms is simply the sum of these two expenditure flows:

23. WPKY = VNPK + V6PK Million Bs/year

Since the payments made for new concessions in 1956 and 1957 are also amortizable, they are added to ordinary investment for accounting purposes. For convenience in the formulation, the concession payments are expressed as flows, rather than lump sums. Being specified in millions of dollars per year, they must be multiplied by the applicable exchange rate:

24. WPKG = WPKY + PWW1 x FPGCW Million Bs/year

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* A more rigorous formulation for this item could have been used, but the labor term is quite small relative to the goods-and-services component of investment, and this crude relation gives a sufficiently accurate approximation.

While this flow is adding to the stock of amortizable assets, which is designated by HPK, two other effects are subtracting from it. One, of course, is the stream of depreciation and amortization charges, approximated as a fixed proportion of the stock:

25. WPKV = CPWV x HPK Million Bs/year

The other is the transfer to other countries of capital equipment that had been invested in in Venezuela. This is approximated also as a fixed proportion of the stock and therefore proportional to amortization, so that the combined stream of flows out of the capital assets account is CPWN x WPKV, and net investment in value terms is:

26. WPKN = WPKG - CPWN x WPKV Million Bs/year

The stock of assets itself is:

27. $HPK = HPK_o + \int_o^t (WPKN)\, dt$ Million Bs.

It should be noted that although CPWN x WPKV is flowing out of the stock of assets, only WPKV is chargeable as a cost.

Subtracting operating costs, VQPE, and depreciation, WPKV, from the total receipts of the Petroleum Sector, VPQT, yields the sector's net profit before taxes:

28. YP1Y = VPQT - VQPE - WPKV Million Bs/year

The revenue to the government through royalties, land area tax, and the profit tax is approximated as a proportion of net profit before tax and subtracted to get net profit after taxes:

29. FPG9 = PPTX x YP1Y Million Bs/ye.

30. YP1N = YP1Y - FPG9 Million Bs/year

When payments are being made to the government for concessions, these payments, FPGC, are added to the regular tax revenue:

31. FPGT = FPG9 + FPGC Million Bs/year

Gross value added in the sector is wage and salary income plus gross profits (not including the revenue VPQT - VPQ, which is treated as a financial transfer from outside of Sector P):

32. YP9G = YP6G + VPQ - VQPE Million Bs/year

Funds not disposed of otherwise available either for transfer to the parent companies or for addition to surplus are the sum of net profit after taxes, YP1N, and depreciation, WPKV, less expenditures for gross investment, WPKY. Reasonable agreement with historical data was obtained by assuming that a fixed fraction of this total was sent abroad and the rest added to local balances. The flow of remittances abroad, then, is:

33. YP7 = CPYW x WPKV + YP1N - WPKY Million Bs/year

or in foreign currency units:

34. YP7W = YP7/PWW1 Million$/year

2.23 The Public Sector

The public sector includes central, state, and municipal governments, and the activities of some of the autonomous institutes--those that perform service functions only. State enterprises, meaning those autonomous institutes that are engaged in production activities, are treated as part of Sector N. Any difference between the revenues of these enterprises and their direct current-account expenses for labor and intermediate goods is added to the public sector revenue.

The equations of the public sector are essentially definitional and accounting equations. Revenues are generally based on flows calculated in other parts of the model, which are merely multiplied by coefficients and summed in the public sector accounts. Expenditures, both for current account and for investment, are calculated from exogenous time series representing either history or projections established outside of the model.

Real gross investment of the public sector is an exogenous policy variable. The activity that it represents is treated as taking place in Sector N, and the real investment of the public sector, ZGKG, is directly translated into a demand for goods and services to be supplied partly from Sector N and partly from abroad. The cost per unit of this investment, PK, depends on the domestic nonagriculture price (from the price function) and on the applicable world price, exchange rate, and import ratio. The corresponding

value flow is the gross investment expenditure by the government.

35. PK = (1-CKW) x PZD x PWKW x PWWK x (1+ PKT2) Million Bs/cap

36. FGKT = PK x ZGKG Million Bs/cap

A separate capital stock is not accounted for in the public sector because of the statistical problem of disaggregating the total nonpetroleum stock of capital and because of the belief that the public sector capital contributes to private production capacity in ways that could be accounted for better by keeping the stocks combined. However, provision is made for recognizing a difference in the capital-capacity ratios of public and private investment, as explained in Section 2.26 below.

Current expenditure by the public sector comprises expenditures on wages and salaries, and on purchases of goods and services from abroad and from Sector N. Transfer payments to consumers and producers and subsidy payments are treated as losses of revenue rather than in the conventional way as part of current expenditure. Both employment in the public sector (SG6E) and the quantity flow of inputs (QNGE) are exogenous variables. So are the import ratio (CJWG), and the wage rate ((P6G)*. The price of the domestic component of inputs (PND) is determined in the price function.

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* An alternative relation is included in the simulation program to permit making the public sector wage rate follow changes in the cost of living (with smoothing and lag), but up to this writing, the alternative had not been used.

The wage and salary expenditure is also the gross value added, since no return to capital is identified in the public sector. It is the product of employment, the wage rate index, and a factor (P6GB) that converts the index into absolute units:

37. V6GQ = P6G x P6GB x SG6E Million Bs/year

To this is added the expenditure for intermediate goods and services to get current account expenditure, which is then added to investment to get the total public sector expenditure:

38. FGQE = $\left[(1-CJWG) \times PND + CJWG \times PWJW \times PWWJG\right] \times QNGE$
+ V6GQ Million Bs/year

39. FGQT = FGQE + FGKT Million Bs/year

The revenue of the Public section is accounted for in six categories, namely, taxes and concession payments from the petroleum sector (FPGT), personal taxes from all sectors plus direct corporate tax from Sector N (F9GY), profits of state enterprises (YU9G), customs revenue (FZG2), indirect taxes plus miscellaneous revenues of the public sector less subsidies and transfers (FNGQ), and profits on foreign exchange transactions (QGEP):

40. FQGT = FPGT + F9GY + YU9G + FQG2 + FNGQ + FQGEP Million Bs/year

The first term in this series, revenue from the petroleum sector, is explained in Section 2.22 above (Equations 29 and 31). The second term has three components as follows: Personal tax revenues from the petroleum and public sectors are assumed to be proportional to the respective personal incomes in these two sectors.

For sector N, personal and corporate tax revenues are combined because separate data were not available; again a simple proportion is used, but the tax base is gross value added, multiplied by CBN, the fraction of the sector that is private business, thus excluding the profit of government enterprises, which is treated separately. Thus the second term of Equation 40 is evaluated by the following:

41. F9GY = PPTY x YP6G + PGTY x V6GQ + PBTY
x CBN x YN9G Million Bs/year

The operating surplus (profit) of government enterprises, excluded from the tax base above, is wholly transferred to the public sector account as a revenue. It amounts to:

42. YU9G = (1 - CBN) x YN9G Million Bs/year

Customs revenue (including duties, consular fees, customs' fees and fines) for each of four categories of imports is a coefficient times the respective value flow of imports (c.i.f., before customs payments). The determination of the quantity flows is explained in Section 2.25, below. For each category the quantity flow is multiplied by the appropriate world price and exchange rate to get the bolivar value flow, and then by a customs revenue coefficient. The formulation permits using different prices and exchange rates for each component, but in fact many of the numerical values are identical. Thus the fourth term in Equation 40 is evaluated as follows:

43. FPG2 = PPT2 x PWW1 x PWNW x QWNP — Million Bs/year
FCG2 = PCT2 x PWWC x PWCW x QWC9 — Million Bs/year
FJG2 = PJT2N x PWWJN x PWJW x CJWN x QJNQ — Million Bs/year
FKG2 = PKT2 x PWWK x PWKW x QWKR — Million Bs/year

44. FQG2 = FPG2 + FCG2 + FJG2 + FKG2 — Million Bs/year

The fifth component of revenue is itself composed of several items, all relatively small. Its first part includes revenue from indirect taxes and miscellaneous fees, minus transfer payments. It is approximated as a coefficient times the real output of the private protion of Sector N. The coefficient, PBTQ, has dimensions of millions of bolívares per quant. An exogenous term, explicitly representing subsidies, is subtracted, yielding what is properly designated "indirect taxes plus miscellaneous receipts less transfer payments and subsidies".

45. FNGQ = PBTQ x CBN x QNQE - FGN7 — Million Bs/year

The final component of revenue is the profit realized from buying and selling foreign currency at different exchange rates. During the years 1961,through 1963, when there was a wide spread of different rates, this was a very important revenue source. Even at other times it was significant on the basis of an eight per cent difference in exchange rates between the petroleum sector and everything else. The first step in the calculation of this revenue is to establish the average rate at which incoming foreign currency is accounted for (PWWA). This is a weighted average of the following rates (all in terms of Bs/dollar):

PWW2 for petroleum exports and capital inflow for concession payments by the petroleum sector

PWWX for nonpetroleum exports

PWW5 for nonpetroleum capital inflow.

With each of these weighted by the value flow to which it applies, the average is given by:

46. $$PWWA = \frac{[PWW1 \times (VPWW + FPGCW) + PWWX \times VNWW + PWW5 \times FWK2W]}{VPWW + FPGCW + VNWW + FWK2W}$$

The profit on foreign exchange transactions is then calculated as the value of each component of outflowing payments multiplied by the difference between the exchange rate that applies to it and the average exchange rate for inflows:

47. FQGEP = (VWNPW + YP7W) x (PWW1 - PWWA) + CJWN x QJNQ x PWJW x (PWWJN PWWA) + CJWG x QNGE x PWJW x (PWWJG - PWWA) + QWC9 x PWCW x (PWWC - PWWA) + QWKR x PWKW x (PWWK - PWWA) + YN7W x (PWW4 - PWWA) Million Bs/year

The overall surplus (deficit if negative) on the consolidated current and capital accounts of the public sector is the difference between total revenue (Equation 40) and total expenditure (Equation 39)

48. FGGS = FQGT - FGQT Million Bs/year

2.24 Consumers' Demand for Domestic Products and Imports

Before going on to describe the other producing sector, Sector N, it seems useful to identify the various sources of demand for its output and to explain how the magnitude of demand from each source is determined. The consumption component is explained here, and other components in the next section.

The total demand by consumers, without distinction between imports and domestic products, is based on the behavioral hypothesis that budget decisions are closely related to disposable income (both in real terms) but that habits and prior commitments have the effect of damping and delaying changes in real purchases when real income changes. The mathematical expression of the relation involves the following terms:

QQ91	Real quantity flow of goods and services purchased by consumers	quants/year
QQ9B	"Equilibrium level" of QQ91 corresponding to static real income	quants/year
YD	Disposable income (in current prices)	Million Bs/year
PN9	Consumer goods price	Million Bs/quant
C9YS	The proportion that would be saved out of real disposable income if the latter were static.	nondimensional
TQY	Time constant, which ostablishes the extent of the lag and smoothing.	years

The price, PN9, is a composite of the domestic and imported consumer goods retail prices, PN9D and PWC9

The former, in turn, is a combination of the wholesale prices of domestic agricultural output (PAD, exogenous) and nonagricultural output (PZD, determined in the price function, Section 2.27), increased by a markup factor for distribution and retailing:

49. PN9D = (C9P1 x PAD + C9P2 x PZD) x (1 + C9P) Million Bs/quant

The world price (PWCW), exchange rate (PWWC), customs revenue coefficient (CT2), and wholesale-to-retail markup (C9P), combine to determine the retail price of imported consumers' goods:

50. PWC9 = PWCW x PWWC x (1 + PCT2) x (1 + C9P) Million Bs/quant

These are weighted according to the import ratio, CCW (see below), to get the price for all consumer goods:

51. PN9 = CCW x PWC9 + (1 - CCW)x PN9D Million Bs/quant

At each step in the evolution through time an equilibrium or target level of real consumption (QQ9B) is calculated from real disposable income (YD/PN9) according to the relation:

52. QQ9B = (1 - C9YS) x (YD/PN9) quants/year

The actual quantity flow of real consumption depends on the past history of this target variable, following its changes through a function called a third-order lag*, as indicated by the shorthand

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* The same kind of distributed-lag function is used in several relations in the model. For those interested, y = DELAY3 (x,t) specifies a finite-difference approximation to the following set of equations--with the addition, of course, of appropriate initial values and limits:

$$v = \frac{3}{T}\int (x-v)dt \qquad u = \frac{3}{T}\int (v-u)dt \qquad y = \frac{3}{T}\int (u-y)dt$$

The function corresponds to DELAY3 in J. W. Forrester's DYNAMO program, but was programmed so that an initial steady-state rate of growth could be specified, rather than a static condition.

expression:

53. QQ91 = DELAY3 (QQ9B, TQY) -- subject to restriction: $d(QQ91)/dt \geq 0$

Since consumption lags disposable income, higher positive rates of growth result in the saving of larger fractions of income. Changes, not only in the level of consumption but also in its rate of growth, lag behind changes in income and its rate of growth. Assigning a larger value to the constant TQY increases the smoothing effect as well as the lag. The restriction following Equation 53 insures that total real demand never decreases.

Once QQ91, the total real consumption, has been determined, the next step is to divide it into an imported part and a part to be supplied from Sector N. As mentioned above (Section 2.1) this division can either be specified exogenously as a time series or be endogenously influenced by relative prices. When the latter option is taken, the effects of factors other than prices can still be represented by exogenous variations of the parameters of the function. In either case, the imported and domestic parts of consumers' demand (expressed as real flows of goods and services) are given, respectively, as follows:

54. QWC9 = CCW x QQ91 quants/year

55. QN9 = (1-CCW) x QQ91 quants/year

When price effects are not to be represented endogenously, CCW in the equations above is, in effect, made an exogenous variable. Otherwise the influence of prices acts through the equations explained and presented below. The relevant prices are those for domestic and

imported consumer goods, given in Equations 49 and 50.

The proportion of consumer goods imported, CCW, may vary between a lower limit, CCW1, and an upper limit (1 - CCW3), where CCW3 itself is the minimum ratio of the supply of domestic good to total supply. Between these postulated limits the proportions are a function of the ratio of domestic and import prices. The coefficient CCW4 controls the sensitivity of the relationship. Note that CCW2 is not a parameter but an internally generated variable. The import function is represented by:

56. $$CCW2 = \frac{1}{1 + CCW4 \times \frac{PWC9}{PN9D}}$$

57. $$CCW = CCW1 + CCW2\ (1 - CCW1 - CCW3)$$

2.25 Demands for Sector N Output and Imports

Sector N, the nonpetroleum enterprise sector, represents a macroeconomic aggregation of activities producing all sorts of goods and services other than petroleum, petroleum products, and government services. The output of the sector is assumed to be demand-determined and demand and output are defined as equal. Because of the broad scope of the sector, the demand for its output is determined from a variety of relations in different parts of the model. Some of these have already been explained; the rest will be explained and the whole set will be summarized in this section.

Almost every component of the demand addressed to Sector N is determined by dividing a total requirement into a part to be imported and another part to be supplied domestically. Hence it is convenient to treat the demands for imports in parallel with the others. The table on the following page summarizes all of the relevant total requirements and their subdivision between imported and domestic supplies, and shows how the total demand for Sector N output is composed.

The demand for exports from Sector N, corresponding to the first entry in the table, is given exogenously as a time-varying value flow in foreign currency (VNWW; Million $/year). The assumption that this dollar value flow is unaffected by changes in the bolivar price or in the exchange rate (PWWX) implies a price-elasticity of demand equal to 1.0. Another assumption implicit in the equations is that the bolivar price of exports is directly geared to the general price index for domestic

SUMMARY OF DEMANDS FOR IMPORTS AND PRODUCT OF SECTOR N

NATURE OF DEMAND	TOTAL DEMAND COMPONENT	PART IMPORTED	PART SUPPLIED BY SEC. N	SECTOR N SUMMATION
NON PETROLEUM EXPORTS	QNWQ (Eq. 58)	x 0	x 1 = QNWQ	QNWQ
INPUTS FOR SECTOR P, for current production	QNPE (Eq. 9)	x CPW6	x (1-CPW6)	
for capital formation	QNPK (Eq. 10)	x CPW8	x (1-CPW8)	
special(1956 & 1957)	QWNP2 (Eq. 13)	x 1	x 0	+
total inputs for Sector P		= QWNP (Eq.11,14)	= QNPQE (Eq. 12)	QNPQE
CONSUMPTION	QQ91 (Eq. 53)	x CCW ≠ QWC9 (Eq. 54)	x (1-CCW) = QN9 (Eq. 55)	
INTERMEDICATE INPUTS (except Sec. P)				
Sector G	QNGE (exogenous)	x CJWG	x (1-CJWG)	+
Sector N	QJNQ (Eq. 60)	x CJWN = QWJR (Eq. 61)	x (1-CJWN) ≠ QNRJ (Eq. 62)	QNRQE (Eq. 66)
CAPITAL FORMATION (except Sec. P)				
Sector G: ZGKG Sector N: ZNKH	QKRQ (Eq. 63)	x CKW = QWKR (Eq. 64)	x (1-CKW) = QNRK (Eq. 65)	=

(Eq. 67) Total Demand for Sector N Output: QNQE

petroleum products (PND). Both of these assumptions are crude but are considered satisfactory because nonpetroleum exports are of such small relative magnitude.* With these assumptions, the quantity flow of nonpetroleum exports is:

58. QNWQ = VNWW x PWWX/PND quants/year

The next group of entries in the table, being demands by the petroleum sector, have already been fully explained (in Section 2.21). The corresponding equation numbers are noted in the table for reference.

Consumption demand, has also been explained--in the section preceding this one--and the equations may be found from the numbers given.

Intermediate inputs for the public sector, QNGE, are specified exogenously, as noted in Section 2.23. Intermediate inputs for Sector N are postulated as being related to the sector's output through an input-output coefficient, AJN, that may be programmed to vary (for technological reasons) with the accumulation of real investment.

59. $\frac{1}{AJN} = \frac{1}{AJN} + \int_0^t (CNAJ \times ZNKH)dt$

60. QJNQ = AJN x QNQE quants/year

Each of the intermediate demands is divided between imports and

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* For any study that was expecially concerned with nonpetroleum exports, the model should be reformulated to set up a separate exporting sector; at that time these asssumptions could be replaced by more sophisticated ones.

domestic supply by its own exogenously variable import coefficient as the table shows. In equation form:

61. QWJR = CJWG x QNGE + CJWN x QJNQ quants/year

62. QNRJ = (1 - CJWG) x QNGE + (1 - CJWN) x QJNQ quants/year

Capital formation, including both that undertaken by the government and that carried out privately, is treated as a combination of imports with activities taking place within Sector N. The latter activities, and the combination as well, are represented as equivalent flows of goods. The total is defined as:

63. QKRQ = ZGKG + ZNKH quants/year

where ZGKG is real gross investment by the public sector (see 2.23) and ZNKH is that undertaken by enterprises in Sector N (explained in Section 2.26, below).

Of this total equivalent flow of goods for capital formation, a part is imported and the remainder represents the activities within Sector N. The import ratio, CKW, is an exogenous variable. The imported and internal parts, respectively, are:

64. QWKR = CKW x QKRQ quants/year

65. QNRK = (1 - CKW) x QKRQ quants/year

The various import demands are used in composing the balance of payments account. The demand components to be supplied domestically are added up in two steps, as the table indicates, to get the total demand that is to be matched by the output of Sector N:

66. QNRQE = QN9 + QNRJ + QNRK quants/year

67. QNQE = QNRQE + QNPQE + QNWQ quants/year

2.26 Private Nonpetroleum Investment

Before the explanation of the behavioral function for private investment, a few words are needed about the definition of the stock of nonpetroleum capital and how it is treated in the model.

The stock of real capital in Sector N comprises the stock that is created by private nonpetroleum investment plus an adjusted amount derived from investment by the public sector. The two are combined because government enterprises are part of Sector N and because it is assumed that public sector infrastructure not only produces direct output but also contributes to the output capacity of the private sector. (In addition, separating private from public capital stock would have introduced another statistical problem)

In making the combination, it is assumed that the increment to capacity per unit of overall public investment may be less than that added by a unit of private investment. In order to keep account of a single stock of capital and still have it serve as a direct measure of the combined capacity, investment by the public sector is adjusted by a factor equal to the ratio of the two capital-capacity ratios. This means that the "capital stock", SNK, really represents the accumulated combined capacity expressed as a hypothetical stock of private-sector capital units. The concepts involved are symbolized as follows and accounting is done according to Equation 68 below:

CNKQ	capital-capacity ratio for private investment	caps/(quants/yr)
CGKQ	capital-capacity ratio for public investment	caps/(quants/yr)
ZNKH	gross real private nonpetroleum investment	caps/year
ZGKG	gross real public investment	caps/year
ZNKA	rate of attrition of the combine stock of capital	caps/year
SNK	equivalent stock of real capital resulting from private and public nonpetroleum investment	caps

68. $$SNK = SNK_0 + \int_0^t (ZNKI + \frac{CNKQ}{CGKQ} ZGKG - ZNKA)dt$$

The behavioral function that is the subject of the explanation below governs the variations in ZNKI, gross real investment in the nonpetroleum sector by private interests.*

Basically, the function is an accelerator with some modifications. The modifications include a replacement term (since gross real investment is to be determined) and terms giving special importance to the state of the petroleum industry and to government investment. In addition, the under-or over-utilization of capacity is considered

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* The description pertains primarily to one of many possible combinations of alternative elements that are provided for in the computer program of Model V-2A. It was used and found satisfactory in simultaneously adjusting the model and re-estimating the history of investment, as described in the next chapter. However, it is presumably not the only combination that would have worked satisfactorily and alternatives have been left in the computer program in case further investigation is undertaken.

explicitly. A term crudely representing financial liquidity was tried but was not satisfactory; without a more elaborate treatment of financial variables it seems better to use an exogenous ceiling (which is also in the program) to represent financial constraint. To provide for unusual circumstances or variables not explicitly accounted for, an exogenous term may be appended to the others. The various terms, each of which will be explained further, are summarized in the following presentation of equations, in which ZNKH (in caps per year) is gross real private investment in nonpetroleum enterprises, and ZNKU and ZNKT are used to subdivide the formulation into convenient steps:

69. ZNKU

= CN1 x ZNKA	replacement of attrition
+ CN2 x DY9G/PN	accelerator; DY9G is smoothed derivative of G.T.I.; PN is general price index
+ CN3 x VPL/PN	VPL is smoothed and lagged petroleum sales
+ CN4 x FGL/PN	FGL is smoothed and lagged public investment
+ CN5 x (CNQ5 - CNQ6) x SNK	CNQ5 is smoothed and lagged over-utilization of capacity; CNQ6 is a reference constant; SNK is the stock of capital.

70. ZNKT = CZ x ZNKU + CK x ZNKX
(ZNKX: exogenous)

71. ZNKH = ZNKT, subject to limits $\begin{cases} \geq 0 \\ \leq \text{ZNKC} \\ \leq \text{exogenous ceiling} \end{cases}$

Attrition--wearing out or decay--of real capital, applies partly to capital that would be replaced (if at all) by public investment. Thus only a part of attrition, corresponding to the coefficient CN1, is

relevant for private entrepreneurs to consider replacing. If private gross real investment, ZNKH, is just equal to the term CN1 x ZNKA, private business is just maintaining capacity. The rest of the terms in the function are concerned with net expansion (or contraction, if negative) of private capacity.

The second term in Equation 69 is an accelerator, DY9G/PN, the smoothed and lagged rate of change of gross territorial income* divided by the general price index, is considered as the overall rate of growth of the economy in real terms and as an indicator of the opportunities for profitable expansion of private nonpetroleum capacity. This is assumed to be a primary factor influencing private investment decisions.

The third term, involving petroleum sales, is based on the key importance that the petroleum industry has in the economy and on the

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* Spurious fluctuations are sometimes generated when the rate of change of a variable is taken across a single interval in a stepwise numerical calculation. To avoid this, a function named DERIVA was devised and is used wherever it is desired to measure the rate of change of a variable. The expression

$$Dx = \text{DERIVA}\ (x)$$

stands for the following formula:

$$Dx = \frac{(x_{t-DT} - x_{t-3DT}) + (x_{t-2DT} - x_{t-4DT})}{4DT}$$

in which DT is the time interval--normally 1/20th of a year--between successive calculations. This function and then the lag-with-smoothing function, DELAY3, that was described in Section 2.24 were applied to gross territorial income, Y9G, to get DY9G.

changes in the general expectations and mood of decision makers that apparently accompany changes in petroleum production. The measure of the petroleum situation VPL, is the lagged value of total petroleum sales:

72. VPL = DELAY3 (VPQT, TVP)

(DELAY3 is explained in Section 2.24)

An alternative provided for in the computer program is the substitution of total exports, petroleum and others, (VQW) for VPQT in the relation above.

The fourth term in Equation 69 attributes a similar role to public investment, FGKT, in influencing the optimism or pessimism or entrepreneurs. This effect is thought to occur partly as a response to the government's creation of infrastructure, and partly through expectations of expanded demand resulting from the incomes generated by the expenditure. An alternative that is built into the program is the use of total public expenditure, FGQT, instead of only the investment component thereof.

The fifth term represents the hypothesis that any significant and sustained deviation of output from a normal relation to capacity will tend to bring about an adjustment of capacity through an increase or decrease in capital formation. For this purpose the following terms are defined:

QNQK	nominal capacity of Sector N	quants/year
CNQ4	proportionate excess of output over capacity (or proportionate idle capacity if negative)	nondimensional
CNQ5	CNQ4, smoothed with first order exponential lag	nondimensional
CNQ6	neutral level of CNQ5	nondimensional
TNRK	time constant of first order exponential lag in definition of CNQ5	years

Capacity is defined as the output that would result if all facilities were being used with normal procedures. Thus it is not an absolute limit but may be exceeded at least temporarily. It is assumed to be proportional to the stock of capital:

73. QNQK = SNK/CNKQ

Overutilization of capacity, as a proportion of capacity, is expressed by:

74. $$CNQ4 = \frac{QNQE - QNQK}{QNQK}$$

The level of investment will not respond instantly to changes in the utilization of capacity, partly because of the time required to make and implement decisions and partly because the decision makers are not so much concerned with short-run fluctuations as with trying to discern longer-run trends beneath them. Therefore CNQ4 is smoothed and lagged with a first order exponential lag:

75. $$CNQ5 = CNQ5_0 + \frac{1}{TNRK}\int_0^t (CNQ4 - CNQ5)dt$$

There are two reasons for modifying CNQ5 by the subtraction of a constant, CNQ6, in the fifth term of the investment function,, Equation 69. Considering the heterogeneity of the nonpetroleum sector it is implausible that all of the activities involved should simultaneously find the demand for their output equal to capacity. Thus a shortage of capacity may be inducing investment in some activities while the sector as a whole has excess capacity.

The other reason for the term CNQ6 is the purely practical problem that it is not possible to make an accurate measurement of either the stock of capital or capacity, and therefore an adjustment may be found necessary in the process of tuning up the model.

The five terms explained in the foregoing paragraphs make up the explicitly bahavioral part of the private investment function. They add up in Equation 69 to ZNKU, an intermediary variable that may or may not be the final determination of gross real private investment, depending on other factor discussed below.

Equation 70, repeated here for reference, provides for the addition of an exogenous increment to represent the effect of factors not explicitly included in the equation for ZNKU such as unusual optimism or pessimism of investors under abnormal circumstances:

70. ZNKT = CZ x ZNKU + CK x ZNKH (repeated)

The term ZNKX is programmed as an exogenous time series. When it is used as an increment to ZNKU, both of the coefficients are assigned

values of 1.0. The coefficients are included primarily to permit substituting an entirely exogenous time series for the computed value by specifying CZ=0, CK = 1.0,and putting the exogenous figures in as ZNKX. This procedure is used in turning up the model, as explained in the next chapter. It is also possible to use other values of the coefficients to apply an overall modification to either ZNKU or ZNKX without changing all of its elements.

After ZNKU has been determined and perhaps modified or even replaced by ZNKX, the result is used only if it lies within the limits expressed as Equation 71; otherwise one of the limits is substituted.

71. ZNKH = ZNKT, within limits $\begin{cases} \leq \text{ZNKC} \\ \geq 0 \end{cases}$ (repeated)

It is unlikely but not impossible that Equation 69 and 70 would--in a depression of the simulated economy--yield a negative estimate for gross investment; this is overruled by the lower limit. The upper limit which is programmed as an exogenous time series, may be used if necessary to represent the effect of any sort of restrictive situation or policy, such as tightening of credit or direct government regulation of investment.

The expenditure flow corresponding to ZNKH, the real gross private investment in Sector N, is calculated using the same cost per unit of capital, PK, that was used for public sector investment (Section 2.23). The equations are:

35. PK = (1 - CKW) x PZK + CKW x PWKW x PWWK x (1 + PKT2) (repeated) Million Bs/cap

76. WNKH = PK x ZNKH Million Bs/cap

2.27 Nonpetroleum Prices

Various prices have been used in the formulation of the foregoing parts of the model. The two prices for petroleum sector output--one for domestic sales and the other for exports--are simply exogenous time series. The export price, of course, is established in foreign currency terms, and its bolívar equivalent depends on the exchange rate. Similarly, four categories of imports have prices exogenously programmed in foreign units; the corresponding bolívar prices are affected not only by the exchange rates but also by the respective customs duties and fees.

The cost per unit of capital, the general price index, and the price of consumers' goods (cost of living) are weighted combinations of imported-goods prices and corresponding domestic prices.

Goods from the domestic nonpetroleum sector are priced according to three different formulae depending on the source of demand. The three formulae correspond to different mixtures of agricultural and nonagricultural output. Although agricultural and nonagricultural investment, production, and other variables are not separately identified in the model, prices for the two components are separately determined and then combined in different proportions for the different purposes. The agricultural product price is exogenous. Because of the unpredictability of some of the factors known to be relevant, and because of the government's practice of intervening to stabilize agricultural

prices, it was not judged worthwhile to formulate this one endogenously. The price of nonagricultural output, however, is determined by a relatively elaborate endogenous function, explained later in this section.

Consumers' demand is assumed to include proportionately more agricultural product than either export or intermediate goods demand, and demand for capital creation is assumed to relate almost entirely to nonagricultural activities. Inputs to the petroleum sector are also assumed to have a negligible agricultural component.

For consumers' expenditures a retail price is the relevant one. Since all other prices are construed as wholesale, a markup factor, C9P, is applied to the combination of agricultural and nonagricultural prices to arrive at the price of the domestic component of consumers' purchases.

77. PN9D = (C9P1 x PAD + PZD)x (1 + C9P) Million Bs/quant

For exports and for non-capital inputs used by the public sector and by the non-petroleum enterprise sector itself, the domestically-produced component is priced as follows:

78. PND = CNPA x PAD + CNPZ x PZD Million Bs/quant

with CNPA smaller than C9P1 and CNPZ larger than C9P2.

All domestically produced goods used for capital formation as well as those for current-activity use in the petroleum sector are valued at the nonagricultural price, PZD.

All other prices being exogenous, the explanation that follows concerns the dynamic function that generates changes in PZD, the price of nonagricultural nonpetroleum domestic output. This price is arrived at by multiplying an index of production costs by a factor that includes a variable markup for non-cost effects. A further markup for indirect taxes is added, and the result is then smoothed by a distributed lag.

Production costs include the costs of:

labor
imported intermediate goods
domestic intermediate goods
finance

Each of these in turn depends on other variables that will be mentioned later.

The markup factor depends on:

an indicator of import restriction
the rate of growth of income
monetary liquidity
the direct tax rate
a constant to cover the normal commercial factors

The cost of labor per unit of nonagricultural output is the product of the average labor cost per man-year and the average number of man-years put in per unit of output. The reciprocal of the latter factor, the productivity of labor in the nonagricultural subsector, increases as new capital is created:

79. $GA6Z = GA6Z_0 + \int_0^t (ZCA6 \times ZNKH)\, dt$ quants/thousand man-years

To get an approximation for total employment, which influences the trend of the wage rate, a similar relation is assumed for a technological coefficient of output per man-year for the sector as a whole:

80. $GA9N = GA9N_o + \int_o^t (CNA9 \times ZNKI1)dt$ quants/thous.man-yrs

In application, this coefficient is assumed to apply for production at nominal capacity, and another term increases the labor requirement per unit output when output deviates on either side of the norm. The technological requirement for labor in Sector N is:

81. $Q9NN = QNQE \times (1/GA9N) \times (1 + CNQ9 \times CNQ4^2)$ thous.man-yrs/yr

where CNQ4 is the proportional deviation of output from nominal capacity (Equation 74), CNQ9 is a constant, and QNQE is the output, in real terms, of Sector N (Equation 67).

Actual employment does not fluctuate with short-term changes in output, because of costs and inconveniences involved in hiring and firing, as well as policies of employment stability. Hence employment in Sector N is made to follow changes in the "required" labor force with a third order lag:

82. SN9E = DELAY3 (Q9NN, TQ9N) thousand people

Because of the extra impediments, both economic and institutional, to laying off personnel, the time constant, TQ9N, is assigned a value several times as large for decreasing as for increasing employment.

Employment thus determined for Sector N is added to that for Sectors G and P (SG6E and SP6E, both of which are exogenous) to get

the economy-wide total. Employment affects the determination of the wage rate, not in terms of its absolute level, but as a proportion of the labor force. The available labor force, SQ9D, is assumed to be a fixed fraction of the population, SQ9, which is programmed to grow exponentially:

83. $SQ9 = SQ9o + \int_o^t (RSQ9 \times SQ9)dt$ thousand people

84. $SQ9D = CSQ9D \times SQ9$ thousand people

Thus the ratio of employment to the labor force is:

85. $GS9E = (SN9E + SP6E + SG6E)/SQ9D$

The labor cost per man-year, or wage index, P6Z, tends to rise when the employment ratio is high. It is also pushed upward by increases in productivity and by increases in living costs. It responds to changes in these pressures with a lag and smoothing. These characteristics are expressed by the following equations:

86. $P6ZA = CZ61 \times PN9 \times GA6Z + CZP62 \times GS9E + P6ZB$ Million Bs/thousand

87. $P6Z = P6Z_o + \frac{1}{TP6Z} \int_o^t (P6ZA - P6Z)dt$ man-years

Dividing the cost per man year by the productivity (Equation 79) gives the labor cost per unit of nonagricultural output.

88. $U6Z = P6Z/GA6Z$ Million Bs/quant

The unit cost for intermediate goods depends on the input-output coefficient, on the division between imported and domestic supplies, and on the corresponding prices. The input-output coefficient may have a trend, which is formulated in terms of its reciprocal, with

a formula analogous to those for labor productivity (Equations 79 and 80):

89. $\frac{1}{AJZ} = \frac{1}{AJZ_o} + \int_o^t (CZAJ \times ZNKH)dt$ quants/quant

The exogenously variable import coefficient is applied to the input-output coefficient to get an imported input coefficient and a domestic input coefficient:

90. AJZW = CJWN x AJZ quants/quant

91. AJZD = (1 - CJWN) x AJZ quants/quant

The price of the imported component of inputs is determined from the world price and the applicable exchange rate and tariff rate, all of which are exogenous:

92. PWJN = PWJW x PWWJN x (1 + PJT2N) Million Bs/quant

The domestic component is priced at PND (Equation 78). Thus, the cost of intermediate goods per unit output is:

93. UJZ = AJZW x PWJN + AJZD x PND Million Bs/quant

Financial costs are approximated as being proportional to the capital-capacity ratio (a constant) and the nominal rate of interest (an exogenous variable):

94. UFZ = CZUF x CNKQ x RINT Million Bs/quant

Combining unit costs for labor, intermediate goods, and finance, with an exogenous term for whatever else may have been neglected, results in the following expression for production costs for non-agricultural nonpetroleum products:

95. UQZ = U6Z +UJZ + UQZK

This is to be increased by a markup factor, CZP, representing the effects of various non-cost influences in the setting of prices, as follows:

96. CZP

= CZP1 x (1 - CCW)	competition with imports
+ CZP2 x DY9G	expansion of demand
+ CZP3 x HQD/QNRQ	money supply
+ CZP4 x PZTY	shifting of direct tax
+ CZP5	commercial margin and miscellaneous

The first term above corresponds to the assumption that a small relative volume of imports (of consumer goods) permits domestic sellers to price their goods up, while a higher import ratio means more intense competition and the necessity of settling for a smaller profit margin.

The second term is based on the idea that markups may be larger in times of expanding income (hence demand) than otherwise.

The third term involves two concepts not mentioned before. In the numerator, HQD is the money supply, defined as currency in circulation plus all balances in commercial banks. The denominator is

the total domestic nonpetroleum demand in real terms. Thus the ratio represents the available means of payment relative to the volume of goods to be paid for. The denominator is defined as:

97. QNRQ = QQ91 + QJNQ + QNGE + QKRQ quants/year

In the fourth terms of Equation 96, PZTY is the coefficient of direct taxes on businesses in Subsector Z (nonagricultural, nonpetroleum), approximated as a proportion of gross output value. It is an exogenous time-series variable. CZP4 is the proportion of this tax that is shifted into the price rather than absorbed.

The final term, CZP5, is a constant representing the normal commercial markup, to the extent that it is not all accounted for in the foregoing terms, plus any other factors that have not been dealt with explicitly.

Putting together the unit cost and the markup and then adding the proportion of indirect tax (BZTQ) that is shifted yields a "target value" of the price, which is followed by the endogenous component of price itself with an exponential lag:

98. PZDA = UQZ x (1 + CZP) + CZP6 x PZTQ Million Bs/quant

99. $PZDB = PZDB_0 + \frac{1}{TPZ} \int_0^t (PZDA - PZDB)dt$ Million Bs/quant

As in the investment function, here too it is possible to add an exogenous time series to the result of this endogenous calculation, or the endogenous price may be entirely ignored and replaced by an exogenous series, depending on the coefficients assigned to the

following equation:

100. PZD = CZPN x PZDD + CZPX x PZDX Million Bs/year

The exogenous time series is intended basically for use when the rest of the model is being tuned up. The endogenous function is normally to be used for policy investigations so that the tendency of different policies to induce inflation can be used as one of the several cirteria.

Since this price, PZD, is a component of each of the other domestic nonpetroleum prices, including the consumers' price index, and it is clear that under some conditions a disturbance in any of the prices may be amplified by a multiplier effect.

To complete the list of prices, the general price index must still be defined. It is the ratio of the wholesale value of all nonpetroleum goods and services purchased within the country to the corresponding real flows:

$$101.\quad PN = \frac{\frac{(QQ91 \times PN9)}{(1 + C9P)} + QNRJ \times PND + QJNQ \times CJWN \times PWJN + QNGE \times CJWG \times PWJG + QKRQ \times PK}{(QNRQE + QWC9 + QWJR + QWKR)}$$

2.28 National Accounts

The remaining equations account for national and territorial incomes and for the balance of foreign payments.

Gross territorial income at factor cost is found by summing value added for the three sectors. The petroleum sector component, YP9G, has already been determined (Equation 32). For the public sector it is the same as wage and salary expenditures V6GQ (Equation 37). For Sector N, it is necessary to sum up the various outputs, evaluated at their relevant prices, and deduct the value of intermediate inputs and indirect tax revenue:

102. YN9G

= QN9 x PN9D	to consumers
+ QNRK x PZD	for investment
+ QNWQ x PND	exported
+ QNGE x (1 - CJWG) x PND	to Sector G
+ QNPQE x PZD	to Sector P
+ QWC9 x PWC x C9P	value added to consumers' imports in distribution and retailing.
- QJNQ x CJWN x PWJN	imported inputs
- VPN	from Sector P
- FNGQ	indirect taxes and miscellaneous fees, less subsidies

Combining the three components of gross value added yields gross territiorial income at factor cost:

103. Y9G = YN9G + YP9G + V6GQ Million Bs/year

In the petroleum sector relations, an equation was presented for income payments remitted abroad, YP7 (Equation 33). The corresponding flow from Sector N is approximated as a fixed proportion of value added excluding the profits of government enterprises. (Multiplying YN9G by the coefficient CBN excludes those profits.)

104. YN7 = CNYW x CBN x YN9G Million Bs/year

Gross national income at factor cost is defined as gross territorial income at factor cost less income remittances abroad. (Remittances from the public sector are assumed negligible, or absorbed in YN7.)

105. Y8G = Y9G - YP7 - YN7 Million Bs/year

Disposable income derived from Sector N and available in the country consists of the value added in the sector less profits of government enterprises, profits retained in businesses, personal and business direct taxes, and remittances of income abroad. As above, the coefficient CBN excludes government profits. The coefficient CBS, applied to the remaining part of value added, accounts for business savings, and the coefficient PBTY for direct taxes. Thus:

106. YN9D = CBN x YN9G x (1 - CBS - PBTY) - YN7 Million Bs/year

For both the petroleum and public sectors, disposable income is construed as wage and salary expenditures less personal income taxes, and these components are added to that from Sector N to get national disposable income:

107. YD = YN9D + YP6G x (1 - PPTY) + V6GQ x (1 - PGTY) — Million Bs/year

As one of the measures of performance of the economy, real disposable income per capita is defined as follows:

108. YDRPC = 1000 x YD/(PN x SQ9) — (Bs of 1957/year)/person*

The balance-of-foreign-payments account is kept in terms of dollar units. Exports in these terms are determined directly from three exogenous variables, the quantity flow of petroleum exports, the world price thereof, and the value of nonpetroleum exports:

109. VQWW = PWW1 x QPW + VNWW — Million $/year

The value flow of imports is found simply by applying the respective world prices (exogenous) to the various quantity flows derived in Section 2.25 above.

110. VWQW = PWNW x QWNP + PWCW x QWC9 - PWJW x QWJR + PWKW x QWKR — Million $/year

Income remittances abroad are also treated as current-account flows:

111. Y7W = YP7/PWW1 + YN7/PWW4 — Million $/year

where PWW1 is the exchange rate for petroleum transactions and PWW4

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* The dimensional units are as follows:
YD: Million Bs. per year
SQ9: thousands of people
PN: general price index based on 1957
Combining these in the equation above, the factor of 1000 is required to put the result in the units stated.

is that relevant for other remittances--generally presumed to be the free rate. The current account balance is:

112. FWQSW = VQWW - VWQW - Y7W Million $/year

Capital flows comprise two exogenous parts, the concession payments to the government by oil companies, and all other capital inflows:

113. FWQKW = FPGCW + FWK2W Million $/year

Any unbalance in the combination of current and capital flow accounts is treated as the rate of change of foreign exchange and gold reserves:

114. DHQW = FWQSW + FWQKW Million $/year

The stock of reserves, of course is:

115. $HQW = HQW_o + \int_o^t (DHQW)dt$ Million dollars

2.3 Dictionary of Symbols for Model V-2A

2.31 Introduction

The dictionary of the principal terms in Model V-2A is presented in the following pages. (A few terms used only for tuning up the model are omitted, for clarity.) In order to make the dictionary somewhat more understandable, some of the principles on which it is based are described first. The notation is designed for use with either FORTRAN or DYNAMO computer programming languages.

Most of the concepts used in the model are familiar to all economists and are measured in conventional units. The currency unit in Venezuela is the Bolívar, abbreviated in the plural, Bs. Two unconventional units of measurement have been defined to avoid the confusion that sometimes occurs between real quantities and the corresponding money values:

1. A quant is a unit of real quantity, defined in terms of barrels for the petroleum sector and in terms of Bolívar value deflated to a standard set of prices for the nonpetroleum aggregate. (Thus, quants of different sectors are not commensurable.) Real quantity flows of output, imports, etc., are designated by code symbols beginning with Q and are in units of quants per year.

2. A cap is a unit of real capital stock. In this global model, it is equivalent to a quant of the nonpetroleum product except that it has been committed to the stock of capital and cannot thereafter be used for any other purposes. Stocks of real capital are designated by code symbols beginning with S, and are measured in caps. (Real investment is coded with the initial letter Z, and is in caps per year.)

2.32 General Principles of the Code

Every variable and constant is symbolized by a group of characters (letters and numerals called a "word". A word may have five characters or less. There are three basic parts from which words are made up (although the second or third part is sometimes absent).

1. The first part of the word is usually a single initial letter which indicates what kind of concept the word represents, usually indicates its dimensional units, and establishes rules for the coding of the second part of the word. If the first letter is D, G, or R, however, it is a prefix and the second letter fulfills the function otherwise fulfilled by the initial letter.

Table 2 is a list of initial letters with the concepts they symbolize and the dimensional units.

2. The second part of the word is called the identifier. It may consist of one, two, or three "identity symbols" according to the usage that has been found convenient with the particular initial letter. These symbols identify production sectors, types of goods, income earning groups, etc., as indicated in Table 3. For example, in the word QN9, the initial letter Q indicates that it is a flow measured in real terms (quants per year). The next two letters are both identifiers corresponding to the nonpetroleum sector and to all population groups, and indicating that the flow goes from the former to the latter. Thus, QN9 is the quantity flow of goods

and services from domestic nonpetroleum enterprises purchased by consumers.

3. The third part of the word, following whatever indentifiers are required to fulfill the rules of the particular initial, consists of modifiers. They are used to specify the different meanings within the range of possibilities established by the first two parts of the word. It is not feasible to give a set of general rules for the modifiers but some attempt has been made to be consistent. The use of a modifier is illustrated by the words QNPE and QNPK. Both of these represent quantity flows of goods to the petroleum sector. The modifiers E and K differentiate between the flow of goods used in current production by Sector P and those used in capital formation in that sector.

Additional rules were used in coding Models V-2 and V-2A but are not explained here. Although they were important in writing the code, it is felt that they would not help in understanding it. The dictionary itself, which follows, is the best supplement to what has already been stated.

TABLE 2

Initial Letters,

Indicating Nature and Dimensions of Variables and Constants.

Symbol	Concept	Units
A	Input-output coefficient	quant i/quant j
B	Input-Capital coefficient	quant i/cap k
C	Coefficients	various
D	(Prefix) Rate of change (except in "DT")	correspond to next letter plus "per year"
F	Financial transfer ("identifiers" show direction of money flow)	Million Bs/year or Million $/year
G	(Prefix) Endogenous ratios and miscellaneous variables	various
H	Holding (value of assets)	Million Bs or Million $
P	Price (including "price of labor"). Also used for tax rates (P_T_)	Million Bs (or $) per quant (or per thousand man years). Sometimes nondimensional
Q	Quantity flow ("identifiers" show direction of goods flow)	quants/year or thousand man years/year
R	(Prefix) Rate of return, proportionate rate of growth, etc.	Proportion/year
S	Stock of capital, goods, land, or number of people, etc. (except in combination SW--)	caps, quants, hectareas, or number, etc.
T	Time coefficient or period	years
U	Cost per unit output	Million Bs i/quant j
V	Value flow ("identifiers" correspond to Q flow)	Million Bs/year or Million $/year
W	Value flow of investment	Million Bs/year
Y	Income (except in word "YEAR")	Million Bs/year
Z	Real investment	caps/year

TABLE 3

"Identifiers"

Usually found in second position in the word, often in both second and third positions. Only the definitions used in Models V-2 and V-2A are given here. Alphabetic symbols sometimes refer to a production sector, sometimes to a product, depending on the context. Numerical symbols represent income recipients and population groups.

A	Agriculture (part of sector N) and its products
B	Private business portion of sector N
C	Consumer goods
G	Public sector
J	Intermediate goods used in sector N or G
K	Capital goods used in sector N or G
N	Nonpetroleum enterprises (both private and state) and their products
P	Petroleum and refining
Q	Total of relevant sectors (defined where used)
R	All users except exports and petroleum sector
U	State enterprises in sector N
W	World: imports or exports depending on position of letter in group
X	Nonagricultural subsector of sector N
1	Owners and Investors (profit, rent, and interest recipients)
5	Agricultural population
6	Wage and salary earners, nonagricultural
7	Indicates that income goes out of the country
8	Recipients of national (as distinguished from territorial) income
9	Total of relevant groups (defined as needed)

2.33 Particular Code Symbols

A,B and C

A6Z	Labor-output ratio, subsector Z	thous.man-years/ quant
A9NN	"Normal" labor-output ratio (i.e., when output = nominal capacity), sector N	thous.man-years/ quant
AJN	Intermediate goods required per unit of gross output of sector N	quants/quant
AJZ	Intermediate goods required per unit of gross output of subsector Z	quants/quant
AJZD, AJZW	Domestic and imported components, respectively, of AJZ	quants/quant
ANP	Quantity of inputs (which includes imports) to petroleum sector for current production, per unit of output capacity	quants N/quant P
APN	Coefficient relating domestic sales by the petroleum sector to the level of activity in the nonpetroleum sector	quants P/quant N
BNGK	Inputs of nonpetroleum goods per unit of real gross investment by government	quants/cap
BNNK	Inputs of nonpetroleum goods per unit of real gross private investment in sector N	quants/cap
BNPK	Input of nonpetroleum goods to petroleum sector per unit of real gross investment	quants/cap
C9P	Proportionate markup from wholesale to retail price for consumer goods	nondimensional
C9P1,2	Weights used in formula for cost of living (consumer price) index	nondimensional
C9QQ	Intermediate step in first approximation for consumption (see equation)	
C9YS	Savings coefficient, based on lagged disposable income	nondimensional

C continued

CBN	Ratio of gross value added in sector N excluding profits of government enterprises to gross value added in sector N including those profits	nondimensional
CBS	Ratio of depreciation allowances plus retained earnings to gross value added in private business portion of sector N	nondimensional
CCW	Proportion of consumer goods that are imported	nondimensional
CCW1,2,3,4	Coefficients to determine CCW	nondimensional
CGKQ	Capital-capacity ratio for government investment	caps/(quants/year)
CJWG	Proportion of inputs for public sector current account that are imported	nondimensional
CJWN	Proportion of inputs for current production of sector N that are imported	nondimensional
CK	Coefficient of exogenous component of investment, ZNKX	nondimensional
CKW	Proportion of capital goods, for all except petroleum sector, that are imported	nondimensional
CN1 through CN6	Coefficients in equation for private nonpetroleum investment (Model V-2A)	
CNA9	Coefficient for trend of A9N (via GA9N)	(quants/thous. man-year)/cap
CNAJ	Coefficient for trend of AJN (via GAJN)	(quants/quant)/cap
CNKQ	Capital-capacity ratio for non-petroleum investment	caps/(quants/year)
CNKQ2 = CNKQ/CGKQ		nondimensional
CNP1,2,3,4	Coefficients to determine PND	

C continued

CNPA, CNPZ	Weights for PND	nondimensional
CNQ4	Proportionate deviation from nominal capacity (of output).	nondimensional
CNQ5	Smoothed proportionate deviation of output from nominal capacity	nondimensional
CNQ6	Equilibrium value of CNQ5	nondimensional
CNQ9	In equation for Q9NN, adjusts labor requirement for deviation of output from nominal capacity	nondimensional
CNW	The fraction of QNRQ that is imported	nondimensional
CNYD = CBN x	(1 - CBS - PBTY - CNYW), used in first approximation for consumption	nondimensional
CNYW	Coefficient for payments to foreign factors of production by sector N	nondimensional
CNZ1,2,3,4	Coefficients to determine private real gross investment (Model V-2)	
CPQK	Coefficient of potential production in the petroleum sector	(quants/year)/cap
CPVE	Coefficient for total expenses on current account of petroleum sector	nondimensional
CPVG	Coefficient for labor income in the petroleum sector	nondimensional
CPVQ	Coefficient to account for the additional income of the petroleum sector	nondimensional
CPW6	Coefficient for imports of intermediate goods for the petroleum sector	quants N/quant P
CPW8	Coefficient to determine imports of capital goods for the petroleum sector	quants N/caps P
CPWN	Coefficient for re-export of capital goods	nondimensional
CPWV	Depreciation rate in the petroleum sector	proportion/year
CPYW	Coefficient for petroleum sector remittances abroad	nondimensional
CPZN	Attrition coefficient for the petroleum sector	proportion/year
CQH	Bias term in equation for GHQD	proportion/year
CSQ9D	Ratio of labor force to total population	nondimensional
CWP	Coefficient for increment in petroleum sector imports due to new concessions	
CZA6	Coefficient for trend of A6Z (via GA6Z)	(quants/thous. man-year)/cap

CZAJ	Coefficient for trend of AJZ (via GAJZ)	(quants/qt)/cap
CZP	Markup accounting for non-cost factors in PZDA	nondimensional
CZP1 - CZP6	Coefficients in function for PZDA (price)	various dimens.
CZP61,CZP62	Coefficients in function for P6Z (work)	various dimens.
CZUF	Coefficient of financial costs in price function	
CZ	Coefficient of endogenous component of investment, ZNKU	nondimensional
CZPN	Coefficient of endogenous component of nonagricultural nonpetroleum price, PZDB	nondimensional
CZPX	Coefficient of exogenous component of nonagricultural nonpetroleum price, PZDX	nondimensional
DHQW	Rate of increase of foreign exchange reserves	million $/year
DPND	Smoothed, lagged rate of change of domestic price	(million Bs/qt)/ year
DT	Time interval used in calculation	years
DY9G	Smoothed rate of change of Y9G	(million Bs/yr)/yr
F	A variable in private investment function that may represent public expenditure either for all purposes or for capital formation	million Bs/year
F9GY	Government revenue from all personal income taxes and from direct business taxes in sector N	million Bs/year
FCG2	Revenue from customs charges on goods imported for consumers	million Bs/year
FGGS	Overall surplus on government accounts (current plus capital)	million Bs/year
FGL	Smoothed and lagged value of F	million Bs/year
FGKT	Government investment expenditures	million Bs/year
FGN7	Subsidy payments to producers	million Bs/year
FGQE	Government expenditures on current account (excluding transfer payments)	million Bs/year

F continued

FGQT	Total government expenditure excluding loans and transfer payments	million Bs/year
FJG2	Revenue from customs charges on imported intermediate goods (not for Sector P)	million Bs/year
FKG2	Revenue from customs charges on imported capital goods (not for Sector P)	million Bs/year
FNGQ	Indirect taxes less subsidies, plus payments for government services and miscellaneous government fees	million Bs/year
FNP	Financial receipts of petroleum companies from their nonpetroleum activities and investments in Sector N	million Bs/year
FPG2	Revenue from customs charges on all goods imported by sector P	million Bs/year
FPG9	Total direct taxes coming from the petroleum industry	million Bs/year
FPGC	Flow of payments for concessions (expressed in domestic currency units)	million Bs/year
FPGCW	Flow of payments for concessions (foreign currency)	million $/year
FPGT	Government revenue from petroleum sector taxes and concession payments	million Bs/year
FQG2	Total revenue from import duty (all goods and sectors)	million Bs/year
FQGEP	Revenue from profits on multiple exchange rate transactions	million Bs/year
FQGT	Total government revenue less loans and transfer payments to nonpetroleum sectors	million Bs/year
FRG2	Revenue from customs charges on all non-petroleum sector imports	million Bs/year
FWK2W	All net capital inflow except concession payments coming from abroad	million $/year
FWQKW	Total net inflow of foreign capital (negative if net outflow)	million $/year
FWQSW	Current account surplus (negative if deficit)	million $/year

G, H and P

GA6Z	Reciprocal of A6Z	
GA9N	Reciprocal of A9N	
GAJN	Reciprocal of AJN	
GAJZ	Reciprocal of AJZ	
GHQD	A function of the relative rate of change of liquidity, used in investment function	proportion/year
GS9E	Proportion of labor force employed	nondimensional
HPK	Value of all fixed capital assets in petroleum sector, including concessions	million Bs
HQD	Supply of money plus other highly liquid assets	million Bs
HQW	Balance of foreign exchange reserves	million $
P6G	Index of government wage and salary rates	nondimensional
P6G2,P6G3	Step increments applied to P6G at times T2 and T3 respectively	nondimensional
P6GB	Conversion factor for determining average government labor expenditure from the index P6G	thous.Bs/man-yr
P6GX	Exogenous time series for P6G	
P6Z	Average wage and salary rate for nonagricultural subsector (Z) of sector N	thous.Bs/man-yr
P6ZA, B	Intermediate terms in function for P6ZU	
P6ZU	Endogenously determined P6Z, equal to smoothed P6ZA	
P6ZX	Exogenous time series for P6Z	
PAD	Price of domestically producted agricultural products	million Bs/ quant
PBTQ	Coefficient for indirect taxes plus payments for government services and miscellaneous government fees, applicable only to private business portion of sector N	million Bs/ quant

P continued

PBTY	Coefficient of direct taxes - business plus personal - on earnings and incomes from private business portion of sector N, less transfers to consumers	nondimensional
PCT2	Customs revenue coefficient for imported consumer goods	nondimensional
PGTY	Coefficient of personal income tax on public sector wages and salaries	nondimensional
PJT2N	Customs revenue coefficient for intermediate goods imports for sector N	
PK	Price of capital goods (domestic and imported, combined)	million Bs/quant
PKT2	Customs revenue coefficient for imported capital goods, not for sector P	
PN	Combination price of domestic and imported nonpetroleum goods for nonpetroleum use	million Bs/quant
PN9	Cost-of-living index, or price of goods used by consumers (domestic plus imported)	million Bs/quant
PN9D	Domestic component of PN9	
PND	Price of domestic nonpetroleum goods	million Bs/quant
PNP	Price of input products (imports and domestic, combined) for use in the petroleum sector	million Bs/quant
PPD	Price of petroleum products in domestic market	Bs/barrel
PPT2	Tariff rate on nonpetroleum goods imported by the petroleum sector	proportion
PPTX	Coefficient of government revenue from royalty, profits tax, and land area tax from the petroleum sector	proportion
PPTY	Personal income tax coefficient in the petroleum sector	proportion
PPW	Price of petroleum and products in world market	$/barrel
PWC	Wholesale price of imported consumer goods	million Bs/quant
PWC9	Retail price of imported consumer goods	million Bs/quant
PWCW	World price for consumer goods	million $/quant

P continued

PWJG	Price of goods imported for public sector current-account activities	million Bs/quant
PWJN	Price of intermediate goods imported for sector N use	million Bs/quant
PWJW	World price for intermediate goods imported for sector N and public sector current-account use	million $/quant
PWK	Price of capital goods imported for sectors N and G	million Bs/quant
PWKW	World price of capital goods for N and G	million $/quant
PWN1	Price of nonpetroleum goods imported by petroleum sector	million Bs/quant
PWNW	World price of goods imported by sector P	million $/quant
NOTE:	The many exchange rates listed below do not necessarily have different values but were programmed so that they could be made different if and when necessary	
PWW1	Exchange rate for the petroleum sector transactions	Bs/$
PWW2	Average exchange rate for imports of capital and intermediate goods for nonpetroleum sectors	Bs/$
PWW4	Exchange rate for income payments transferred abroad (not from sector P)	Bs/$
PWW5	Exchange rate for capital inflows (non-P)	Bs/$
PWWA	Average exchange rate for all exports and capital inflows (used in formula for profits on exchange transactions)	Bs/$
PWWC	Exchange rate for consumer goods imports	Bs/$
PWWJG	Exchange rate for imports by government for current activity	Bs/$
PWWJN	Exchange rate for intermediate goods imported for sector N	Bs/$
PWWK	Exchange rate for imports of capital goods, except by sector P	Bs/$

P continued and Q

PWWX	Exchange rate for sector N exports	Bs/$
PZD	Price of domestic nonpetroleum nonagricultural products and services	million Bs/quant
PZDA,B	Intermediate terms in calculation for PZD	
PZDX	Exogenous time series for PZD	
PZTQ	Indirect tax rate for Z product	
PZTY	Direct tax rate applicable to subsector Z	
NOTE:	All Q variables have dimensions of quants/year unless noted otherwise	
Q9NN	Theoretical labor input requirement for current level of output, sector N	thous.man-yrs/yr
QJNQ	Flow of intermediate goods used by sector N	
QJRQ =	QJNQ + QNGE, intermediate goods flow for all but sector P	
QKRQ	Inputs required for investment activity in sectors N and G	
QN9	Domestically produced component of supply of consumer goods	
QNGE	Inputs for current activity by government	
QNGK	Inputs for investment activity by government	
QNPE	Inputs to the petroleum sector for current production	
QNPK	Inputs for investment in the petroleum sector	
QNPQ	Total quantity flow of nonpetroleum goods for use by the petroleum sector	
QNPQE	Domestically produced nonpetroleum goods supplied to the petroleum sector	
QNQE	Gross output of the domestic nonpetroleum sector	(sector N)
QNQK	Nominal capacity of nonpetroleum sector	(sector N)
QNRJ	Domestic component of supply of intermediate goods for all but sector P (QJRQ)	

QNRK Domestic component of supply of capital goods for all but sector P (QKRQ)

QNRQ Demand for nonpetroleum goods, except demand by the petroleum sector and demand for exports

QNRQE Domestic supply of nonpetroleum goods for all but exports and petroleum sector use

QNWQ Quantity flow of exports from sector N

QPN Quantity of petroleum sector output sold in Venezuela

QPQE Total quantity of petroleum and products produced for all uses

QPQK Potential production in the petroleum sector

QPW Quantity of petroleum and products exported

QQ91 Quantity of goods and services purchased by consumers out of income; i.e., real consumption

QQ9B Intermediate variable used in calculating QQ91

QWC9 Imported component of QQ91

QWJR Imported component of QJRQ

QWKR Imported component of QKRQ

QWNP Total imports of nonpetroleum goods for the petroleum sector

QWNP1 Total imports for petroleum sector except when additional imports are induced by new concession situation in 1956-1957.

QWNP2 Additional petroleum sector imports induced by granting of new concessions in 1956-1957

NOTE: All R variables are in dimensions of proportion/year

RDHQ Proportionate rate of change of DHQ

RDYG1 Proportionate rate of change of DY9G

RFG Proportionate rate of change of government expenditure (for private investment function)

RHQD	Smoothed proportionate rate of change of HQD	
RINT	Nominal interest rate representing financing costs	
RL	Rate of growth of variable representing need for liquidity, in private investment function	
RQ9N	Proportionate rate of change of Q9NN	
RQQ9	Proportionate rate of change of QQ9B	
RSQ9	Proportionate rate of growth of total population	
RVP	Proportionate rate of change of V, in private investment function	
RWNKH	Smoothed proportionate rate of change of WNKH	
RY9G	Smoothed proportionate rate of change of Y9G	
SG6E	Employment in the Public sector	thousand people
SN9E	Employment in sector N	thousand people
SNK	Equivalent stock of real fixed capital for sector N	caps
SP6E	Employment in sector P	thousand people
SPK	Stock of real fixed capital in the petroleum sector	caps
SQ9	Total population	thousand people
SQ9D	Available labor force	thousand people
SW--	All words beginning SW are so-called "switches," used to change parts of the model for tune-up purposes	
NOTE:	All T variables are in dimensions of years	
T2,T3	Times designated for step changes in P6G	
TFG	Time constant for delay and smoothing of response to government expenditure in private nonpetroleum investment function	
TGP6	Time constant for delay and smoothing of P6G function	

TNQE3	Time constant for smoothing of DY9G	
TNRK	Time constant for smoothing of CNQ5	
TP6Z	Time constant for delay and smoothing of P6Z function	
TPR	Interval for printing out results	
TPZ	Time constant for delay and smoothing in PZD function	
TQ9N	Time constant for delay and smoothing of Q9NN in determining SN9E	
TQH	Time constant for delay and smoothing of DHQ in determining RHQD	
TQY	Time constant for third order lag in consumption response	
TVP	Time constant for delay and smoothing of V in determining VPL	
U6Z	Labor cost per unit of output, subsector Z	million Bs/quant
UQZ	Total cost per unit of output, subsector Z	million Bs/quant
UQZX	Exogenous term in formula for UQZ	million Bs/quant
UFZ	Financial cost per unit of output, subsector Z	million Bs/quant
UJZ	Cost of intermediate goods per unit of output, subsector Z	million Bs/quant
V	A variable in private investment function that may represent the value of either exports or petroleum production	million Bs/year
V6PK	Labor costs for capital formation in sector P	million Bs/year
V6GQ	Government expenditures on wages and salaries on current account	million Bs/year
VNPE	Value of inputs to sector P for current production	million Bs/year
VNWW	Value in dollars of the exports from sector N	million $/year

VNPK	Value of inputs to sector P for capital formation	million Bs/year
VPL	Smoothed and lagged value of V	million Bs/year
VPN	Value of total petroleum sales in Venezuela	million Bs/year
VPQ	Value of total sales of the petroleum sector	million Bs/year
VPQT	Total revenue of the petroleum sector	million Bs/year
VPW	Value of total exports of petroleum and products	million Bs/year
VPWW	Value of exports of petroleum and products in foreign currency	million $/year
VQ9	Value of consumption flow	million Bs/year
VQPE	Operating expenditure relating to petroleum sector current production	million Bs/year
VQW	Value of total export flow	million Bs/year
VQWW	Value of total exports in foreign currency	million $/year
VWNPW	Value of the flow of imports for petroleum sector in foreign currency	million $/year
VWNRW	Value of imports for nonpetroleum uses in foreign currency	million $/year
VWQW	Value of the flow of all imports in foreign currency	million $/year
WNKH	Value of gross private investment in sector N	million Bs/year
WPKG	Value of gross investment in the petroleum sector, including concessions (amount depreciable by tax laws)	million Bs/year
WPKN	Value of net capital investment in petroleum sector	million Bs/year
WPKV	Depreciation and amortization of the value of all fixed capital assets of the petroleum sector as computed for the revenue authorities	million Bs/year

WPKY	Value flow corresponding to real investment activity in sector P, not including payments for concessions	million Bs/year
Y7W	Factor income going abroad (in foreign currency)	million $/year
Y8G	Gross national income at factor cost	million Bs/year
Y9G	Gross territorial income at factor cost	million Bs/year
YD	Disposable income	million Bs/year
YDRPC	Real disposable income per capita	Bs per person/yr
YEAR	Calendar year with decimals running from .00 at January 1 through (1.0-DT) for last period in the year	
YN7	Factor payments going abroad from sector N	million Bs/year
YN7W	Factor payments going abroad from sector N (foreign currency)	million $/year
YN91	Intermediate variable used in first approximation for consumption	million Bs/year
YN9D	Disposable income earned in sector N	million Bs/year
YN9G	Gross value added in sector N	million Bs/year
YP1N	Net profits after taxes in the petroleum sector	million Bs/year
YP1Y	Net profits before taxes in the petroleum sector	million Bs/year
YP6G	Wage and salary income in the petroleum sector	million Bs/year
YP7	Remittances of income abroad from the petroleum sector	million Bs/year
YP7W	Remittances abroad of the petroleum sector in foreign currency	million $/year
YP9D	Disposable income earned in the petroleum sector	million Bs/year

YP9G	Gross value added in the petroleum sector	million Bs/year
YU9G	Profits of state enterprises (treated as government revenue)	million Bs/year
NOTE:	All Z variables have dimensions of caps/year	
ZGKG	Government real gross investment	
ZNKA	Attrition of effective real capital (i.e., physical replacement requirements) in sector N	
ZNKC	Ceiling on real gross private investment	
ZNKH	Real gross private investment actually undertaken in sector N (= ZNKT, subject to the limits: $0 \leq$ ZNKH $\leq$ ZNKC)	
ZNKT	Real gross private investment that would take place if no restrictions were imposed on it, = CZ x ZNKU + CK x ZNKX	
ZNKU	Endogenously calculated part of ZNKT (see above)	
ZNKX	Exogenous deviation of ZNKT due to expected changes in conditions and to optimism, etc. (Also used for exogenous investment with CZ = 0 and CK = 1.0)	
ZPKG	Real gross investment in the stock of real fixed capital of the petroleum sector	
ZPKN	Net real investment in the stock of real fixed capital in the petroleum sector	

CHAPTER 3

MAKING THE MODEL QUANTITATIVE

3.1 History and its Role in Model-Building

Formulating an abstract model is one thing; making it into a quantitative simulation of a specific economy is quite another matter. For this model especially, the latter process required using some unusual methods, partly because of the unorthodox nature of the model and partly because of the inadequacies and inconsistencies of the data at hand. It is expected that similar problems will be encountered by the researchers of CENDES and CORDIPLAN in establishing the numerical content of Model V-3, as well as by others doing this sort of work elsewhere. Perhaps some of the crude techniques that we worked out ad hoc will prove to be worth refining for other applications, in spite of their inelegance in their present form.

The original conception of the process of developing a quantitativ model was more or less as follows:

1) A set of historical time series would be compiled from various sources as a representation (with, of course, some degree of inaccuracy) of the way the Venezuelan economy behaved in reality.

2) An abstract simulation model would be formulated as a set of equations designed to explain how the significant variables in the economy interact and evolve through time;

presumably the set of model variables would include counterparts of most of those in the history.

3) Some of the coefficients for the model equations would be determined from previous survey studies or cross-sectional data, while others would be determined from the time series on related variables. Some, it was recognized, would have to be guessed, but it was hoped these would be few, and unimportant. It was assumed that some changes in the abstract formulation might be found necessary on the basis of the quantitative fitting process.

4) After the conclusion of Step 3, the complete simulation model would be tested and its output compared with history. Additional adjustments would be made at this point to improve the correspondence between the simulation and history. After that, it would be possible to say that the model behaved like the economy to the extent that the behavior of the economy was known.

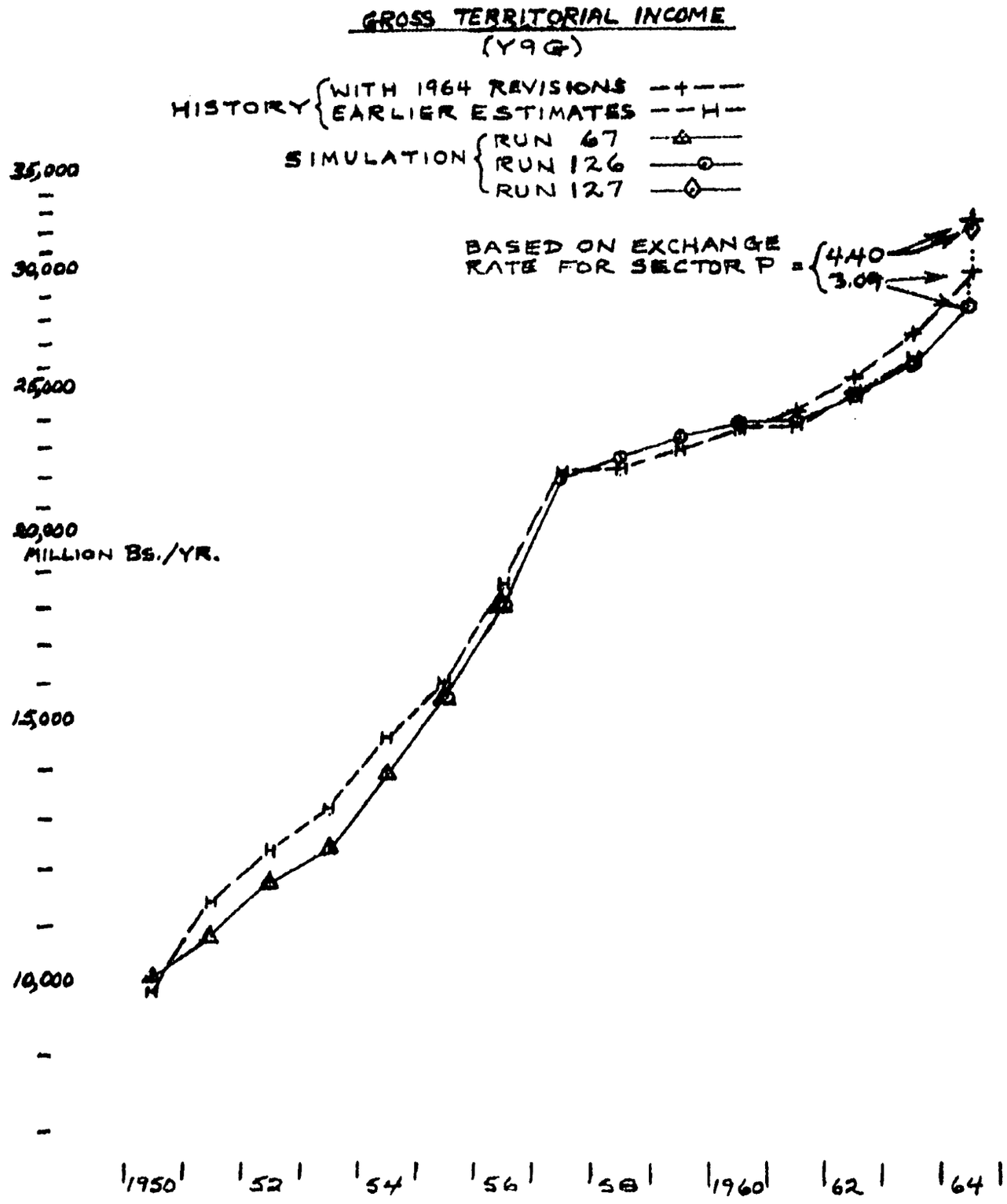
One of the lessons that was painfully learned in the course of this project was that the ideal situation described above cannot be realized with the kind of data that were available on the economic history of Venezuela. As the compilation of data progressed, and especially after the numbers began to be used in the model, more and

more deficiencies and inconsistencies were discovered. Before long we found that we were using the model to evaluate and reestimate some of the historical data at the same time that we were trying to use the data to establish the model. Of course this was not true with respect to all of the data, or the situation would have been hopeless. The more concrete explanations that follow, and the discussion of sources in Appendix B, indicate the different degrees of confidence that were placed on different sets of numbers, and the ways in which some of them were modified for consistency with those that were judged more reliable.

In the end, after many model changes and reestimates of some of the historical data, the simulation and history were brought into good agreement, and the simulation is now considered reliable for comparative studies of policy alternatives.

The graphs on the following pages show some of the principal variables produced by the simulation and compare them with their historical counterparts. The remainder of this chapter explains how the numerical content of simulation was arrived at, as well as some of the historical reference data.

FIG. 3-1


GROSS TERRITORIAL INCOME
(Y9G)
HISTORY
WITH 1964 REVISIONS
EARLIER ESTIMATES
SIMULATION
RUN 67
RUN 126
RUN 127
BASED ON EXCHANGE RATE FOR SECTOR P =
4.40
3.09
35,000
30,000
25,000
20,000
15,000
10,000
MILLION BS./YR.
1950
52
54
56
58
1960
62
64

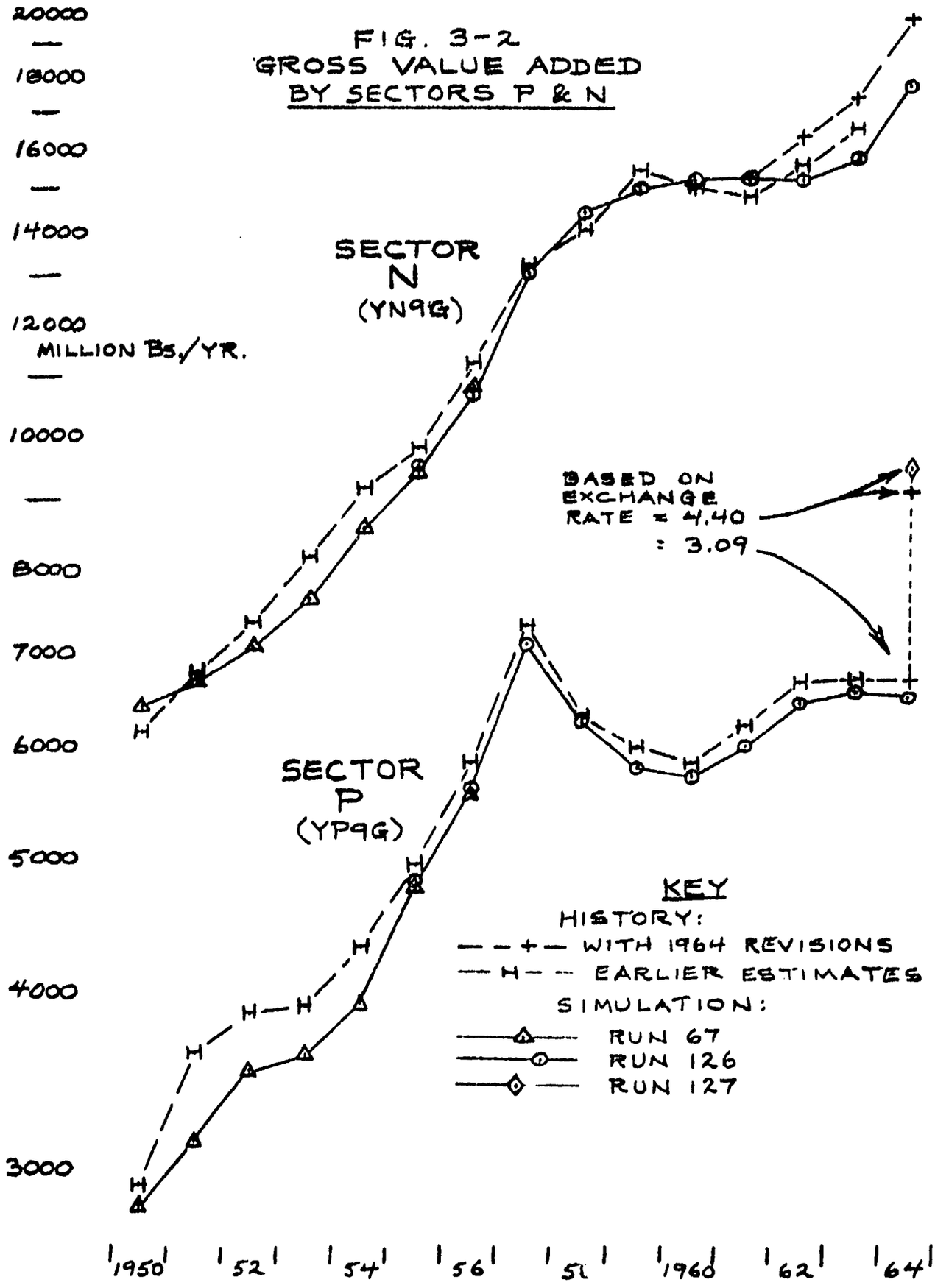
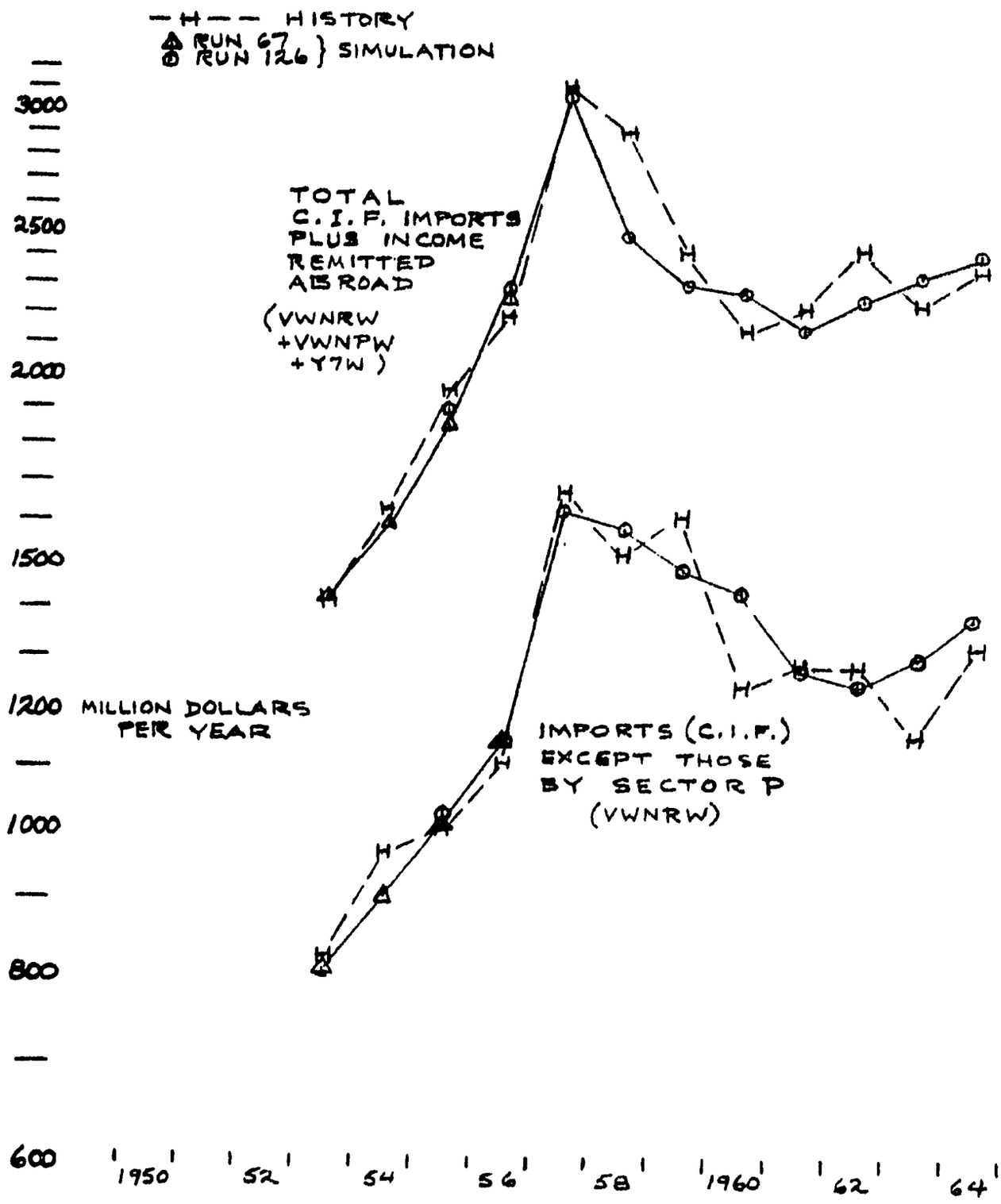


FIG. 3-2
GROSS VALUE ADDED
BY SECTORS P & N
20000
18000
16000
14000
12000
MILLION Bs/YR.
10000
8000
7000
6000
5000
4000
3000
SECTOR
N
(YN9G)
SECTOR
P
(YP9G)
BASED ON
EXCHANGE
RATE = 4.40
: 3.09
KEY
HISTORY:
— — + — WITH 1964 REVISIONS
— H — — EARLIER ESTIMATES
SIMULATION:
RUN 67
RUN 126
RUN 127
1950
52
54
56
58
1960
62
64

FIG. 3-3

FOREIGN PAYMENTS, CURRENT ACCT.



NOTE: EXPORTS AND CAPITAL FLOWS ARE PROGRAMMED IN THE SIMULATION TO BE THE SAME AS HISTORY

FIG. 3-4

PUBLIC SECTOR REVENUE

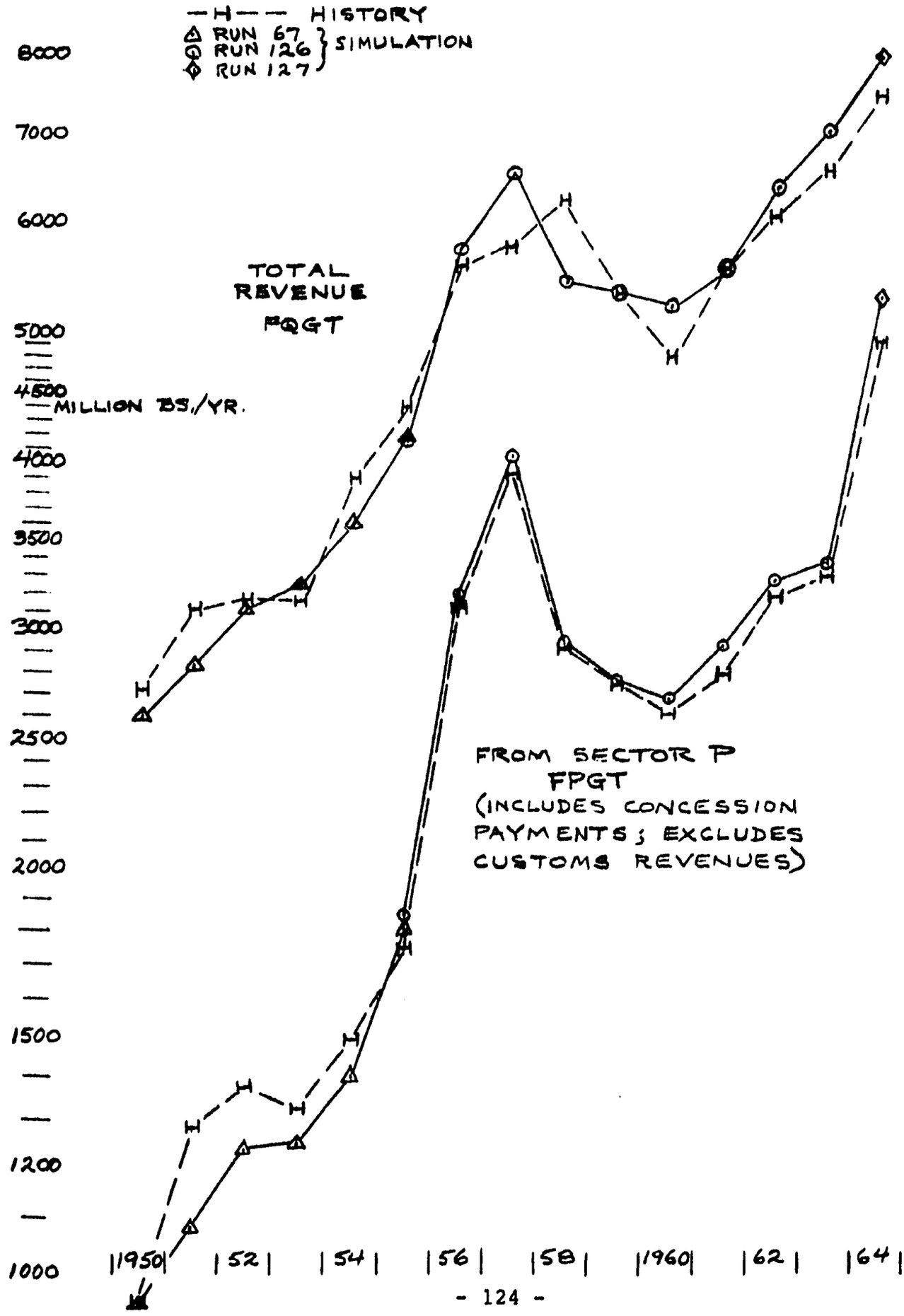
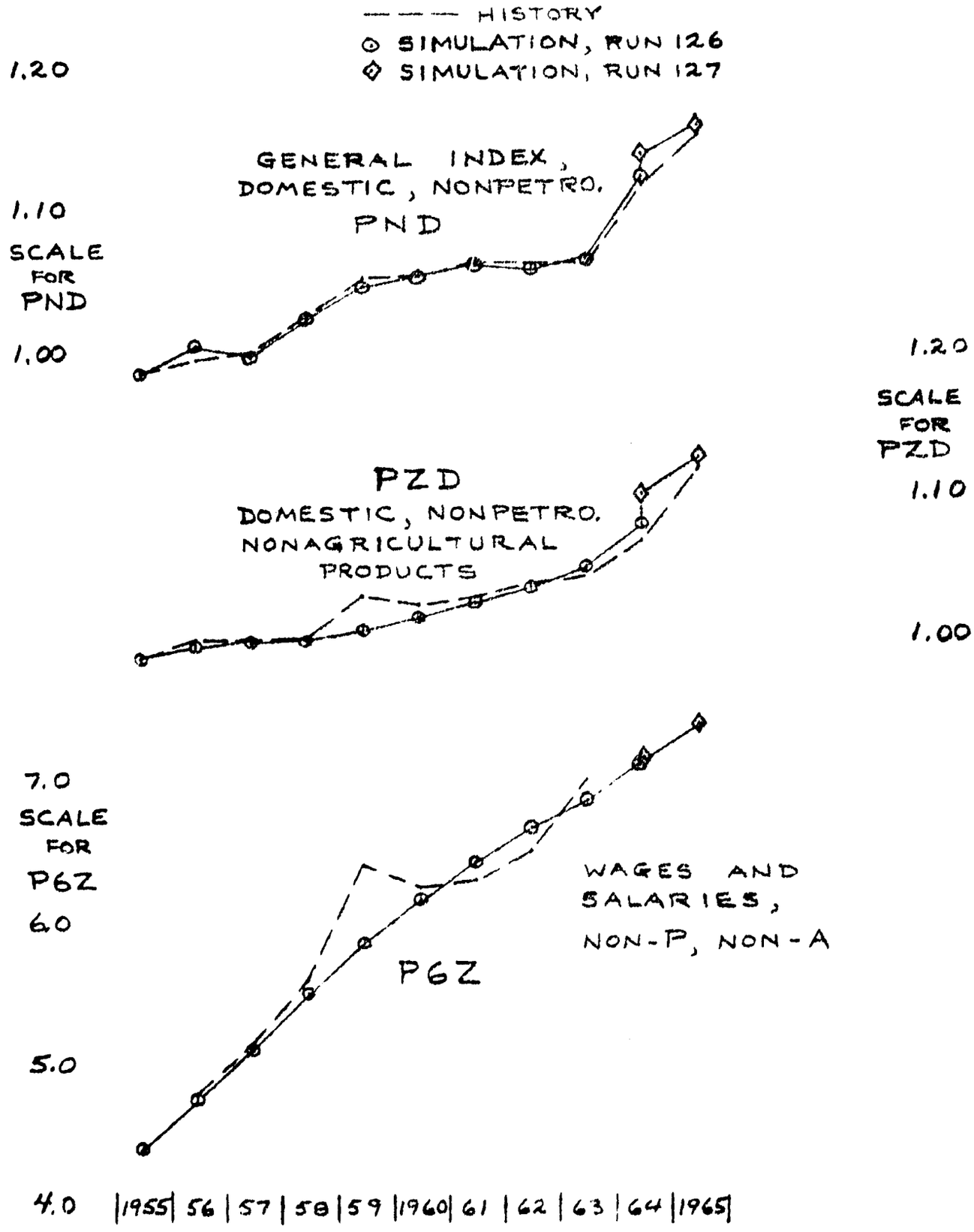


FIG. 3-5

PRICES



3.2 The Basic Data on the Economy

Numerical data (mostly historical time series) from a variety of sources were compiled and adjusted for two different kinds of use: first, for estimating coefficients and the time profiles of exogenous variables, and second, for use as a history of the past performance of the economy against which to test the performance of the model. Actually, it turned out that these two operations could not be kept separate and independent; it is useful, nevertheless, to recognize the two different ideas.

Details of the sources and modifications that were made to some of the data are explained in an appendix to this chapter. The vast majority of the information used came from the Annual Economic Reports of Banco Central de Venezuela.* All information on the petroleum sector, however, came from publications of the Ministerio de Minas e Hidrocarburos, supplemented by some unpublished data from their files. Actually, for the years 1960 through 1964, most of the petroleum sector data from these two sources is essentially in agreement, but for earlier years there are significant differences, and it was believed that the Ministerio publications were more reliable

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* Designated "Memoria" in earlier years, and "Informe Económico" more recently. In this report we use the abbreviation MBC (for Memoria, Banco Central) regardless of the actual title.

sources. Whereas the Ministerio de Minas maintained a consistent series of data over the entire period studied (and even longer), the methodology of the Central Bank reports changed a number of times, making it difficult to relate data for different periods. Aside from these changes from time to time, it was found that in the earlier reports of the Banco Central, figures in different chapters of any given report were inconsistent and contradictory.

In view of the incocsistencies and other shortcomings of the data, it was frequently suggested or asserted that the project staff should go deeper into digging out and analyzing data from raw primary sources. As it was, we put considerable time and effort into reconcilation of inconsistent data, seeking information that was not in the reports, and making analyses of the economy that, according to original plans, were to have been done by others. Had we gone any further into basic statistical research it would have meant abandoning completely the prime objective of introducing simulation into the Venezuelan planning process.

As fundamental reference data, it was assumed that the balance of payments and government accounts in the Banco Central reports and all the data from the Ministerio de Minas e Hidrocarburos were correct. Other data series were adjusted if necessary to make them consistent with these. Adjustments were also made to achieve consistency throughout the rest of the series and to eliminate discontinuities where time series were pieced together from reports of different vintages.

The national income data from the Banco Central reports were used to establish the history of value added in the non-petroleum economy and MMH data were used for the petroleum sector to build a history of gross territorial income and gross national income. With some further elaboration, a set of historical national income, foreign payments, and government accounts was constructed for the period 1950 through 1963. These accounts are presented in the appendix following this chapter.

3.3 Evaluation of Coefficients: The Simpler Cases

Rigorous statistical methods for estimating all of the parameters of a dynamic nonlinear model like V-2A have not been invented. It may even by one of those problems that can be mathematically proved to have no solution.

Even if such methods did exist, they would probably require more complete and reliable data before they could be used effectively. Quite frankly, the development of a simulation model under the existing conditions rests on the belief that judgment, rough estimates, and even guesses, can be put together to make a model that will give insight into the economic development process and that will give at least a somewhat better basis for policy decisions than less comprehensive methods using the same data.

Even with the support of that belief, it was deemed important to make reasonably good approximations for as many as possible of the 80 or so coefficients in the system, especially considering that some of them were suspected of being variable. Different coefficients presented us with different kinds and degrees of difficulties and required the use of different methods. The most simple and straightforward cases will be explained first, and then progressively more complicated problems and solutions.

3.31 One-coefficient Relations.

The simplest relations for which coefficients had to be evaluated were direct proportions and linear relations between pairs of variables for which data were available and were believed reasonably reliable. Examples of such relations were:

YN7 = CNYW x YN9G

QNPE = ANP x QPOK

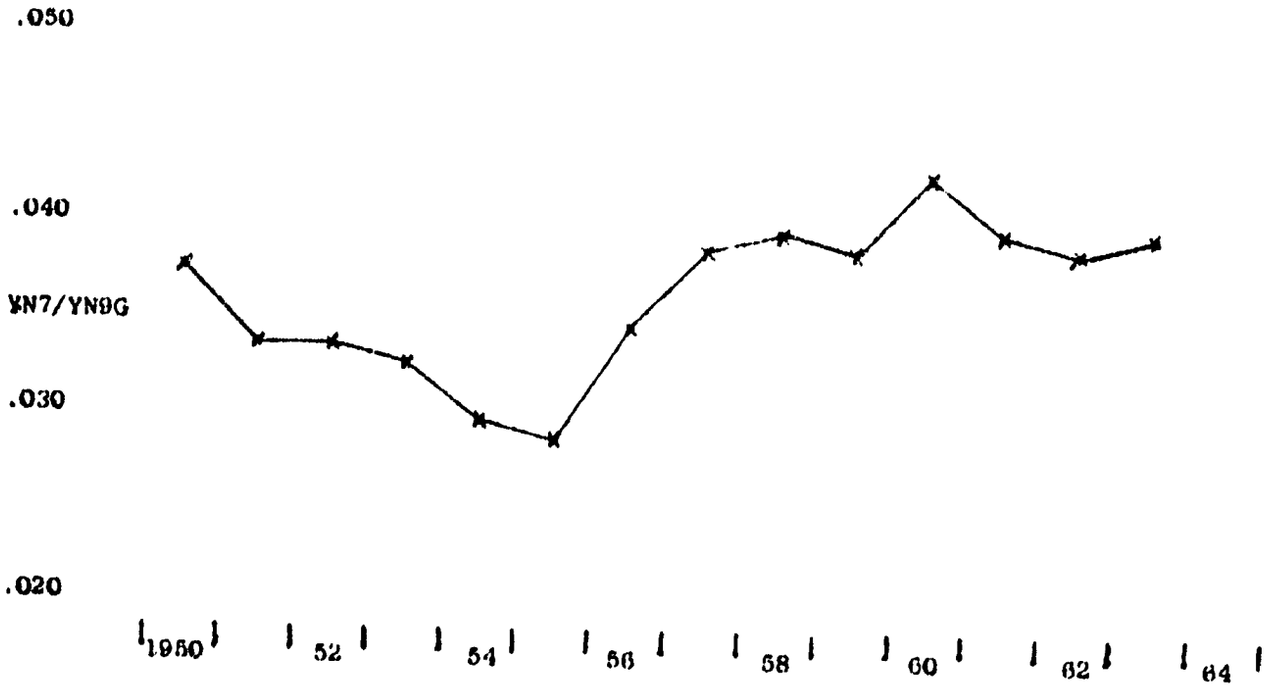
QWC9 = CCW x QQ91

An obvious approach in such cases would be to make regressions by the method of least squares. However, since we were never sure that the coefficient we were seeking was actually invariant with time, our practice was to analyze the relation graphically, usually by plotting the ratio of the two variables against time.

This has been done in Figure 3-6 for the first of the examples above. The relation indicates that factor income remittance abroad from the non-petroleum sector (YN7) are represented in the model as a fraction (CNYW) of value added in the nonpetroleum enterprise sector (YN9G). The graph shows that the ratio of the two variables has apparently varied over the course of time in a way that is not random, but that could not be represented by a simple trend. If this variation was thought to be important to the behavior of the simulation, an explanation would be sought. Another variable might be introduced into the relation, or at least the coefficient CNYW would be programmed to vary from year to year and a verbal explanation of its behavior be sought.

FIG 3-6

RATIO OF FOREIGN REMITTANCES TO GROSS VALUE ADDED
Non-Petroleum Sector



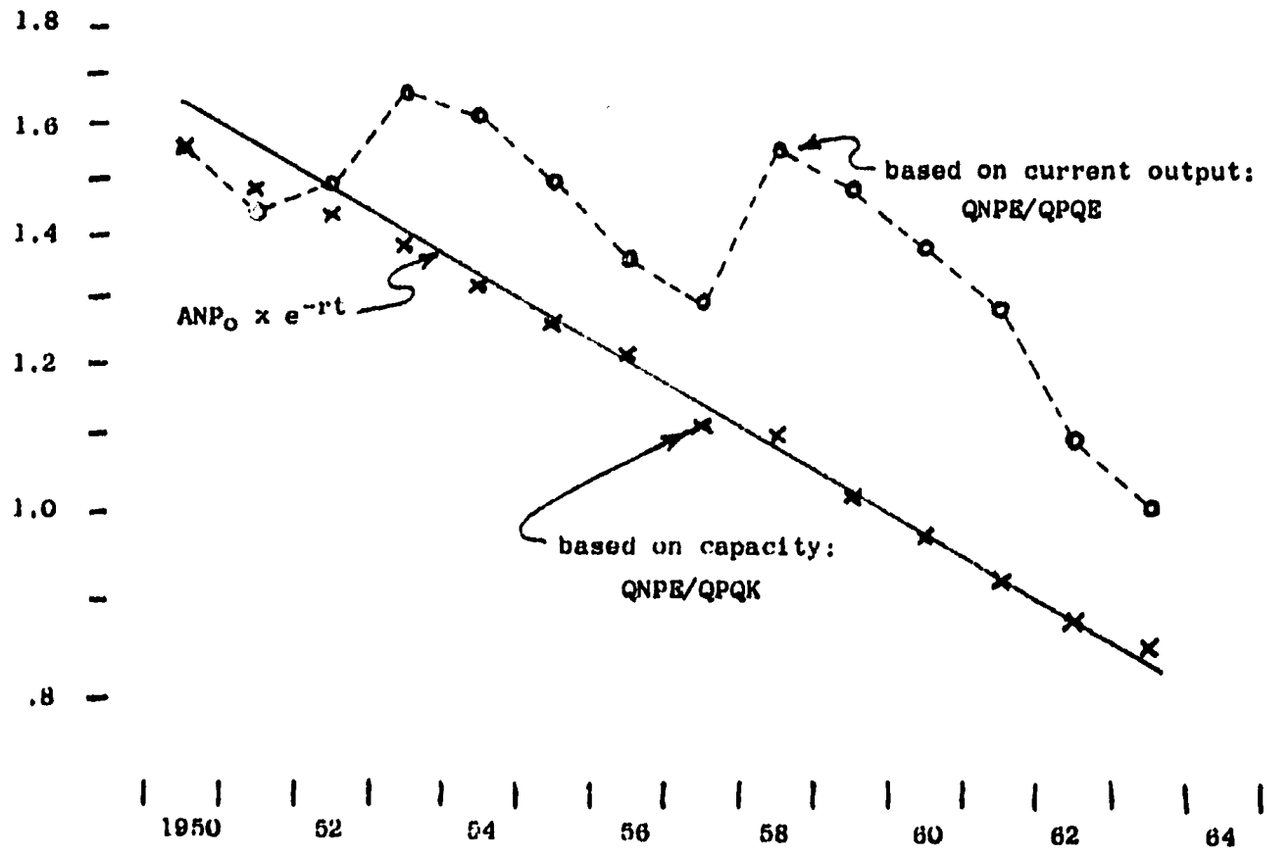
Actually, it is quite certain that the error introduced by assuming a constant value for CNYW would be unimportant. Moreover, the more recent data are of greater importance--both because they are more reliable and because their recency makes them more pertinent for projections into the future--and it is noteworthy that the ratio is very stable in the last seven years of the series. On these grounds the coefficient was assigned a constant value of 0.04.

The second example is graphed in Figure 3-7. In addition to the ratio corresponding to the equation as written above and used in the model, an alternative that was considered and rejected is also shown. The numerator of both ratios is the flow of nonlabor inputs purchased by oil companies for current operations (QNPE). The denominator of one (the upper line on the graph) is the total current output of the petroleum sector (QPQE). This ratio, in other words, is a conventional input-output coefficient, in real terms. The other ratio has for its denominator the potential production, or nominal capacity, of the sector (QPQK). Clearly, the conjecture that the latter might be a better determinant of input requirements than actual output is borne out by the data.

In this ratio, QNPE/QPQK, a clearly defined trend is evident, such as would result from a steadily changing technology. A simple regression of QNPE on QPQK might have suggested this as an economy of scale, but it would have been hard to explain why the input coefficient continued downward after 1960 when production leveled off and capacity

FIG 3-7

COEFFICIENT FOR PETROLEUM SECTOR INPUTS

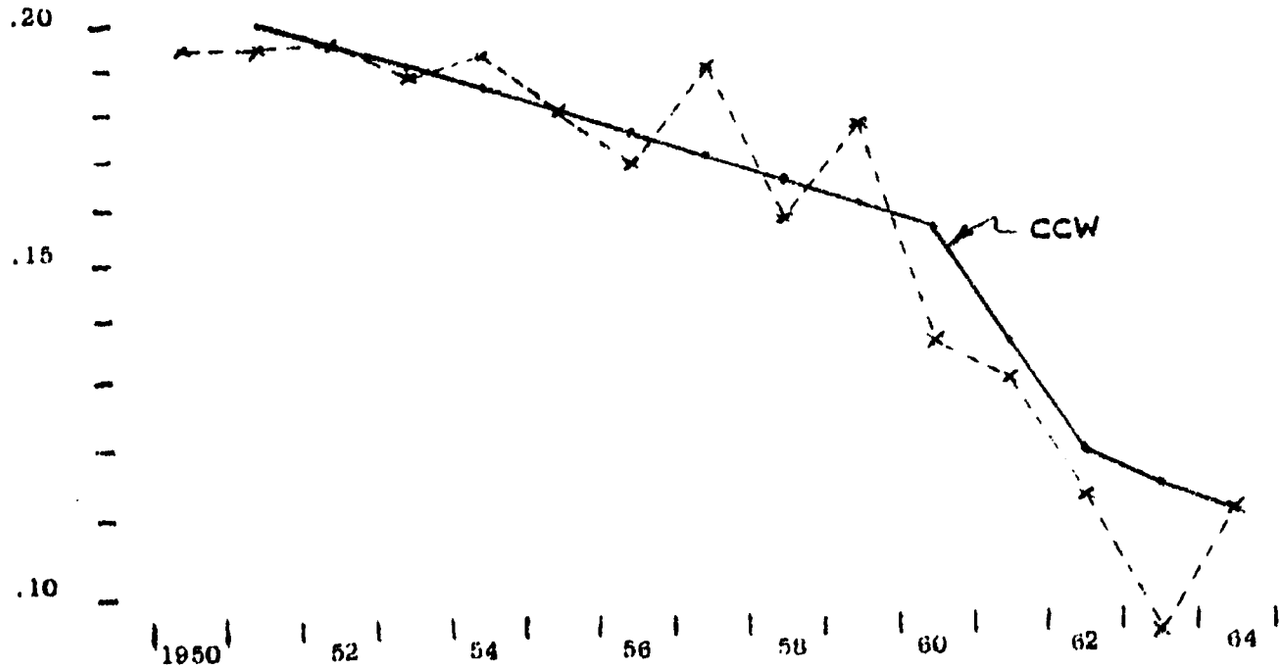


was allowed to decline slightly. A multiple regression with time as a second independent variable might have given usable results, but our taste happens to be better satisfied by a logarithmic decline of ANP (note that the graph is semi-logarithmic, which is according to our usual practice) than by a linear relation which might be inadvertently extrapolated into the negative region.

Another reason for at least looking at the relations graphically is that they might turn out like the third example, the relation between consumer goods imports and total real consumption. This ratio is graphed in Figure 3-8. Here again a time trend is visible within the scatter, but any line that fits well up to 1960 misses all the points thereafter. This serves to remind us that in 1961 there was a change in exchange rates, particularly for final goods, and the beginning of a policy of import substitution, implemented by a combination of measures that cannot be directly represented in this model. Considering these facts, it would be surprising if there was not a break in the trend of the consumer-goods import coefficient, and therefore the data were fitted with a broken line as shown in the graph.

FIG 3-8

PROPORTION OF CONSUMER GOODS IMPORTED



3.32 A Multi-Variate Relation

A graphical approach, somewhat different from that of the foregoing examples, can also be helpful in working out relations with more than one independent variable (besides time). By visually comparing the time-profiles of various independent variables and the dependent one, it is sometimes possible to get a good idea of the appropriate relative weights of the independent variables so that only minor adjustments necessary in the tuning-up process.

This approach was a part of the battery of methods applied to the investment and price functions, discussed later. First a simpler case than those will be explained, one that was formulated with only two independent variables, although it turned out in fact to be more complicated than expected.

The variable to be accounted for was the quantity flow of imports by the petroleum sector, QWNP. It was not considered practical to distinguish statistically between intermediate goods and capital goods imported for this sector. Nevertheless, it was believed that different import coefficients would be appropriate for the two categories. Therefore an equation was formulated for total petroleum sector imports as the sum of one coefficient times current-use inputs and another coefficient times capital-formation inputs:

$$\underset{\text{imports}}{QWNP1} = CPW6 \times \underset{\text{current}}{QNPE} + CPW8 \times \underset{\text{capital}}{QNPK}$$

(The numeral 1 is appended to the symbol for petroleum sector

imports to distinguish this version from a more complete one, explained below.)

The dependent variable and both independent variables are graphed in Figure 3-9. By inspection and cut-and try procedures it was determined that making CPW8 about one and one half times as large as CQW6 would give about the right timewise relative variation for the combination. It was also found, by trial and error, that values of about .4 for CPW6 and .6 for CPW8 would give a fairly good fit over the first six years of the history and again in the one year of 1958, being much too low in 1956 and 1957 and too high from 1959 on.

It was considered significant that the years when petroleum-sector imports suddenly jumped far above this relation were 1956 and 1957, when extensive new concessions were sold to the oil companies. It is assumed that the companies were stockpiling materials and equipment in anticipation of exploiting the new areas, and that adding a special increment in those two years is justifiable on that basis.* The portion

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* The increment, in fact was made endogenous by relating it to the flow of concession payments, which was zero in all years except these two:

QWNP2	=	CWP	FPGCW	QWNP1
extra imports		constant	concession payments	equation above

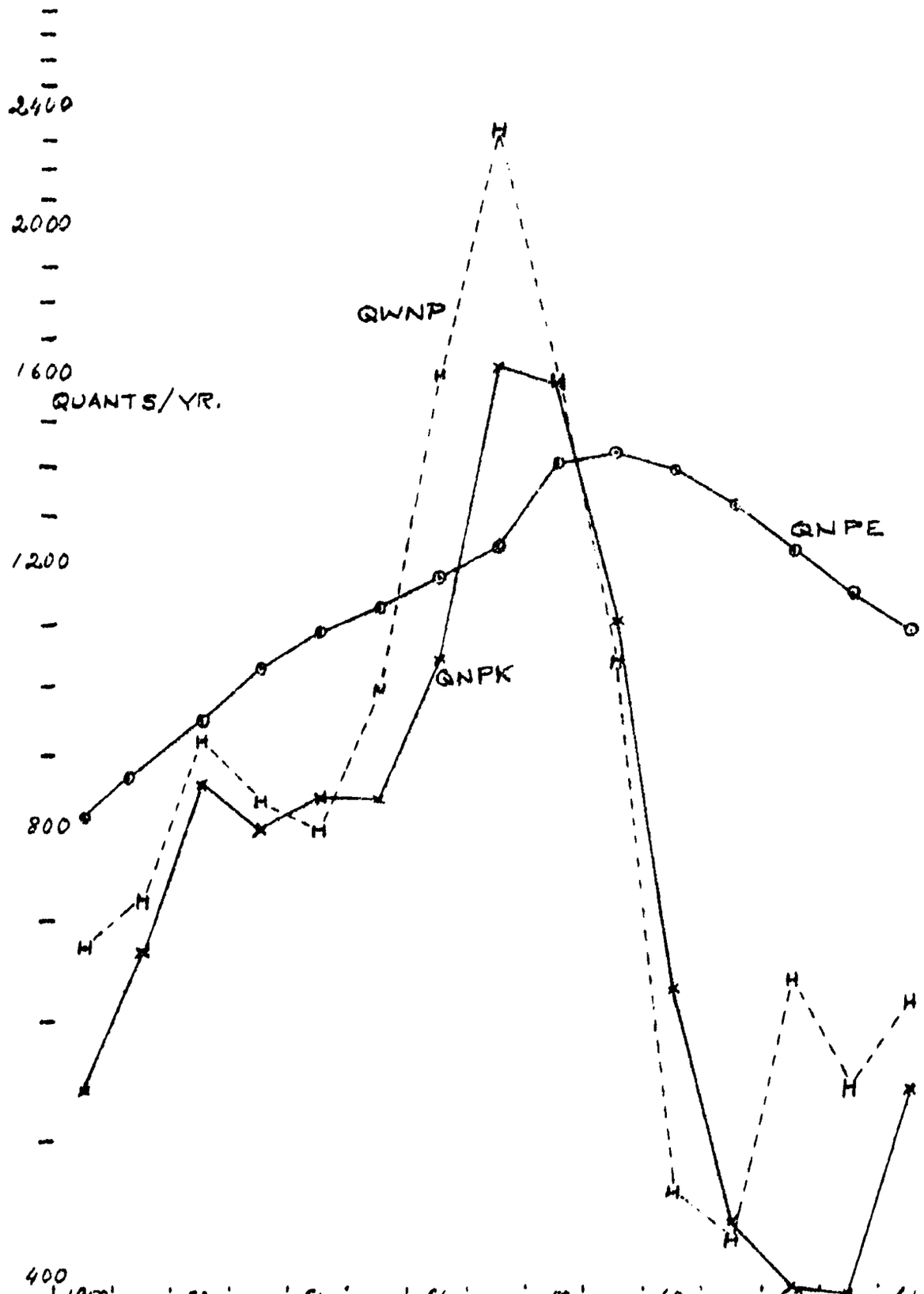
The total import flow for Sector P, then, is:

QWNP = QWNP1 + QWNP2

FIG. 3-9

PETROLEUM SECTOR INPUTS AND IMPORTS

Φ QNPE : INPUTS FOR CURRENT OPERATION
X QNPK : INPUTS FOR INVESTMENT
H QWNP : IMPORTS, TOTAL FOR SECTOR P



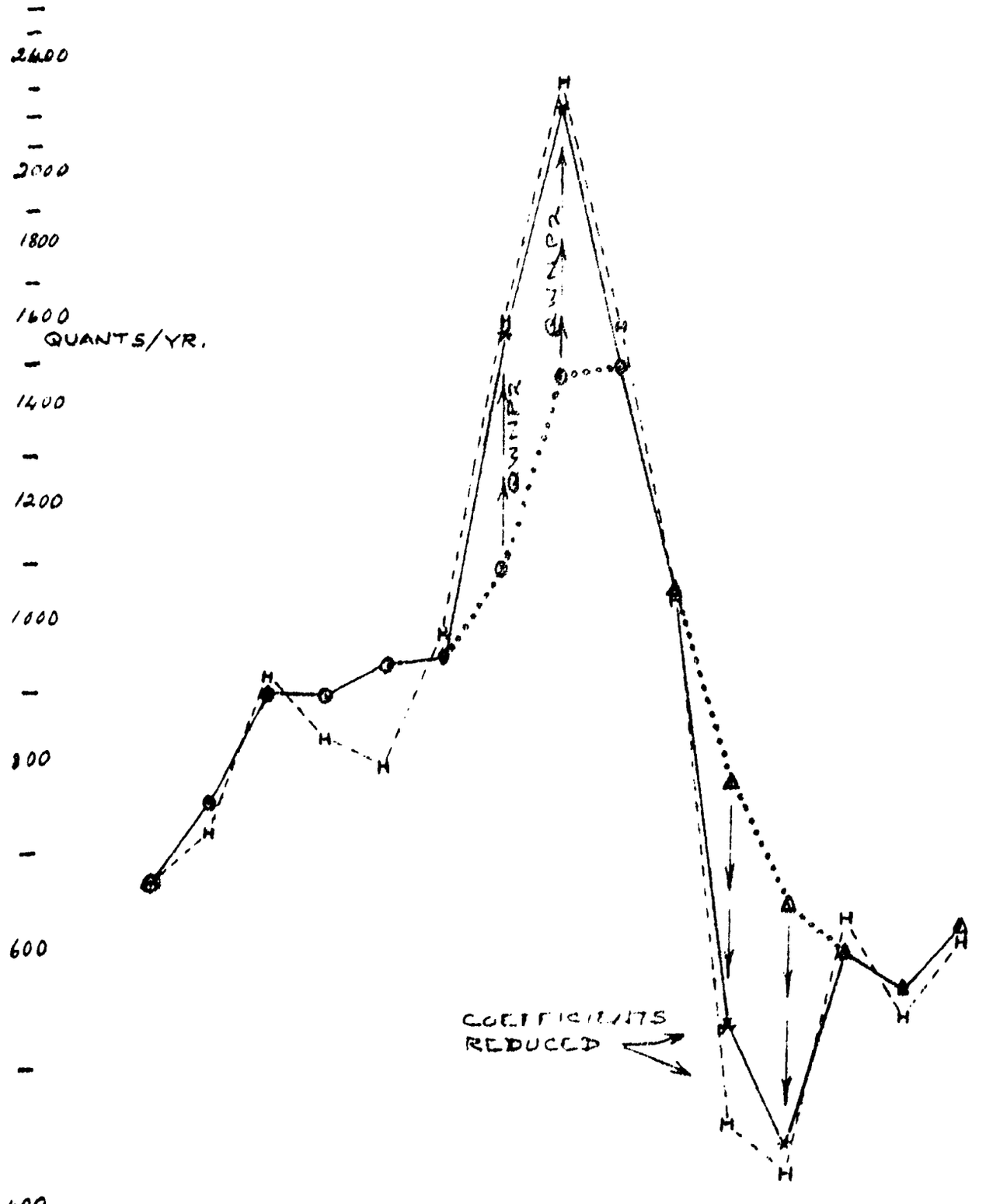
of Figure 3-10 from 1950 through 1958 shows how the equation given above, with coefficients of .4 and .59, gave good results except for the two abnormal years 1956 and 1957, and how the addition of QWNP2 in each of those years made up for the discrepancy.

This still left the problem of fitting the historical series from 1959 onward. When this problem was first attacked, in 1963, there seemed to be no regularity to petroleum sector imports for the four years 1959-1962. Two years later, with data on 1963 and 1964 added to the series, a pattern became apparent and was explainable. The pattern, statistically, was that the same equation used for the earlier years, but with somewhat smaller coefficients, fitted the history extremely well for the four years 1959 and 1962 through 1964, while actual imports in 1960 and 1961 were only 60 to 65% of what this relation predicted. The coefficients for 1959 and the last threee years were reduced from .4 to .3 for CPW6 and from .59 to .56 for CPW8, while to get reasonably close to the historical data for 1960 and 1961 they had to be further reduced to .2 and .40 respectively. The results of these combinations are also shown in Figure 3-10.

The hypotheses whereby this pattern is explained are, first, that a general reduction of the proportion of imports was brought about through restrictive licensing under the import-substitution policy, and second, that in 1960 and 1961 the stockpiles accumulated in 1956 and 1957 were drawn upon in place of new imports, since the anticipated expansion

FIG. 3-10
IMPORTS BY PETROLEUM SECTOR (QWNP)

--H-- HISTORY
⊙ .4 QNPE + .59 QNPK
△ .3 QNPE + .56 QNPK
* "ABNORMAL" POINTS
—— THE COMBINATION USED IN THE SIMULATION IS SHOWN BY THE SOLID LINE



of investment for which they had been built up had in fact turned into a contraction instead. On these hypotheses, it is reasoned that the coefficients CPW6 = .3 and CPW8 = .56 are the normal values for the period after 1958, and that 1960 and 1961 must be regarded as exceptional. There is still a likelihood, however, that these coefficients will be further reduced in the future (that is, after 1964) for two reasons. Because the change in the petroleum sector exchange rate, from 3.09 to 4.40 Bs/$ in 1964 has reduced the cost advantage of direct imports as compared with domestic purchases, and because domestic sources of supply are expanding under the government's development policy.

3.4 A Data-Interpretation Problem: Imports with Multiple Exchange Rates

In the explanations above, for the sake of separating the problems, it was assumed that some sort of usable history existed for both the independent and the dependent variables. In fact, the problems of evaluating coefficients were often complicated by difficulties of relating variables of the model to noncorresponding variables in the source data. For example, the formulation of the model treats imports in four categories, each one basically defined as a "real Quantity" flow, and each one including transportation and other "imported services". The categories are all goods for the petroleum sector, and consumer, intermediate, and capital goods for nonpetroleum uses. The balance of payments accounts in the Banco Central Memoria and Informes permit direct separation of the first category from the rest, in terms of dollar value flows, which we converted to "real" flows by dividing by a world market price index. Separation of the remainder into its three components was done less directly, on the basis of Tables G-V in the Appendix of the M.B.C.'s.

In these tables imports are classified into seven categories and four destinations, but the data do not include international shipping costs or imported services. The flows are given in tons and bolívars. The product categories of the value flows, for all destinations except petroleum companies, were combined as follows to parallel the nonpetroleum use categories of the model:

Model	MBC
Consumers' goods	Alimentos Bebidas Otros productos de consumo
Intermediate goods (For Sectors N and G)	Materias primas y auxiliares
Capital goods (For Sectors N and G)	Maquinarias, accesorios y herramientas Material de transporte

It was found that the total value of imports from these tables, when converted at the fixed exchange rates that prevailed through 1960, was from 5 to 15 percent less in every year than total imports on an f.o.b. basis in the balance-of-payments account, both for the petroleum sector and for the rest of the economy. Therefore the totals found for each category were multiplied by a factor that accounted for this difference in addition to the ratio of c.i.f. values to f.o.b. values, as found in the balance of payments accounts. The factor used was the same for all categories, but varied somewhat from year to year in order to match the total of nonpetroleum imports (c.i.f.) in the balance of payments account.

The procedure was straightforward and free of difficulties except for the years 1961, 1962, and 1963, when the interpretation of data are obscured by a system of multiple exchange rates that is not explicitly accounted for in the statistical data. With different exchange rates applicable to different specific goods, and with a sequence of

changes taking place in the list of goods eligible for a preferential exchange rate, each of our aggregate categories--or even each of the less aggregated categories in the MBC's--had to be considered as subject to some kind of average exchange rate, which changed in the course of time. The same average exchange rate could not be assumed to apply to different categories, because one of the objectives of the policy was to change the relative prices of imported final, intermediate and capital goods. And with the categorized data in bolívares and the totals in dollars, there was not sufficient information to determine either "real quantity flows" or dollar value flows by categories. The solution had to be reached by a series of tentative guesses and inspection of their calculated consequences for plausibility.

During the period of multiple exchange rates, the free rate was stabilized most of the time at about 4.54 Bs/$, the "controlled" rate was fixed at 3.35 Bs/$, and the petroleum sector rate was fixed at 3.09 Bs/$. With the object of promoting import substitution without inflating domestic prices, dollars were sold at the controlled rate to be used for importing selected intermediate goods whose cost might affect the price of Venezuela-made final goods, for importing capital goods for approved projects, and for importing limited quantities of consumer necessities when the domestic supply was inadequate. All nonpetroleum transactions not authorized for the controlled rate took place at the free rate. From time to time the list was narrowed down,

so that a progressively smaller volume of goods came in at the controlled rate and progressively more at the free rate, thus shifting the average rate upward. For the purpose of analyzing imports into the categories of the model during the three years of the multiple system, it was assumed, from qualitative knowledge, that the shift toward the free rate started earlier and took place faster for consumer goods than for non-petroleum-sector intermediate or capital goods. After several trial calculations the following schedule of rates was found to give a consistent and plausible set of time paths of imports in the three categories while yielding each year an overall average exchange rate close to that determined by CORDIPLAN. (Some of the trials used different transitions for intermediate than for capital goods, but the results were not as good on that basis.)

	1950-1960 (fixed rates until March 1961)	1961 (Estimated as explained above)	1962	1963	1964 (Rates fixed in January)
Petroleum	3.09	3.09	3.09	3.09	4.40
Nonpetroleum:					
Consumers' goods	3.35	3.80	4.40	4.50	4.50
Intermediate and Capital goods	3.35	3.35	3.60	3.90	4.50

With these exchange rates, and with a factor to account for freight and services and apparent omissions as before, the dollar value flows for each category were estimated and made to add up to the total shown

in the balance of payments account. The quantity flows were determined as before, from the dollar amount deflated by a world trade price index.

3.5 Interlocking Relations and the Tuning-up Process

The various relations discussed earlier in the chapter, despite certain complexities, could be isolated from the rest of the system in relatively small pieces, so that the coefficients could be experimented with and evaluated a few at a time. Greater difficulties were encountered in adjusting the coefficients of relations in networks that could not be so nicely disassembled because of complex feedback linkages and because of the lack of statistical counterparts for some of their main variables. These difficulties were dealt with by formulating and experimenting with several simplified computer models of portions of the system and, in later versions of the model, by including devices for isolating parts of the system and making special kinds of experiments on them.

It had been recognized before the project started that it would be impossible to make direct and independent estimates of many coefficients that would appear in the equations of the model. For these unidentified coefficients, it was planned that satisfactory values would be sought (and presumably found) by trial and error in experiments on the complete simulation. For a very simple model with only half a dozen coefficients it would not have mattered much how this operation--which we called "tuning-up"--was conducted. We discovered, however, that even Model V-2 (the simpler ancestor of V-2A) was too complex to be tuned up as a whole without great difficulty and inefficiency.

The particular problem described below is representative of those that will be encountered in more complex form in future models that are more detailed. The method that was used was a first, ad hoc approach. Supplementary devices, developed since, are described later, in connection with the investment and price functions. For more complicated models like V-3, the problems will be much more formidable, and it will be important to devise and include in the basic program more efficient means of isolating or extracting parts of the system and in other ways facilitating the process of making tests and adjustments.

In model V-2*, it was not feasible to work independently with any of the set of relations involving consumption (VQ9), total demand for real nonpetroleum goods and services (QNRZ, QNPQ, and QNWQ), its division between imports and domestic production (WQNR and QNQE), gross value added in the nonpetroleum sector (Y9G) and total disposable income (YD). The inseparability was due partly to feedback or multiplier relations, one of which is affected by no less than nine coefficients, and partly to the absence of trustworthy statistical counterparts for any of the

---

* The partial model was developed and is explained here in terms of the early Model V-2, before the "A" was added to indicate an extensive reformulation. In that model, imports for nonpetroleum uses were not disaggregated, so that QNQE is related to QNRQ in a much simplier way--through the single import coefficient CNW--than in V-2A, where different coefficients apply to different categories of imports. The rest of the equations used here are the same for both models except for some unimportant details.

variables mentioned above except exports (QNWQ), imports (QWNR), and--with a little more doubt--sectoral value added (YN9G). Since exports are exogenous, the adjustment of all the coefficients had to be judged in terms of the behavior of imports and value added.

The pertinent equations, somewhat consolidated and with ratchets and ceiling omitted for clarity, are:

QQ9B intermediary variable	=	(1-C9YS)	x	YD disposable income	/	PN general price index
QQ91 real consumption	=	DELAY3 third-order lag		(QQ9B , TQY) see above		TQY time constant
ZNETC part of QNRQ external to this network	=	ZNKH gross real N-sector investment	+	ZGKG gross real G-sector investment	+	QNGE G-sector real current-account purchases
QNRQ demand for N-goods but not for export or Sector P	=	AJN x QNQE gross real output of Sector N	+	QQ91 real consumption	+	ZNETC see above
QWNR portion of QNRQ imported	=	CNW	x	QNRQ see above		
QNRQE portion of QNRQ not imported	=	(1-CNW)	x	QNRQ see above		
QNETC demand for N-goods not subject to CNW	=	QNPQE for Sector P	+	QNWQ exports from Sector N		
QNQE gross real output of Sector N	=	QNRQE portion depending on CNW	+	QNETC independent of CNW		

YN9G = QNQE (PND - AJN x PN - APN x PPD - CBN x PBTQ,
gross value added — see above — N-Sector price — general price — domestic petroleum price — indirect tax coeff.

YD = YPETC + YN9G
disposable income in Venezuela — disposable income generated in Sectors P and G — value added Sector N

[CBN x (1 - CBS - PBTY) - CNYW]
CBN: private business fraction; CBS: business saving coeff.; PBTY: direct tax coeff.; CNYW: coeff. of remittances abroad

Without even considering the time constant of the consumption lag, nine coefficients are involved, as follows:

AJN intermediate goods required per unit of QNQE output

APN ratio of domestic petroleum sales to gross output of Sector N (both in real terms)

C9YS steady-state savings coefficient

*CBN ratio of private value added in Sector N to total (including government enterprises)

CBS fraction of private value added retained by businesses in Sector N

CNW fraction of QNRQ that is imported

*CNYW ratio of income remitted abroad to gross value added, Sector N

PBTQ coefficient of indirect tax revenue

*PBTY coefficient of direct tax revenue

Each of the three coefficients starred is the ratio of a known flow to YN9G, and hence can be directly estimated, subject to the effects of possible slight changes in the estimate of YN9G.

Something is known about most of the other coefficients. Often, however, what is known is the numerator of the fraction, while the denominator is one of the variables in the equations above and will be altered by a change in the coefficient one wants to adjust, as well as by a change in any of the other eight. Since imports are known might be supposed that an error in the simulated history of imports could be corrected by altering CNW in proportion to whatever error was observed. But a change in CNW will change not only QWNR but also QNRQE, which in turn will affect QNQE and YN9G--upsetting the adjustment of the latter if it had already been achieved--and, through income and consumption, will change the QNRQ by which the coefficient CNW is being multiplied. Thus the change required in CNW is not proportional to the observed error (a fairly simple matter to deal with), and (more difficult) not only QWNR but also YN9G (and all the other variables) will be affected. (Also tax revenues, but correcting those is not too hard.) Attempting to correct YN9G by changing one or more other coefficients would then throw off imports again. To make matters worse, from time to time new estimates of one or another of the "exogenous" variables (exogenous relative to this subsystem) had to be introduced, requiring a new tuning-up operation to compensate for the change.

In order to avoid the need for making large numbers of runs with the complete simulation to tune up this particular part of the system, a simplified partial model was programmed, including only the relations

and even omitting the time lag so that a static equilibrium solution could be found directly. To simplify the use of the partial model still further, the equations were manipulated into forms giving explicit solutions for YN9G and QNRQ.*

With this model (Modelo YN9G) many combinations of coefficients could be tried out in the time required for a single run of the complete system, and, along with the others, the CNW and C9YS, which had been the most elusive in previous tune-up attempts, were pretty well pinned down. When the first changes were made in the estimated

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* Just as the Keynesian equation for a closed economy, $Y = c.Y + I + G$, can be transformed into the multiplier form, $Y = \frac{1 + G}{(i-c)}$, the equations (omitting the lag) can be juggled around to isolate the desired variable on the left-hand side, but the resulting equations are rather complicate. They are:

$$YN9G = \frac{GAMA - AJN \times PN}{1 - MU} \times (1 - CNW) \frac{ALFA}{PN} \times YQETC + ZNETC + QNETC$$

$$QNRA = YN9G \frac{AJN}{GAMA - AJN \times PN} + \frac{ALFA \times BETA}{PN} + \frac{ALFA}{PN} \times YPETC + ZNETC$$

In which the following new definitions were used for convenience:

$$ALFA = (1 - C9YS)$$
$$BETA = CBN \times (1 - CBS - PBTY) - CNYW$$
$$GAMA = PND - APN \times PPD - CBN \times PPTZ$$
$$MU = (1 - CNW) \times AJN \times (1 - ALFA \times BETA) + ALFA \times BETA \times GAMA/PN$$

history of private nonpetroleum investment. Modelo YN9G facilitated the readjustments of coefficients that were necessary to keep income and imports in the right range.

Of course, since this was a static model, some further adjustments had to be made when its indications were applied in the main model with its time lag in the multiplier circuit. There adjustments were fairly small, however, and were easily accomplished.

3.6 The Special Problem of Private Nonpetroleum Investment

One of the main factors in determining the dynamic characteristics of any economy that includes a significant private enterprise sector is, of course, the behavior of private investors. Unfortunately, the function representing investors' behavior is one of the most difficult to establish, even with goods statistics. The problem of dubious statistics on the history of Venezuelan investment led to the use of a semi-theoretical, semi-empirical approach with a great deal of experimentation.

The experimentation started in early versions of Model V-2, which had been programmed with the option of substituting an exogenous time series for its endogenous investment function, so that we could alternate between tuning up the rest of the system with a given investment history that we thought was correct, and tuning up the investment function as part of the whole system. Further work on adjusting the system to suit a specified investment history went on, as described above, in Model YN9G. Another approach that was tried was the use of a model of Sector N as a whole. This was not found very profitable, however, because the difficulties of keeping details of the submodel and of the complete model the same while they evolved--or of keeping track of the differences--outweighed the small benefits gained by

isolating what was in fact the major part of the whole system.*

Later, another partial model was made, representing only the investment function itself, with all of its inputs exogenous, but differing from earlier partial models in that it was designed to permit trying out a wide range of alternatives. Not only could different variables be used as the exogenous inputs, but in addition it was possible to multiply or divide variables by each other, to find and use their derivatives, and to apply distributed lags to either the variables or the derivatives. With this model, named SIM, a "feel" for the investment function was gained, some alternatives were eliminated, and several different ways of reproducing the "history" of private investment were developed, none of which was very satisfactory.

Although we had already had trouble with the history of private nonpetroleum investment and had indeed fabricated a new history in place of the one in the official statistics, we were still, up to this point, making the mistake of treating our postulated investment history most of the time as a fixed reference. On one hand we were adjusting

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* In the future, especially with a more complex model, this approach should be tried again, but with the separate sector or subsector programmed as a subroutine that can either be used alone in a simple test-program framework or "plugged in" to the full model without copying or changing any of it. If this suggestion is followed, some careful thought and clever programming will be necessary to insure that the computer-printed information on any run fully and correctly designates the characteristics of the subroutines that were used.

the multiplier system to go with it while on the other hand we were trying to devise an investment function that would generate it. Eventually the history had to be reconsidered further.

The very first attempts at establishing the history of private nonprtroleum investment had made use of BCV data* on all nonpetroleum investment (private plus government) expressed in 1957 prices, and on public sector investment expenditures from other chapters in the same Memorias and Informe, which, however, were expressed in current prices. Thest two series were put on the same basis by making a price adjustment (relatively small), and public investment was subtracted from the total. The difference should have been private nonpetroleum gross investment. The result, however, was not plausible. What it indicated was an upward trend, reaching a peak in 1954, then a steep descent to a very low point in 1957, which is generally recognized as the peak of the boom period, followed by a rising trend during 1958, 1959, and 1960, the year when national income and other indicators indicated a definite recession.

Adjut ments in other related data to try to achieve some approach to consistency with this investment history were unsuccessful. Consultations with experts at CORDIPLAN led to the postulation of a new "history" for private nonpetroleum investment based largely on opinions as to its relative rate of increase or decrease from one year to the next. This new time series was used in the early V-2 Model and in the partial model, YN9G, and the various co-

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* Memoria 1956, 1958 through 1961, and "Informe Economico 1962"

the partial model, YN9G, and the various coefficients were adjusted to achieve consistency of national income and imports. The adjustment required varying a number of coefficients year by year, but the years where the greatest variations were necessary were years of political transition and uncertainty, which it was believed might justify the variations in the coefficients that were used.

Once a set of coefficients had been worked out that would yield satisfactory results for the variables derived from investment, a long series of experiments, both with the complete model and with Model SIM described above, was carried out with the object of making private nonpetroleum investment a function of variables within the system. The object was achieved only by means of such major discontinuities in the coefficients that the validity of the solution was subject to serious doubt.

With Model V-2A, in which different categories of imports were distinguished instead of all being lumped together, a new look at the situation revealed that the hypothetical "history" that had been used for investment did not harmonize with presumably more reliable data on capital goods imports. Obviously, the capital-goods import data should have been used earlier to help in estimating investment, but sometimes it requires the discipline of an explicit model to make one do the right thing. Up to this point we had only been concerning ourselves with total non-petroleum-sector imports, where the discrepancies were less obvious.

Once the question of the history of investment was re-opened, another factor was taken into consideration, the availability of new evidence for recent years. New estimates had been made for investment from 1960 to 1964--information which had not existed when the earlier "history" was established. Estimates for this period were now available from two sources: CORDIPLAN, and the 1964 "Informe" of the BCV, and they were found to be in close agreement. It was therefore felt that our estimate of investment should be revised for those five years to agree with this apparently more reliable data. At the same time, both the earlier history of investment and the endogenous investment function would be reevaluated.

Some new features that had been built into Model V-2A made it easier than before to experiment with the investment function. Several "switches" (i.e. means of signaling for the computer to follow alternative instructions) were programmed at convenient points, in addition to the original device mentioned earlier, for using either endogenous or exogenous investment (or a combination of the two) in the remainder of the system. In previous versions, all of the variables to be printed out had to be specified in the program of the model itself, and any change in the specifications of variables to be observed required recompiling the whole model as if it were a new model version (a time-consuming procedure on the IBM-1620 with a model like this one). The inflexibility was relieved in Model V-2A by having the first set of

six output variables specified in a subroutine, which could be recompliec in a minute or so whenever we wanted to have some different variables printed. Thus, if we had difficulty in understanding the behavior of a particular variable, we could observe others that entered into its determination. As the process of tuning up the model was shifted in focus from one part of the model to another, appropriate changes could easily be made in the information printed out.

A very simple and extremely useful feature that we had not thought of before was having the investment function calculate an endogenous value that would be printed in the output even when the exogenous value was being used (and printed beside it).

In addition to making it possible to study the behavior of the investment function without having its aberrations propagated through the multiplier system, this feature also enabled us to alternate between trying changes in the investment function coefficients and trying different versions of investment history until the endogenous and exogenous values were close to agreement, and then to close the loop, making investment endogenous without upsetting all the other adjustments.

With the aid of these new features a series of cut-and-try experiments revealed that a rather large change in the postulated "history" would alleviate several problems simultaneously: 1. The need would be eliminated for varying the personal savings coefficient from year to year as had previously been done in order to make income behave properly. 2. It would be possible to match capital goods imports with a less severe and more plausible variation in the capital-goods import coefficient, and

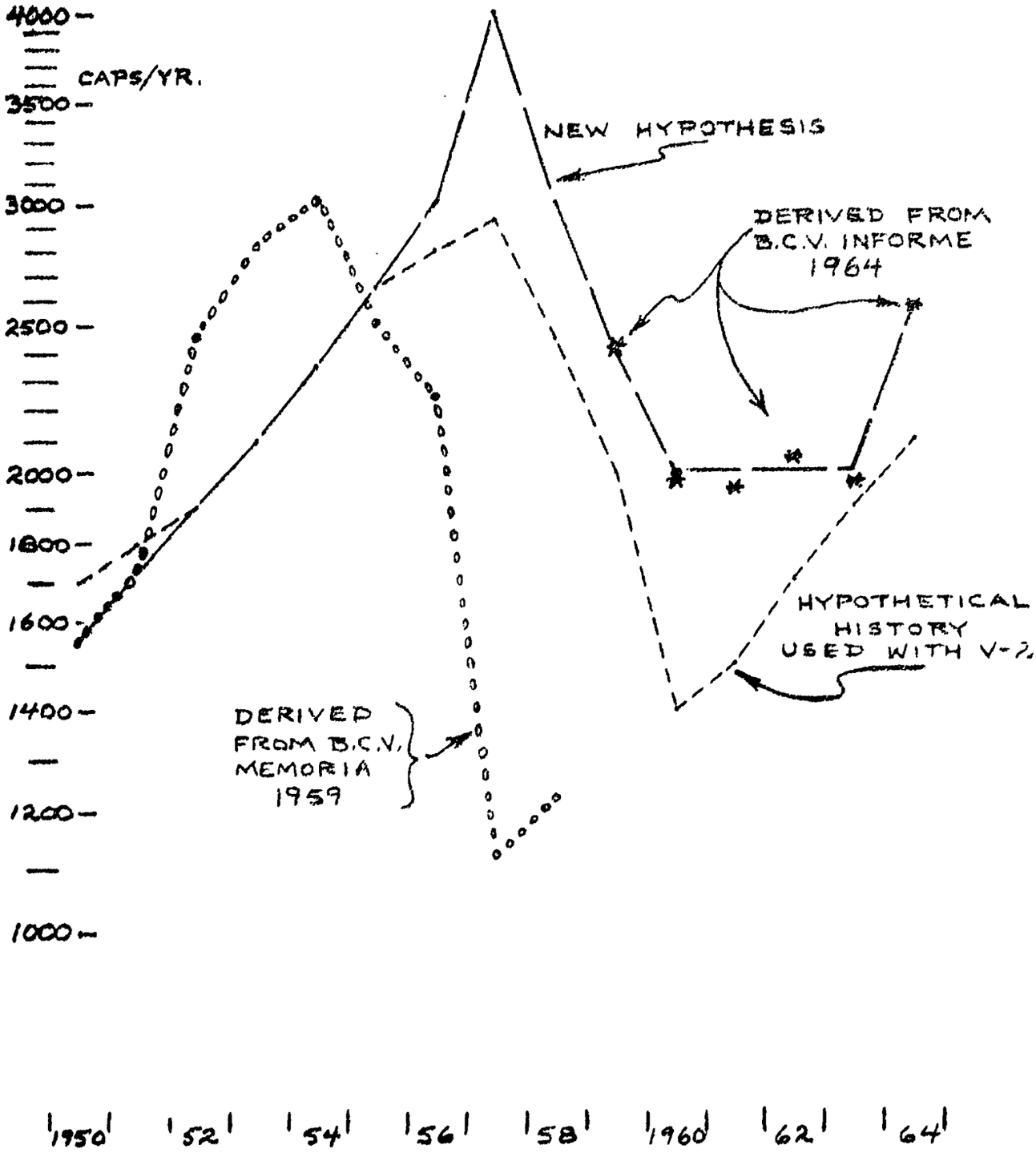
3. The new investment series could be generated endogenously without the abrupt and drastic changes that were formerly required in the coefficients of the investment function

On the basis of these results (particularly Numbers 1 and 2), it is believed that this latest version of the "history" of private nonpetroleum investment is likely to be closer to the truth than what was used earlier Unfortunately, this reinvestigation of the question was done and this conclusion reached after it was too late to revise all of the accounts presented in the appendix and they, therefore, are based on the earlier estimate (Changing the investment figures it should be clear, would require changing various other items in several of the accounts to keep them consistent and balanced)

Figure 3-11 shows the two different hypothetical "histories" of real private nonpetroleum investment ZNKH, together with its "history" as originally derived from the MBC

Figure 3-12 shows, at the top the two hypothetical histories and the corresponding variable as produced endogenously by the simulation Lower the simulated variation of capital-goods imports (for nonpetroleum use) is shown in comparison with its history The two lines at the bottom of the page show how the capital-goods import coefficient CKW was varied through time for each of the assumptions about investment history It is notable that the new hypothesis requires less irregularity in this coefficient The second set of CKW values (the dashed line) were also used in the simulation whose results are shown in the upper parts of the figure

FIG. 3-11
REESTIMATION OF HISTORY OF PRIVATE INVESTMENT (NONPETROLEUM)



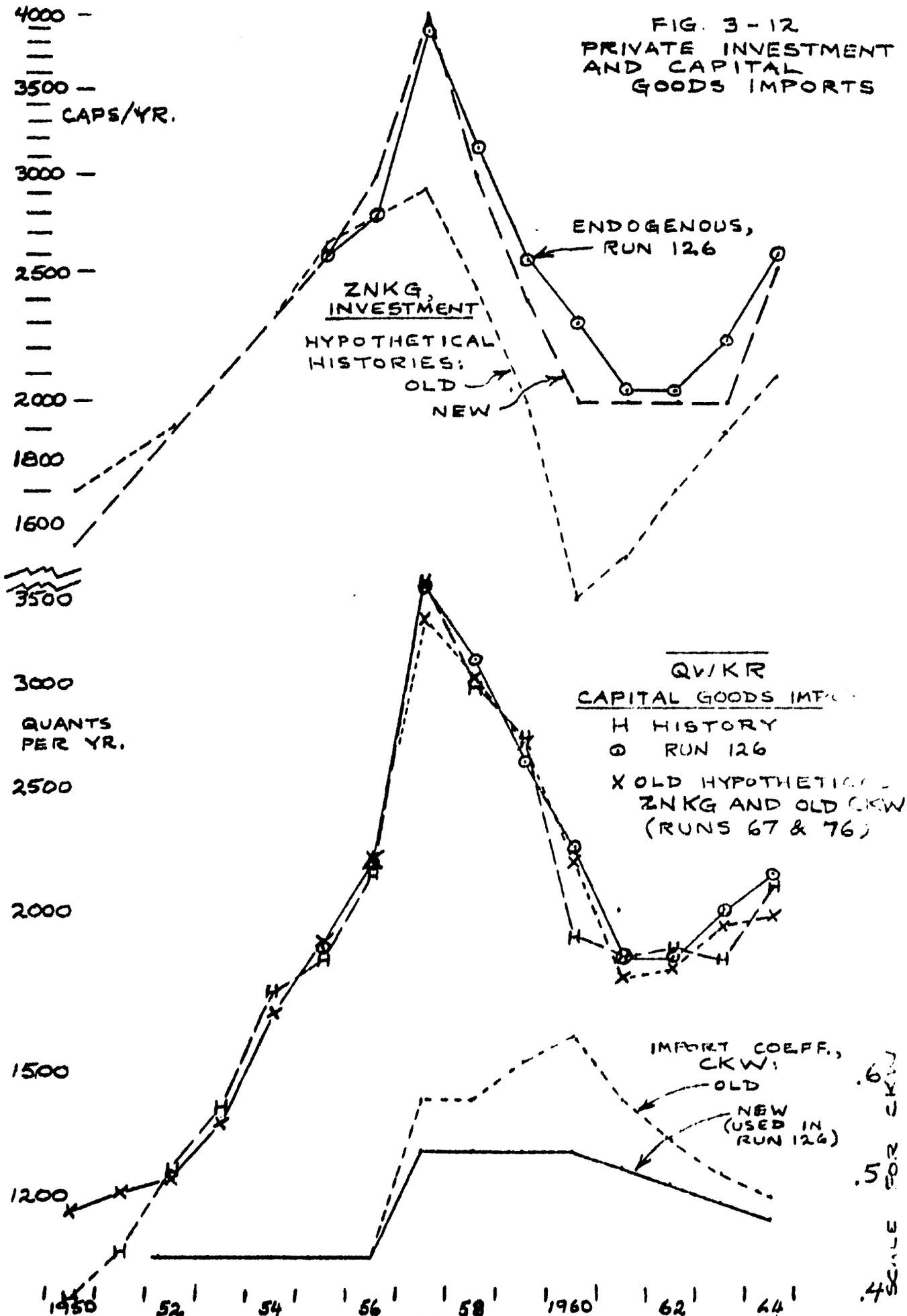


FIG. 3-12
PRIVATE INVESTMENT AND CAPITAL GOODS IMPORTS
4000
3500
CAPS/YR.
3000
2500
2000
1800
1600
ENDOGENOUS, RUN 126
ZNKG, INVESTMENT
HYPOTHETICAL HISTORIES:
OLD
NEW
3500
3000
QUANTS PER YR.
2500
2000
1500
1200
QV/KR
CAPITAL GOODS IMP
H HISTORY
RUN 126
X OLD HYPOTHETI
ZNKG AND OLD CKW
(RUNS 67 & 76)
IMPORT COEFF., CKW:
OLD
NEW (USED IN RUN 126)
.6
.5
.4
SCALE FOR CKW
1950
52
54
56
58
1960
62
64

3.7 The Price Function

In contrast to the situation surrounding the investment function, there was no problem about ascertaining what the output of the domestic nonpetroleum price function should be. Although the methods used by the Banco Central to produce its price index data are not perfect, the price data are considered among the most reliable of the economic statistics available on Venezuela.

Two main difficulties prevented the establishment and adjustment of the price function on a truly empirical basis. One was lack of good data on some of the variables that we suppose exert an influence on prices. The other, ironically, is that prices in Venezuela have been so remarkably stable (at least from 1950 until 1963) that there was very little information to indicate how inflation might develop or how important different factors might be in influencing price trends. Data now available for 1964 and 1965 show an incipient inflationary tendency that--although unfortunate for Venezuela--helps to clarify the price mechanism for us, but these data were,of course, not available in the early stages of the study, during 1963 and 1964.

Even so, the absence of change up to 1963 put limits on acceptable behavior of the simulation, and showed that our first, oversimplified formulation was wrong. The simulation, at that stage,predicted that

the increased average price of imports resulting from exchange rate changes in 1961 and 1962 would induce the general domestic price index to start moving up toward a higher level. However, no such tendency was evident in the statistics through 1963.

Efforts to correct the behavior of the price function in the context of the old V-2 model were successful only when we resorted to tricks to represent effects that the model was not designed to treat explicitly. It was eventually concluded that a satisfactory price function would have to be more complicated than we had formerly thought, involving some variables that could not readily be generated in Model V-2. Tentative formulations were worked out on theoretical grounds with considerable discussion and debate within the group as well as consultations outside. Since many factors seemed relevant, the questions for debate were mainly their relative significance and the degree of simplification that could be safely made.

There was no way of answering these questions empirically, as already pointed out, because of the stability of the price index. Multiple regressions were tried with various combinations of factors. All of them gave high correlation coefficients, and all of them yielded equations dominated by very large constant terms. (Unfortunately, the regressions were made in terms of the absolute level of the price index, and not in terms of its changes.)

From the theoretical review and qualitative descriptions of price

determination in Venezuela, it was concluded that an adequate price function could not be fitted into the framework of the existing Model V-2 but would require a good many changes outside of the price function itself This was one of the main reasons for the major reformulation that resulted in Model V-2A The price mechanism has already been described (in Chapter 2) The associated model changes consisted mainly of some disaggregation The new function generates nonagricultural nonpetroleum wages and prices P6Z and PZD, and the latter has then to be combined with an exogenous agricultural price index to get the combined price, PND, which was formerly not disaggregated Disaggregation of imports which also proved useful for some other reasons made it possible to take better account of the selective import restriction policies, including multiple exchange rates, and it is believed that this is an important benefit of the new formulation.

The new function was tuned up within the mail model, which has been programmed with various "switches" to permit isolating the wage function or the price function from the rest of the model, with or without isolating them from each other. Although using the whole model to tune up one function is inefficient in terms of computer time, it was done this way to reduce coordination and communication problems, and it is believed that the result was a net saving in professional staff time and calendar time.

With the many coefficients that could not be independently evaluated, it took a certain amount of fumbling to "get a feel" for the function. (Figure 3-13 shows some of these attempts.) As an aid to understanding the probable effects of changing different coefficients, the results of one of the runs were analyzed graphically (Figures 3-14 and 3-15), a procedure that proved very helpful. Finally a combination of coefficients was found that permitted an excellent reproduction of history, as shown in Figure 3-5 in the first part of the chapter.

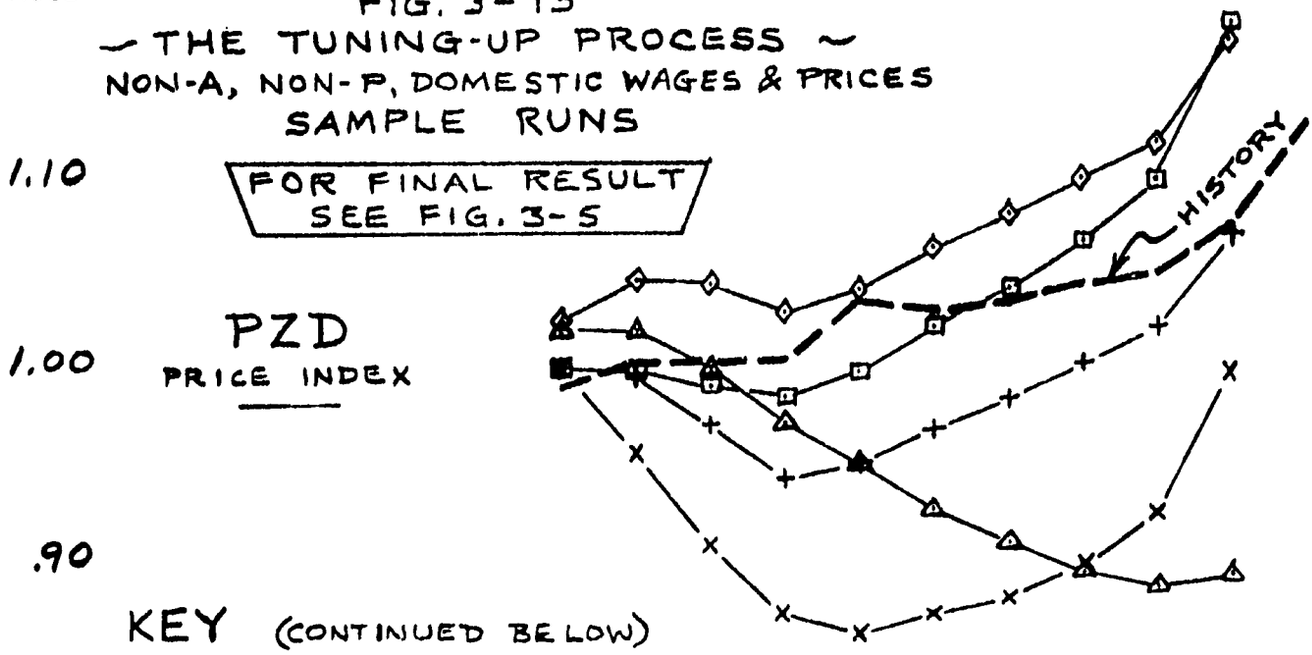
FIG. 3-13

— THE TUNING-UP PROCESS —

NON-A, NON-P, DOMESTIC WAGES & PRICES

SAMPLE RUNS

FOR FINAL RESULT SEE FIG. 3-5



KEY (CONTINUED BELOW)

SYMBOL	RUN	CZA6	CZUF	CZP61	TP6Z2	PZTQ
△	108	.0002	0	.06	1.25	STARTS @ .095; .05 FROM 1958 ON.
+	109	✓	.1	.35	✓	
◇	115	.0001	.2	✓	.60	
□	118	.0008	✓	.175	1.25	.05 THRUOUT
×	120	✓	✓	.10	✓	

KEY ~ CONTINUED

SYMBOLS	GA6Z	GAJZ	CZP62	CZP3	-4	-5	-6
△	10	7	5	4	0	.3	.5
+ & ◇	✓	4	1	0	.5	.06	.7
□ & ×	20	2					

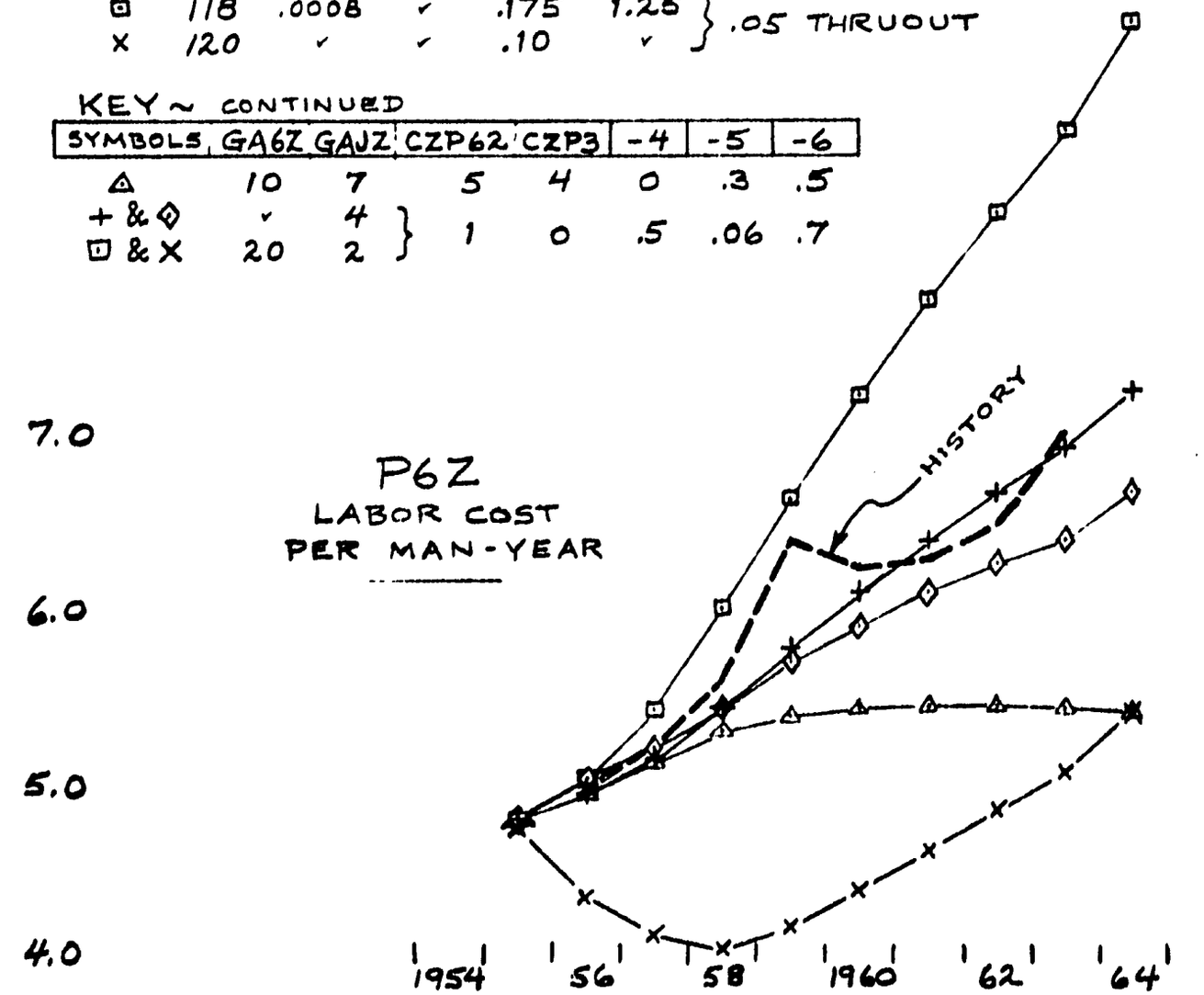
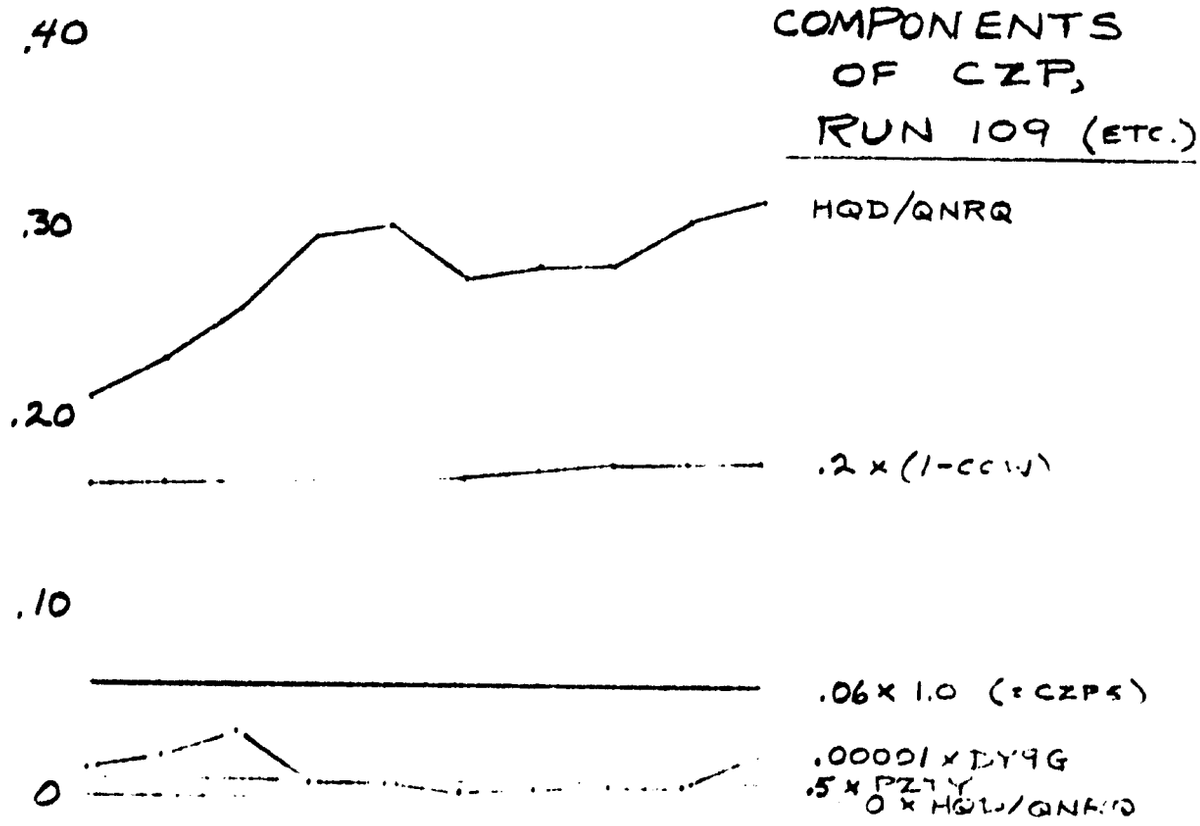
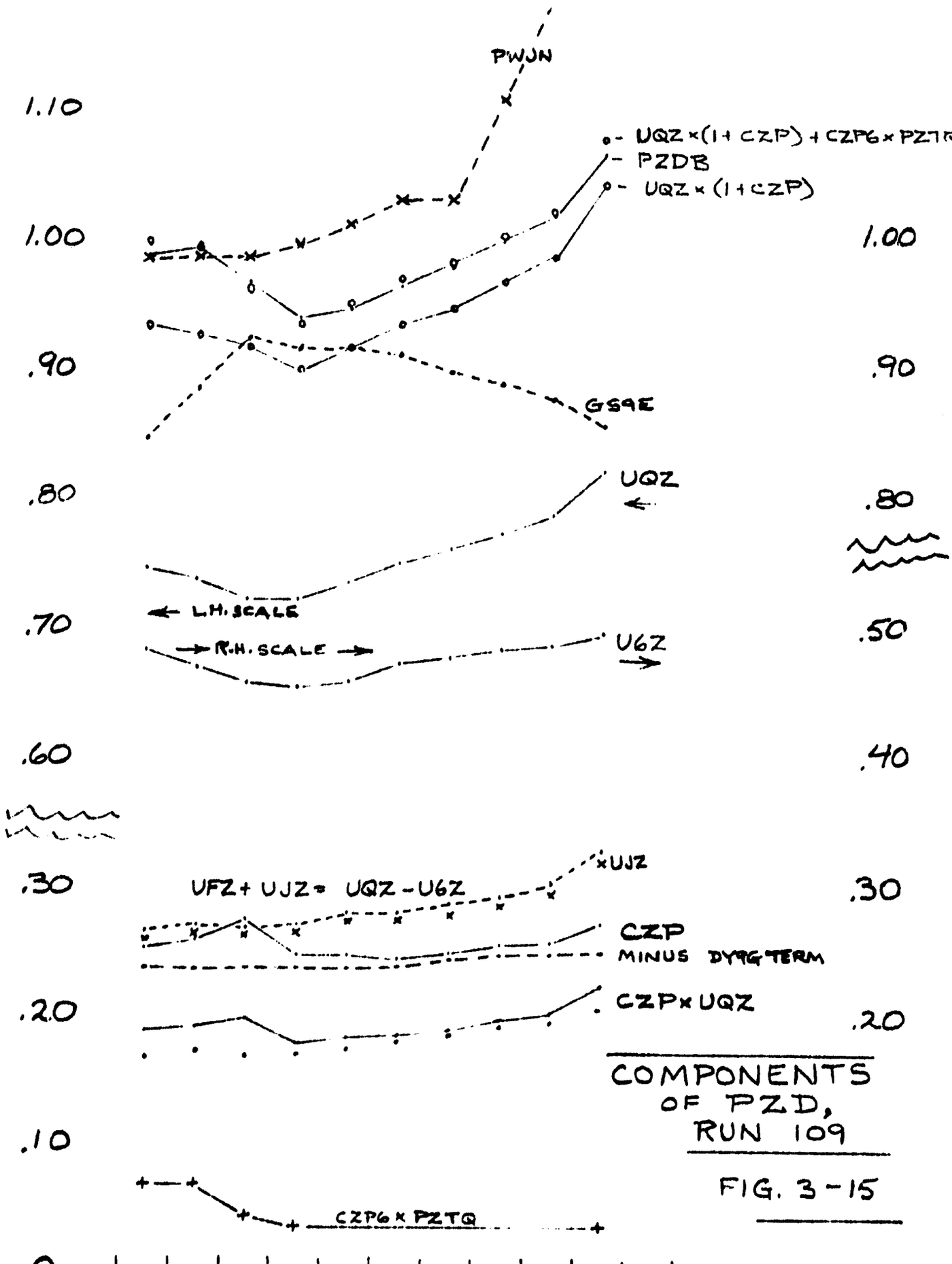


FIG. 3-14

COMPONENTS OF CZP, RUN 109 (ETC.)





COMPONENTS OF PZD, RUN 109

FIG. 3-15

APPENDIX TO CHAPTER 3

THE HISTORICAL DATA

CONTENTS

APPENDIX I

The Historical Data

Introduction

This appendix explains the various sources used to compile an internally consistent set of accounts for the Venezuelan economy covering the period 1950-1963, inclusive. The many items included in the accounts represent the historical time paths of the most important economic variables with which the outputs of the computerized simulation models are to be compared.

The elaboration of the accounts was necessary for several reasons. No system of accounts was found for the entire period to be simulated. Moreover, it was found that discrepancies existed among sources and even within some sources, whereas the simulation required a set of accounts that were internally consistent. Finally, these accounts are helpful in estimating the values of variables for which no information is available, as by extrapolation and interpolation.

A preliminary account of the general methodology used in making the tables should aid in understanding this report. Each explanation of a table will follow the order in which the items are given in the respective table, subdividing each broad category into each of the three sectors comprising the model. Hence, for such items as gross value added (gross territorial income), investment, etc., the data are provided separately for each sector.

For the petroleum sector, wherever available and applicable, the

data were obtained directly from the Ministry of Mines and Hydrocarbons either in the form of published documents such as, Republica de Venezuela, Ministerio de Minas e Hidrocarburos, Petroleo y Otros Datos Estadisticos (Caracas: Division de Economia Petrolera, 1963 and 1964); unpublished mimeographed memoranda; or notes from conversations with experts from the Ministry.

For the rest of the economy, including the government and non-petroleum sectors, the balance of payments, and the accounting relationships, the data were obtained from the yearly publications of the Central Bank [such as, Republica de Venezuela, Banco Central de Venezuela, Memoria, 1959, 1960, 1961 and Informe Economico, 1962, 1963 (Caracas: 1960-1964)] ; unpublished, mimeographed memoranda from the Central Planning Office (CORDIPLAN); and from notes from conversations with experts from both of the above mentioned organizations.

Hereafter, references to the sources will be as follows: for information obtained from the Ministry of Mines--MMH, followed by a specification as to whether the source is a published report, and unpublished report, conversations; for the other information--MBC (year) for the Memorias and Informes Economicos, CORDIPLAN for information from the Central Planning Office, and BCV for information obtained directly from the Central Bank through conversations.

Immediately following is a brief summary of the work performed in

compiling the tables that comprise the historical data.

Summary:

1. Petroleum Sector Variables

In general, no serious difficulties were encountered in the determination of historical series for petroleum variables. MMH publications provided the necessary information for most of the sector's variables such as, investment expenditures, profits, depreciation allowances, tax payments, remittances abroad, and the value of fixed assets. Equally reliable data were obtained from MMH unpublished memoranda, including figures for exports, prices and labor costs, Finally, data on Petroleum sector imports were found in both MMH and BCV publications. These figures match, because the former took the information from the latter. They are reliable, because it is generally agreed that foreign trade statistics published by the BCV are among the most reliable of the statistics collected by that institution.

For all other variables in this sector, historical series had to be estimated from scattered information (some published, other unpublished). The most important of these concerned the flow of goods and services from Sector N to Sector P; and the estimation of the sector's potential output, capital-capacity ratio, and stock of real capital.

2, Nonpetroleum Variables

In general, the historical series of the public sector account,

the Balance of Payments account, and value added in each sector were taken as guideposts; and the other series were adjusted where necessary to achieve consistency with these. This was helpful in estimating time paths of important variables for which no figures were available and for adjusting the figures that were not believed reliable. Estimates and adjustments were made in the context of all of the accounts in order to try to establish a family of time series whose numbers would be consistent at any point in time and whose variation through time would be plausible and explainable.

From the series on value added and indirect taxes, it was possible to estimate gross domestic production, after allowing for adjustments in the price series. Similarly, from the data on imports and value added, it was possible to estimate intermediate-good demand, after allowing for adjustments in import-substitution. The estimation of consumption and private investment was also greatly facilitated by the value added series.

Gross Territorial Product and Income Account (Value Added) The compilation of this table was made possible by the confidence placed on the value added series of each sector. And with the inclusion of series determined elsewhere, such as foreign sector income payments and direct tax payments, the completion of the table depended upon the historical series for nonpetroleum depreciation allowances, business savings and consumption. The estimation of these series was simplified by the

sensitivity tests performed with the computer, and by the fact that consumption is the only one of the three variables that plays a functional role in the model. The combined total of the other two variables was roughly approximated from partial statistics as proportional to value added. The consumption series was estimated as a residual in the "Uses" account, thus leaving as a residual in this table the personal savings series.

Gross Territorial Product and Income Account (Uses): Except for the consumption series, all of the figures in this table were taken from the other accounts. Given the total from the Value Added Account, the consumption series was left as residual. The fact that this method results in violent fluctuations in the consumption series (and thus also in the personal savings series) which are not easily explainable can only mean that significant inconsistencies in the source data remain.

Public Sector Account: Although the publications of the BCV provided most of the information on government, some series had to be modified for purposes of the model, others because of the data problems. However, because of the assistance rendered by officials of the BCV and CORDIPLAN, most definitional, methodological and statistical problems were resolved with relative ease. As examples can be cited the problems concerning autonomous institutes (divided into state enterprises operating as commercial firms and administrative agencies operating as branches of government); subsidy and transfer payments; and to a lesser extent, personal and non-petroleum corporate income taxes.

Capital Formation Account: Perhaps the compilation of this table was the most difficult, because of the low reliability attributed to many component series. The discussion here will be limited to the most important of these series--private nonpetroleum investment; additional information is provided in the discussion of Table Four. The main problem concerning the series published by the BCV, as already stated in Section 5 of the report, was our inability to explain its behavior in terms of other macro-economic variables (such as, rate of change in gross output, capacity utilization, relative prices, and changes in demand). Moreover, it was clearly inconsistent with such variables as value added and import and any adjustments made in value added and imports to fit the published investment series caused additional serious misadjustments in other series. The published data on nonpetroleum private investment was rejected, therefore, and a new series was constructed and substituted which, when used in the model, gave a satisfactory reproduction of the related variables that were better established and which, at the same time, was in keeping with the quantitative opinions expressed by our informants. The final selection was made only after carefully weighing the following information: (1) data published by the BCV on total nonpetroleum investment and imports of capital goods; (2) the correlation of the several investment series with gross output, petroleum sales, nonpetroleum demand, capacity utilization and value added in the sector, petroleum exports, etc.;

(3) the results of many computer runs; and (4) the expert opinions of many people, but especially the opinions of officials from the institutions mentioned.

This series, thus, is not truly historical but can only be explained as compatible with historical data on other macroeconomic variables and consistent with qualitative observations of experts.

Balance of Payments Account: As in the case of the Public Sector, this account was also relatively free from obstacles, since it was possible to rely heavily on the published data. It was decided to accept the figures for the annual balance in foreign exchange reserves, and to calculate the annual balances on capital account by subtracting from the annual changes in the former the annual balances on current account. To the extent that foreign trade statistics for the Petroleum sector differ from the BCV figures, differences will appear between the figures of the BCV and those found in this table. However, the one major difficulty encountered and never adequately solved, concerns the years 1960-1962. During these years, several exchange rates were in effect, making difficult the cross-references with other accounts. Since the figures in this table were obtained in dollars, the application of average exchange rates to obtain the bolivar values used in the other accounts does not guarantee the accuracy of the latter.

Explanation of the Tables

Table One - Gross Territorial Product and Income Account

(Value added method)

I Gross Territorial Income

1. Government:

Gross Territorial Income (GTI) in this sector represents value added in Government; and comprises the wages and salaries paid by the central, state, and municipal governments but not including the autonomous institutes considered as state enterprises.

For all the years, figures for wages and salaries were obtained from the Central Bank reports as follows: 1950-1958 from MBC (1959), p. 463, Table 19-10; 1959 from MBC (1962), p. 532, Table 24-1; 1960-1963 from MBC (1963), p. 520, Table 25-1; and from BCV directly for wages and salaries paid by state enterprises.

2. Petroleum:

Gross Territorial Income in Petroleum represents gross value added in the sector and was derived by summing up the following items: depreciation and amortization, net profits after taxes, direct corporate taxes (royalties, income and land), and wages and salaries.

For all the years, the figures were obtained from the following two sources: MMH, Petroleo...1964 and MMH, unpublished report, "Total Industria: Resumen de Sueldos y Salarios"--a report of only one page.

The first four items listed above were taken from the first source, p. 120 (the table "Distribución de los Ingresos, 1947-63") and p. 125 (the table "Participación Causada Provenientes de la Industria Petrolera..."). The item (wages and salaries) was taken from the second source cited.

3. Nonpetroleum:

Nonpetroleum GTI represents value added in the Nonpetroleum sector by private and state enterprises, including the wages and salaries paid by state enterprises. It was obtained from countrywide GTI, as given in the MBC's cited above, by subtracting the petroleum and government sector components of GTI found in the same sources. The petroleum component of GTI for the years 1950-1956 had to be adjusted, however, in order to put it in current prices. This was done by deriving the "implicit price index" from the ratio of current countrywide GTI, at market prices, to deflated countrywide GTP in 1957 prices and dividing one by the other. No adjustment was necessary for the remaining years.

The exact sources used were the following:

(1) Countrywide GTI in current prices:

For 1950-1958	MBC (1959),	p. 454 (Table 19-5);
For 1959	MBC (1960),	p. 380 (Table 18-4);
For 1960-1963	MBC (1963),	p. 448 (Table 21-9) and pp. 463-464 (Tables 21-31 to 21-33).

(2) GTI in Sector G: see "1. Government" above.

(3) GTI in Sector P:

For 1950-1956	MBC (1959),	p.495 (Table 20-4H) and p. 454 (Table 19-15);
For 1957-1958	MBC (1959),	pp. 456 and 457 (Tables 19-6 and 19-7);
For 1959	MBC (1960),	p. 380 (Table 18-4);
For 1960-1963	MBC (1963),	p.448 (Table 21-9) and pp. 463-464 (Tables 21-31 to 21-33).

4. Total

The resulting summation of the sectoral value added gives the countrywide GTI for purpose of comparison with the computerized model outputs.

II. Foreign Factor Income Payments (Remittances Abroad)

1. Petroleum:

The figures for repatriation of factor incomes earned in the Petroleum sector and remitted abroad by petroleum companies were obtained from MMH, Petroleo...1964, p. 123 (Table "Origen y Applicación de los Fondos, 1947-63"). The four items of the table totaling these remittances are:

(1) "Pago de Deudas a largo plazo";

(2) "Retiro de Acciones";

(3) "Disminución en la cuenta con la Casa Matriz";

(4) "Dividendos Pagados"

2. Nonpetroleum:

The figures for repatriated factor income from the rest of the economy (Nonpetroleum sector) were available only for the years 1953-1963 in MBC (1961), p. 162 (Table 6-20-A) and MBC (1963), p. 171 (Table 6-16). For 1950-1952 the figures were derived by means of "reasoned guesswork", extrapolation, and estimates based on the time paths of such economic indicators as GTI, foreign investment, etc.

The exact items in the source tables are:

(1) "B-Sectores Empresas de Hierro" and "C-Sector Resto de la Economía";

a. "Ingresos Sobre Inversiones"

b. "Transferencias Unilaterales"

3. It is assumed that Government does not remit factor incomes abroad. Although this assumption is not entirely correct, such remittances are in fact very small and figures are available only since 1961.

III Gross National Income

The figures for GNI were derived by subtracting foreign factor income payments from countrywide GTI. No sectoral subdivision was made, however, since it was not necessary.

IV Direct Corporate Taxes

1. Petroleum
2. Nonpetroleum

} See explanation of the table "Public sector Account"

V Depreciation Allowances

1. Petroleum:

The figures for depreciation and amortization by petroleum companies were obtained from MMH, Petroleo...1964, p. 120 (Table "Distribución de los Ingresos, 1947-63").

2. Nonpetroleum:

Because the depreciation figures in the MBC's were believed to be less reliable than the capital stock series available in the same sources depreciation was estimated from the replacement series that was derived from the figures on capital stock and gross investment. This estimation was very rough; hence, the reliablility of the resulting figures is poor. However, depreciation allowances in this sector do not play any functional role in the model.

The determination of private nonpetroleum depreciation allowances from private nonpetroleum replacement requirements involved making two assumptions--namely, that depreciation allowances are essentially the replacement requirements in current prices; and that private replacement requirements are related to total (public plus private) nonpetroleum replacement requirements in the same proportion that private nonpetroleum

gross investment is related to total (public plus private) nonpetroleum gross investment.

The final step required multiplying private replacement requirements by an appropriate price index to obtain private depreciation allowances.

The exact sources used are the following:

(1) For public investment, see the explanation of the table "Public Sector Account".

(2) For gross fixed investment: MBC (1950), p. 412 (Table 18-2); MBC (1960), p. 408 (Table 20-1); MBC (1962), p. 492 (Table 22-1); MBC (1963), p. 488 (Table 23-1).

(3) For capital stock: MBC (1959), p. 420 (Table 19-8); MBC (1960), p. 410 (Table 20-5); MBC (1962), p.494 (Table 22-5); MBC (1963), p. 487 (Table 23-4).

(4) For the price index: MBC (1956), Appendix Table H-II; MBC (1959), Appendix Table H-III-1; MBC (1961), Appendix Table H-III-3; MBC (1963), Appendix Table H-III-1.

VI Undistributed Profits

1. Petroleum:

No part of the profit in the Petroleum sector is directly distributed in Venezuela. Moreover, over long periods the total of gross profits is roughly accounted for by the sum of remittances abroad, depreciation allowances, and taxes. This balance is not maintained at all times,

however; there is frequently a residual, which may be either positive or negative and which is treated as undistributed profits for the purpose of these accounts.

The figures were derived by comparing remittances abroad with net profits after taxes, the source being MMH, Petroleo...1964, p. 120 (item "Utilidad neta") and p. 123 (items cited above).

2. Nonpetroleum:

Figures for undistributed profits in the Nonpetroleum sector for the years 1950-1956, as published in MBC (1959), were inconsistent with those published for 1957-1962 and appeared excessive. Since the two series overlap in 1957, the ratio of the figures for that year was used to reduce all of the earlier series.

The data were obtained from MBC (1959), p. 452 (Table 19-2); MBC (1961), p. 511 (Table 19-5); and MBC (1963), p. 442 (Table 21-1).

3. State Enterprises:

See explanation of the table "Public Sector Account".

VII Personal Income

1. Petroleum:

Since petroleum profits are not distributed in Venezuela, personal income in this sector is equal to the wages and salaries paid by petroleum companies. These figures were obtained directly from MMH in the form of

a mimeographed report: "Total Industrias:: Resumen de Sueldos y Salarios".

2. Government:

Personal income in Government is by definition the wages and salaries paid by government (central, state and municipal) and the autonomous institutes that are not state enterprises. It is therefore equivalent to GTI in the sector. (See sources cited above, Part I, item 1.)

3. Nonpetroleum:

Personal income in this sector represents wage and salary income plus the distributed profits of private, nonpetroleum companies. The figures were derived by subtracting from GTI for the sector the following items: foreign factor income payments, corporate profit taxes, depreciation allowances, and undistributed profits.

VIII Disposable Income

Disposable income equals personal income minus personal income taxes plus government transfers to consumers. For this account, transfer payments were subtracted from personal income taxes before calculating disposable income. (See sources cited above, Part I, item 1.)

IX Consumption and Personal Savings

Not having been able to obtain reliable figures for consumption and personal savings, it was necessary to obtain the consumption series as a residual in the Uses account and the personal savings series as a residual in the Value Added account.

Table Two - Gross Territorial Product and Income Account (Uses)

The uses of gross product for this table were compiled by subtracting from the total obtained in the previous table exports, government expenditures, private investment, imports, customs revenues, and indirect taxes; and deriving consumption as a residual. The subtraction of imports (c.i.f.), customs revenues and indirect taxes from gross uses gives gross territorial income (which is equivalent to gross territorial product at factor cost).

I Exports

1. Petroleum
2. Nonpetroleum

See explanation of the table "Balance of Foreign Payments".

II Government Expenditures

1. Petroleum
2. Nonpetroleum

See explanation of the table "Public Sector Account".

III Gross Private Investment

1. Petroleum
2. Nonpetroleum

See explanation of the table "Gross Territorial Capital Formation".

IV Consumption

See explanation of the table "Gross Territorial Product and Income Account--Value Added".

V Gross Uses

Summation of the items I - IV above.

VI Imports

1. Petroleum
2. Nonpetroleum

See explanation of the table "Balance of Foreign Payments Account".

VII Customs Revenues

1. Petroleum
2. Nonpetroleum

See explanation of the table "Public Sector Account".

VIII Indirect Taxes (minus subsidies)

1. Petroleum

It is assumed that petroleum companies pay no indirect taxes. Although in actuality these companies do pay indirect taxes, the amounts are so small that they can be disregarded without creating any problems of accounting.

2. Nonpetroleum

See explanation of the table "Public Sector Account"

IX Gross Terrirorial Income

Gross territorial income is the same as gross territorial product except that indirect taxes and customs revenues are subtracted and subsidies are added, to value it at factor cost. (SOME payments for Government services were subtracted with the indirect taxes. These payments should have been classified as purchases of intermediate goods, and subtracted in finding value added, but the error due to this item is very small.

Table Three - Public Sector Account

I Incomes

A. Petroleum:

1. Direct Taxes: Royalties, Income and Surface Area:

Direct tax revenue of Government from the Petroleum sector includes royalties, income taxes, and the surface area taxes. The figures for these items were obtained from MMH; Petroleo...1964, p. 125 (Table "Participación Causada Provenientes de la Industria Petrolera...").
It should be noted that concession payments by petroleum companies to Governement are excluded from the figures. The data for concession payments were obtained directly from the Ministry, since it was discovered that the corresponding figures given in the source cited are incorrect.

2. Indirect Taxes: Customs Revenues

Customs revenues collected from the Petroleum sector include import duties, consular fees, etc. The data were obtained from the same source cited above; the items in the table are "derecho de importación" and "otros impuestos".

B. Nonpetroleum:

1. Direct Taxes: Corporate

For many years, it was not possible to derive this source of revenue from the government accounts of the earlier MBC's. Hence, the

figures had to be calculated from data available in different tables of the reports, by subtracting direct tax revenue from Petroleum as given in the government accounts ("Cuenta Consolidada del Sector Publico" and several tables in the chapter "Analisis de las Financas Publicas") from countrywide direct corporate tax revenue as given in the national income accounts ("Ingreso Personal y Disponible").

Although not necessary for later years, the same procedure was followed throughout in order to maintain consistency.

The sources used are the following:

(1) 1950-1958: MBC (1959), pp. 452 (Table 19-2) and 463 (Table 19-18)

(2) 1959: MBC (1961), pp. 511 (Table 19-5) and 97 (Table 4-9).

(3) 1960-1961: MBC (1962), pp. 476 (Table 21-1), and 84 (Table 4-8), and 87 (Table 4-11).

(4) 1962-1963: MBC (1963), pp. 442 (Table 21-1) and 93 (Table 4-11).

2. Indirect Taxes (minus subsidies):

This item is equal to internal indirect taxes plus miscellaneous taxes minus subsidies. It includes the following sources of revenue: (1) taxes on domestic products (such as excise and sales taxes); (2) various taxes imposed by state and municipal governments (such as patents); (3) income of all levels of Government from various types of services performed, as well as revenue for services performed by the

the administrative agencies (non-commercial autonomous institutes), and (4) subsidies as a negative revenue.

There are no "ready-made" figures for this item in the MBC's thus, they were calculated from available information in the following manner: from figures given as "impuestos Indirectos" in the government accounts were subtracted customs revenues (including those for Petroleum) and foreign exchange profits (see below for the explanation of these items). Then, the figures for subsidies, given in the national income accounts, were deducted. Finally, the revenue of administrative agencies ("ingresos propios"), representing income from services rendered, were added.

The exact sources used are:

(1) "Impuestos Indirectos": MBC (1959),,pp. 463 and 464 (Tables 19-9 and 19-10); MBC (1962), pp. 536 (Table 24-5) and 331 (Table "Producto Teritorial Bruto"); and MBC (1963), p. 448 (Table 21-9).

(2) Customs Revenues:
(3) Foreign Exchange Profits: } See below for source and explanation.

(4) Subsidies: MBC (1962), P. 454 (Table 19-5); MBC (1961), p. 515 (Table 19-10); MBC (1962), pp. 485-487 (Tables 21-11-13); and MBC (1963), p. 448 (Table 21-9).

(5) "Ingresos Propios": MBC (1959), p. 463 (Table 19-3) MBC (1962), p. 532 (Table 24-1); MBC (1963), p. 520

(Table 25-1); and data on the "ingresos propios" of state enterprises (commerical autonomous institutes) obtained directly from BCV.

To calculate these figures, the revenue of state enterprises was deducted from the revenue of all autonomous in institutes.

3. Customs Revenues:

The term customs revenues, as used in these accounts, represents total revenue from imports collected by Government--namely, import duties, consular fees, customs fees and fines, etc. The figures were not available in the MBC's; instead, they were obtained from CORDIPLAN which provided a detailed breakdown of Government revenue for the period 1950-1962. However, the figure for 1963 had to be calculated separately; it was estimated from the CORDIPLAN figures and from information in MBC (1963).

4. Profits of State Enterprises:

The profits of commerical autonomous institutes are considered as a separate source of revenue of Government, their activity being included in the Nonpetroleum sector. These enterprises comprise the government agencies that operate as private companies and include such activities as transportation (shipping and airlines), production (iron and steel, petrochemicals, industrial raw materials), and services

(hotels, race tracks, credit).

The figures for this item were obtained directly from BCV. They are not very reliable, but except for 1961-1963 are not significant sums.

C. Other sources of Revenue:

1. Personal Income Taxes:

Personal tax figures include income taxes, taxes on wills and donations, and social security contributions. The sources for these figures are: MBC (1959), p. 452 (Table 19-2); MBC (1962), p. 476 (Table 21-1); and MBC (1963), p. 442 (Table 21-1).

2. Foreign Exchange Profits:

The figures for foreign exchange profits which represent the profits of Government from foreign exchange transactions, were provided by CORDIPLAN for the years 1950-1962. However, these figures are also available in the MBC's. For 1963, the source was MBC (1963). pp. 518, and 93 (Table 4-11).

D. Transfer Payments to Consumers:

All MBC's publish figures for government transfer payments to consumers, producers and international organizations. Only those to consumers are taken into account in this table, however, since the latter two essentially consist of credits granted by autonomous institutes to producers, and financial transactions are outside the scope of these accounts.

The exact sources are: MBC (1959), p. 465 (Table 19-11); MBC(1962), p. 532 (Table 24-1); and MBC (1963), p. 442 (Table 21-1).

II Expenditures

A. Current Expenditures:

1. Purchases of Goods and Services:

For purposes of these accounts, state enterprises are considered to form part of the Nonpetroleum sector. Therefore, Government purchases of goods and services do not include the corresponding purchases made by state enterprises.

The MBC's publish in some detail the expenditures of the Public sector. Regarding current expenditures, a breakdown was made into purchases of goods and services (including the item "conservación") and payments of wages and salaries. The exact sources used are: MBC (1959), p. 465 (Table 19-11); MBC (1962), p. 532 (Table 24-1); and MBC (1963), p. 521 (Table 25-2).

2. Payments of Wages and Salaries:

Wages and salaries paid by Government include, for purposes of these accounts, only those paid by the administrative body of government. They do not include those paid by state enterprises.

The sources for these figures are: MBC (1959), p. 465 (Table 19-11); MBC (1962), p. 532 (Table 24-1); MBC (1963), p. 522 (Table 25-3).

3. Current Account Surplus (+) or Deficit (-)

(Government Savings)

Total Government revenue, less transfers to consumers, less total current expenditures equals savings of Government.

B. Capital Expenditures:

Investment expenditures of Government also include, for purpose of these accounts, the capital expenditures of state enterprises. The figures had to be calculated from the separate items in the government accounts published in the MBC's, since the totals erroneously included the financial item "amortization of public debt". The items comprising investment expenditures are:

(1) "compras y formación de nuevos activos"

(2) "compras de activos existentes"

(3) "inversiones en empresas de servicios publicos"

For the years 1950-1960, the exact sources used are: MBC (1959), p. 465 (Table 19-11) and MBC (1962), p. 532 (Table 24-1). For 1961, 1962, and 1963, the figures were supplied by CORDIPLAN because of the unreliability attributed to the MBC's figures by members of that agency.

III Consolidated Public Sector Balance

The consolidated balance of the public sector, balance on current account minus investment expenditures, is included here only for

accounting and checking purposes, and does not play any functional role in the model.

Table Four - Gross Territorial Capital Formation Account

This table includes both capital formation and the financing of capital formation. The former comprises the investment expenditures of Government, and of private individuals and companies in the Petroleum and Nonpetroleum sectors. The latter comprises domestic savings (including business savings in both sectors, consumer savings and Government savings), depreciation allowances in the two sectors, and the balance in the current account of the Balance of International Transactions. It should be noted that Government savings do not include the payments received for petroleum concessions in 1956 and 1957.

I Gross Territorial Capital Formation

1. Petroleum

Gross investment figures in the Petroleum sector were obtained from p. 123 (Table "Origen y Aplicación de los Fondos, 1947-62", item "Aumento en los Activos Fijos [Gastos de Capital]"), in MMH, Petroleo... 1964.

2. Private Nonpetroleum

The "historical" series for private nonpetroleum investment given in this table, as stated in Section 5.1 in the body of the report, is an hypothetical series compatible with the historical data on such other variables as capital goods imports, value added, and petroleum sales and tax revenue; and consistent with the qualitative observations

of experts. Following is a brief chronological explanation of the derivation of the time series.

The only published information on private nonpetroleum investment is provided in the annual reports of the BCV. The series, however, is given only in constant prices of 1957 and includes Government investment. The first task was, therefore, to separate private investment from the total. Since Government investment is separately given by the same source in current prices only, the total too had to be converted into current prices by multiplying by some appropriate price index--the general wholesale price index was selected for this purpose. Private nonpetroleum investment in current prices was obtained as a residual, after subtracting Government investment from the total, and converted to constant prices by applying the general wholesale price index.

The series obtained was then found to be inconsistent with the other historical series, and was at the same time much less reliable than those series. It had to be rejected after exhaustion of all reasonable adjustments and modifications, without success.

The present series, which replaced the other, was arrived at only after a careful re-study and re-consideration of all other relevant variables, of the qualitative changes that took place during the period being simulated, and of the scant information available on the behavior

of Venezuelan investors. The time paths of capital goods imports, value added, petroleum sales, and petroleum tax revenue were compared with several plausible alternative time series for private nonpetroleum investment that were constructed from the qualitative opinions of experts, scattered information on investment activity in several publications, and personal judgment. Once the "most likely" and most plausible series was selected, it was converted into current prices by applying the general wholesale price index.

3. Government

See explanation of the table "Public Sector Account".

II Financing of Gross Territorial Capital Formation

1. Savings:

a. Petroleum

b. Private Nonpetroleum — See explanation of the table "Gross Territorial Product and Income Account --Value Added".

c. Consumers

d. Government - See explanation of the table "Public Sector Account".

2. Depreciation Allowances:

a. Petroleum

b. Nonpetroleum — See explanation of the table "Gross Territorial Product and Income Account--Value Added".

3. Balance in the Current Account of the Balance of Foreign Payments: See explanation of the table "Balance of Foreign Payments".

Table Five - Balance of Foreign Payments

I Current Account

A. Exports:

1. Petroleum:

In accordance with the decision to obtain all available information on the Petroleum sector from MMH, figures for exports by this sector were taken from Petroleo y Otros Datos Estadisticos, 1964, of the Ministerio de Minas e Hidrocarburos.

The above figures are given in Bolívares. Hence, they were converted into dollars by applying the appropriate exchange rate of Bs. 3.09 per $1.00.

2. Nonpetroleum:

The exports of the rest of the economy, represented by the Nonpetroleum sector, are available only for the years 1953-1963. Three MBC's were used, in each case taking the figures in dollars from the reports' balance of payments accounts:

(a) For 1953 and 1954: MBC (1959), p. 228 (Table 10-2-B), item "B - Otros Bienes y Servicios: Exportaciones f.o.b.").

(b) For 1955-1963: MBC (1963), p. 171 (Table 16-5, items "B - Sector Empresas Hierro: Exportaciones,"

and "C - Sector Resto de la Economía: Exportaciones". For the years 1950 through 1952, figures for non-petroleum exports were projected back from those for later years, consistent with the series of other variables for those years.

B. Imports:

1. Petroleum:

Import figures for the Petroleum sector are not available for 1950 through 1952; hence, the figure used in the table is an "intelligent guess". For all the other years, the information came from p. 13 (Table "Transacciones Internacionales: Sector Petrolero, 1953-1963"); items "Importacion", "Fletes", and "Servicios", in MMH, Petroleo...1964.

2. Nonpetroleum:

As in the case of Petroleum, no data on nonpetroleum imports are available for 1950-1952. Therefore, estimates were made such as to make the figures consistent with other series. For the remaining years, the sources were MBC (1961), p. 162 (Table 6-20-A) and MBC (1963), p. 171 (Table 6-16). The exact items are:

B - Sector Empresas de Hierro

2. Importaciones
3. Transporte y Seguros
5. Otros Servicios

C - Sector Resto de la Economía

2. Importaciones
3. Oro no Monetario (neto)
4. Transporte y Seguros
6. Otros Servicios

The first source provided the figures for 1953 and 1954, in bolívares; they were converted into dollars by applying the Bs. 3.35 exchange rate. The second source provided the figures for the remaining years, in dollars. These were converted to bolívares in the following manner: for 1955-1960, by using the Bs. 3.35 exchange rate; for 1961, by using an estimated average exchange rate of Bs. 3.45; for 1962, using Bs. 3.85; and for 1963, using Bs. 4.20.

Following is a brief explanation as to why the different rates were used. The exchange rate system applicable to nonpetroleum transactions underwent a drastic change in 1961, following the imposition of exchange controls in November, 1960. Two exchange markets went into effect, one "controlled" (Bs. 3.35) and the other "free" (stabilizing by the end of 1961 at Bs. 4.50). In 1962, the "controlled" market was almost entirely eliminated, thereby releasing many imports from the previously allowed low rate. Since the taking into account of the "correct" exchange rates would have required a more complicated and cumbersome (and perhaps impossible) calculation of imports without any significant improvement of the end result, it was decided to use the estimates provided by CORDIPLAN (the government planning agency).

C. Foreign Factor Income Payments:

See explanation of the table Gross Territorial Income and Product Account: Value Added.

All figures were obtained in Bolívares and converted into dollars by applying the respectively applicable exchange rates, as explained above.

D. Current Account Surplus (+) or Deficit (-)

The balance on current account is simply the result of subtracting items B and C, above, from total exports (item A). The sectoral subdivision was considered unnecessary and not made.

II Capital Account

A. Concessions:

Concession payments made by petroleum companies are considered capital flows. In only two years were such payments made, the information being supplied by MMH directly in Bolívares. The conversion into dollars was at Bs. 3.09 per $1.00

B. Others: Petroleum and Nonpetroleum

All other capital flows are combined into a single amount in the table, since it was not necessary to separate them sectorally (which would have been an impossible task, anyway). The figures were obtained by difference, subtracting the annual balances on current account from the annual changes in foreign exchange reserves. This was done because

data consistent with the definition of "balance on capital account" in this table were not available.

III Balance of Foreign Exchange Reserves

The MBC's do not give a consistent series of the annual balances of foreign exchange reserves for the period 1950-1963. Figures for some years are missing, for other years they are given only in Bolívares, and for still other years they are available in dollars only. As a result, it was thought prudent to take the figures for 1950-1959 from the International Financial Statistics (IFS), published by the International Monetary Fund. The figures for 1960-1963 were taken from the MBC report for 1963, in order to have a common source for all the figures in the Table during these years.

The exact sources are: IFS, Supplement to 1962/63 Issue, p. 238, and MBC (1963), p. 223 (Table 8-15). The following items are summed up to arrive at the IFS totals:

A. Central Bank, 1) Gold and, 2) Foreign Exchange

B. IME position, Gold Tranche Position

C. Commercial Banks, 1) Gold and, 2) Foreign Exchange

From related statistics given in IFS, item B. was estimated for the years 1950-1953 as equal to the 1954 figure.

SELECT BIBLIOGRAPHY

Official Publications

Banco Central de Venezuela. Memoria 1956, 1958-1961, (Caracas: 1957, 1959-1962) and Informe Económico, 1962, 1963, 1964, (Caracas: 1963, 1964, 1965). Reports on the state of the economy published annually. The title "Memoria" was changed to "Informe Económico" in 1962.

Ley de Impuesto Sobre la Renta y Ley de Timbre Fiscal (Caracas: Editorial Torre). A book containing laws passed by Congress and published in the Congressional Report: Gaceta Oficial.

Ministerio de Minas e Hidrocarburos. Petroleo y Otros Datos Estadisticos, 1963, 1964 (Caracas: Division de Economía Petrolera, 1963, 1964).

Publications of petroleum statistics with the purpose of making available to the public information on the petroleum industry.

Algunos Aspectos de las Actividades Petroleras Venezolanas y Mundiales, 1963 (Caracas: Division de Económica Petrolera, 1963). A separate publication of Section I of the Ministry's annual report to Congress: Memoria, 1963.

Oficina Central de Coordinacion y Planificacion. Plan de la Nacion, 1963-1966 (Caracas: Secretaria General de la Presidencia, 1963).

Other Published Sources

International Bank for Reconstruction and Developmnet. The Economic Development of Venezuela (Baltimore, Md., U.S.A.: The Johns Hopkins Press, 1961). The report of a special mission organized by the IBRD at the request of the Government of Venezuela.

Shoup, C.S. et al. The Fiscal System of Venezuela (Baltimore, Md., U.S.A. The Johns Hopkins Press, 1959. The report of a Commission to Study the Fiscal System of Venezuela, organized at the request of the Government of Venezuela.

Unpublished Sources

Banco Central de Venezuela. Mimeographed memoranda and private conversations with officials of the Bank.

Ministerio de Minas e Hidrocarburos. Mimeographed reports and tables, and private conversations with the officials of the Ministry.

Oficina Central de Coordinacion y Planificacion. Mimeographed reports and tables, and private conversations with planning officials.

Note: In addition to these sources, a great deal of published and unpublished information was made available to the group by experts and officials of government agencies and departments

and of private companies. Moreover, personal consultations with these many helpful people contributed greatly to our understanding of the Venezuelan economy.

TABLE ONE GROSS TERRITORIAL PRODUCT AND INCOME ACCOUNT (VALUE ADDED)

(Millions of Bolívares Per Year)

		1950	1951	1952	1953	1954
I	Gross Territorial Income					
	a) Petroleum	2916	3628	3882	3915	4318
	b) Nonpetroleum	6141	6799	7372	8198	9195
	c) Government	930	1011	1088	1122	1187
	d) Total (a + b + c)	9987	11438	12342	13235	14700
II	Less Foreign Factor Income Payments					
	a) Petroleum	848	1076	913	907	1202
	b) Nonpetroleum	235	230	250	268	273
	c) Total (a + b)	1083	1306	1163	1175	1475
III	Equals Gross National Income	8904	10132	11179	12060	13225
IV	Less Direct Corporate Taxes					
	a) Petroleum	946	1284	1376	1324	1490
	b) Nonpetroleum	215	213	206	111	298
	c) Total (a + b)	1161	1497	1582	1435	1788
V	Less Depreciation Allowances					
	a) Petroleum	420	495	530	558	613
	b) Nonpetroleum	790	926	722	969	937
	c) Total (a + b)	1210	1421	1252	1527	1550
VI	Less Undistributed Profits					
	a) Petroleum	122[b]	125[b]	349[b]	384[b]	210[b]
	b) Nonpetroleum	279	307	374	355	437
	c) State Enterprise Profits	-32	-3	-8	-7	-22
	d) Total (a + b + c)	369	429	715	732	625
VII	Equals Personal Income					
	a) Petroleum	580	648	714	742	803
	b) Nonpetroleum	4654	5126	5828	6502	7272
	c) Government	930	1011	1088	1122	1187
	d) Total (a + b + c)	6164	6785	7630	8366	9262
VIII	Less Personal Income Tax (plus transfers)	36	41	21	40	41
IX	Equals Disposable Income	6128	6744	7609	8326	9221
X	Less Consumption	5857	6791	7336	7913	8830
XI	Equals Private Savings	271	-47	273	413	391

(a) Excludes concession payments (Bs. 975 and Bs. 1142 million in 1956 and 1957, respectively).

(b) Included only to balance the account. For further details see the corresponding item in the explanation of the table.

TABLE ONE (Continued)

1955	1956	1957	1958	1959	1960	1961	1962	1963
4961	5869	7357	6362	6009	5883	6238	6699	6761
9833	11330	13298	14054	15542	15185	14858	15667	16625
1246	1445	1507	1834	2286	2522	2650	2547	2971
16040	18644	22162	22250	23837	23590	23746	24913	26357
1919	1689	2085	2433	1063	1793	2017	2522	2370
287	398	514	560	604	655	600	604	668
2206	2087	2599	2993	1667	2448	2617	3126	3038
13834	16557	19563	19257	22170	21142	21129	21787	23319
1746	2150[a]	2780[a]	2912	2736	2601	2792	3185	3296
355	854	711	973	421	335	599	470	481
2101	3004	3491	3885	3157	2936	3391	3655	3777
680	732	812	836	939	948	929	911	872
900	747	556	558	743	828	1181	1338	1345
1580	1479	1368	1394	1682	1776	2110	2249	2217
-209[b]	426[b]	689[b]	-817[b]	272[b]	-511[b]	-540[b]	-829[b]	-693[b]
461	510	604	555	511	313	247	389	464
-13	46	17	-106	-189	-73	-25	-65	-55
239	982	1310	-368	594	-271	-318	-505	-284
825	872	991	998	999	1052	1040	910	916
7843	8775	10896	11514	13452	13127	12256	12931	13822
1246	1445	1507	1834	2286	2522	2650	2547	2971
9914	11092	13394	14346	16737	16701	15946	16388	17709
113	163	222	271	78	-101	-145	-139	-75
9801	10929	13172	14075	16659	16802	16091	16527	17784
9259	10749	12905	12520	15119	14272	14774	16081	16006
542	180	267	1555	1540	2530	1317	446	1778

TABLE TWO GROSS TERRITORIAL PRODUCT AND INCOME ACCOUNT (USES)

(Millions of Bolívares Per Year)

		1950	1951	1952	1953	1954
I	Exports					
	a) Petroleum	3356	3798	4209	4397	4796
	b) Nonpetroleum	194	218	255	291	365
	c) Total (a + b)	3550	4016	4464	4688	5161
II	Government Expenditures					
	a) Current	1349	1485	1549	1604	1775
	b) Capital	947	977	986	1085	1529
	c) Total (a + b)	2296	2462	2535	2689	3304
III	Gross Private Investment					
	a) Petroleum	561	727	967	901	933
	b) Nonpetroleum	1583	1764	1881	2064	2303
	c) Total (a + b)	2144	2491	2848	2965	3236
IV	Consumption	5857	6791	7336	7913	8830
V	Equals Gross Uses	13847	15760	17183	18255	20531
VI	Less Imports (c.i.f.)					
	a) Petroleum	500	542	763	674	631
	b) Nonpetroleum	2000	2300	2600	2772	3242
	c) Total (a + b)	2500	2842	3363	3446	3873
VII	Less Customs Revenues					
	a) Petroleum	78	164	168	178	86
	b) Nonpetroleum	452	412	452	447	591
	c) Total (a + b)	530	576	620	625	677
VIII	Less Indirect Taxes (Nonpetroleum)	830	904	858	949	1281
IX	Equals Gross Territorial Income	9987	11438	12342	13235	14700

1955	1956	1957	1958	1959	1960	1961	1962	1963
5491	6350	7864	7098	6653	6640	6838	7240	7302
375	449	647	700	760	730	607	627	718
5866	6799	8511	7798	7413	7370	7445	7867	8020
1814	2041	2274	2963	3570	3877	3984	3892	4396
1734	2286	3009	2932	2506	2102	1707	1862	2220
3548	4327	5283	5895	6076	5979	5691	5754	6616
928	1160	1822	1788	1262	730	516	474	503
2610	2783	2959	2501	2088	1471	1601	1862	2128
3538	3943	4781	4289	3350	2201	2117	2336	2631
9259	10749	12905	12520	15119	14272	14774	16081	16006
22211	25818	31480	30502	31958	29822	30027	32038	33273
780	1283	1892	1298	862	390	362	535	464
3337	3661	5568	5102	5358	4181	4281	4893	4712
4117	4944	7460	6400	6220	4571	4643	5428	5176
95	131	210	154	124	110	107	113	123
620	605	640	752	858	688	669	675	757
715	736	850	906	982	798	776	788	880
1339	1494	1008	946	919	863	862	909	860
16040	18644	22162	22250	23837	23590	23746	24913	26357

TABLE THREE PUBLIC SECTOR ACCOUNT

(Millions of Bolívares Per Year)

		1950	1951	1952	1953	1954
I	CURRENT REVENUES:					
	A. Petroleum:					
	1. Direct Taxes					
	a) Royalties	519	727	751	786	874
	b) Income and Surface Area	427	557	625	538	616
	c) Total (a + b)	946	1284	1376	1324	1490
	2. Indirect Taxes: Customs Revenues	78	164	168	178	86
	3. Total Petroleum Tax Revenue (1 + 2)	1024	1448	1544	1502	1576
	B. Nonpetroleum:					
	1. Direct Taxes					
	a) Corporate	215	213	206	111	298
	2. Indirect Taxes	830	904	858	949	1281
	3. Customs Revenues	452	412	452	447	591
	4. Total Nonpetroleum Tax Revenue (1 +2 + 3)	1497	1529	1516	1507	2170
	5. State Enterprise Profits	-32	-3	-8	-7	-22
	C. Other Sources of Revenue:					
	1. Personal Income Taxes	106	109	133	157	172
	2. Foreign Exchange Profits	203	111	114	126	137
	D. Less Transfer Payments to Consumers	70	68	112	117	131
	E. Equals Total Revenue less Transfers	2728	3126	3187	3168	3902
II	CURRENT EXPENDITURES:					
	A. Purchases of Goods and Services[d]	419	474	461	482	588
	B. Payments of Wages and Salaries[e]	930	1011	1088	1122	1187
	C. Total (A + B)	1349	1485	1549	1604	1775
III	CURRENT ACCOUNT SURPLUS: (Government Savings)(I-II)	1379	1641	1638	1564	2127
IV	INVESTMENT EXPENDITURES:	947	977	986	1085	1529
V	CONSOLIDATED PUBLIC SECTOR BALANCE (III-IV):	432	664	652	479	598

(c) Excludes concession payments (Bs. 975 and Bs. 1142 million in 1956 and 1957, respectively).

(d) Does not include the purchases by state enterprises.

(e) Does not include the wages and salaries paid by state enterprises.

1955	1956	1957	1958	1959	1960	1961	1962	1963
1003	1188[c]	1550[c]	1415	1444	1503	1553	1703	1731
743	962	1230	1497	1292	1098	1239	1482	1565
1746	2150	2780	2912	2736	2601	2792	3185	3296
95	131	210	154	124	110	107	113	123
1841	2281	2990	3066	2860	2711	2899	3298	3419
355	854	711	973	421	335	599	470	481
1339	1494	1008	946	919	863	862	909	860
620	605	640	752	858	688	669	675	757
2314	2953	2359	2671	2198	1886	2130	2054	2098
-13	46	17	-106	-189	-73	-25	-65	-55
210	238	291	404	242	232	195	226	258
156	179	225	370	404	356	731	974	1237
97	75	69	133	164	333	340	365	333
4411	5622[c]	5813[c]	6272	5351	4779	5590	6122	6624
568	596	767	1129	1284	1355	1334	1345	1425
1246	1445	1507	1834	2286	2522	2650	2547	2971
1814	2041	2274	2963	3570	3877	3984	3892	4396
2597	3581[c]	3539[c]	3309	1781	902	1606	-2230	-2228
1734	2286	3009	2932	2506	2102	1707	1862	2220
863	1295[c]	530[c]	377	-725	-1200	-101	368	8

TABLE FOUR GROSS TERRITORIAL CAPITAL FORMATION ACCOUNT

(Millions of Bolívares Per Year)

		1950	1951	1952	1953	1954
I	GROSS TERRITORIAL CAPITAL FORMATION					
	A. Petroleum	561	727	967	901	933
	B. Private Nonpetroleum	1583	1764	1881	2064	2303
	C. Government	947	977	986	1085	1529
	D. Total (A + B + C)	3091	3468	3834	4050	4765
II	FINANCING OF CAPITAL FORMATION					
	A. Savings:					
	1. Petroleum	122	125	349	384	210
	2. Private Nonpetroleum	279	307	374	355	437
	3. Government	1379	1641	1638	1564	2127
	4. Consumers	271	-47	273	413	391
	5. Total (1 + 2 + 3 + 4)	2051	2026	2634	2716	3165
	B. Depreciation Allowances:					
	1. Petroleum	420	495	530	558	613
	2. Nonpetroleum	790	926	722	969	937
	3. Total (1 + 2)	1210	1421	1252	1527	1550
	C. Sub-Total (A+B)	3261	3447	3886	4243	4715
	D. Less Current Account Surplus or Deficit (-) in the Balance of Foreign Payments	170	-21	52	193	-50
	E. Equals Total Financing	3091	3468	3834	4050	4765

TABLE FOUR (Continued)

1955	1956	1957	1958	1959	1960	1961	1962	1963
928	1160	1822	1788	1262	730	516	474	503
2610	2783	2959	2501	2088	1471	1601	1862	2128
1734	2286	3009	2932	2506	2102	1707	1862	2220
5272	6229	7790	7221	5856	4303	3824	4198	4851
-209	426	689	-817	272	-511	-540	-829	-693
461	510	604	555	511	313	247	389	364
2597	3581	3539	3309	1781	902	1606	2230	2228
542	180	267	1555	1540	2530	1317	446	1778
3391	4697	5099	4602	4104	3234	2630	2236	3677
680	732	812	836	939	948	929	911	872
900	747	556	558	743	828	1181	1338	1345
1580	1479	1368	1394	1682	1776	2110	2249	2217
4971	6176	6467	5996	5786	5010	4740	4485	5894
-301	-53	-1323	-1225	-70	707	916	287	1043
5272	6229	7790	7221	5856	4303	3824	4198	4851

TABLE FIVE BALANCE OF FOREIGN PAYMENTS ACCOUNT

(Millions of Dollars Per Year)

		1950	1951	1952	1953	1954
I	EXPORTS					
	A. Petroleum	1086	1229	1362	1423	1552
	B. Nonpetroleum	58	65	76	86	109
	C. Total (A + B)	1144	1294	1438	1509	1661
II	IMPORTS					
	A. Petroleum	162	175	246	218	204
	B. Nonpetroleum	597	687	776	827	968
	C. Total (A + B)	759	862	1022	1045	1172
III	FOREIGN FACTOR INCOME PAYMENTS					
	A. Petroleum	274	348	295	293	389
	B. Nonpetroleum	71	69	75	80	81
	C. Total (A + B)	345	417	370	373	470
IV	CURRENT ACCOUNT SURPLUS or DEFICIT (-)	40	15	46	91	19
V	NET INFLOW or OUTFLOW (-) OF FOREIGN CAPITAL					
	A. Concession Payments					
	B. Others	-91	-16	14	-43	-18
	C. Total (A + B)					
VI	INCREASE or DECREASE (-) IN FOREIGN EXCHANGE RESERVES	-51	-1	60	48	1
VII	BALANCE OF FOREIGN EXCHANGE RESERVES	396	395	455	503	504

1955	1956	1957	1958	1959	1960	1961	1962	1963
1777	2055	2545	2297	2153	2149	2213	2343	2363
112	134	193	209	227	217	176	163	171
1889	2189	2738	2506	2380	2366	2389	2506	2534
252	415	612	420	279	126	117	173	150
1004	1102	1649	1535	1610	1248	1241	1271	1122
1256	1517	2261	1955	1889	1374	1358	1444	1272
621	547	675	787	344	580	653	816	767
86	119	153	167	180	195	174	157	159
707	666	828	954	524	775	827	973	926
-74	6	-351	-403	-33	217	204	89	336
	315	370						
130	99	492	17	-363	-321	-224	-90	-179
	414	862						
56	420	511	-386	-396	-104	-20	-1	157
560	980	1491	1105	709	605	585	584	741

CHAPTER 4

THE GENERAL MODEL, V-3

4.1 General Scheme

Model V-3 is another simulation model, designed to operate on the same principles and to be used for investigations based on the same fundamental approach as Model V-2A. Unlike the earlier model, however, it is in a very general form that will permit a large degree of disaggregation when that is deemed desirable and when appropriate input information and computing facilities are available. The same framework can be used, meanwhile, for a more highly aggregated configuration. Aside from disaggregation, Model V-3 incorporates some significant features and relationships that are not represented in Model V-2A.

The generality of the formulation is such that Model V-3 can be used as a model of other countries besides Venezuela or of hypothetical cases. It is thus potentially a means of making comparisons between particular counties as well as general studies of the ways in which policy should be differently designed for countries with different economic structures or at different stages of development. General studies of that sort are needed to help international assistance agencies attack the problems of development more efficiently.

In the Venezuelan application, which is to be carried out by

CENDES, CORDIPLAN, and the U.C.V. Departamento de Cálculo, it is intended that the model should first be implemented with only a fraction of the number of sectors, population groups, etc., that it is designed to accommodate. While operational problems are being solved and preliminary experimental studies are being made on this basis, a parallel effort is to be carried on in collecting and analyzing additional statistics that will be needed to develop the fully elaborated system. Studies will be required, not only on the current and recent history of the detailed accounting variables, but also on the behavioral relations that determine them. In making these studies it is expected that the simulation itself will prove a valuable tool in somewhat the way that Models V-2 and V-2A served in testing and modifying the behavioral relations that they included. Also, as in the previous work, partial models will presumably play a useful role in the analysis of data and fitting of relationships.

Model V-3 is organized around a social accounting matrix that distinguishes four kinds of activity: production, consumption accumulation, and external transactions*. Variables have been defined

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* The accounting system is based on that of Richard Stone and his associates in the Cambridge Growth Project at the University of Cambridge (England). See their report: A Social Accounting Matrix (A Programme for Growth, Paper No. 2) published by Chapman and Hall, London, 1963, and by M.I.T. Press, Cambridge, Massachusetts.

and coded in symbolic form to represent the concepts relevant for any transactions within this matrix, and equations have been wrtten for the accounting and economic relations among the variables.

This matrix will be useful, both from an empirical and abstract point of view, as it will be used for organizing the gathering of data on a consistent basis, and also for the checking of the internal consistency of the abstract formulation. It accounts for 25 different categories of goods and services (each of which may have an imported and a domestic component), 6 different categories of income, 5 different types of governmnet activities, 5 different types of real assets, and 14 different types of financial assets.

It distinguishes 25 different productive sectors, 4 different household sectors, a government sector, 6 financing intermediaries, and a rest-or-the-world sector. The different sectors and categories are listed in the next section (4.2).

This degree of disaggregation is provided for, but not required by the model formulation. The computer program is to be freely compressible to operate on smaller numbers of sectors.

For each of the productive sectors relations are specified for each of the following functions: first, production functions, which connect the flow of both material and labor inputs as well as the stock of capital with production. In their specification, attention has been paid not only to long run forces such as technological progress, but also to short run phenomena such as labor hoarding. Second, supply functions, which determine price and output, taking into account both

cost and demand factors. It should be pointed out here that both the accounting framework and the model distinguish four different levels of price for each category of goods and services: producers', market, wholesalers, and retail prices. In addition, inventory stocks, both desired and undesired, are provided for. Third, wage functions for three different categories of labor in each sector. Fourth, an investment and capital function, which explains investment starts, together with accounting for capital stock and production capacity. Different gestation periods and lifetimes of capital goods are recognized. Capital consumption allowances are also explained by functions related to fiscal practice. Fifth, tax functions, for indirect, direct, and capital taxes and also for import and export duties. Sixth, functions for the distribution of profits for three different sizes of business enterprises. Seventh, supply and demand functions for each of the different categories of real and financial assets.

For each of the four different household sectors, an explanation is included for: first, the total and disposable income. Second, expenditure for each of the different categories of domestic and imported goods and services. Third, transactions on financial and real assets.

For the government sector, expenditure on both current and capital account is explained in terms of exogenous targets for five different

public sector functions, such as education, defense, etc., and also by the needs of a development policy which might entail current and capital transfers to different sectors of the economy. Government financial revenues are accounted for and explained in terms of the taxes levied on different goods, sectors, and income-earners, as well as exchange rate differentials, profits of government enterprises, and miscellaneous fees.

Exports of goods and services are given as exogenous, but imports (which are subdivided in a similar fashion to domestic production) are endogenously determined by relating them to the levels of various activities of production and investment in the economy. These relationships are designed to explain the process of import substitution as influenced by relative prices, technical progress and government policy. Instruments of policy include tariffs, multiple exchange rates, and quotas. Capital flows between the rest of the world and the country are mainly exogenously determined, but there is provision for an endogenous explanation of some of them.

The six financial sectors operate in markets for 14 types of financial assets. Also engaged in these transactions are enterprises, families, the government, and the rest of the world. The complete set of demand and supply equations for all types of financial assets by all sectors and groups makes a very detailed and very complicated picture

of the financial system. A mechanism is included that adjusts the [illegible] and interest rates of different assets and clears all of the markets involved. The operation of these markets affects and modifies decisions about production, consumption, and investment. These feedback effects involve lags and rigidities that correspond approximately to behavior that has been observed in reality.

Thus the "real" and "monetary" spheres of the economy are related, so that their interaction can be better understood and the consequences of different combinations of government financial policies can be traced in detail.

4.2 Sectors and Categories, Model V-3 (Disaggregated Version)

Agriculture and Livestock

01 Small scale farmers

02 Oriented-agriculture: livestock and fishing

03 Oriented-agriculture: other food

04 Oriented-agriculture: industrial materials

Mining

05 Mining (not including petroleum)

06 Petroleum

Traditional Activities

07 Food products, artisan

08 Food products, business

09 Other products, artisan

10 Other products, business

Intermediate Activities

11 Metals

12 Petrochemicals

13 Petroleum products

14 Electricity

15 Other (including artisan production of construction materials)

Mechanical Products

16 Automobiles

17 Household goods

18 Capital goods

19 Other (including repairs)

Construction

20 High-cost housing construction

21 Low-cost housing construction

22 Construction of public works

23 Other private construction

Services

24 Public services (including gas and water)

25 Private services

Income Groups

30 Low-income salaried workers

31 Medium-income salaried workers

32 High-income salaried workers

33 Low-income proprietors

34 Medium-income proprietors

35 High-income proprietors

Consumer Groups

36 Low-income farm families

37 Low-income urban families

38 Middle-income families

39 High-income families

Institutions

Governmental:

50 Government

Financial:

60 Central Bank of Venezuela

61 Social Security (and insurance companies)

62 Commerical Banks

63 Investment Banks

64 Housing mortgage lenders, private

65 Housing mortgage lenders, public

Exterior

70 Exterior as one sector

71-99 Imported goods corresponding the the national goods of sectors sectors 1-29.

Types of Real Assets

1 Land

2 Buildings

3 Machinery and equipment

4 Vehicles

5 Livestock

Types of Financial Assets

1. Stocks

2. Debts

3. Bonds

4. Titles

5. Mortgages

6. Foreign securities

7. Commerical credit

8 Short-term loans

9. Long-term Loans

10. Housing loans

11. Gold and foreign exchange

12. Fixed term savings deposit

13. Deposits on current account

14. Currency

4.3 Equations of Model V-3*

Flows of Goods and Services from Productive Sector i to Sector j

$i = 01,.....,29$; $71,.....,99$ $\qquad i \neq 25$

$QFLUC_{i,j} = AN_{i,j} \times QN_j$	$i = 1,....,29$	$j = 1,....,29$
$QFLUK_{i,j} = \frac{AKN_{i,j}}{TG_j} \times SKGE_j$	"	"
$QFLUC_{i,j} = QCNF_{i,j}$	"	$j = 36,...,39$
$QFUK_{i,j} = QKNF_{i,j}$	$i = 20,21$	$j = 36,...,39$
$QFLUK_{i,j} = 0$	$i \neq 20,21$	$j = 36,...,39$
$QFLUC_{i,50} = QCNG_i$	$i = 1,....,29$	$i \neq 25$
$QFLUK_{i,50} = QKNG_i$	"	"
$QFLUC_{i,70} = QEXPC_i$	"	"
$QFLUK_{i,70} = QEXPK_i$	"	"
$QFLUC_{i,j} = AM_{i,j} \times QN_j$	$i = 71,...,99$	$j = 1,....,29$
$QFLUK_{i,j} = \frac{AKM_{i,j}}{TG_j} \times SKGE_j$	"	"
$QFLUC_{i,j} = QCMF_{i,j}$	"	$j = 36,...,39$
$QFLUK_{i,j} = 0$	"	"
$QFLUC_{i,50} = QCMG_i$	"	"
$QFLUK_{i,50} = QKMG_i$	"	"
$QFLUT_{i,j} = QFLUC_{i,j} + QFLUK_{i,j}$	$i = 1,....,29$; $71,...,99$	$j = 1,....,29$; $36,...,39,50,70$

* Definitions will be found in Section 4.4

$$QFLUC_{25j} = AN_{25j} \times QNj + QINT_{25j} + \sum_{\substack{i=1,\ldots,29 \\ 71,..,99}} QFLUCi,j \qquad j = 1,\ldots,29$$

$$QFLUC_{25j} = QINT_{25j} + \sum_{\substack{i=1,\ldots,29 \\ 71,\ldots,99}} QFLUCi,j \qquad j = 36,..,39,50$$

$$QFLUK_{25j} = \frac{AKN_{25j}}{TGj} \times SKGEj + \sum_{\substack{i=1,\ldots,29 \\ 71,..,99}} QFLUKi,j \qquad j = 1,\ldots,29,60,\ldots,65$$

$$QFLUK_{25j} = QKNFi,j + \sum_{\substack{i=1,\ldots,29 \\ 71,..,99}} QFLUKi,j \qquad j = 36,..,39$$

$$QINT_{25j} = FINTMPj/PIN \qquad j = 1,\ldots,29,36,\ldots,39,50,70$$

Sales and Purchases of Goods and Services

$$VVENT_i = \sum_j QFLUT_{i,j} \times PNV_i + QFLUT_{i,70} \times PEX_i \times PTC \qquad i = 1,\ldots,24 \quad j = 1,\ldots,29,36,\ldots,39,50$$

$$VVENT_{25} = \sum QFLUT_{25j} \times PNV_{25} + VDIST + FINTMP \qquad "$$

$$VDIST = \sum_{i=1,\ldots,29;\ j=1,\ldots,29,50} QFLUT_{i,j} (PNM_i - PNV_i) + \sum_{i=1,\ldots,29;\ j=36,\ldots,39} QFLUT_{i,j} \times (PND_i - PNV_i) + \sum_{i=71,\ldots,99;\ j=1,\ldots,29,50} QFLUT_{i,j} \times (PXM_i - PXV_i) + \sum_{i=71,\ldots,99;\ j=36,\ldots,39} QFLUT_{i,j} \times (PXD_i - PXV_i)$$

$$VCOMPC = \sum_{i=1,\ldots,29} QFLUC_{i,j} \times PNM_i + \sum_{i=71,\ldots,99} QFLUC_{i,j} \times PXM_i \qquad j = 1,\ldots,29,50$$

$$VCOMPC_j = \sum_{i=1}^{29} QFLUC_{i,j} \times PND_i + \sum_{i=71}^{99} QFLUC_{i,j} \times PXD_i \qquad j = 36,\ldots,39$$

$$VCOMPT_{70} = \sum_{i=1,\ldots,29} QFLUT_{i,70} \times PEXB_i$$

$$VCOMPK_j = \sum_{i=1,\ldots,29} QFLUK_{i,j} \times PNM_i + \sum_{i=71,\ldots,99} QFLUK_{i,j} \times PXM_i \qquad j = 1,\ldots,29,50$$

$$VCOMPK_j = \sum_{i=20,21} QFLUK_{i,j} \times PND_i \qquad j = 36,\ldots,39$$

$$VCOMPT_j = VCOMPC_j + VCOMPK_j \qquad j = 1,..,29,36,..,39,50,60,..,65,70$$

$$FINTMP_{j,i} = \sum_j (FINT_{j,i} - HDEPL_{j,i} \times RDP_i) \times \frac{HDEPC_{j,i} + HDEPL_{j,i}}{\sum (HDEPC_{j,i} + HDEPL_{j,i})} \qquad j = 1,..,29,36,..,39,50$$

$$FINTMP = \sum_{i,j} FINTMP_{i,j}$$

$$VVENTC_{i,j} = QFLUC_{i,j} \times PNV_i \; (PXV_i)^{(1)} \quad \begin{matrix} i = 1,..,29,71,..,99 \\ j = 1,..,29 \end{matrix}$$

$$VVENTK_{i,j} = QFLUK_{i,j} \times PNV_i \; (PXV_i)^{(1)} \quad \begin{matrix} i = 1,..,29,71,..,99 \\ j = 1,..,29 \end{matrix}$$

$$VCOMPC_{i,j} = QFLUC_{i,j} \times PNM_i \; (PXM_i)^{(1)}$$

$$VCOMPK_{i,j} = QFLUK_{i,j} \times PNM_i \; (PXM_i)^{(1)}$$

$$VDISTC_{i,j} = QFLUC_{i,j} \; (PNM_i - PNV_i) \quad i = 1,..,29$$

$$VDISTC_{i,j} = QFLUC_{i,j} \; (PXM_i - PXV_i) \quad i = 71,..,99 \qquad j = 1,..,29,50$$

$$VDISTC_{i,j} = QFLUC_{i,j} \; (PND_i - PNV_i) \quad i = 1,..,29$$

$$VDISTC_{i,j} = QFLUC_{i,j} \; (PXD_i - PXV_i) \quad i = 71,..,99 \qquad j = 36,..,39$$

$$VDISTK_{i,j} = QFLUK_{i,j} \; (PNM_i - PNV_i) \quad i = 1,..,29$$

$$VDISTK_{i,j} = QFLUK_{i,j} \; (PXM_i - PXV_i) \quad i = 71,..,99 \qquad j = 1,..,29,50$$

$$VDISTK_{i,j} = QFLUK_{i,j} \; (PND_i - PNV_i) \quad i = 1,..,29$$

$$VDISTK_{i,j} = QFLUK_{i,j} \; (PXD_i - PXV_i) \quad i = 71,..,99 \qquad j = 36,..,39$$

(1) Definitions will be found in Section 4.4

Coefficients of Current Inputs, Technical Progress, Capital, and Labor; Also Substitution of Imports

$$ANi,j = Ai,j - AM_{i+70,j} \qquad i = 1,..,29 \qquad j = 1,..,29$$

$$AMi,j = AMi,j \times \left[1 - AMPi,j \times \frac{PXMi - PNMi}{PNMi} \times DT - AMKi,j \times \frac{DERIVA\ (SCAPACi)}{SCAPACi} \times DT \right] - AMEi,j \times BNEDUC \times DT \Big]^{1}$$

$$(ALIi,j)^{DT} \times AMi,j \quad (ALSi,j)^{DT} \times AMi,j$$

$$FSSj,n = PWj,n \times QEMPj,n \times (1 + AASj) \qquad j = 1,..,29,30,39,50 \quad n = 30,31,32$$

$$QEMPj,_{30} = PROM\ (BTRABj,_{30} \times QNj) \qquad j = 1,..,29$$

$$QEMPj,n = PROM\ (BTRABj,n \times SCAPACj) \qquad j = 1,..,29 \qquad n = 31,32$$

$$BTRABj,n = ATRQj,n \times \left(\frac{QNj}{QCAPACj} - 1\right)^2 + BETRj,n \qquad j = 1,..,29 \quad n = 30,..,32$$

$$BETRj,n = BETRj,n \times \left[1 - ATRj,n \times \frac{DERIVA\ (SCAPACj)}{SCAPACj} \times DT - ATEj,n \times BNEDUC \times DT\right]^{0}$$

$$FSSj = \sum_{n=30}^{32} FSSj,n \qquad j = 1,..,29$$

$$AKNi,j = AKi,j - AKMi,j$$

$$AKM_{i,j} = AKM_{i,j} \times \left[1 - AKMP_{i,j} \times \frac{PXM_i - PNM_i}{PNM_i} \times DT - AKMK_{i,j} \times \frac{DERIVA\ (QCAPAC_i)}{QCAPAC_i} \vee 0 \times DT - AKME_{i,j} \times BNEDUC \times DT\right] \vee (AKLI_{i,j})^{DT} \times (AKM_{i,j})^{DT} \times AKM_{i,j} \wedge (AKLS_{i,j})^{DT} \times AKM_{i,j}$$

$$AM_{i,j} = AM_{i,j} \wedge (QCUOTC_{i,j}/QN_j)$$

$$AKM_{i,j} = AKM_{i,j} \wedge (QCUOTK_{i,j} \times TG_j/AKGE_j)$$

Supply and Demand

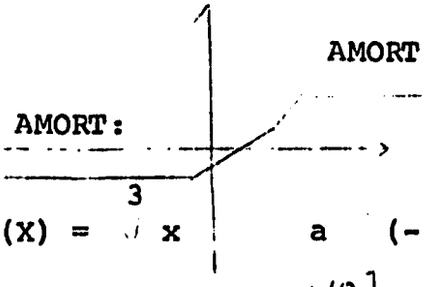
$$QDNR_j = \sum_i QFLUT_{j,i} \qquad i = 1,..,29,36,..,39,50,70 \quad j = 1,..,29$$

$$QDNE_j = EXTRAP\ (QDNR_j)$$

$$QPLAN_j = QDNE_j + AMORT\ (STN_j - ST_j) \qquad j = 5,..,23$$

$$QN_j = QPLAN_j \wedge QCAPAC_j + AMORT\ (QPLAN_j - QCAPAC_j) \qquad j = 5,..,23$$

Subroutine AMORT:



0 AMORT (X) = x a (- a)

$$QN_j = QCAPAC_j + AMORT\ [(QDNE_j - QCAPAC_j) \vee 0] \qquad j = 1,..,4$$

$$QN_{24} = QDNR_{24}$$

$$QN_{25} = QDNR_{25} + VDIST/PNV_{25} + \sum_{j=60}^{65} FGAST_j/PNV_{25}$$

$$ST_j = [ST_j + (QN_j - QDNR_j) \times DT] \vee 0 \qquad j = 1,..,23$$

$$STN_j = AST_j \times QDNE_j \left(1 - ACFN_j \times RREND(8)\right) (1 + ACNF_j \times RINF)$$

Employment and Active Population

$SPOB = SPOB \times (1 + RPOB)$ — Total population

$SPBA_{36} = SPBA_{36} \times (1 + RPOBR - RURB)$ — Rural unskilled population

$SPBA_{37} = SPBA_{37} \times (1 + RPOBUN) + SPBA_{36} \times RURB$ — Urban unskilled population

$RPOBUN = RPOBU - RCALIF$ (1)

$RCALIF = RCALIF + AED \times BNEDUC \times DT$

$SPBA_{38} = SPBA_{38} \times (1 + RPOBU + RINMG) + SPBA_{37} \times RCALIF$

$$QEMP_{36} = \sum_{j=1,\ldots,4} QEMPj,n \qquad n = 30,31,33$$

$QEMPj,_{33}^{34} = \text{exogenous}$ — $j = 1,\ldots,29$

$$QEMP_{37} = \sum_{j} QEMPj,_{30} + \sum_{j=5}^{29} QEMPj,_{33} \qquad j = 5,\ldots,29,38,39,50$$

$$QEMP_{38} = \sum_{j=5}^{29,50} QEMPj,_{31} + \sum_{j=1}^{4} QEMPj,_{34}$$

$RDESn = 1 - \frac{QEMPn}{SPBAn}$ — $n = 36,37,38$

$$QEMP_{50} = \sum_{n=30}^{32} QEMP_{50,n}$$

$QEMP_{50,n} = \text{exogenous}$ — $n = 30,\ldots,32$

(1) Rate of increase of unskilled urban population

Fixed Capital

Real Assets, k = 1,...,5

SACTREi,k = SACTREi,k + (QACTNi,k - QACTMi,k) x DT (real assets)

QACTMi,k = AKAi,k + AKBi,k x SACTREi,k (attrition of capital)

QACTNi,k = QKNi/BCPKi,k (new assets of type K in sector i)

BCPKj,k = $1/\sum$ AKi,j

k = 2,3,4
i = some of 1 - 29
according to k:
k = 2 i = 23
k = 3 i = 11,18,19
k = 4 i = 16

BCPKj,k = BCPKj,k + APKj,k x QACTMj,k x DT k = 1,5

APKj,n = exogenous (policy)

$SACTRE_{2,5} = SACTRE_{2,5} \Big/ (BCPK_{2,5} \times SACTRE_{2,1})$

QCAPACi = INFIMO (SACTREi,k x BCPKi,k) k = 1,2,3,4 or less depending on i

QKNi = GEST (QKIi, TGi) (completions of capactiy in gestation)

QKIi = PROM (QKITEOi, QKIi) (actual starts of capacity in gestation)

QKITEOi = tentative starts of capacity in gestation

SKGEj = SKGEj + (QKIj - QKNj) x DT (capacity in gestation)

HACTREi,k = SACTREi,k x PACTREi,k (value of real assets at current prices)

FDEPRj,k = ADEPRj,k x HACTREj,k (depreciation) k = 2,4,5

$$FDEPRj = \sum_{k=2}^{5} FDEPRj,k$$

$$HACTREi = \sum_{k=1}^{5} HACTREi,k$$

Investment

For j = 2,3,4,7,....,10,11,12,13,15,....,22

$$QKITEOj = AINV1j \times PROM(QCAPACj) + AINV2j \times PROM \left[\left(\frac{QNj}{QCAPACj} - 1 \right) \times QCAPACj \right] + AINV3j \times \left(\frac{PNMj}{PIN} - 1 \right) + AINV4j \times \left(\frac{PIN}{PIX} - 1 \right)$$

$$+ AINV5j \times QDNEj + AINV6j \times DERIVA \left[PROM \left(\frac{QDNRj}{BCPKj} \right) \right]$$

$$- AINV7j \times PROM \left[RREND(9) \right] - RBj - AINV8j \times PROM \left(\sum_{k=7,8,9} HPVVLj,k / \sum_{k=7,12,13,14} HACVLj,k \right) + BINV1j + BINV2j$$

$$QKITEO_{25} = AINV9_{25} \times DERIVA \left[PROM \left(\frac{VVENTj - VCOMPCj}{PIN \times BCPKj} \right) \right] + BINVi,_{25}$$

$$+ BINV2,_{25} - AINV8,_{25} \times PPOM \left(\sum HPVVL_{25,k} \sum_{k=7,12,13,14} HACVL_{25,k} \right)$$

For other values of j, exogenous

Prices

$$PCOSTj = \left[VCOMPCj + FINTPj + FRENTj\right] + FDEPRj \times \frac{1}{QNj} + \sum_{n} BTRABj,n \times PWj,n \times (1 + AASj) + AIMPDj \times PTDj + AIMPPj \times PTPj$$

$$j = 7,\ldots,10,15,\ldots,23,25$$

$$PMINFj = AMINFj \times PROM\ (RINF - AUINF) + AMUFj \times \sum_{k=7,8,9} HPVVLj,k / \sum_{k=7,12,13,14} HACVLj,k$$

$$PMDEMj = AED1,j \times \left(\frac{QNj}{QCAPACj} - 1\right) V0 + AEFD2,j \times \left(\frac{QNj}{QCAPACj} - 1\right) 10 + AEFD3,j \times DERIVA\left(\frac{QNj}{QCAPACj} - 1\right) - AMSTj \times (STj - STNj)$$

$$PMXj = AMXj \times DERIVA\ (\ QFLUTj \div 70,0/QNj\ )$$

$$PNPj = PROM\left[PCOSTj \times (AMUj + RMINFj + RMDEMj + RMXj)\right] \times ACPj + (1 - ACPj) \times BCPGj$$

$$PNPj = PROM\left[PCOSTj \times (AMUj + BCPGj)\right] \qquad j = 11,\ldots,14,24$$

$$PNP_5 = PEX_5 \times PTC$$

$$PNP_6 = \text{exogenous}$$

$$PNPj = PNPj \times \left[1 + DT \times PROM\left(APD1j\ \left(\frac{QDNRj}{QNj} - 1\right) + APD2j\ \left(\frac{QDNRj}{QNj} - 1\right) 10\right)\right] \qquad j = 1,\ldots,29$$

$$PNVj = PNPj \times (1 + PTINj)$$

$$PNMj = PNVj + PNVj \times DT \times \left[AMUM1j + AMUM2j \times (RINF - AUINF) V0 - AMUM3j \times (STj - STNj) + AMUM5j \times \sum_{k=7,8,9} HPVVLj,k / \sum_{k=7,12,13,14} HACVLj,k + AMUM4j \times (PXMj - PNMj)\right] \qquad j = 1,\ldots,29$$

$$PNDj = PNMj + PNMj \times DT \times \left[AMUD1j + AMUD2j \times (RINF - AUINF) V0 - AMUD3j \times (STj - STNj) + AMUD4j \times (PXDj - PNDj)\right] \quad j=1,..,29$$

$$PTIEU = PTIEU \times \left[1 + DT \times APTU1 + APTU2\ (RINF - AUINF) \quad V0 \right.$$
$$\left. + APTU3 \times RPOBU + APTU4 \times QSVUG \right]$$

$$PTIER = PTIER \times \left[1 + DT \times (APTR1 + APTR2 \times (RINF - AUINF) \quad V0 \right.$$
$$\left. + APTR3 \times RBi + APTR4 \times QSVRG + APTR5 \times QSVTG) \right]$$

$$PRENTj = PRENTj \times \left[1 + DT \times ACONTRj\right] + ARE1j \times PACTREj,_2$$
$$+ ARE2j + \frac{SPBAj}{SACTREj2} \qquad j = 36,37,38,39$$

$$PRENTj = ARE1j \times PACTREj,_1 + ARE2j \times VVENTj \qquad j = 1,\ldots,4$$

$$PRENTj = ARE1j \times PACTREj,_2$$

$$PIX = \sum_{i=71}^{99} PXMi \times QFLUTi,\ o/QFLUTo,o$$

$$QFLUTo,o = \sum_{\substack{i=71,\ldots,99 \\ j=1,\ldots,29,36,\ldots,39,50}} QFLUTi,j$$

$$PXVi = PXi \times PRC \times (1 + ATMCi)\ PXi \times PTC \times (1 + ATMKi)$$

$$PXMi = PXVi \times \frac{PNMi}{PNVi} \times (1 + ACUOTAi)$$

$$PXDi = PXMi \times \frac{PNDi}{PNMi} \times (1 + ACUOTDi)$$

$$PEXBi = PEXi \times PTC \times (1 - ATEXi)$$

$$PACTREi,_1 = PTIER \qquad i = 1,2,3,4,36$$

$$PACTREi,_1 = PTIEU \qquad i = 5,\ldots,25,37,\ldots 39,50$$

$$PACTREi,_2 = \frac{PNM_{22} \times QFLUK_{22,i} + PNM_{23} \times QFLUK_{23,i}}{QFLUK_{22,i} + QFLUK_{23,i}} \qquad i = 1,\ldots,29,50$$

$$PACTREi,_3 = \sum_{j=1}^{29}(PNMj \times QFLUKj,i + PXMj \times QFLUKj + 70,i)/$$
$$\sum_{i=1}^{29}(QFLUKj,i + QFLUKj + 70) \qquad i = 1,\ldots,29,50$$

$$PACTREi,_4 = \frac{PNM_{16} \times QFLUK_{16,i} + PXM_{86} \times QFLUK_{86,i}}{QFLUK_{16,i} + QFLUK_{86,i}} \qquad i=1,....,29,50$$

$$PACTREi,_5 = PNM_2 \times BVACA \qquad i=1,...,4$$

$$PACTREn,_2 = PND_{21} \quad n = 36,37 \qquad PACTREn,_2 = PND_{20} \quad n = 38,39$$

$$RINF = \sum_{j=1}^{29} APPj \times \frac{DERIVA\ (PNMj)}{PNMj}$$

$$APPj = \frac{VAGREj}{\sum_{i=1,....,25} VAGREi}$$

$$PIN = \sum_{j=1}^{25} APPj \times PNMj$$

$$PWINn = \sum_{j=1}^{25} APWj,n \times PWj,n / \sum_{j=1}^{25} APWj,n\ (0) \times PWj,n\ (0) \qquad n = 30,31,32$$

$$APWj = QEMPj,n \sum_{i=1}^{25} QEMPi,n$$

$$PICV = \sum_{j=1,....,29}^{29} APCVj \times PNDj + \sum_{j=71}^{99} APCVj \times PXDj / \sum_{j=1}^{29} APCVj(0)$$

$$\times PNDj\ (0) + \sum_{j=71}^{99} APCVj\ (0) \times PXDj\ (0)$$

$$APCVj = \sum_{n=36}^{39} QCNFj,n / \sum_{\substack{n=36,...,39 \\ i=1,...,29}} QCNFi,n \qquad j = 1,...,29$$

$$APCVj = \sum_{n=36}^{39} QCMFj,n / \sum_{\substack{n=36,...,39 \\ i=71,...,99}} QCMFi,n \qquad i = 71,...,99 \quad j = 71,...,99$$

Government

$$FIMPIN_j = \frac{PTIN_j}{1 + PTIN_j} \times VVENT_j + \sum_{i=1}^{99} QFLUC_{i,j} \times ATMC_{i,j}$$

$$\times PX_j \times PTC + QFLUT_{j,70} \times PEX_i \times PTC + FSS_j$$

$$\times ATNCE_j/(1 + AAS_j)$$

$$FIMPM = \sum_{\substack{i=71,\ldots,99 \\ j=1,\ldots,29,36,\ldots,39,50}} (QFLUC_{i,j} \times ATMC_{i,j} + QFLUK_{i,j} \times ATMK_{i,j}) \times$$

$$\times PTC + QFLUT_{j,70} \times PEX_i \times PTC + FSS_j \times ATNCE_j/(1 + AAS_j)$$

$FIMPD_j = ATD_j \times VBAI_j$ $\qquad j = 1,\ldots,29$

$FIMPP_j = ATP_j \times HK_j$

$FIMPDF_j = FYF_j \times ATDF_j$ $\qquad j = 36,\ldots,39$

$FIMPPF_j = ATPF_j \times HFIVIV_j$

$HFIVIV_j = SACTRF_{j,2} \times PFVIV_j$

$PFVIV_j = INOD\ (PPOM_j\ (PND_{20}, PND_{21}))$

$$FINCE = \sum_{j=1}^{29,50} \frac{AINCE_j}{1 + AAS_j} (FSS_j + FSSGE_j)$$

$$FINCG = \sum_{j=1}^{29} FIMPIN_j + FIMPM + FIMPEX + \sum_{j=1}^{29} (FIMPD_j + FIMPP_j)$$

$$+ \sum_{j=36}^{39} (FIMPDF_j + FIMPPF_j) + FINCE + FTRA_{70,50}$$

$$+ FINT_{70,50} + FBC + \sum_{j=1}^{29} FSUPEG_j$$

$$FGCG = VCOMPC_{50} + FSS_{50} + \sum_{j=1}^{29,36,\ldots,39,60,\ldots,65,70} FTRA_{50,j}$$

$$FSS_{50} = \sum_{n=30}^{32} FSS_{50,n}$$

$$FSS_{50,n} = QEMPGn \times PW_{50,n}$$

$$FTRA_{50,j} = FINT_{50,j} + FTRARS_{50,j}$$

$$FSUPCG = FINCG - FGCG$$

$$FGKG = VCOMPK_{50} + FSSGEG$$

$$FSUPTG = FSUPCG - FGKG$$

$$FSSGEG = \sum FSSGEGj \qquad j = 30,31,32$$

Exterior

$$PEXBi = PEXi \times PTC \times (1 - TEXi) \qquad \text{(received by the exporter)} \quad i=1,,29$$

$$PEX = \sum_{i=1}^{29} QFLUTi,_{70} \times PEXi$$

$$EIMPO = \sum_{\substack{i=71,..,99 \\ j=1,..,29,36,..,39,50}} QFLUTi,j \times PXi$$

$$EBC = UEX - EIMPO$$

$$EBCC = EBC - EREM + EINTN_{70} + ETRACN_{70}$$

$$EINTN_{70} = \frac{1}{PTC}(FINTR_{70} - FINTP_{70})$$

$$ETRACN_{70} = \frac{1}{PTC}\sum_{j}(FTRAC_{70,j} - FTRACj,_{70}) \qquad j = 1,..,29,36,..,39,50,60,..,65$$

$$EBP = EBCC + ETRAKN_{70} + EENCAP$$

$$FTRAi,j = FTRACi,j + FTRAKi,j$$

$$ETRAKN_{70} = \frac{1}{PTC} \times \sum_{j}(FTRAK_{70,j} - FTRAKj,_{70}) \qquad j = 50,60,..,65$$

$$WREXT = WREXT + EBP \times DT$$

$$HREXT = WREXT \times PTC$$

$$EEBCAP = \frac{1}{PTC}\left(\sum_{k=1}^{14} FDNVL_{70,k} - \sum_{j=1}^{65} FDNVLj,_{6} - \sum_{j\neq 60} FDNVLj,_{11}\right)$$

Profits of Productive Sectors

Profits before direct taxes:

$$VBAIj = VVENTj - VCOMPCj + FINTNj - FIMPNj - FGSj - FDEPRj$$

$$- FSUPEGj + FTRA_{50,j} - FRENTj \qquad j = 1,\ldots,29$$

$$FINTNj = FINTRj - FINTPj$$

$$VBJ - VBAIj + VSTj - FINTRj + FSUPEGj$$

$$VBNj = VBAIj - FIMPDj - FIMPPj$$

$$FBDj = INOD\ (ABDj \times BNj,\ BDj)$$

$$FBDj,n = ABJ,_{n} \times BDj \qquad n = 33,34,35$$

$$FRENTj = PRENTj \times SACTREj,_{2} \qquad j = 1,\ldots,29$$

$$RBj = VBNj/\sum_{k=1}^{5} HACTREj,k \qquad j = 1,\ldots,29$$

$$VSTj = DSTj \times PNPj$$

Salaries

$$PWj,n = PWj,n + PWj,n \times DT \times AW1j,n + AW2j,n \times DERIVA \times \frac{VBAIj}{FSSj,n}$$

$$- AW3j,n \times RDESn + AW4j,n \times \left(PICV - \frac{PWj,n}{PWj,n(0)}\right)$$

$$+ AW5j,n \times \left(PWINn - \frac{PWj}{PWJ(0)}\right), \qquad j = 1,\ldots,29,38,39$$

$$PW_{50,n} = \text{exogneous}$$

$$VAGRENj = VVENTj + VSTj - VCOMPCj - FIMPINj - FDEPRj - FINTMPj \qquad j = 1,..,29$$

Family Incomes

$$FYF_n = FYSS_n + FYBD_n + FTRA_n + FSEG_n + FRENTR_n + FINTR_n - FINTP_n \qquad n = 36,37,38,39$$

$$FYSS_{36} = \sum_{j=1,\ldots,4} \frac{FSS_{j,30} + FSS_{j,31}}{1 + AAS_j}$$

$$FYBD_{36} = \sum_{j=1,\ldots,4} FBD_{j,33}$$

$$FYSS_{37} = \sum_{j=5}^{29,38,39,50} \frac{FSS_{j,30}}{1 + AAS_j} + \frac{FSSGEG_{30}}{1 + AAS_{50}}$$

$$FYBD_{37} = \sum_{j=5}^{29} FBD_{j,33}$$

$$FYSS_{38} = \sum_{j=5}^{29,50} \left(\frac{FSS_{j,31}}{1 + AAS_j}\right) + \sum_{j=1}^{4} \left(\frac{FSS_{j,32}}{1 + AAS_j}\right) + \left(\frac{FSSGEG_{31}}{1 + AAS_{50}}\right)$$

$$FYBD_{38} = \sum_{j=1}^{4} FBD_{j,34}$$

$$FYSS_{39} = \sum_{j=5}^{29,50} \left(\frac{FSS_{j,32}}{1 + AAS_j}\right) + \frac{FSSGEG_{32}}{1 + AAS_{50}}$$

$$FYDB_{39} = \sum_{j=4}^{29} (FBD_{j,34}) + \sum_{j=1}^{29} FBD_{j,35})$$

$$FRENTR_n = \sum_{m=36}^{39} FRENTV_{m,n} + \sum_{m=36}^{39} FRENTT_{m,n} \qquad \text{(housing and land)}$$

$$FTRA_n = \sum_{j} FTRA_{j,n}$$

$$FRENTV_{m,n} = \sum_{j=36}^{39} SACTRE_{j,2} \times PRENT$$

$$FRENTT_{m,n} = \sum_{j=1}^{65} SACTRE_{j,1} \times PRENT$$

Consumption, Saving, and Investment by Families

$$YDH_n = PROM(FYF_n) \qquad n = 36,..,39$$

$$FRENTP_n = \sum_{j=38,39} FRENTP_{n,j}$$

$$FRENT_{i,n} = (1 - \sum_{j\neq 38,39} ARENT_{n,j}) \times SACTRE_{n,2} \times PRENT_n \qquad n = 36,..,39$$

$$FRENTP_{n,j} = ARENT_{n,j} \times SACTRE_{n,2} \times PRENT_n \qquad n = 36,..,39$$

$$FSFVIV_n = \sum_{j=64,65} (FAMT_{n,j,5} + FINT_{n,j,5}) \quad \text{(housing interest and amortization costs)}$$

$$VCOMPT_{j,n} = PND_j \times QMIN_{j,n} + APGS_{j,n}\,(YDH_n - VGSMIN_n) \qquad j = 1,..,29;\ j \neq 16,17,20,21$$

$$VQOMPT_{j,n} = PXD_j \times QCUOTA_j + APGS_{j,n}\,(YDH_n - VGSMIN_n) \qquad j = 71,..,89;\ j \neq 86,87,90,91$$

$$FSS_{n,30} = PW_{n,37} \times QMIN_{37,n} + APGS_{37,n}\,(YDH_n - VGSMIN_n)$$

$$VGSMIN_n = \sum_{\substack{j=1,..,29,71,..,99 \\ j\neq 16,17,20,21}} PND_j \times QMIN_{j,n} + \sum_{\substack{j=16,17,86,87 \\ 20,21}} ACONT_{j,n} \times PND_j \times QMIN_{j,n}$$
$$+ FRENTP_n + FSFVIV_n + PW_{n,37} \times QMIN_{37,n}$$

$$QMIN_{j,n} = QMIN_{j,n} \times RMIN_{j,n} \qquad n = 36,..,39 \qquad j = 1,..,29,71,..,99$$

$$\left.\begin{matrix} QCNF_{j,n} \\ QKNF_{j,n} \end{matrix}\right\} = AGAST_{j,n} + AGAST1_n \times DERIVA(SPBA_n) + AGAST2_{j,n} \times PROM(YAF_n)$$
$$+ AGAST3_{j,n} \times PND_j \times (1 - ACONT_{j,n})/TPL_{j,n} + AGAST4_{j,n} \times ACONT_{j,n}$$
$$\times PND_j + QMIN_{j,n} \qquad QCNF_{j,n}: j = 16,17 \quad QKNF_{j,n}: j = 20,21$$

$$QCMF_{j,n} = AGASTO_{j,n} + AGAST1_{j,n} \times DERIVA(SPBA_n) + AGAST2_{j,n} \times PROM(YAF_n)$$
$$- AGAST3_{j,n} \times PXD_j \times (1 - ACONT_{j,n})/TPL_{j,n} + AGAST4_{j,n} \times ACONT_{j,n}$$
$$\times PXD_j \qquad j = 86,87$$

$$FREMn,_{70} = AREM,_{60} \ (YDHn - VGSMINn) \qquad j = 86,87$$

$$QCNFj,n = VCOMPTj,n/PNDj \qquad j = 1,\ldots,29$$

$$QCMFj,n = VCOMPTj,n/PXDj \qquad j = 71,\ldots,89;\ j \neq 84$$

$$YAFn = FYFn - \left(\sum_{\substack{j=1,\ldots,29 \\ j \neq 20,21}}^{37,71,\ldots,89} VGASTj + FREMn,_{70} + FRENTPn \right.$$

$$\left. + FINTn,_{60} + FIMPDFn + FIMPPFn \right)$$

$$QEMPn,_{30} = FSSn,_{30}/PWn,_{37} \qquad n = 38,39$$

Financial System

1) Define FFDSNj

$$HSTj = HSTj + VSTj$$

2) Define $HACTREj = \sum_{k=1}^{} HACTRE(j,k) + HSTj \qquad j = 1,\ldots,25$

$$= \sum_{k=1}^{5} HACTRE(j,k) \qquad j = 36,\ldots,39,50$$

3) Define:

$$HACVL(j,k) = HACVL(j,k) + FDNVL(j,k)$$

$$HPVVL(j,k) = HPVVL(j,k) + FONVL(j,k)$$

$$HACVL(j) = \sum_{k=1}^{14} HACVL(j,k) \qquad j = 1.,.,.25,36,\ldots,39,50,60,\ldots,65$$

$$HACT(j) = HACTRE(j) + HACVL(j)$$

$$FINTR(j) = \sum_{k=1,\ldots,6}^{8,9,10,12} HACVL(j,k) \times RREND(k)$$

$$FINTN(j) = FINTRj - FINTPj$$

$$FINTP(j) = \sum_{k=1,\ldots,6}^{8,9,10,12} HPVVL(j,k) \times RREND(k)$$

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1) $FFDSNj = VVENTj + FINTNj - VCOMPCj - FSSj - FIMPj$

$$- FRENTj - (FBDj + FREMj) \qquad j = 1,\ldots,25$$

$$FFDSNj = YDHn \qquad j = 36,..,39$$

Markets

1. Shares:

   a) Demand

$$FDNVL(39,1) = HACVL(39) \times \Big[ADVL1(39,1) + ADVL2(39,1) \times HACVL(39,1)/HACT(39) + ADVL3(39,1) \times RREND(1) + ADVL4(39,1) \times RREND(2) + ADVL5(39,1) \times RREND(10) + ADVL6(39,1) \times FFDSN(39)/HACT(39) + ADVL7(39,1) \times \sum_{k=11,12} HACVL(39,k)/HACT(39)\Big] \times DT$$

$$FDNVL(j,1) = 0 \qquad j = 1,\ldots,25,36,37,38,50$$

   b) Supply

$$FONVL(j,1) = HACT(j) \times \Big[AOVL1(j,1) + AOVL2(j,1) \times HPVL(j,1/HACT(j) + AOVL3(j,1) \times RREND(1) + AOVL4(j,1) \times RREND(2) + AOVL5(j,1) \times RREND(9) + AOVL6(j,1) \times \frac{FFDSN(j)}{HACT(j)}\Big] \times DT - \sum_{n=50,70} FTRAKn,j \qquad j = 1,\ldots,25$$

2. Obligations:

   a) Demand

$$FDNVL(39,2) = HACVL(39) \times \Big[ADVL1(39,2) - ADVL2(39,2) \times HACVL(39,2)/HACT(39) + ADVL3(29,2) \times RREND(2) - ADVL4(39,2) \times RREND(1) - ADVL5(39,2) \times RREND(4) + ADVL6(39,2) \times FFDSN(39)/HACT(39) + ADVL7(39,2) \times \sum_{k=11,12} HACVL(39,k)/HACT(39)\Big] \times DT$$

$$FDNVL(j,2) = 0 \qquad j = 1,\ldots,25,36,37,38,50$$

b) Supply

$$FONVL(j,2) = HACT(j) \times \Big[AOVL1(j,2) - AOVL2(j,2) \times HPVVL(j,2)/HACT(j) - AOWL3(j,2) \times RREND(2) - AOV14(j,2) \times RREND(1) + AOVL5(j,2) \times RREND(9) - AOVL6(j,2) \times \frac{FFDSN(j)}{HACT(j)} \Big] \times DT \qquad j = 1,\ldots,25$$

3. Bonds 4. Titles:

a) Demand

$$FDNVL(j,k) = HACT(j) \times \Big[ADVL1(j,k) + ADVL2(j,k) \times HACVL(j,k)/HACVL(j) + ADVL3(j,k) \times RREND(3) + ADVL4(j,k) \times RREND(4) + ADVL5(j,k) \times RREND(12) + ADVL6(j,k) \times FFDSN(j)/HACT(j) + ADVL7(j,k) \times VCOMPK(j)/HACT(j) + ADVL8(j,k) \times \sum_{j=12,13,14} HACVL(j,1)/HACT(j) \Big] \times DT \qquad j = 1,..,25,38,39$$

$$FDNVL(j,k) = 0 \qquad j = 36,37,50$$

b) Supply

FONVL(50,k): exogenous

$$FONVL(j,k) = 0 \qquad j \neq 50$$

5. Mortgages:

a) Demand

$$FDNVL(j,5) = HACT(j) \times \Big[ADVL1(j,5) + ADVL2(j,5) \times HACVL(j,5)/HACT(j) ADVL3(j,5) \times RREND(5) + ADVL4(j,5) \times RREND(4) + ADVL5(j,5) \times RREND(12) + ADVL6(j,5) \times FFDSN(j)/HACT(j) + ADVL7(j,5) \times \sum_{j=12,13,14} HACVL(j,1)/HACT(j) \Big] \times DT \quad j = 38,39$$

$$FDNVL(j,5) = 0 \qquad j = 1,\ldots,25,36,37,50,70$$

. Foreign Securities:

a) Demand

$$FDNVL(j,6) = HACT(j) \times \Big[ADVL1(j,6) + ADVL2(j,6) \times HACVL(j,6)/HACVL(j)$$
$$+ ADVL3(j,6) \times RREND(6) + ADVL4(j,6) \times EBP/WREXT +$$
$$ADVL5(j,6) \times \sum_{j=12,13,14} HACVL(j,1)/HACT(j)\Big] \times DT \qquad j = 38,39$$

$$FDNVL(j,6) = 0 \qquad j = 1,\ldots,25,36,37,50,70$$

$$FONVL(70,6) = \sum_{j=1}^{100} FDNVL(j,6)$$

$$FONVL(j,6) = 0 \qquad j \neq 70$$

7. Commercial Credit:

$$FDNVL(j,8) = \sum_{j=1,..,25}^{36,..,39,50} (QFLUCj,i \times PNVJ \times (1 - ACONTCj,i) + QFLUKj,i$$
$$\times PNVj \times (1 - ACONTKj,i) \qquad j = 1,\ldots,24$$

$$FDNVL(25,8) = \sum_{i=1,..,25} \Big(\sum_{j=1}^{24} QFLUCj,i \times (PNMi - PNVj) \times (1 - ACONTCj,i)$$
$$+ QFLUKj,i \times (PNMj = PNVj) \times (1 - ACONTKj,i) \Big) + \sum_{i=36}^{50,70}$$
$$\Big(\sum_{j=1}^{24} \big(QFLUCj,i \times (PND - PNVj) \times (1 - ACONTCj,i) + QFLUKj,i$$
$$\times (PNDj - PNVj) \times (1 - ACONTKj,i) \big) \Big) + \sum_{i=1,..,25}^{50} \Big(\sum_{j=71}^{95}$$
$$\big(QFLUCj,i \times (PXMj - PXVj) \times (1 - ACONTCj,i) + QFLUKj,i$$
$$\times (PXMj - PXVj) \times (1 - ACONTKj,i) \big) \Big) + \sum_{i=36,..,39} \Big(\sum_{j=71}^{94}$$
$$\big(QFLUCj,i \times (PXDj - PXVj) \times (1 - ACONTCj,i) + QFLUKj,i$$
$$\times (PXDj - PXVj) \times (1 - ACONTKj,i) \big) \Big)$$

$$FDVL(70,8) = \sum_{j=71}^{95} \left(\sum_{i=1,..,25}^{36,..,39,50} (QFLUCj,i \times PXj \times PTC \times (1 - ACONTCj,i) + QFLUKj,i \times PXj \times PTC \times (1 - ACONTKj,i)) \right)$$

$$FONVL(j,8) = \sum_{i=1}^{25} QFLUCi,j \times PNMi \times (1 - ACONTCi,j) + QFLUKi,j \times PNMi \times (1 - ACOMTKi,j) + \sum_{i=71}^{95} (QFLUCi,j \times PXMi \times (1 - ACONTCi,j) + QFLUKi,j \times PXMi \times (1 - ACONTKi,j)) \quad j = 1,..,25,50$$

$$FONVL(j,8) = \sum_{i=1}^{25} (QFLUCi,j \times PNDi \times (1 - ACONTCi,j) + QFLUKi,j \times PNDi \times (1 - ACONTRi,j) + \sum_{i=71}^{95} (QFLUCi,j \times PXDi \times (1 - ACONTCi,j) + QFLUKi,j \times PXDi \times (1 - ACONTRi,j))$$

$$ACONTGi,j = \left(\sum_{k=12,13,14} HACVLj,k / \sum_{k=7,8} HPVVLj,k \; RREND(8) \right)$$

8. Short-term Loans:

$$FDNVL(j,8) = 0 \qquad j = 1,..,25,36,..,39,50,70$$

$$FONVL(j,8) = HACT(j) \times (AOVL1(j,8) + AOVL2(j,8) \times HPVVI(j,8)/HACT(j) + AOVL3(j,8) \times RREND(8) + AOVL4(j,8) \times RREND(9) + AOVL5(j,8) \times HST(j)/HACT(j)) \times DT \quad j = 1,..,25$$

$$FONVL(j,8) = 0 \qquad j = 36,..,39,50,70$$

9. Long Term Loans:

$$FDNVL(39,9) = HACT(39) \times (ADVL1(39,9) + ADVL2(39,9) \times HACVL(39,9)/HACT(39) + ADVL3(39,9) \times RREND(9) + ADVL4(39,9) \times FFDSN(39)/HACT(39) + ADVL5(39,9) \times \sum_{k=13,14} HACVL(39,k)/HACT(39) \times DT$$

$$FDNVL(j,9) = 0 \qquad j = 1,..,25,36,37,38,50,70$$

$$FONVL(j,9) = HACT(j) \times \Big[AOVL1(j,9) + AOVL2(j,9) \times HPVVL(j,9)/HACT(j) + AOVL3(j,9) \times RREND(9) \times AOVL4(j,9) \times VCOMPK(j)/HACT(j)\Big] \times DT \qquad j = 1,..,25$$

$$FONVL(j,9) = HACT(j) \times \Big[AOVL1(j,9) + AOVL2(j,9) + HPVVL(j,9)/HACT(j) + AOVL3(j,9) \times RREND(9) + AOVL4(j,9) \times \sum_{i=16,17} VCOMPC(i,j)/HACT(j)\Big] \times DT \qquad j = 38$$

$$FONVL(j,9) = 0 \qquad j = 36,37,39,50$$

10. Housing Loans:

$$FNDVL(39,10) = HACT(39) \times ADVL1(39,10) + ADVL2(39,10) \times HACVL(39,10)/HACT(39) + ADVL3(39,10) \times RREND(10) + ADVL4(39,10) \times RREND(12) + ADVL5(39,10) \times FFDSN(39)/HACT(39) + ADVL6(39,10) \times \Big[\sum_{k=12,13,14} HACVL(39,k)/HACT(39)\Big] \times DT$$

$$FONVL(j,10) = AOVL1(j,10) \times (VCOMPK_{20,j} + AOVL2(j,10) \times VCOMPK_{21,j} \qquad j = 36,..,39$$

$$FONVL(j,10) = 0 \qquad j \neq 36,..,39$$

11. Gold and Foreign Exchange:

$$FDNVL(j,11) = HACT(j) \times \Big[ADVL1(j,11) + ADVL2(j,11) \times HACVL(j,11)/HACT(j) + ADVL3(j,11) \times FBP/WREXT + ADVL4(j,11) \times RREND(11) + ADVL5(j,11) \times \sum_{k=13,14} HAVVL(j,k)/HACT(j)\Big] \times DT \qquad j = 1,..,25,38,39$$

$$FDNVL(j,11) = 0 \qquad j = 36,37,50$$

12. Term Deposits:

$$FDNVL(j,12) = HACT(j) \times \Big(ADVL1(j,12) + ADVL2(j,12) \times HACVL(j,12)/HACT(j) + ADVL3(j,12) \times RREND(12) + ADVL4(j,12) \times FFDSN(j)/HACT(j) + ADVL5(j,12) \times \sum_{k=13,14} HACVL(j,k)/HACT(j) \Big) \times DT \qquad j = 1,..,25,38,39$$

$$FDNVL(j,12) = 0 \qquad j = 36,37,50,70$$

$$FONVL(j,12) = 0 \qquad j = 1,..,25,36,..,39,50,70$$

13. Demand Deposits:

$$FDNVL(j,13) = (1 - ACAJA(j) \times \Big(FFRN(j) + \sum_{k=1}^{14} FONVL(j,k) - \sum_{k=1}^{12} FDNVL(j,k) \qquad j = 1,..,25,36,..,39,50$$

$$FDNVL(70,13) = 0$$

14. Currency:

$$FDNVL(j,14) = ACAJA(j) \times \Big(FFRN(j) + \sum_{k=1}^{14} FONVL(j,k) - \sum_{k=1}^{12} FDNVL(j,k) \qquad j = 1,..,25,36,..,39,50$$

$$FDNVL(70,14) = 0$$

Financial System

BEHAVIOR OF FINANCIAL INTERMEDIARIES

60. Central Bank of Venezuela:

$$FDNVL(60,3) = HACVL(60) \times ADVL1(60,3) + ADVL2(60,3) \times HACVL(60,3)/HACVL(60) + ADVL3(60,3) \times RREND(3) + ADVL4(60,3) \times HACVLX(60,3)/HACVL(60) + ADVL5(60,3) \times FDNVL(60,11)(t-1)/HACVL(60) \times DT$$

$$FDNVL(60,8) = HACVL(60) \times ADVL1(60,8) + ADVL2(60,8) \times HACVL(60,8)/HACVL(60) + ADVL3(60,8) \times RREND(8) + ADVL4(60,8) \times HACVLX(60,8)/HACVL(60) + ADVL5(60,8) \times FDNVL(60,11)(t-1)/HACVL(60) \times DT$$

$$FDNVL(60,11) = EBP \times PTC$$

$$FDNVL(60,k) = 0 \qquad k = 3,8,11$$

$$FONVL(60,11) = HACT(60) \times [AOVL1(60,1) + AOVL2(60,11) \times HPVVL(60,1)/HACT(60) + AOVL3(60,1) \times HPVVLX(60,1)/HACT(60)] \times DT - FTRAK_{50,60}$$

$$FONVL(60,8) = FSTDBY \quad \text{(exogenous)}$$

$$FONVL(60,k) = 0 \qquad k \neq 1,8,13,14$$

$$FONVL(60,13) + FONVL(60,14) = FFRN(60) + \sum_{k=1}^{14} FONVL(60,k) - \sum_{k=1}^{14} FDNVL(60,k)$$

61. Social Security:

$$FDNVL(61,k) = HACVL(61) \times \Big[ADVL1(61,k) + ADVL2(61,k) \times HACVL(61,k)/HACVL(61) + ADVL4(61,k) \times RREND(1) + \ldots\ldots + ADVL13(61,k) \times RREND(10) + ADVL14(61,k) \times HACVLX(61,k)/HACVL(61) + ADVL15(61,k) \times FFDSNj(61)/HACVL(61) + ADVL16(61,k) \times \sum_{j=13,14} HACVL(61,j)/HACVL(61) \Big] \times DT \qquad k = 1,..,5,8,..,12$$

$$FDNVL(61,k) = 0 \qquad k = 6,7$$

$$FDNVL(61,13) = (1 - ACAJA(61) \times (FFRN(61) + \sum_{k=1}^{12} FONVL(61,k) - \sum_{k=1}^{14} FDNVL(61,k)$$

$$FDNVL(61,14) = ACAJA(61) \times FFRN(61) + \sum_{k=1}^{12} FONVL(61,k) - \sum_{k=1}^{14} FDNVL(61,k)$$

$$FONVL(61,k) = 0 \qquad k = 1,..,14$$

62. Short-term Lending Institutions:

$$FDNVL(62,k) = HACVL(62) \times \Big[ADVL1(62,k) + ADVL2(62,k) \times HACVL(62,k)/HACVL(62) + ADVL4(62,k) \times RREND(1) + \ldots\ldots + ADVL11(62,k) \times RREND(8) + ADVL12(62,k) \times \sum_{k=12,13} FONVL(62,k)/HACVL(62) + ADVL13(62,k) \times \Big(\sum_{k=13,14} HACVL(62,k) - ARESV(62,12) \times HRWL(62,12) - ARESV(62,13) \times APVVL(62,13) \Big)/HACVL(62) \Big] \times DT \qquad k = 1,..,6,8$$

$$FDNVL(62,k) = 0 \qquad k = 7,9,10,12$$

$$FDNVL(62,11) = HACVL(62) \times ADVL1(62,11) + ADVL2(62,11) \times HACVL(62,11)/$$

$$HACVL(62) + ADVL3(62,11) \times \sum_{k=13,14} HACVL(62,k) -$$

$$ARESV(62,12) \times HPVVL(62,12) - ARESV(62,13) \times HPVVL(62,13)/$$

$$HACVL(62) \times DT$$

$$FDNVL(62,13) = 1 - ACAJA(62) \times \sum_{k=12,13} ARESV(62,k) \times HPVVL(62,k) +$$

$$HACVL(62 \times ADVL1(62,15) + ADVL2(62,15) \times (HACVL(62,15)$$

$$- \sum_{k=12,13} ARESV(62,k) \times HPVVL(62,k)/HACVL(62) + ADVL3(62,15)$$

$$\times RINPN(62) + ADVL4(62,15) \times RREND(1) + \ldots +$$

$$ADVL11(62,15) \times RREND(8) + ADVL12(62,15) +$$

$$\sum_{k=12,13} FONVL(62,k)\ (t - 1)/HACVL(62) \times DT$$

$$FDNVL(62,14) = ACAJA(62) \times \sum_{k=12,13} ARESV(62,k) \times HPVVL(62,k) + HACVL(62)$$

$$\times ADVL1(62,15) + ADVL2(62,15) \times (HACVL(62,15) -$$

$$\sum_{k=12,13} ARESV(62,k) \times HPVVL(62,k)/HACVL(62) + ADVL3(62,15)$$

$$\times RINPN(62) + ADVL4(62,15) \times RREND(1) + \ldots + ADVL11(62,15)$$

$$\times RREND(8) + ADVL12(62,15) \times \sum_{k=12,13} FONVL(62,k)\ (t - 1)/$$

$$HACVL(62) \times DT$$

$$FONVL(62,k) = HACVL(62) \times AOVL1(62,k) \times HPVVL(62,k)/HACT(62) +$$

$$AOVL3(62,k) \times HPVVLX(62,k)/HACVL1(60) \times DT -$$

$$\sum_{k=1,2} FTRAKn,_{62} \qquad k = 1,2$$

$$FONVL(62,8) = HACVL(62) \times \Big[AOVL1(62,8) \times HACVL(62,8)/HACVL(62) + AOVL2(62,8) \times HPVVL(62,8)/HACVL(62) + AOVL3(62,8) \times (RREND(8) - RRED)\Big] \times DT$$

$$FONVL(62,k) = 0 \qquad k = 3,4,5,6,7,9,10,11,14$$

$$FONVL(62,13) = FFRN(62) + \sum_{k=1}^{12} FONVL(62,k) - \sum_{k=1}^{14} FDNVL(62,k)$$

$$FONVL(62,12) = HACVL(62) \times \Big[AOVL1(62,12) + AOVL2(62,12) \times HPVVL(62,12)/HACVL(62) + AOVL3(62,12) \times (RREND(8) - RREND(12) + AOVL4(62,12) \times FONVL(62,13)\ (t-1)/HACVL(62)\Big] \times DT$$

63. Long-term Lending Institutions:

$$FDNVL(63,k) = HACVL(63) \times \Big[ADVL1(63,k) + ADVL2(63,k) \times HACVL(63,k)/HACVL(63) + ADVL3(63,k) \times RREND(1) + \ldots + ADVL11(63,k) \times RREND(9) + ADVL12(63,k) \times RREND(12) + ADVL13(63,k) \times FFDSNj(63)/HACVL(63) + ADVL14(63,k) \times \sum_{j=12,13,14} HACVL(63,j)/HACVL(63)\Big] \times DT \qquad k = 1,..,6,9,12$$

$$FDNVL(63,k) = 0 \qquad k = 7,8,10,11$$

$$FDNVL(63,13) = \Big(1 - ACAJA(63) \times FFRN(63) + \sum_{k=1}^{14} FONVL(63,k) - \sum_{k=1}^{12} FDNVL(63,k)\Big)$$

$$FDNVL(63,14) = ACAJA(63) \times \Big(FFRN(63) + \sum_{k=1}^{14} FONVL(63,k) - \sum_{k=1}^{12} FDNVL(63,k)\Big)$$

$$FONVL(63,k) = HACVL(63) \times \left[AOVL1(63,k) + AOVL2(63,k) \times HPVVL(63,k)/ HACT(63) + AOVL3(63,k) \times HPVVLX(63,k)/HACVL(63) \right] \times DT - \delta_{k1} \sum_{n=50,70} FTRAKn,_{63} \qquad k = 1,2$$

$$FONVL(63,k) = 0 \qquad k \neq 1,2,\ldots,12$$

$$FONVL(63,12) = HACVL(63) \times \left[AOVL1(63,12) + AOVL2(63,12) \times HPVVL(63,12)/ HACVL(63) + AOVL3(63,k) \times RREND(9) - RREND(12) + AOVL4(63,k) \times \sum_{j=12,13,14} HACVL(63,j)/HACVL(63) \right] \times DT$$

Housing Financing Institutions, Private:

$$FDNVL(64,k) = HACVL(64) \times \Big(ADVL1(64,k) + ADVL2(64,k) \times HACVL(64,k)/ HACVL(64) + ADVL3(64,k) \times RREND(3) + ADVL4(64,k) \times RREND(10) + ADVL5(64,k) \times RREND(12) + ADVL6(64,k) \times FONVL(64,12) \; (L_{-1})/HACVL(64) + ADVL7(64,k) \times \sum_{j=12,13,14} HACVL(64,j)/HACVL(64) \Big) \times DT \qquad k = 3,10,12$$

$$FDNVL(64,k) = 0 \qquad k = 1,2,5,\ldots,9,11$$

$$FDNVL(64,13) = (1 - ACAJA(64) \times \Big(FFRN(64) + \sum_{k=1}^{14} FONVL(64,k) - \sum_{k=1}^{12} FDNVL(64,k) \Big)$$

$$FDNVL(64,14) = ACAJA(64) \times FFRN(64) + \sum_{k=1}^{14} FONVL(64,k) - \sum_{k=1}^{12} FDNVL(64,k) \Big)$$

$$FONVL(64,k) = HACVL(64) \times \Big(AOVL1(64,k) + AOVL2(64,k) \times HPVVL(64,k)/ HACVL(64) + AOVL3(64,k) \times HPVVLX(64,k)/HACVL(64) \Big) \times DT - \delta_{k1} \times \sum_{n=50,70} FTRAKn,_{64} \qquad k = 1,2$$

$$FONVL(64,k) = HACVL(64) \times \Big(AOVL1(64,k) + AOVL2(64,k) \times HPVVL(64,k)/ HACVL(64) + AOVL3(64,k) \times RREND(5) + AOVL4(64,k) \times RREND(12) + AOVL5(64,k) \times FONVL(64,12) - PROM\ FONVL(64,12)\ (t-1)/FROM\Big(FONVL(64,12)\Big)\Big) \times DT \qquad k = 5,12$$

$$FONVL(64,k) = 0 \qquad k \neq 1,2,5,12$$

65. Housing Financing Institutions, Public:

$$FNDVL(65,10) = HACVL(65,10) \times \Big[ADVL1(65,10) + ADVL2 \times HACVL(65,10)/ HACVL(65) + ADVL3 \times \sum_{j=12,13,14} HACVL(65,j)/HACVL(65) \Big] \times DT$$

$$FDNVL(65,13) = (1 - ACAJA(65) \times \Big[FFRN(65) + \sum_{k=1}^{14} FONVL(65,k) - \sum_{k=1}^{12} FDNVL(65,k) \Big]$$

$$FDNVL(65,14) = ACAJA(65) \times \Big(FFRN(65) + \sum_{k=1}^{14} FONVL(65,k) - \sum_{k=1}^{12} FDNVL(65,k) \Big)$$

$$FDNVL(65,k) = 0 \qquad k \neq 10,13,14$$

$$FONVL(65,1) = FTRAK_{50,65}$$

$$FONVL(65,k) = HACVL(65) \times \Big[AOVL1(65,k) + AOVL2(65,k) \times HPVVL(65,k)/ HACVL(65) + AOVL3(65,k) \times RREND(5) + AOVL4(65,k) \times RREND(12) + AOVL5(65,k) \times FONVL(65,1)\ (t-1)/HACVL(65) \Big] \times DT \qquad k = 5,12$$

$$FONVL(65,k) = 0 \qquad k \neq 1,5,12$$

Equilibrium Conditions

$$\sum_{j=1}^{100} FDNVL(j,k) = \sum_{j=1}^{100} FONVL(j,k) \qquad k = 1,..,5,8,..,10,12$$

RREND(8) = exogenous

RREND(7) = 0

RREND(11) = 0

In addition, the following relation is fulfilled:

$$\sum_{i} (FDNVL(i,13) + FDNVL(i,14)) =$$

$$\sum_{i} (FONVL(i,13) + FONVL(i,14))$$

4.4 Dictionary of Symbols for Model V-3

The system of coding the concepts and variables of Model V-3 differs from that used for Model V-2. Only the use of the initial letters to indicate the types of variables and their dimensions is similar. Even so, there are changes in the meaning of some of the initials. Following the initial letter, the rest of each code word is based on mnemonics. Sectors, categories of people, etc., are indicated by indexes following the word.

A

Aij	Total input-output coefficient	j,i=1,...,29
AKi,j	Coefficient of goods from origin i to destination j per unit of capacity	i,j=1,...,29
AKMi,j	Coefficient of imported goods from origin i to destination j per unit of capacity	i=71,...,99 j=1,...,29
AKNi,j	Coefficient of national goods from origin i to destination j per unit of capacity	j,i=1,...,29
AMi,j	Coefficient of imported goods per unit of output	i=71,...,99 j=1,....,29
ANi,j	Coefficient of national goods per unit of output	i,j=1,..,29

B

BCPGj	Variable for control of prices	j=1,...,29
BCPKi,k	Output of product i per unit of stock k	(Bs./year)/Bs.
BETRj,n	Optimum coefficient of labor of type n in sector j	(million man-years in the base year) j=1,...,29 n=30,..,32
BTRABj,n	Coefficient of labor of type n in sector j	(million man-years in the base year) j=1,...,29 n=30,..,32
BVACA	Ratio between the price of animals for breeding and those for use.	

E - Million dollars per year

EBC	Commercial balance
EBCC	Balance of payment on current account (exterior)
EBP	Balance of payment on current and capital accounts
EEX	Total exports
EIMPO	Total imports
$EINTN_{70}$	Net amount of interest paid abroad
$ETRACN_{70}$	Net amount of current transfers received from abroad
$ETRAKN_{70}$	Net amount of capital transfers received from abroad
EENCAP	Net capital inflow

F - Million Bs. per year (current prices)

FBDj	Profits distributed from sector j	j=1,...,29
FBDj,n	Profits distributed from sector j to group n	j=1,...,29 n=33,34,35
FBNDj	Undistributed profits in sector j	j=1,...,29
FDEPRj	Capital consumption allowance in sector j	j=1,...,29
FDEPRj,n	Capital consumption allowance, type n capital, sector j	j=1,...,29 n=2,3,4,5
FDNVL(j,k)	Net demands for assets of type k by sector j	j=1,..,29,36,..,39, 50,60,..,65,70
FFDSNj	Approximate net disposable funds of sector j before transactions in financial assets	j=1,..,29,36,..,39, 50,60,..,65
FFRNj	Net funds received by sector j from the financial market	j=1,..,29,36,..39, 50,60,..,65
FGCG	Current expenditures of the government	
FGKG	Capital expenditures of the government	
FIMPDj	Direct taxes from sector j	j=1,..,29,36,..,39
FIMPDFj	Direct taxes paid by families	j=36,...,39
FIMPINj	Indirect taxes from sector j	j=1,...,29
FIMPPj	Patrimonial tax levied on sector j	j=1,..,29,36,..,39
FINCE	Total receipts of INCE	
FINCG	Current receipts of the government	
FINTi,j,k	Interest payments of sector i to sector j on account of financial assets of type k	j,i=1,..,29,36,..,39, 50,60,..,65,70 k=1,...,8
FINTMPj	Interest imputed to the financial sector and charged to sector j	j=1,..,29,36,..,39, 50

F - Continued

FINTMP	Total imputed interest	
FINTPj	Interest payments of sector j	i,j=1,..,29,36,..,39, 50,60,..,65,70
FINTRj	Interest receipts of sector j	j=1,..,29,36,..,39, 50,60,..,65,70
FONVL(j,k)	Net supply of assets of type k by sector j	k=1,...,14
FRENTj	Payments of rents by sector j	j=1,..,29,36,..,39, 50,60,..,65,70
FSFVIVn	Financing payments on housing paid by family n	n=36,...,39
FSSj	Wage and salary costs of sector j including contributions to social security and INCE	j=1,...,29
FSSj,n	Wage and salary costs of type n paid by sector j including contributions to social security and INCE	n=30,31,32 j=1,..,29,38,39
FSSGEGn	Salaries paid by the government for labor of type n	n=30,31,32
FSUPCG	Current surplus of the government and savings	
FSUPEGj	Surplus of government enterprises in sector j	j=1,...,29
FSUPTG	Total government surplus	
FTRAi,j	Transfer payments from sector i to sector j	i=1,..,29,36,..,39, 50,60,..,65,70 j=1,..,29,36,..,39, 60,..,65,70
FTRACi,j	Current transfer payments from sector i to sector j	(index idem)

F - Continued

FTRAKi,j	Capital transfer payments from sector i to sector j	(index idem)
$FTRARS_{50j}$	Transfers from the government to sector j other than the payments of interest on the public debt	
FYBDn	Personal income other than wage and salary income of families of type n	n=36,...,39
FYFn	Personal income of families of type n	n=36,...,39
FYSSn	Personal wage and salary income of families of type n	n=36,...,39

H - Million Bs. (current prices)

HACTi	Value of assets of sector i	i=1,...,99
HACTREi	Total value of real assets in sector i	i=1,...,99
HACTREi,k	Value at current prices of the stock of real assets of type k in sector i	i=1,...,99 k=1,...,5
HACVLi,k	Value of financial assets of type k in sector i	i=1,...,99 k=1,...,14
HACVLi	Value of financial assets in sector i	i=1,...,99
HFIVIVj	Fiscal value of housing in sector j	j=36,...,39
HPVVLi	Total value of financial liabilities in sector i	i=1,...,99
HPVVLi,k	Value of financial liabilities of type k in sector i	k=1,...,14 i=1,..,29,36,..,39, 50,60,..,65,70

P - Current Bs./Bs. of 19--

PACTREi,k	Price of real assets of type k in sector i	i=1,..,29,36,..,39,50 k=1,...,5
PCOSTj	Unit cost of product in sector j	j=1,..,29
PEXi	International price for goods exported from sector i	i=1,..,29
PFVIVj	Fiscal valuation of housing in sector j	j=36,...,39
PICVn	General cost of living index for families in group n	n=36,...,39
PIN	General wholesale price index, national goods	
PIX	General wholesale price index, imported goods	
PMDEMj	Normal commercial margin	j=1,...,29
PMINFj	Margin added to cost due to expected inflation	j=1,...,29
PMXj	Additional commercial margin caused by the lack of market competition in producing import substitutes	j=1,...,29
PNDj	Retail price of national goods and services of sector j	j=1,...,29
PNMj	Wholesale price of national goods and services of sector j	j=1,...,29
PNPj	Producers price of national goods and services of sector j	j=1,...,29
PNVj	Sellers price of national goods and services of sector j	j=1,..,29
PRENTj	Rental price (million Bs./unit of housing or land)	
PTC	Rate of exchange of the U. S. dollar (Bs. per $)	

P - Continued

PTDj	Coefficient of direct tax on income of sector j	j=1,..,29,36,..,39
PTIER	Price of rural land (million Bs. per hectare)	
PTIEU	Price of urban land (million Bs. per square meter)	
PTINj	Coefficient of indirect tax in sector j	
PTPj	Coefficient of patrimonital tax of sector j	j=1,..,29,36,..,39
PWj,n	Salary rate in effect in sector j and group n (million Bs. per man-year)	n=30,31,32 j=1,..,29,38,39,50
PXi	International price of imports of goods of sector i (million dollars at current price/Bs. of 19--)	i=71,...,99
PXDj	Retail price of imported goods and services of sector j	j=71,...,99
PXMj	Wholesale price of imported goods and services of sector j	j=71,...,99
PXVj	Ex-customs price of imported goods and services of sector j	j=71,...,99

Q - Million Bs. of 19--

QACTMi,k	Rate of attrition of real assets of type k in sector i	
QACTNi,k	Rate of incorporation of new real assets of type k in sector i	i=1,..,29,36,..,39,50 k=1,...,5
QCAPACj	Capacity of production of sector j	j=1,..,29
QCMFi,j	Consumption of imported goods of origin i by families of group j	i=71,...,99 j=36,...,39
QCMGi	Consumption of imported goods of origin i by the government	i=71,...,99
QCNFi,j	Consumption of national goods of origin i by families of group j	i=1,....,29 j=36,...,39
QCNGi	Consumption of national goods of origin i by the government	i=71,...,99
QCUOTCi,j	Import quotas of noncapital goods of origin i for sector j	
QCUOTKi,j	Import quotas of capital goods of origin i for sector j	
QDNEj	Expected demand of sector j	j=1,...,29
QDNRj	Demand realized by sector j	j=1,...,29
QEMPj,n	Employment of labor of type n in sector j (man-years)	j=1,..,29,38,39,50 n=30,31,32,33,34
QFLUCi,j	Flow of goods and services from sector i to sector j on current account	i=1,..,29,71,..,99 j=1,..,29,36,..,39, 50,70
QFLUKi,j	Flow of goods and services from sector i to sector j on capital account	i=1,..,29,71,..,99 j=1,..,29,36,..,39, 50,70
QFLUTi,j	Total flow of goods and services from sector i to sector j	i=1,..,29,71,..,99 j=1,..,29,36,..,39, 50,70
QKI	Rate of starting to install capacity in sector i	i=1,..,29,51,..,55

Q - Continued

$QINT_{25j}$	Volume of financial services provided by the financial sector to sector j	j=1,..,29,36,..,39 50,70
QKITEOi	Desired rate of starting to install capacity in sector i	i=1,..,29,51,..,55
QKMGi	Purchases of imported capital goods of type i by the government	i=71,...,99
QKNi	Rate of completing installation of capacity in sector i	i=1,..,29,51,..,55
QKNFj,n	Purchases of nationally produced capital goods from sector j by family group n	n=36,...,39 j=1,....,29
QKNGi	Purchases of nationally produced capital goods from sector i by the government	i=1,....,29
QMINj,n	Minimum quantities of goods from sector j purchased by families group n	n=36,...,39 j=1,....,29
QNj	Gross production of sector j	j=1,....,29
QPLANj	Gross production planned by sector j	j=1,...,29
QEXPCi	Exports of sector i, noncapital goods	i=1,...,29
QEXPKi	Exports of sector i, capital goods	i=1,...,29
QSVUG	Volume of housing and urban services of the government	

R - Rate

RBj	Rate of profits in sector j	j=1,...,29
RINF	Rate of change of profits	
RREND(k)	Rate of return of financial assets of type k	k=1,...,14
RRED	Rate of rediscount	

S

SACTREi,k	Stock of real assets of type k in sector i (Bs. of 19--)	i=1,..,29,36,..,39, 50 k=1,...,5
SKGEi	Capacity in gestation in sector i (Bs. of 19--)	
SPOB	Total population of the country (thousand people)	
STj	Stocks of goods of type j (Bs. of 19--)	j=1,...,29
STNj	Normal stocks of goods of type j (Bs. of 19--)	j=1,...,29

T

TGj	Gestation time of a unit of capacity in sector j	j=1,...,29

V - Million Bs. per year (current prices)

VAGREj	Net value added at factor cost by sector j	j=1,...,29
VBj	Profits before direct tax of sector j	j=1,...,29
VBAIj	Private profit before direct tax of sector j	j=1,...,29
VBNj	Private profit net of direct tax of sector j	j=1,...,29
VCOMPCj	Value of current-account purchases by sector j	j=1,..,29,36,..,39,50
VCOMPCi,j	Value of current-account purchases from sector i by sector j	i=1,..,29,71,..,99 j=1,..,29,36,..,39,50
VCOMPKj	Value of capital purchases of sector j	j=1,..,29,36,..,39,50
VCOMPKi,j	Value of capital purchases from sector i by sector j	i=1,..,29,71,..,99 j=1,..,29,36,..,39,50
VCOMPTj	Total value of purchases by sector j	j=1,...,29
VCOMPTi,j	Total value of purchases from sector i by sector j	i=1,..,29,71,..,99 j=1,..,29,36,..,39,50
VDIST	Total value of gross distribution margins	
VDISTCi,j	Value of gross distribution margin on sales from sector i to sector j on current account	i=1,..,29,71,..,99 j=1,..,29,36,..,39,50
VDISTKi,j	Value of gross distribution margin on sales from sector i to sector j on capital account	i=1,..,29,71,..,99 j=1,..,29,36,..,39, 50,70
VDISTTi,j	Total value of gross distribution margin on sales from sector i to sector j	i=1,..,29,71,..,99 j=1,..,29,36,..,39, 50,70
VGSMINn	Minimum expenditure of family group n	n=36,...,99

V - Continued

VPAPi,j,k	Sales of assets of type k by sector i to sector j	i,j=1,..,25,36,.. 39,50,..,65,70 k=1,...,8
VSTj	Variation of stocks in sector j	j=1,...,29
VVENTi	Value of total sales of sector i	i=1,...,29

Y - Million Bs. per year (current prices)

YAFn	Savings of families of type n	n=36,...,39
YDHn	Expected income of family of type n	n=36,...,39

CORRECTIONS

Dynamic Models for Simulating
The Venezuelan Economy

p. 22, line 6: after "conditions" insert "to ascertain whether the conclusions are contingent on the conditions"

p. 54, Eq. 11 : change CPW7 to CPW6

p. 60, Eq. 33 : In three terms after the multiplication sign should be enclosed in parentheses

p. 86, Eq. 79 : change ZCA6 to CZA6

p. 92, line 10: after "and" insert "since the latter influences the wage rate, which in turn affects PZD,"

p. 219 : Items 02, 03, 04, should read "Market-oriented agriculture ..." etc.

p. 226 : footnote should read: "Price in parentheses replaces other when I = 71 to 99

p. 231, line 8 : brackets misplaced; should enclose (RREND(9) - RBJ) instead pf on the first term