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1. INTRODUCTION

Walras’ great vision of describing mathematically the functioning of a complete economy has been realized in our time. With the advent of social accounting, the Keynesian macroeconomic shortcut, and the computer, the construction of big mathematically-statistical representations of national economies has been made possible. The first macroeconomic models appeared during the 1930s and 1940s as descriptions of the advanced economies. The models of the developing economies began appearing during the 1950s, but it was not until the second half of the 1960s that macromodels were constructed for the Latin American economies. Since then, they have proliferated rapidly.

At the beginning, some of the macroeconometric models for developing economies did not differ much from those of the mature, industrialized economies. Their general structure and the specification of the individual equations was similar, if not identical, to the pioneer models. This is perfectly understandable. However, the usefulness of these models for alternative policy simulations or forecasting was limited. They were not faithful representations of their economies and could not be expected to follow their movements very closely.

More recently, however, stimulated by the post-Keynesian theorizing on economic growth and development, and by the efforts of econometricians to tailor their models better to the features of each country, the LDC models have begun to differ from those of the advanced economies. The differences intend to represent variety in economic development, behavior, technology, and institutions that characterize the developing economies, as well as the economic peculiarities of the country in question. This does not mean that the structure and specification of the LDC models are (or are expected to be) totally different from those of the advanced nations. After all, the anatomy and physiology of all economies are essentially the same. The difference seems to be in size, complexity, refinement of market mechanism, and speed with which the macroeconomic organs function, using as the standard of comparison those of the advanced economies. Macro
bottlenecks, which are most useful for econometric specifications, appear in different parts of the system—agriculture being a typical example. Latin American models, being the last to appear so far, have received the benefits of these efforts for more faithful econometric portrayal.

The purpose of this paper is to present the Mexican econometric model that we have developed at the Department of Econometric Research on Mexico of Wharton EFA\(^2\) and to make some general comments on econometric model building for the developing economies. Applications of the Mexican model will also be included.

2. Some Preliminary Considerations of Model Building for the Developing Economies

The best procedure for model specification of developing economies is to try to translate into econometrics their characteristic features. These have been elaborated extensively by the development theorists in their efforts to distinguish conceptually the LDC from the MDC.\(^3\) A brief listing and discussion of these distinctive traits seem a natural way to start. This list can be considered as a kind of descriptive model, or standard, which should help in the specification of the Mexican model, and in evaluating the specifications of other macroeconometric models of developing economies in which we may be interested. For this reason, the list will be supplemented with some features peculiar to the Latin American economies and, particularly, to the Mexican economy.

Since the differences between the LDC and the MDC arise from their relative position in the development race, all of the traits listed are also present, in some degree, in the advanced countries. That is why there is a fundamental similarity in the models of both kinds of economies. Moreover, social accounting systems, whose entries are to be explained by macromodels, are essentially the same in layout for all market economies. This is a recognition not only of the basic underlying similarity between the LDC and the MDC, but also of the accounting source of similarity between their models. Accordingly, both types of macromodels attempt, with their equations, to explain consumption, investment, exports, imports, production, prices, and so on. Consequently, the differences which we are listing below should be seen as traits that are only more apparent and pronounced in the LDC but not totally absent in the MDC. However, they do call for differences in the models, through endogenization of some variables, or through new, special equations, or through different specifications for the common ones.

In the list that follows, two related features of the developing economies, one external, the other internal, seem to be dominant: (1) their comparative overall productive backwardness vis-à-vis the MDC, and (2) the relative unevenness of their productive sectors, when compared internally. In the literature, (1)

\(^2\) One of the main purposes of this department (DIEMEX) has been to determine the extent to which econometric tools can be applied to developing countries. The cases of Mexico and Peru have been explored so far.

\(^3\) We take these common abbreviations, less developed (LDC) and more developed country (MDC), from the development literature. See, for example, E. E. Hagen, *The Economics of Development* (Homewood, Ill.: Irwin, 1968), p. 6. By an LDC, we understand here an economy in transition, active in the process of growth, not a stationary one.
has also been called supply deficiency, output constraint, technological backwardness, and so forth. (2) has been called "dualism," sectoral gaps, traditional versus modern sectors, agricultural versus industrial sectors, regional or structural imbalance, and so on. Most of the other features and problems of the developing economies seem to arise from these two. The external problems of capital and technological imports, exports of primary goods, balance-of-payments problems, as well as the internal problems of maldistribution of income, rural-urban labor migration, the big economic role of the government, existence of overcapacity in the modern productive sectors, and in some cases, even inflation, can be traced to them.

Supply Deficiency

If we take the Keynesian view that the main characteristic of industrialized nations is their possession of a developed and efficient productive sector, and that their short-run problem is the recurrent deficiency in aggregate demand, we can say, by contrast, that the main trait of developing countries is their comparative deficiency in aggregate supply.\(^4\) Agricultural supply, still bound to old-fashioned productive methods, is very much the result of the whims of the weather. Industry is relatively underdeveloped, concentrated on a few products (automobiles and steel are the favorites in Latin America), subject to bottlenecks in physical (raw materials or machinery) or technological (operative know-how, organizational knowledge) inputs, and likely to be affected by political events. Services are comparatively small, hampered, too, by lack of skilled technicians and adequate capital equipment.

This does not mean that the developing countries have no short-run problem of aggregate demand. They do, and they need the Keynesian tools to keep their existing productive capacity as fully utilized as possible, without undue inflationary pressure. However, their crucial problem is to enlarge that productive capacity in order to make employment, income, and demand possible. They have before them the example of the MDC and of recent productive successes, like Russia and Japan. Internal social demands arising from growing expectations also contribute to making supply enlargement their basic economic concern.

The process of economic growth, then, is central in the developing economies, and it should be captured in their economic descriptions. Other characteristics and processes are, one way or another, connected with growth. Those connections should be given special importance in model building. Growth of inputs, especially capital, which is the bottleneck in developing economies, should be given special attention. Labor migration from the rural to the urban productive sector should also be considered. By the same token, the determinants or major constraints of these capacity-enlarging inputs, normally frozen into the assumptions of the short run, should be examined and made to play their part, if possible, in the main process of development.

\(^4\) The Keynesian problem was why factories and machines shut down in a rich country or the paradox of poverty in the midst of plenty. The developing nations' problem is how to bring machines and factories to the country or how to break the ancestral condition of poverty by importing superior productive methods.
Besides, the actual duration of the “long-run” process of growth of the LDC has been reduced substantially when compared with that of the MDC. The former are essentially importing from the latter the scientific industrial revolution. This takes less time to accomplish. A statistical sample of a decade from an LDC probably compresses growth processes that took from thirty to forty years in the economic history of the MDC.

Capital Accumulation and Its Financing

The first binding constraint of development is capital, the nonhuman input. The task of circumventing this bottleneck has become the responsibility of both private and public sectors. Governments of some developing economies have tried not only to provide the capital for infrastructure, but to contribute to the addition of productive capacity as manufacturers and entrepreneurs. The Mexican economy is a clear example, with its three-hundred “empresas descentralizadas y organismos de participacion estatal.” The Japanese government at the start of the big capacity-creating efforts of the Meiji restoration provides another one. The exception of the socialist developing economies, capacity creation, however, has been the responsibility of the private entrepreneur. Private investment has been the larger flow in the accumulation of capital in plant and equipment. Public investment, in the form of roads, irrigation projects, communication, and other infrastructure, has supported these direct productive efforts. Private and public savings (surplus in current account) have been the sources of financing funds for the investment flows. The first source, in the LDC especially, has been explained as arising from the unequal distribution of income, as we will see below. The second is constrained by the low taxing ability of most of the developing countries.

Nevertheless, internal savings are not necessarily the first stumbling block met by the LDC in accumulating capital. The lack of enough foreign reserves can be their binding constraint. Since they cannot produce the plant and equipment necessary for new industries, capital imports from the MDC become the only way to grow industrially. Thus, exports and external finances arise as crucial means of payment for capital accumulation and capacity enlargement.

Exports of Primary Goods

Since agricultural and extractive production are predominant, and manufactures and services are being developed, the LDC is an exporter of primary products. Its main exports are limited in number and frequently consist of one or two agricultural or mineral exports. Coffee represents 40 percent and 60 percent of the total merchandise exports of Brazil and Colombia, respectively; sugar accounts for more than 70 percent of Cuban exports; and copper accounted for 76 percent of Chilean goods exports in 1969. Agricultural exports, due to defi-


ciencies in irrigation infrastructure, ineffective pestilence controls, inadequate fertilizers, and acts of God, are subject to wide fluctuations. In the long run, prices of primary goods are believed to be deteriorating in relationship to the prices of the capacity-creating imports (capital goods and technical services) that the LDC need from the MDC.⁷

The capacity to import, then, of the developing country is constrained to a large extent by the value of its exports. The analysis and quantification of this bottleneck is indispensable for the econometric understanding of the developmental process. Equally important here is the transmission of cycles of the MDC to the LDC. To the instability of supply of the primary exports, demand instability should be added. Primary exports depend on the demand-oriented imports of the industrial countries. Instability in effective demand, the Keynesian problem, is felt in the export position of the developing countries and is carried through to capital imports and the expansion of the LDC supply.

External Debt and Foreign Investment

As a corollary of the constraint posed by its export earnings, the developing country tends to rely on its capital-account imports to finance its efforts to grow. Normally, this is accomplished by incurring external debt. Debt service increases as a proportion of export earnings but eventually the added capacity should repay for itself by increasing exports and/or reducing imports by at least the amount of debt and interest incurred.⁸

Foreign direct investment is the other item of capital account sought by the LDC to finance their capital imports. In spite of its economic advantage in solving simultaneously the savings and foreign-currency gaps, foreign investment has political and historical drawbacks (excessive profits, low wages) that limit its use. Some Latin American countries are trying, however, to enlarge it, while legislating ways of reducing its harmful aspects. Recently, in the case of Brazil, large inflows of foreign investment seem to be one of the main causes of a spectacular increase in the rate of growth. This achievement has been associated with a shift in the composition of exports—moving away from traditional goods to manufactures—and has also been associated with a reduction of the rates of inflation.⁹

Foreign aid, the third element in capital accounts, does not now make a substantial contribution toward the deficit balance of LDC's current account. Its importance, however, is clear, being a way in which the MDC, or the international organizations supported by them, can perform the function of spreading their technology (or share their productive surpluses) at minimum cost to the developing nations.

⁸ Hagen, op. cit., p. 365.
⁹ Some writers believe that inflation per se is not the main hindrance to growth. They claim that the fluctuations in the rate of inflation are the problem. See R. A. Krieger, "Inflation and Growth: the Case of Latin America," Columbia Journal of World Business, Vol. V. No. 6 (Nov.–Dec. 1970).
Income Distribution

The characteristic unevenness of the developing economies shows in income distribution. The contrast between the “haves” and “have-nots” is more notable in the LDC. It also plays a role in development. Savings and investment are essentially done by the recipients of nonwage income. On the other hand, the size of the internal market for consumption goods is determined by wage earners. Income distribution, then, plays a crucial role in investment and consumption by influencing the flow of internal savings available, while at the same time tending to limit the size of the internal market for consumption demand. It is also useful in understanding import substitution in light durable consumer goods, as a common strategy of supply enlargement in the LDC.

Population

Rapid population growth can be interpreted as another characteristic of the LDC, resulting from their uneven adoption of modern technique and outlook. Their adoption of modern medicine has substantially reduced the death rate—especially among infants. Birthrates, however, continue at traditionally high levels. Abatement of this condition must await the eventual adoption of values and views of the MDC on family size, education of children, and the process of urbanization. Migration, in principle, should also be considered. In most of the Latin American countries, however, its role is not significant.

Internal Labor Migration

Internal labor migration is another consequence of the unevenness in the agricultural and industrial sectors in the LDC. Rural labor migration to the cities is mainly caused by the difference in productivities and wages between these sectors. In the Mexican case, for example, the ratio of urban-rural labor productivity is approximately 5:1. Uneven capital accumulation stands at the bottom of the process. A Mexican urban worker has eight times more real capital to work with than does his rural counterpart. This problem calls for exploration of its demographic aspects in order to gain a better understanding of what is involved for econometric purposes.

Labor Force and Population

Since models for developing countries should be cast in a long-term framework, the growth of human input requires consideration. Enlargement of the labor force depends on economic and demographic factors. Production functions, converted into labor-requirement functions, and capital-labor ratios have been used for short-run, demand-oriented determination of employed labor. Population growth, with sex and age composition, are, on the other hand, the long-run supply determinants of the working force. In the LDC, the rapid growth of population makes the supply approach indispensable. “Development with unlimited supplies of labor” (and especially when the supply of labor is clearly outmatching the periodic supply of capital) calls for particular attention on the part of the econometrician.
Growth of the skilled and technical part of the labor force is the second important constraint on capacity creation of the LDC in addition to capital. Essentially, this growth is related to education and, particularly, to technological education. This aspect, so evident and so important, is difficult to introduce explicitly in statistical models.

Prices, Wages, and Money Supply

Inflation is an unsolved, worldwide problem, but in the developing countries, it appears in its extreme form. Brazil and Chile, with annual price increases of 30 percent or more, are two well-known examples. The severity of the problem in the LDC, and especially in Latin America, has had two main explanations in the literature: (1) structural imbalance in the productive sector (agricultural versus industrial), and (2) government monetary excesses.10

However, production bottlenecks, as well as rises in import or export prices, can explain the start, but not the persistence and high rates, of Latin American hyperinflations.11 The prolongation and aggravation of the process requires the addition of other reinforcing factors, namely excessive growth of the money supply, the appearance of the price-wage spiral, and recurrent devaluation. In other words, structural imbalance can explain inflation; hyperinflation requires a monetary explanation.

Since, generally speaking, organized labor has not been politically independent or strong in Latin America, the price-wage vicious cycle has not been the basic pressuring force. This does not mean that the LDC's unions have not learned from hyperinflation. They have, but their reactions have, in general, been patient and modest. In Mexico, for example, they endured substantial real-wage reductions during the 1940s and early 1950s. The main fuel, thus, has come from the activity of the government printing presses. This governmental tendency arises from growing deficits caused by lack of taxing power (rooted, in turn, in political weakness) and the growing public expenditures required by growth and welfare programs. The third self-preserving mechanism, periodic devaluation, enters both as a result and a further cause of the inflationary process. Internal inflation erodes the capacity to import development goods, the pace of growth is retarded, and a devaluation is in order to move the economy again. This gives a new impetus to inflation and the mechanism of periodic devaluation is incorporated into the process.

Overcapacity

A paradox common to the LDC is the existence of particular pockets of overcapacity in the midst of general supply limitation. It appears essentially in the modern productive sectors, and it can be larger than that of the MDC's corresponding sectors. Some examples are the automobile industries in Argentina, Chile, and Mexico; other cases are the Mexican poultry industry and its hotel
industry.\textsuperscript{12} There are several reasons for this: (1) inaccurate demand estimates, due to lack of statistical information or the cost of gathering it; (2) the mirage of protectionism and the entrepreneurial desire to control the new market; and (3) the oversized plant and equipment available in the MDC.

**Length of Lags**

Based on observation of the behavior in the LDC, it seems that the time delays, or lags, between economic impulse and economic reaction differ from those of the MDC. With regard to private consumption, impulsiveness or lack of careful consumer planning may very well produce shorter income-consumption lags. In investment, the reverse may be true, because of the much larger construction and installation periods. The decision lag is perhaps shorter here, due to lack of long investigations and planning, but the implementation lag is certainly longer, even when the smaller size of investment goods in the developing economy is considered. Demographic processes are probably longer, due to poorness of communications, illiteracy, and traditional inertia.

**Government and Political Change**

The role of the government in the economy is usually bigger in the developing country. In most cases, the degree of economic intervention and direct participation in economic life is larger than in the MDC. It is not unusual, then, to find the government of the LDC with more economic instruments at its disposal than its MDC counterpart has. Also, it is common to find these governments as one of the larger (if not the largest) of the industrialists or merchants. When this is the case, a cyclical element is introduced in the economy which coincides with the political cycle: this arises not only from the stop-and-go nature of government investment at each administrative change, but also from the impact on private investment, which normally takes a waiting position during political changes.

3. **The Mexican Model**

The Mexican macroeconometric model presented here is the latest one in a succession of versions developed in an ongoing project of research on Mexico at Wharton EFA. This version, V, has been produced by enlargements and modifications of the earlier attempts. The purpose of these additions and changes has been to incorporate successively, as we were able to secure more and better data, additional aspects of the economy, and to respecify equations as we tried to approximate more closely the actual workings of the economy.

Each successive version was an attempt to make the model closer to what we consider to be the defining characteristics of the Mexican economy. Owing to limitations of space, we will not give here a full explanation of the theoretical

and institutional justification of the behavioral equations. For that, the interested reader is referred to the full document presented at the Cuernavaca conference. We will, however, list briefly the main features that we have tried to incorporate, which are those of section 2, plus those peculiar to the Mexican economy:

1. Internal and external sources of instability: the impact of the political climate on the economy and the dependence on foreign trade; the internal and external sources of inflation.

2. The dominant role played by the federal government as infrastructure builder and entrepreneur; public finances.

3. The general unevenness in economic life as exemplified in functional income distribution, in rural versus urban production, in federal versus non-federal taxation.

4. The rapid demographic processes resulting in high population growth, urbanization, or rural-urban labor-force migration.

5. The proximity to the U.S. markets with its effects on international labor migration, tourism and border transactions, and trade in general.

6. The development process of creating capacity, through capital and technological imports, in the context of general capital limitations and abundance of unskilled and semiskilled labor.

7. The comparatively shorter decision-making horizon in all economic processes, resulting in shorter lags vis-à-vis the MDC.

8. The simplicity of economic organisms and behavior when compared with those of the MDC.

The rest of this section consists of the nomenclature and the full listing of the equations of the model. The list contains 143 equations, 40 of which are behavioral; the rest are accounting and other identities. The behavioral equations have been estimated by the ordinary least squares method; the 10 containing distributed lags were estimated by fitting a polynomial of third degree with two end-point restrictions.

We list now alphabetically the symbols used and their meanings. The symbols are of two kinds: simple (consisting of only one letter) and compound (consisting of two or more letters and numbers). In the case of the compound symbols, the final letters and numbers have the following meaning:

- Ending in $C$: Current billion pesos
- Ending in $R$: Real billion pesos of 1950
- Ending in $DC$: Current billion dollars
- Ending in $L$: Per worker of the productive sector in question
- Ending in $N$: Per capita
- Ending in $\%$: Annual rate of change
- Ending in 1, 2, or 3: Lags of one, two, or three previous years

All predetermined variables (exogenous or lagged endogenous) are underlined. The only exceptions to these rules are two compound symbols: $L1$ and $L23$, rural and urban labor force. The number endings here do not mean lags, but primary and secondary plus tertiary productive sectors, respectively. They are not, thus, underlined. The abbreviations NIA and BOP mean National Income Accounts and Balance of Payment Account.
A condensed flow chart of this model and, in fact, a very condensed version of this whole paper, can be found in Abel Beltran del Rio, “Mexico: an Economy at the Crossroads,” Wharton Quarterly, University of Pennsylvania, Fall 1971.

### List of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFR</td>
<td>Balance of productive factors in NIA</td>
</tr>
<tr>
<td>BFR*</td>
<td>Balance of productive factors in BOP</td>
</tr>
<tr>
<td>BGR</td>
<td>Balance of goods in BOP</td>
</tr>
<tr>
<td>BGSFR</td>
<td>Balance of goods, services and factors or net foreign demand in NIA</td>
</tr>
<tr>
<td>BGSFR*</td>
<td>Balance of goods, services and factors or net foreign demand in BOP</td>
</tr>
<tr>
<td>BGSR</td>
<td>Balance of goods, tourism and border transactions in NIA</td>
</tr>
<tr>
<td>BGSR*</td>
<td>Balance of goods, tourism and border transactions in BOP</td>
</tr>
<tr>
<td>BOTR</td>
<td>Balance of other items in current account in BOP</td>
</tr>
<tr>
<td>BTBR</td>
<td>Balance of tourism and border transactions in BOP</td>
</tr>
<tr>
<td>CGR</td>
<td>Public consumption</td>
</tr>
<tr>
<td>CITR</td>
<td>Domestic or internal aggregate demand</td>
</tr>
<tr>
<td>CMC</td>
<td>Capacity to import or current earnings deflated by import price-index</td>
</tr>
<tr>
<td>COCDU</td>
<td>COCOP multiplied by DUMRS</td>
</tr>
<tr>
<td>COCOP</td>
<td>Domestic, physical consumption of copper (millions of tons)</td>
</tr>
<tr>
<td>COCOT</td>
<td>Domestic, physical consumption of cotton (millions of bales)</td>
</tr>
<tr>
<td>COLEA</td>
<td>Domestic, physical consumption of lead (millions of tons)</td>
</tr>
<tr>
<td>COMET</td>
<td>Domestic, physical consumption of nonferrous metals: lead, copper and zinc (millions of tons)</td>
</tr>
<tr>
<td>CPR</td>
<td>Private consumption</td>
</tr>
<tr>
<td>CPRN</td>
<td>Private consumption per capita (thousands of 1950 pesos per person)</td>
</tr>
<tr>
<td>CR</td>
<td>Consumption</td>
</tr>
<tr>
<td>DBGEDC</td>
<td>Public external debt</td>
</tr>
<tr>
<td>DBGER</td>
<td>Public external debt</td>
</tr>
<tr>
<td>DC</td>
<td>Depreciation</td>
</tr>
<tr>
<td>DDBGR</td>
<td>Change in public external debt</td>
</tr>
<tr>
<td>DGDPR</td>
<td>Change in gross domestic product</td>
</tr>
<tr>
<td>DGR</td>
<td>Public depreciation</td>
</tr>
<tr>
<td>DIPRN</td>
<td>Disposable personal income per capita (thousands of 1950 pesos per person)</td>
</tr>
<tr>
<td>DIUDC</td>
<td>Disposable personal income in the U.S.</td>
</tr>
<tr>
<td>DIUR</td>
<td>Disposable personal income in the U.S.</td>
</tr>
<tr>
<td>DPEUEJ</td>
<td>Change in export price index, PEUEJ, of main exporting countries to Mexico</td>
</tr>
<tr>
<td>DPGNP</td>
<td>Change in GNP price deflator</td>
</tr>
<tr>
<td>DPR</td>
<td>Private depreciation</td>
</tr>
<tr>
<td>DR</td>
<td>Depreciation</td>
</tr>
<tr>
<td>DUMBBR</td>
<td>Dummy for government restrictions to the bracero program, 1.0 for 1965–1968; 0.0 elsewhere</td>
</tr>
<tr>
<td>DUMCU</td>
<td>Dummy for U.S.' suspension of sugar buying from Cuba; 1.0 for 1960–1968; 0.0 elsewhere</td>
</tr>
<tr>
<td>DUMDV</td>
<td>Dummy for aftereffects of devaluation of 1954; 1.0 for 1956–1961; 0.0 elsewhere</td>
</tr>
<tr>
<td>DUMRE</td>
<td>Dummy for census revisions of labor data; 1.0 for 1960–1968; 0.0 elsewhere.</td>
</tr>
<tr>
<td>DUMRS</td>
<td>Dummy for U.S.' trade protection to its nonferrous metal producers: 1.0 for 1958–1968; 0.0 elsewhere</td>
</tr>
<tr>
<td>DUMTFE</td>
<td>Dummy for exceptional federal exports tax collection; 1.0 for 1955–1956, 1961, and 1967; 0.0 elsewhere</td>
</tr>
</tbody>
</table>
Macroeconometric Model Building in Latin America

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>DUMTPC</td>
<td>Dummy for exceptional federal nontax collection; 1.0 for 1965; 0.0 elsewhere</td>
</tr>
<tr>
<td>DX23P</td>
<td>Change in idle urban productive capacity</td>
</tr>
<tr>
<td>DX1PRU</td>
<td>Change in rural potential population productivity</td>
</tr>
<tr>
<td>DX231P</td>
<td>Gaps between urban and rural potential population productivity</td>
</tr>
</tbody>
</table>

E

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAADC</td>
<td>Net production of gold and silver</td>
</tr>
<tr>
<td>EAAR</td>
<td>Net production of gold and silver</td>
</tr>
<tr>
<td>EAGR</td>
<td>Main agricultural goods exports: cotton, coffee and sugar</td>
</tr>
<tr>
<td>EBR</td>
<td>Labor exports or bracero earnings</td>
</tr>
<tr>
<td>EBRRL</td>
<td>Labor exports or bracero earnings per Mexican worker (thousands of 1950 pesos per worker)</td>
</tr>
<tr>
<td>ECOFR</td>
<td>Exports of coffee</td>
</tr>
<tr>
<td>ECOPR</td>
<td>Exports of copper</td>
</tr>
<tr>
<td>ECTR</td>
<td>Exports of cotton</td>
</tr>
<tr>
<td>EG</td>
<td>Goods or merchandise exports</td>
</tr>
<tr>
<td>EGC</td>
<td>Goods or merchandise exports</td>
</tr>
<tr>
<td>EGER</td>
<td>Goods exports, explained by equations in the model</td>
</tr>
<tr>
<td>EGFR</td>
<td>Manufactured goods exports</td>
</tr>
<tr>
<td>EGR</td>
<td>Goods or merchandise exports</td>
</tr>
<tr>
<td>EGSR</td>
<td>Goods or merchandise exports</td>
</tr>
<tr>
<td>EGSFR</td>
<td>Exports of goods, services and factors or total trade exports</td>
</tr>
<tr>
<td>ELEAR</td>
<td>Lead exports</td>
</tr>
<tr>
<td>EMETR</td>
<td>Nonferrous metals exports: lead, copper and zinc</td>
</tr>
<tr>
<td>EOG</td>
<td>Other goods exports</td>
</tr>
<tr>
<td>EOTDC</td>
<td>Exports of other items in current account</td>
</tr>
<tr>
<td>EOTR</td>
<td>Exports of other items in current account</td>
</tr>
<tr>
<td>ESUGR</td>
<td>Sugar exports</td>
</tr>
<tr>
<td>ETBR</td>
<td>Tourism and border exports</td>
</tr>
<tr>
<td>EZINR</td>
<td>Zinc exports</td>
</tr>
</tbody>
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F

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<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBGFC</td>
<td>Domestic banking credit to the federal government</td>
</tr>
<tr>
<td>FBGFR</td>
<td>Domestic banking credit to the federal government</td>
</tr>
<tr>
<td>FADC</td>
<td>Foreign reserves</td>
</tr>
<tr>
<td>FRR</td>
<td>Foreign reserves</td>
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G

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC</td>
<td>Public expenditure</td>
</tr>
<tr>
<td>GDPC</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GDPR</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GNPC</td>
<td>Gross national product</td>
</tr>
<tr>
<td>GNPR</td>
<td>Gross national product</td>
</tr>
<tr>
<td>GNPUHC</td>
<td>U.S. gross national product</td>
</tr>
<tr>
<td>GNPUR</td>
<td>U.S. gross national product</td>
</tr>
<tr>
<td>GR</td>
<td>Public expenditure</td>
</tr>
<tr>
<td>GSC</td>
<td>Government surplus or deficit</td>
</tr>
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</table>

I

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICHR</td>
<td>Inventory investment</td>
</tr>
<tr>
<td>IGGR</td>
<td>Government fixed, gross investment</td>
</tr>
<tr>
<td>IGOER</td>
<td>Federal organizations and enterprises fixed, gross investment</td>
</tr>
<tr>
<td>IGR</td>
<td>Public gross, fixed investment</td>
</tr>
<tr>
<td>IPR</td>
<td>Private gross, fixed investment</td>
</tr>
<tr>
<td>IPUSF</td>
<td>U.S. index of industrial production of food and beverages (1957–1959 = 1.0)</td>
</tr>
<tr>
<td>ITR</td>
<td>Gross fixed investment</td>
</tr>
<tr>
<td>ITR</td>
<td>Investment</td>
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K

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KFIR</td>
<td>Federal government capital stock in the rural sector</td>
</tr>
<tr>
<td>KGR</td>
<td>Government capital stock</td>
</tr>
<tr>
<td>KPR</td>
<td>Private capital stock</td>
</tr>
<tr>
<td>KR</td>
<td>Capital stock</td>
</tr>
<tr>
<td>K23R</td>
<td>Private and federal government capital stock in urban sector</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>L</td>
<td>Labor force (millions of workers)</td>
</tr>
<tr>
<td>L1</td>
<td>Labor force in rural or primary sector (millions of workers)</td>
</tr>
<tr>
<td>LINRU</td>
<td>Rural labor participation rate: ratio of labor force over population in rural sector</td>
</tr>
<tr>
<td>L23</td>
<td>Labor force in urban or secondary and tertiary sectors (millions of workers)</td>
</tr>
<tr>
<td>L23NB</td>
<td>Urban labor participation rate: ratio of labor force over population in urban sector</td>
</tr>
<tr>
<td>MCAPR</td>
<td>Capital goods imports</td>
</tr>
<tr>
<td>MCONR</td>
<td>Consumption goods imports</td>
</tr>
<tr>
<td>MFR</td>
<td>Factor imports</td>
</tr>
<tr>
<td>MGC</td>
<td>Goods or merchandise imports</td>
</tr>
<tr>
<td>MGR</td>
<td>Goods or merchandise imports</td>
</tr>
<tr>
<td>MGSR</td>
<td>Imports of goods, services and factors or total trade imports</td>
</tr>
<tr>
<td>MJGR</td>
<td>Government payments of interest to foreign bond holders</td>
</tr>
<tr>
<td>MOTDC</td>
<td>Imports of other items in current account</td>
</tr>
<tr>
<td>MOTR</td>
<td>Imports of other items in current account</td>
</tr>
<tr>
<td>MGR</td>
<td>Imports of production goods</td>
</tr>
<tr>
<td>MRPR</td>
<td>Private payments of profits to foreign stockholders</td>
</tr>
<tr>
<td>MRDC</td>
<td>Imports of raw materials and fuels</td>
</tr>
<tr>
<td>MRR</td>
<td>Imports of raw materials and fuels</td>
</tr>
<tr>
<td>MTBR</td>
<td>Imports of tourism and border transactions</td>
</tr>
<tr>
<td>N</td>
<td>Population (millions of persons)</td>
</tr>
<tr>
<td>NG</td>
<td>Population rate of growth</td>
</tr>
<tr>
<td>NIC</td>
<td>National income in NIA</td>
</tr>
<tr>
<td>NIC:</td>
<td>National income generated by the model</td>
</tr>
<tr>
<td>NIR</td>
<td>National income</td>
</tr>
<tr>
<td>NNPC</td>
<td>Net national product</td>
</tr>
<tr>
<td>NRUL</td>
<td>Rural population (millions of persons)</td>
</tr>
<tr>
<td>NURB</td>
<td>Urban population (millions of persons)</td>
</tr>
<tr>
<td>NURBN</td>
<td>Ratio of urban to total population</td>
</tr>
<tr>
<td>NWIC</td>
<td>Nonwage income</td>
</tr>
<tr>
<td>PCFMB</td>
<td>Ratio of Mexican over Brazilian price of coffee</td>
</tr>
<tr>
<td>PCOFB</td>
<td>Brazilian price of coffee (dollars per hundred lbs.)</td>
</tr>
<tr>
<td>PCOFM</td>
<td>Mexican price of coffee (dollars per hundred lbs.)</td>
</tr>
<tr>
<td>PEEU</td>
<td>European (EEC plus EFTA) export price index (1953 = 1.0)</td>
</tr>
<tr>
<td>PEJP</td>
<td>Japanese export price index (1960—1962 = 1.0)</td>
</tr>
<tr>
<td>PEUEJ</td>
<td>Weighted export price index of main exporting countries to Mexico (U.S., Europe and Japan), weights of 1968</td>
</tr>
<tr>
<td>PEUS</td>
<td>U.S. export price index (1958 = 1.0)</td>
</tr>
<tr>
<td>FGNP</td>
<td>GNP price deflator (1950 = 1.0)</td>
</tr>
<tr>
<td>FGNP%</td>
<td>GNP price deflator rate of change</td>
</tr>
<tr>
<td>PM</td>
<td>Imports price index (1950 = 1.0)</td>
</tr>
<tr>
<td>PM%</td>
<td>Imports price index rate of change</td>
</tr>
<tr>
<td>PRCDU</td>
<td>PRCP multiplied by DUMRS</td>
</tr>
<tr>
<td>PRCP</td>
<td>Domestic, physical copper production (thousands of tons)</td>
</tr>
<tr>
<td>PRCOT</td>
<td>Domestic, physical cotton production (thousands of tons)</td>
</tr>
<tr>
<td>PRLEA</td>
<td>Domestic, physical lead production (thousands of tons)</td>
</tr>
<tr>
<td>PRMET</td>
<td>Domestic, physical nonferrous metals production: lead, copper and zinc (thousands of tons)</td>
</tr>
<tr>
<td>PSGMP</td>
<td>Ratio of Mexican over Philippines price of sugar</td>
</tr>
<tr>
<td>PSUGM</td>
<td>Price of Mexican sugar (dollars per hundred lbs.)</td>
</tr>
<tr>
<td>PSUGPH</td>
<td>Price of Philippines sugar (dollars per hundred lbs.)</td>
</tr>
<tr>
<td>RDPAV</td>
<td>Paved roads (thousands of kilometers)</td>
</tr>
<tr>
<td>REX</td>
<td>Rate of exchange (dollars per peso)</td>
</tr>
</tbody>
</table>
Macroeconometric Model Building in Latin America

S

SBGSFR Discrepancy between NIA and BOP data on balance in current account
SDBFR Discrepancy between NIA and BOP data on balance of factors
SDBGSR Discrepancy between NIA and BOP data on balance of goods and services
SDNIC Discrepancy between NIA data and the model's identity of national income
SDTFNC Discrepancy between two data sources used on federal indirect or nonincome taxes

T

T Time (1948 = 1.0)
TC Total taxes and nontaxes
TFG Federal government taxes
TFEC Federal export taxes
TFIC Federal income taxes
TFMC Federal import taxes
TFMGC Rate of taxation on imported merchandise
TFNIC Federal indirect or nonincome taxes
TFNIC Federal indirect or nonincome taxes

TDNIC: Discrepancy between NIA data and the model's identity of national income

TFOC Other federal taxes
TFPAC Federal nontax income: "productos, derechos y aprovechamientos"

TFRS Federal sales taxes: "ingresos mercantiles"
TNFC Nonfederal taxes: D.F., state and local
TNIC Total indirect or nonincome taxes
TNIC% Total indirect taxes rate of growth
TR Total taxes and nontaxes
TRDGR Total taxes plus public depreciation

U

UXRP Idle capacity
UX1RP Rural idle capacity
UX23RD UX23RP multiplied by DUMRE
UX23RP Urban idle capacity

WIC Wage income
WMAC Daily, average minimum wage rate (current pesos per worker)
WMRC Daily, minimum rural wage rate (current pesos per worker)
WMUGC Daily, minimum urban wage rate (current pesos per worker)
WRC Yearly, average wage rate (thousand current pesos per worker)
WRC% Yearly, average wage-rate rate of growth
WRCA Unit labor cost or ratio of average wage rate to labor productivity
WRCA% Unit labor cost rate of change
WRFUDC U.S. hourly manufacturing wage rate (dollars per worker)
WMMMC Ratio of daily, minimum urban wage to U.S. hourly manufacturing rate converted into current pesos

X

X1R Rural production
X1RL Rural labor productivity (thousands of 1950 pesos per worker)
X1RP Potential rural production or rural capacity
X2R Secondary production
X3R Tertiary production
X23R Urban production
X23PBD X23PNB multiplied by DUMRE
X23PNB Potential urban population productivity (thousands of 1950 pesos per urban person)
X23RL Urban labor productivity (thousands of 1950 pesos per worker)
X23RP Potential urban production or urban capacity
XR Potential production or capacity
I. Generation of Aggregate Demand

IA. Generation of Domestic Demand

Private consumption per capita

\[ CPRN = 0.10488 + 0.39560 \times DIPRN + 0.34350 \times DIPRNI + 0.11960 \times DIPRN2 \]

\[ \sum_{i=0}^{2} w(i) = 0.8587 \]

\[ R^2 = 0.9877 \quad S.E. = 0.0215 \quad DW = 2.0793 \quad F(2, 13) = 603.3416 \]

Public consumption

\[ CGR = -0.68719 + 0.60410 \times TR \]

\[ R^2 = 0.9837 \quad S.E. = 0.2247 \quad DW = 1.2862 \quad F(1, 17) = 1086.4641 \]

Private gross, fixed investment

\[ IPR = \frac{1.37563 - 0.76030 \times DUMPO + 0.05611 \times KPR1 + 0.18120 \times DGDPRI}{1.0629} \]

\[ \sum_{i=0}^{2} w(i) = 0.8588 \]

\[ R^2 = 0.9552 \quad S.E. = 0.4816 \quad DW = 2.0697 \quad F(4, 11) = 80.9639 \]

Public gross, fixed investment

\[ IGR = -0.16872 + 0.83383 \times DDBGR + 0.40620 \times TRDGR + 0.20362 \times FBGFR \]

\[ R^2 = 0.9765 \quad S.E. = 0.3603 \quad DW = 2.1081 \quad F(3, 15) = 250.3858 \]

Investment of federal government organizations and enterprises

\[ IGOER = 0.62296 + 0.32234 \times FBGR1 + 1.35670 \times DDBGR + 0.5008 \times DDBGRI \]

\[ \sum_{i=0}^{3} w(i) = 1.8575 \]

\[ R^2 = 0.9185 \quad S.E. = 0.3766 \quad DW = 1.2617 \quad F(3, 12) = 57.3715 \]

Inventory changes

\[ ICHR = 0.31206 + 2.5922 \times DPGNP + 0.05210 \times DGDPRI + 0.07080 \times DGDPRI1 \]

\[ \sum_{i=0}^{3} w(i) = 0.2235 \]

\[ R^2 = 0.8515 \quad S.E. = 0.1610 \quad DW = 2.0251 \quad F(3, 12) = 29.6755 \]

Private consumption

\[ CPR = CPRN \times N \]

Consumption

\[ CR = CPR + CGR \]

Gross, fixed investment

\[ IR = IPR + IGR \]

Investment: gross fixed plus inventory changes

\[ ITR = IR + ICHR \]

Public investment net of federal organizations and enterprises investment

\[ IGGR = IGR - IGOER. \]
Domestic aggregate demand

\[ CITR = CR + ITR \]

1B. Generation of Foreign Demand

1B(i). Exports

Exports of cotton

\[ ECOTR = 1.74205 - 3.41745 COCOT2 + 0.52469 PRCOT1 \]
\[ (8.999) \quad (-5.489) \quad (3.683) \]
\[ R^2 = 0.6156 \quad S.E. = 0.1944 \quad DW = 1.7479 \quad F(2, 16) = 15.4124 \]

Relative price of Mexican to Brazilian coffee

\[ PCFMB = PCOFM/PCOFB \]

Exports of coffee

\[ ECOFR = 0.64692 + 0.77732 ECOFR1 - 0.44755 PCFMB \]
\[ (1.883) \quad (5.044) \quad (-1.566) \]
\[ R^2 = 0.5741 \quad S.E. = 0.1076 \quad DW = 2.3463 \quad F(2, 16) = 13.1329 \]

Relative price of Mexican to Philippines sugar

\[ PSGMP = PSUGM/PSUGPH \]

Exports of sugar

\[ ESUGR = -0.13087 + 0.44480 IPUSE + 0.20956 DUMCU - 0.27291 PSGMP \]
\[ (-1.087) \quad (2.831) \quad (4.814) \quad (-1.872) \]
\[ R^2 = 0.9311 \quad S.E. = 0.0441 \quad DW = 2.6200 \quad F(3, 15) = 82.1127 \]

Exports of nonferrous metals: lead, copper and zinc

\[ EMETR = 0.27415 - 0.56093 DUMRS + 1.57891 PRMET - 0.20054 COMET \]
\[ (0.351) \quad (-8.258) \quad (1.083) \quad (-0.221) \]
\[ R^2 = 0.8974 \quad S.E. = 0.04596 \quad DW = 2.4087 \quad F(3, 15) = 53.4719 \]

Exports of lead

\[ ELEAR = -0.19166 - 0.16455 DUMRS + 3.03442 PRLEA - 0.61904 COLEA \]
\[ (-0.888) \quad (-4.113) \quad (3.241) \quad (-1.000) \]
\[ R^2 = 0.9228 \quad S.E. = 0.04596 \quad DW = 1.6541 \quad F(3, 15) = 72.7337 \]

Consumption of copper in the period of U.S. restrictions

\[ COCDU = COCOP \times DUMRS \]

Production of copper in the period of U.S. restrictions

\[ PRCDU = PRCOP \times DUMRS \]

Exports of copper

\[ ECOFR = 1.13451 - 1.09724 DUMRS - 16.04651 PRCOP + 19.88620 PRCDU \]
\[ (2.297) \quad (-2.106) \quad (-2.306) \quad (2.627) \]
\[ + 7.69851 COCOP - 11.75707 COCDU \]
\[ (1.717) \quad (-2.552) \]
\[ R^2 = 0.9088 \quad S.E. = 0.04806 \quad DW = 2.1233 \quad F(5, 13) = 36.8633 \]

Exports of manufactured goods

\[ EGMFR = -1.17954 + 0.00052 GNPUTR \]
\[ (-6.711) \quad (9.114) \]
\[ R^2 = 0.8201 \quad S.E. = 0.10685 \quad DW = 0.6438 \quad F(1, 17) = 83.0712 \]

Tourism and border exports

\[ ETBR = -2.39964 + 0.02245 RDPAV + 0.75075 DUMDV + 0.00238 DIUR \]
\[ (-5.071) \quad (1.947) \quad (7.854) \quad (7.039) \]
\[ R^2 = 0.9594 \quad S.E. = 0.1888 \quad DW = 2.9561 \quad F(3, 15) = 142.8593 \]

Exports of labor per worker

\[ EBRRL = 0.09415 - 0.01248 DUMBR - 0.07318 WRMMUC - 0.01846 X1RL \]
\[ (8.407) \quad (-3.551) \quad (-2.947) \quad (-3.322) \]
\[ R^2 = 0.9152 \quad S.E. = 0.0038 \quad DW = 1.8624 \quad F(3, 15) = 65.7711 \]

Production of gold and silver

\[ EAAR = (EAAAD\times REX)/PGNP \]
Economic and Social Research in Latin America

Exports of zinc
(27) \[ EZINR = EMETR - ELEAR - ECOPR \]

Exports of agricultural goods
(28) \[ EAGR = ECOTR + ESUGR + ECOFR \]

Exports of goods explained by the model
(29) \[ EGER = EAGR + EMETR + EGMFR \]

Exports of other goods
(30) \[ EOGR = (EGDC \times REX)/PGNP - EGER \]

Exports of goods
(31) \[ EGR = EGER + EOGR \]
(32) \[ EGC = EGR \times PGNP \]

Exports of labor: bracero earnings
(33) \[ EBRR = EBRRL \times L1 \]

Other exports in trade account
(34) \[ EOTR = (EOTDC \times REX)/PGNP \]

U.S. gross national product
(35) \[ GNPUR = (GNPUDC \times REX)/PGNP \]

U.S. disposable personal income
(36) \[ DIUR = (DIUDC \times REX)/PGNP \]

Total trade exports: goods, services and factors
(37) \[ EGSFR = EGR + EBRR + EAAR + EOTR + ETBR \]

IB(ii). Imports
Imports of consumer goods
(38) \[ MCONR = 0.23921 + 0.00426 CR + 0.11120 FRR + 0.1233 FRRI + 0.07370 FRR2 \]
\[ (1.295) \quad (2.222) \quad (2.4134) \quad (3.9358) \quad (1.6357) \]
\[ \sum w(i) = 0.3082 \]
\[ R^2 = 0.6926 \quad S.E. = 0.1209 \quad DW = 2.1126 \quad F(3, 12) = 12.2677 \]

Imports of capital goods
(39) \[ MCAPR = 1.78374 - 0.13774 X2R + 0.23077 FRR + 0.33850 JR + 0.0430 fRI \]
\[ (7.625) \quad (-5.197) \quad (2.656) \quad (4.9568) \quad (0.7785) \]
\[ \sum w(i) = 0.3815 \]
\[ R^2 = 0.9218 \quad S.E. = 0.1449 \quad DW = 2.7021 \quad F(4, 11) = 45.1882 \]

Imports of raw materials and fuels
(40) \[ MRR = (MRDC \times REX)/PGNP \]

Tourism and border imports
(41) \[ MTBR = -1.05262 + 0.26925 CMC \]
\[ (-6.497) \quad (16.955) \]
\[ R^2 = 0.9409 \quad S.E. = 0.1446 \quad DW = 1.1732 \quad F(1, 17) = 287.4587 \]

Private payments of interest and dividends abroad
(42) \[ MPPR = 0.16413 + 0.01082 X23R \]
\[ (1.938) \quad (8.120) \]
\[ R^2 = 0.7830 \quad S.E. = 0.12409 \quad DW = 0.8460 \quad F(1, 17) = 65.9364 \]

Public payments of interest abroad
(43) \[ MIGR = -0.06879 + 0.05542 DBGER \]
\[ (-1.996) \quad (9.854) \]
\[ R^2 = 0.8422 \quad S.E. = 0.07264 \quad DW = 0.6560 \quad F(1, 17) = 97.0940 \]

Imports of production goods
(44) \[ MPGR = MCAPR + MRR \]
Imports of goods
(45) \( MGR = MPGR + MCONR \)
(46) \( MGC = MGR \times PGNP \)

Imports of factors of production
(47) \( MFR = MPFR + MIGR \)

Other imports in trade account
(48) \( MOTR = (MOTDC \times REX)/PGNP \)

Total trade imports: goods, services and factors
(49) \( MGSFR' = MGR + MTBR + MFR + MOTR \)

Weighted price index of main exporting countries to Mexico
(50) \( PEUEJ = 0.63 PEUS + 0.25 PEEU + 0.04 PEJP \)

Annual change in price index of main exporting countries to Mexico
(51) \( DPEUEJ = PEUEJ - PEUEJI \)

Price index of imports
(52) \[ PM = 1.32176 + 3.92619 TFMGC + 5.03750 DPEUEJ + 2.15990 DPEUEJ^2 \]
\[ (12.371) \quad (4.696) \quad (2.6029) \quad (1.1100) \]
\[ \sum_{i=0}^{1} w(i) = 7.1973 \]
\[ R^2 = 0.7684 \quad S.E. = 0.1331 \quad DW = 0.9219 \quad F(3, 12) = 17.5894 \]

Rate of change of import price index
(53) \[ PM\% = (PM - PMI)/PMI \]

Capacity to import: export earnings deflated by import price index
(54) \[ CMC = [(EGSFR*) \times PGNP]/PM \]

IB(ii). Balance of Trade or Net Foreign Demand

Balance of goods
(55) \( BGR = EGR - MGR \)

Balance of tourism and border transaction
(56) \( BTBR = ETBR - MTBR \)

Balance of goods and services
(57) \( BGSR* = BGR + BTBR \)

Balance of factors
(58) \( BFR* = EBRR - MFR \)

Balance of other items in trade account
(59) \( BOTR = EOTR - MOTR \)

Balance of trade: goods, services and factors
(60) \[ BGSFR* = BGR + BTBR + BFR* + BOTR + EAAR \]

Balance of goods and services in NIA (conciliation)
(61) \( BGSR = BGSR* + SDBGSR \)

Balance of factors in NIA (conciliation)
(62) \( BFR = BFR* + SDBFR \)

Balance of trade: goods, services and factors in NIA
(63) \( BGSFR = BGSR + BFR \)

IC. Total Aggregate Demand

Gross national product
(64) \( GNPR = CITR + BGSFR \)
(65) \( GNPC = GNPR \times PGNP \)
II. Generation of Value-Added Output

Output originating in primary sector
\[ X_{1R} = 1.54792 + 0.17425 CPR + 1.15516 EAGR \]
\[ R^2 = 0.9816 \quad S.E. = 0.4133 \quad DW = 1.2108 \quad F(2, 16) = 489.6113 \]

Output originating in secondary sector
\[ X_{2R} = -4.16634 + 0.63336 IR + 0.35448 CR \]
\[ R^2 = 0.9965 \quad S.E. = 0.5996 \quad DW = 1.0393 \quad F(2, 16) = 2534.3875 \]

Output originating in tertiary sector
\[ X_{3R} = -2.06446 + 0.59023 ETBR + 0.57309 CR \]
\[ R^2 = 0.9980 \quad S.E. = 0.5303 \quad DW = 1.2959 \quad F(2, 16) = 4510.9609 \]

Gross domestic product
\[ GDPR = X_{1R} + X_{2R} + X_{3R} \]
\[ GDPC = GDPR \times PGNP \]

Annual change in gross domestic product
\[ DGDP = GDP - GDP_{t-1} \]

Gross domestic urban product
\[ X_{23R} = X_{2R} + X_{3R} \]

III. Capital Formation

Capital stock in the urban sector
\[ K_{23R} = -4.43803 + 0.97649 KR \]
\[ R^2 = 1.000 \quad S.E. = 0.1444 \quad DW = 0.3752 \quad F(1, 17) > 999 \]

Private capital stock
\[ K_{PR} = IPR + 0.90 K_{PR1} \]

Public capital stock
\[ K_{GR} = IGR + 0.95 K_{GR1} \]

Capital stock
\[ KR = K_{PR} + K_{GR} \]

Capital stock of federal government in rural sector
\[ K_{FIR} = KR - K_{23R} \]

Private depreciation
\[ DPR = 0.10 K_{PR1} \]

Public depreciation
\[ DGR = 0.05 K_{GR1} \]

Depreciation
\[ DR = DPR + DGR \]
\[ DC = DR \times PGNP \]

IV. Creation of Capacity: Potential Value-Added Production

Rural capacity
\[ X_{1RP} = -12.49223 + 4.41883 K_{1R1} \]
\[ R^2 = 0.9442 \quad S.E. = 0.6933 \quad DW = 0.3739 \quad F(1, 17) = 305.7893 \]

Urban capacity
\[ X_{23RP} = 6.83255 + 0.81752 K_{23R1} \]
\[ R^2 = 0.9912 \quad S.E. = 2.1628 \quad DW = 0.4497 \quad F(1, 17) = 2031.5142 \]

Capacity
\[ X_{RP} = X_{1RP} + X_{23RP} \]
Macroeconometric Model Building in Latin America

Unused rural capacity
(85) \[ UX1RP = X1RP - X1R \]

Unused urban capacity
(86) \[ UX23RP = X23RP - X23R \]

Unused capacity
(87) \[ UXR P = XRP - GDPR \]

Annual change in used urban capacity
(88) \[ DXU23P = UX23RP - UX23RP1 \]

V. Demography Processes and Labor Supply

Population
(89) \[ N = NG \times N1 \]

Urban-rural potential productivity gaps
(90) \[ DX231P = (X23RP/NURB) - (X1RP/NRUL) \]

Ratio of urban to total population: urbanization
(91) \[ NURBN = \frac{0.36908 + 0.00849 T + 0.00280 DX231P + 0.00360 DX231P1}{(208.854)} - \frac{7.6985}{(12.4946)} + \frac{0.00250 DX231P2 + 0.00150 DX231P3}{(8.8262)} - \frac{3.5369}{(3.5369)} \]

\[ \sum_{i=0}^{3} w(i) = 0.0107 \]

\[ R^2 = 1.000 \quad S.E. = 0.0001 \quad DW = 5.5279 \quad F(3, 12) = > 999 \]

Urban population
(92) \[ NURB = N \times NURBN \]

Rural population
(93) \[ NRUL = N - NURB \]

Annual change in rural potential productivity
(94) \[ DX1PRU = (X1RP/NRUL) - (X1RP/NRUL1) \]

Rural labor participation rate
(95) \[ L1NRU = 0.38528 - 0.00196 DUMRE - 0.32790 DX1PRU - 0.51720 DX1PRU1 \]

\[ \begin{array}{c}
(87.379) \\
(-0.974) \\
(-1.6638) \\
(-3.8388) \\
(-5.6660) \\
(-3.1876)
\end{array} \]

\[ \begin{array}{c}
- 0.54270 DX1PRU2 - 0.37870 DX1PRU3 - 0.00070 DX23P \\
(-9.3369) \\
(-2.7378) \\
(-5.6311) \\
(-3.1876)
\end{array} \]

\[ \begin{array}{c}
- 0.00110 DXU23P1 - 0.00110 DXU23P2 - 0.00070 DXU23P3 \\
(-9.6770) \\
(-5.6311) \\
(-3.1876)
\end{array} \]

\[ \sum_{i=0}^{3} w_1(i) = -1.7665 \]

\[ \sum_{i=0}^{3} w_2(i) = -0.0036 \]

\[ R^2 = 0.9867 \quad S.E. = 0.0013 \quad DW = 2.2905 \quad F(5, 10) = 223.1250 \]

Rural labor force
(96) \[ L1 = L1NRU \times NRUL \]

Urban potential productivity
(97) \[ X23PNB = X23RP/NURB \]

Urban potential productivity in the revised data period
(98) \[ X23PBD = X23PNB \times DUMRE \]

Unused urban productive capacity in the revised data period
(99) \[ UX23RD = UX23RP \times DUMRE \]
Urban labor participation rate
(100) \( L_{23NB} = 0.68591 - 0.12852 X_{23PNB} + 0.10019 X_{23PBD} - 0.30454 \ DUMRE \)
\[ (36.351) \quad (-20.934) \quad (8.301) \quad (-6.967) \]
\[ + 0.00301 \ U X_{23RP} - 0.00242 \ U X_{23RD} \]
\[ (4.700) \quad (-3.419) \]
\[ R^2 = 0.9674 \quad S.E. = 0.00241 \quad DW = 1.9357 \quad F(5, 13) = 107.9482 \]

Urban labor force
(101) \( L_{23} = L_{23NB} \times NURB \)

Labor force
(102) \( L = L_1 + L_{23} \)

Rural labor productivity
(103) \( X_{1RL} = X_{1R}/L \)

Urban labor productivity
(104) \( X_{23RL} = X_{23R}/L_{23} \)

VI. Income Distribution
VIA. National Income Breakdown: Wage and Nonwage Income
Average minimum daily wage rate (current pesos per worker)
(105) \( WMAC = (WMRC \times L_1 + WMUC \times L_{23})/L \)

Ratio of minimum rural wage rate to U.S. manufacturing wage rate
(106) \( WMRC = WMRC/(WRFUDC \times REX) \)

Rate of change of wage rate
(107) \( WRC\% = 0.01307 - 0.00356 \ U X_{23RP} + 1.68756 \ PGNP\% \)
\[ (1.305) \quad (-2.530) \quad (18.430) \]
\[ R^2 = 0.9659 \quad S.E. = 0.0156 \quad DW = 1.3768 \quad F(2, 16) = 256.1040 \]

Average annual wage rate
(108) \( WRC = (1.0 + WRC\%) \times WRC1 \)

Wage income
(109) \( WIC = WRC \times L \)

Labor unit cost
(110) \( WRCA = WRC/(GDPR/L) \)

Rate of change of labor unit cost
(111) \( WRCA\% = (WRCA - WRCA1)/WRCA1 \)

Net national product
(112) \( NNPC = GNPC - DC \)

Model’s national income
(113) \( NIC = NNPC - TNIC \)

National income
(114) \( NIC = NIC + SDNIC \)
(115) \( NIR = NIC/PGNP \)

Nonwage income
(116) \( NWIC = NIC - WIC \)

Disposable income per capita
(117) \( DIPRN = [(NIC - TFIC)/PGNP]/N \)

VIIB. Public Income and Finance
Federal income taxes
(118) \( TFIC = -1.27427 + 0.04001 \ NIC \)
\[ (-4.201) \quad (20.957) \]
\[ R^2 = 0.9605 \quad S.E. = 0.6501 \quad DW = 1.0844 \quad F(1, 17) = 439.2012 \]
Federal export taxes

\[
TFEC. = 0.35076 + 1.02380 \text{ DUMTFE} + 0.06586 \text{ EGC}
\]

\[
R^2 = 0.9038 \quad \text{S.E.} = 0.0811 \quad DW = 1.4300 \quad F(2, 16) = 85.5648
\]

Federal import taxes

\[
TFMC. = -1.45476 + 0.23801 \text{ MGC}
\]

\[
R^2 = 0.8522 \quad \text{S.E.} = 0.5258 \quad DW = 0.8140 \quad F(1, 17) = 104.7648
\]

Federal sales taxes

\[
TFSC. = -0.23470 + 0.00962 \text{ GDPC}
\]

\[
R^2 = 0.9822 \quad \text{S.E.} = 0.1167 \quad DW = 0.7020 \quad F(1, 17) = 996.2786
\]

Federal nontax income

\[
TFPAC. = 0.24270 + 0.000750 \text{ GDPC} + 2.67050 \text{ DUMTPC}
\]

\[
R^2 = 0.9692 \quad \text{S.E.} = 0.1810 \quad DW = 2.6903 \quad F(2, 16) = 284.6804
\]

Other federal taxes

\[
TFOC. = 0.7211 + 0.11610 \text{ TFC}
\]

\[
R^2 = 0.9008 \quad \text{S.E.} = 0.2797 \quad DW = 2.2890 \quad F(1, 17) = 164.3864
\]

Nonfederal taxes: D.F., state and local

\[
TNFC. = -0.84372 + 0.37313 \text{ TFC}
\]

\[
R^2 = 0.9900 \quad \text{S.E.} = 0.2730 \quad DW = 2.1512 \quad F(1, 17) = 1781.9036
\]

Federal indirect or nonincome taxes

\[
TFNIC. = TFMC. + TFEC. + TFSC. + TFOC. + TFPAC.
\]

\[
TFNIC = TFNIC. + SDTFNC
\]

Indirect or nonincome taxes

\[
TNIC = TFNIC + TNFC
\]

Rate of change of indirect taxes

\[
TNIC\% = (TNIC - TNIC1)/TNIC1
\]

Federal taxes

\[
TFC = TFIC. + TFNIC
\]

Taxes

\[
TC = TFC + TNFC
\]

\[
TR = TC/PGNP
\]

Average tariff on imports of goods

\[
TFMGC = TFMC./MGC
\]

Public expenditure

\[
GR = CGR + IGR
\]

\[
GC = GR \times PGNP
\]

Public surplus or deficit

\[
GSC = TC - GC
\]

Taxes plus public depreciation

\[
TRDGR = TR + DGR
\]

Public foreign debt

\[
DBGER = (DBGEDC \times REX)/PGNP
\]

Annual change in public foreign debt

\[
DDBGR = DBGER - DBGER1
\]

Banking system credit to the federal government

\[
FBGFR = FBGFC/PGNP
\]
Economic and Social Research in Latin America

Foreign reserves
(140) \[ FRR = \frac{(FRDC \times REX)}{PGNP} \]

VII. Price Formation

Rate of change of the general price index: GNP deflator
(141) \[ PGNP\% = 0.01667 + 0.38848 \times WRCA\% + 0.32394 \times PM\% + 0.00746 \times TNIC\% \]
\( (4.007) \]
\( (4.103) \]
\( (2.580) \]
\( (0.236) \]
\[ R^2 = 0.9520 \quad S.E. = 0.0100 \quad DW = 2.3499 \quad F(3, 15) = 119.8805 \]

General price index: GNP deflator
(142) \[ PGNP = (1.0 + PGNP\%) \times PGNP \]

Annual change in the general price index
(143) \[ DPGNP = PGNP - PGNP \]

4. Simulations

This final section is devoted to econometric results. We will present two long-term simulations of the Mexican economy obtained from model solutions. They cover the full six-year term, 1971–1976, of the new administration of President Echeverria. We provide actual figures for 1968–1970, to give a basis of comparison. It should be noted, however, that some of the figures for this previous period are preliminary or even our own estimates, given the unusual delay in the publication of data. We think, however, that they are good enough to be included.

Given the uncertainties that go with long-term simulations, we have followed two procedures to give empirical meaning to our results. First, we have used the available information at mid-1971 on the exogenous variables and adjustments of the behavioral equations to try to produce a realistic forecast for 1971. Secondly, for the rest of the period, 1972–1976, we have used two contrasting assumptions about the behavior of the federal government: one deflationary, the other expansionary. In this way, we expect to set up lower and upper bounds within which the real economy will probably move.

With regard to the contrasting assumptions from 1972 to 1976, we can summarize them in the following table. They represent divergent hypothetical policy packages that the administration could take in a single-minded pursuit of stability or high employment.

Essentially, the two policies boil down to different spending patterns by the federal government. Being the dominant economic agent, the federal impact is

<table>
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<tr>
<th>Average Annual Growth of the Policy Variables: 1972–1976</th>
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<tr>
<td>Fiscal Measures</td>
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<td>Government investment</td>
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<td>Federal enterprise investment</td>
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<td>Public works: highways</td>
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<td>Government consumption</td>
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<tr>
<td>Monetary Measures</td>
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<tr>
<td>Banking credit to federal government</td>
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<td>External debt</td>
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<table>
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<th>Expansionary Hypothesis</th>
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<tr>
<td>Deflationary Hypothesis</td>
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<td>Monetary Measures</td>
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critical in the system, and, as can be seen in the two tables which follow, it can
turn the economy into different paths. In each table, there are two sections, I and
II, in real and current billions of pesos respectively, for each simulation, containing
a selection of the original computer print-outs. Reference to concepts in the tables
will be made by section and line. Thus, for example, real gross national product
and current inventory change are (I-2) and (II-14) in both tables.

Analysis of the Simulations

Since 1971 is the same in both projections, and since 1972 exhibits the same
tendencies in both cases (more pronounced in one than in the other), we will
analyze 1971–1972 first. Then, we will make a comparison of the divergent long-
run patterns, 1973–1976. In the short run, the most striking facts are the following:
   This can be seen in the rates of growth of GDP (I-1) and GNPR (I-2), the first
   one being the measure commonly used by Mexican economists.
2. A slowing down of the rate of inflation in 1971 and a tendency to grow
   again in 1972. See GNP deflator (I-21) and its rate of growth (I-22).
3. A consecutive improvement in the balance on current account in 1971 and
   in 1972. See (I-18).

These three basic facts are, of course, closely interrelated. The 1970–1971
recession is, in part, the normal result of Mexican political change and, in part,
the effect of conscious effort on the part of the new administration to fight inflation
and deterioration of the external position in 1970 by means of an austerity pro-
gram. Another contributing external deflationary element is the 1969–1970 U.S.
recession, whose lagged effects have been clearly felt in the sluggishness of exports.
The U.S. inflation, on the other hand, has also contributed to Mexican inflation
by filtering through imports, 65 percent of which come from there.

The two simulation patterns diverge after 1973. They can be summarized in
four points:
1. The deflationary policy induces economic growth of 6–6.5 percent, as
   measured by gross domestic product (I-1); the expansionary policy produces
   7–7.5 percent growth.
2. Deflation stabilizes and reduces the external deficit; expansion destabilizes
   and increases it, as measured by the real balance on current account (I-18). In fact,
   by the end of the period, the expansionary calculation projects a deficit of the
   magnitude of last year’s −3.6 to −3.7 billion.
3. Deflation succeeds in breaking the inflationary growth; expansion keeps
   it going at approximately the 1970–1971 rates, according to the GNP deflator
   (I-21) and (I-22).
4. Deflation increases the rate of idle productive capacity; expansion tends
   to keep it constant, as shown by the ratio of unused capacity to gross domestic
   product, i.e., (I-23) divided by (I-1).

These facts give support to the contention of some Mexican economists that
rapid rates of growth of 7–7.5 percent tend to “overheat” the economy and to
produce rising prices and growing external deficits. Slower rates of 6–6.5 percent,
on the other hand, appear to be too sluggish, given past Mexican experience. If
### TABLE 1
**Expansionary Simulation, Wharton-DIEMEX Macromodel, Selected Variables**

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### Section II: In Billions of Current Pesos

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1 Thousands of 1950 pesos.
2 1950 = 1.0.
3 GNP price deflator rate of change in percent.
4 Millions of persons.
5 Thousands of current pesos.
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1 Thousands of 1950 pesos.
2 1950 = 1.0.
3 GNP price deflator rate of change in percent.
4 Millions of persons.
5 Thousands of current pesos.
this is the case, the 6.5—7 percent range seems to be the golden mean. It is clear, however, that the unemployment problem, the most serious of the Mexican problems, will not be solved with this rate. If the labor force keeps growing at 3.5 percent (the rate of population growth), it is necessary to create approximately 552,000 jobs in 1971 to accommodate new workers alone, given the 1970 total labor force of 15.78 million. If we extend this calculation, Mexico will have 19.39 million people looking for work in 1976. Our high simulation estimates a figure of 19.26 million in 1-24, and we can take this, for practical purposes, as a full-employment projection. Any calculation below this will result in unemployment. Our low projection, for instance, indicates an excess of labor supply of 300,000 workers in 1976, in spite of its being a 6.3 percent average-growth simulation. It should be noted that this number is probably an underestimate of unemployment. In his excellent econometric study, David Ibarra,13 for example, compares a full-employment projection and a 6.2 percent projection and comes up with an estimate of 2.5 million workers in excess labor supply for 1976. His high figure (or full employment) is 18.76 million workers; his low (6.2 percent growth) is 16.29. In spite of these differences, there is here a basic agreement on the fundamental issue: a full-employment path is not compatible with internal and external stability, unless structural changes (in capital-labor ratios and import content of investment, to start with) are introduced into the system.

This is precisely what the new administration seems to have in mind in its plan of introducing labor-intensive investment programs in the rural sector, instead of traditional, large-scale capital-intensive projects. When implemented, these new projects may help to alleviate rural unemployment and reduce the migratory flow to the cities. The numerical solution, however, cannot be estimated yet because of the absence of information on the magnitude and nature of the projects.

The basic dilemma of the Mexican economy raises the broader question of stability versus employment for some of the Latin American economies. Argentina, Brazil, Colombia, Chile, and Peru, up to the end of the 1960s, have also been unable to combine growth with stability. The apparent inability of Mexico to achieve this joint objective, in spite of its favorable political, economic, and trade positions, makes it doubtful that the other countries will, at least in the next half decade, considering their demographic and political circumstances.14

The long-run comparison also yields some aspects, which although similar in direction, are different in magnitude. Private consumption and investment, exports and imports, and government finance are some cases in point. The fast-growth simulation produces a substantially higher private consumption per capita

14 This doubt of reconciling high growth (5 percent or more) with external and price stability (5 percent or less) seems to be supported by the data. With the possible exception of Brazil, which has managed simultaneously to speed up its growth, reduce its inflation, and substantially increase its foreign reserves during the late sixties (very favorable international coffee prices, due to a large extent to the Brazilian coffee frost of 1969, has been one of the contributing factors to this happy state of affairs), high growth and stability, especially external stability, seem unattainable for the major developing Latin American economies at their present capacity-creation stage.
(I-5) than the slow case: 7.5 percent average rate of growth versus 6.8 percent for 1971–1976. This means that the size of the internal market—commonly blamed for the high industrial average fixed costs and for being the bottleneck of industrial development—can be enlarged by aggressive public investment. Apparently, the argument should be reversed in the long run: it is not the lack of consumption power that keeps Mexican industry small, with high fixed average costs. It is the lack of industrial growth, and especially efficient public industrial growth, that is mainly responsible for insufficient employment, income, and consumption. This is the case when the government assumes a leading industrial role, as in Mexico. Its initiative becomes the basic driving force of the system.

Private investment (I-10), a more passive element in capital formation, responds favorably to the better rate of economic growth stimulated by the government. In the fast calculation, it grows at an average rate of 7.1 percent compared with 4.7 percent in the slow case. In real terms, exports (I-19) and imports (I-20) differ slightly in the two simulations. In current prices, however, they differ substantially, as can be seen in (II-19) and (II-20). The net result is a much larger deficit in current account in the fast simulation (II-18). This shows that at the present stage of industrialization, Mexico's growth is partially financed by deficits in current account, of which productive imports take the largest share. The public deficit (not included in tables) grows at a much faster pace in the expansionary simulation. In 1976, it grows to $-31.88 billion, in comparison with $-22.73 billion in the slow case. In both cases, however, a fiscal impasse seems to be reached—especially in the fast simulation, where external and internal public debt are already growing at their limits. This clearly points toward the need for a fiscal reform that will permit sustained growth (somewhere between our two alternatives), while minimizing the impact on consumption and private investment. More progressivity in the higher levels of the income-tax scales seems to be a reasonable way of solving the fiscal impasse of Mexican growth.

We close the comparison by pointing out some facts that seem to remain basically unaltered in both simulations, during 1972–1976. The traditional Mexican structural imbalances in income distribution, in government finance, and in regional development stay almost unaffected.

1. The relative shares of labor and capital remain nearly constant, with labor getting one-third and capital two-thirds of national income. A slight gain for labor, however, appears in the expansionary economy. (Not shown in tables.)

2. The ratios of total and federal taxes to gross domestic product also remain essentially unaffected, 11 percent and 8.2 percent respectively. The nonfederal tax ratio stays at 2.7 percent in both simulations.

3. The urban-rural gap will result in almost constant productive shares, with the urban sector accounting for 89 percent, and the rural for 11 percent, of GDP in both projections. The basic source and the consequences of this regional productive imbalance can be found in the capital formation and demographic tables, respectively (not included in this condensation). The disproportion in urban-rural capital-labor ratios will remain unaffected. On the average, the urban worker will have at least 7.5–8 times more real capital to work with than his rural
counterpart in both cases. The effects of the continuation of the productive gap will be to maintain a steady migratory flow to the urban centers (Mexico City, Guadalajara, Monterrey and towns bordering on the United States), with the consequent pressures on city facilities, enlargement of the “belts of poverty” around metropolitan areas, and growth of urban unemployment and underemployment.

A Final Word

In closing, we would like to formulate briefly our stand on some important questions commonly asked with regard to econometric models as empirical tools for the analysis of growth in the LDC’s.

Specification of developing-country models poses a challenge in building a new macro theory, but why go to the next step and create formal statistical models? Since we are in the economic-model business, we have thought often about this question and have formulated answers to the frequent charges that LDC data are poor in quality and sparsely available, and that economic behavior is erratic or irrational.

Economists are masters at working with poor and inadequate data. The issue for econometricians is to make as much systematic sense as possible out of sparse, “noisy” data. The basic statistical materials for the developing countries are, in many respects, like those we had to work with twenty or thirty years ago in the industrial countries. Our MDC models now stand on firmer footing as a result of all the spadework of the intervening years.

Economic and social problems are so intractable that we should do everything possible to make gains in knowledge, no matter how modest. It is for modest, systematic gains that we are working with macromodels of LDC’s. The most sophisticated methods must be applied to eke out precious gains. Much of the sophistication concerns the attempt to obtain estimates of parameters that are consistent in the statistical sense of the term. This is extremely important because the most useful application of macromodels of the LDC economies is in simulations of long-term growth patterns. In such studies, biases (lack of consistency) build up over time and can throw decade growth results far off track.

Methods of dealing in modern econometrics with “undersized” samples have been developed, and it is with these methods in mind that we have tackled the empirical task of implementing this measurement of the econometric structure of Mexico. We hope that it can set a pattern for future econometric research in the rest of Latin America.

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13 The actual capital-labor ratios result in 15 to 16 times more capital per worker in the urban than in the rural sector for 1972-76. We have halved them in order to account for the lack of data on private rural capital.

14 It should be remembered that even the fast calculation does not reduce the present unemployment and underemployment rates—whatever they are in 1971. The only thing it does is to keep them constant over the period.