RESEARCH REPORT 50

GOVERNMENT EXPENDITURES ON AGRICULTURE AND AGRICULTURAL GROWTH IN LATIN AMERICA

Victor J. Elías

October 1985

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GOVERNMENT EXPENDITURES ON AGRICULTURE AND AGRICULTURAL GROWTH IN LATIN AMERICA

Victor J. Elías

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FOREWORD

Government expenditures are generally regarded as a major influence on the pace and pattern of agricultural development. Agricultural research, rural education, and development of a wide range of activities from fertilizer distribution to credit are commonly funded by government. Nevertheless, there have been few studies of government expenditures on agriculture and its effects on output.

This report by Victor Elías builds on his earlier report, *Government Expenditures on Agriculture in Latin America*, Research Report 23. In that report he presented a compilation of basic data for the analysis of government expenditures for 1950-80. In this report, he enlarges that data set.

Lags between expenditure and response and the varying complementarity and competitiveness between public and private expenditures on agriculture make it difficult to measure the effects of government expenditures on agricultural production accurately. Nevertheless, Victor Elías takes the step from describing government expenditures on agriculture to measuring those effects. His experience with measuring sources of growth has enabled him to determine that the effects of government expenditure on the growth of agricultural production are significant and to point to the particular value of expenditure on research and extension. He also shows that government expenditures complement private investment, rather than replace it.

Elías' preliminary work on how the objectives of governments are reflected in their agricultural expenditures points the way to further research that can enhance the usefulness his results have for policymakers. This report is a part of a major effort at the International Food Policy Research Institute to analyze how alternative strategies for development affect agriculture.

John W. Mellor

Washington, D.C.
October 1985

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Victor J. Elías

1

SUMMARY

The main objective of this research report is to evaluate how government expenditures affected agricultural output between 1950 and 1980 in nine Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, and Venezuela.

The methodology used is based on the sources-of-economic-growth and production function techniques. The two approaches require good measurement of the output and inputs that enter into agricultural performance.

The growth rate of agricultural output in Latin America in the period studied was matched only in West Asia. Agricultural output in Brazil, Costa Rica, and Venezuela grew at annual rates of between 4.4 and 4.9 percent. Colombia and Mexico had rates of 4.0 percent. Agricultural output grew more slowly in Argentina, Bolivia, Chile, and Peru, at annual rates of about 2.0 percent. Per capita rates were lower.

The growth of agricultural output in these countries changed often during the period under study. Contrary to expectations, this growth was less variable in the countries with the higher rates of growth.

The expansion of agricultural output was made possible, in part, by an expansion of the land input in all countries but Chile. For all Latin America the number of hectares increased at an average annual rate of 2.5 percent. This was partly a result of the increase in the number of livestock.

The average increase in output cannot be attributed completely to increases of traditional inputs (land, labor, and capital). For all nine countries, the total input (an aggregate index of land, labor, and capital) increased at an average annual rate of 2.1 percent. This leaves a residual of almost 40 percent of the growth of output unexplained.

There were major differences in the growth of output of different countries (from 1.9 to 4.9 percent per year as an average for the whole period 1950-80), but not in the rate of growth of total inputs (from 1.2 to 2.5 percent per year). This implies that the differences in output growth were caused by something other than differences in the total growth of inputs.

In seven out of nine countries, capital had the largest share in the rate of growth of total inputs. In the explanation of output growth, capital had the largest share in four countries, which all had lower rates of output growth. In the three countries with the highest rates of growth of output, the residual had the largest share in its explanation.

To describe the trends, size, and composition of government expenditures on agriculture (GEA), an aggregate concept of GEA is used. It includes expenditures on research, extension, administration, marketing, land reform, education, and health. This concept is also used as an indicator of one type of agricultural policy used by governments (called expenditure policy). Another is price policy.

This classification of government agricultural policies can help identify their effects on agriculture. But this division does have some shortcomings, such as when price policies also imply some government expenditures (for example, price controls that may require transfer payments).

Expenditure policies are believed to affect agriculture mainly by shifting the supply curve of agricultural output. Most price policies, on the other hand, affect agriculture without shifting the supply curve. (They could distort input prices and affect supply too.) These two types of policies are related through a budget restraint. This means that expenditures generated by price policies (a food subsidy, for example) decrease expenditures on research or irrigation. This has been observed in some Asian and African countries.

GEA has been analyzed through its aggregate behavior and changes in its composition. The rate of growth of aggregate GEA of countries for the whole period 1950-80 varied between 3.3 and 14.8 percent. The rate of growth of GEA in each country also differed in each decade, with a large decrease occurring in most countries after 1978.

In 1980, GEA per hectare varied between U.S. $9 (Argentina) and U.S. $538 (Venezuela). The average for the nine countries was about U.S. $200, a figure slightly smaller than the one for the United States (U.S. $244). GEA

per person employed in agriculture varied from U.S. $136 (Bolivia and Peru) to U.S. $1,000 (Venezuela). Average GEA per unit of labor for the nine countries was about U.S. $500, which is much less than the figure for the United States (U.S. $9,412). This reflects the much lower labor-land ratio in the United States. For all the countries the trend of GEA per unit of labor was much higher than the trend of GEA per hectare because the labor-land ratio decreased.

The highest shares of GEA were given to education and health. The next highest were for irrigation. The shares of land reform and research and extension came next.

Credit subsidies varied widely throughout the period under consideration. This variability was far higher than the variability of GEA. This suggests that farmers are more uncertain about the credit subsidy than about GEA, and, as theory suggests, this influences expectations about how they invest. The size of the credit subsidy was, in some years, as high as or higher than GEA.

An evaluation of the influence of government expenditure policies on agricultural growth was made using the sources-of-economic-growth methodology. The influence of GEA on agricultural growth can be seen in the 40 percent of this growth that was not explained by the growth of land, labor, and capital.

Twenty percent of that residual was explained by growth of the so-called modern inputs (irrigation, fertilizer, tractors, and so on) provided by the private sector. A similar share was explained by the growth of a public input, built from the GEA series. This public input is defined as a weighted average of past GEA (with geometrically declining weights). Other alternatives for defining it were explored, such as the use of current GEA or of only a component of GEA.

The average contribution of GEA to the rate of growth of output was around 0.25 percent, which is almost 7 percent of the growth of agricultural output. A higher contribution of GEA was seen in Colombia, Costa Rica, and Venezuela.

The contribution of GEA was higher when either irrigation or research and extension had the highest share of GEA. It was also found that the lower the rate of growth of agricultural output, the smaller the contribution of GEA to agricultural growth. Finally, there was a weak relationship between the contribution of the public input and the importance of the contribution of some private inputs. A positive relationship was found between the contribution of public inputs to agricultural growth and GEA per hectare.

In order to verify the "crowding out" hypothesis, which is that public investment may reduce private investment, the behavior of some components of GEA was related to traditional and modern inputs. There was a positive correlation between research and extension expenditures and the use of fertilizers and between land reform expenditures and the use of irrigation. There was also a small negative correlation between education and health expenditures and the use of labor. Evidence in favor of the "crowding out" hypothesis in agriculture was not found, except for labor. But that can be explained in part by the migration of labor to cities.

To check on the results from the sources-of-economic-growth methodology, production functions were fitted. First, a Cobb-Douglas production function was fitted to each country separately, with the public input treated as an additional input. The results show that the estimates of the parameters of all the inputs improve with the inclusion of public inputs; the effects of public inputs were, in general, positive; and the best definition of the public input is an aggregated one, computed as a weighted average of current and past GEA.

Next, a multiple production function using Klein's method was estimated to verify the relevance of aggregating output from crops and livestock. This approach improved the previous estimates, giving more reasonable values for output-input elasticities.

Lastly, a variable parameter model was estimated that pooled time-series and cross-section data to analyze the interactions between GEA and private, traditional inputs. Public inputs interacted positively with land and negatively with labor. This last result agrees with the other results of this report and could imply some kind of labor-saving technological change.

Finally, the exogeneity of GEA was studied by considering the effects of some policies on the share of GEA in the total government budget. Variables such as the share of agriculture in the gross domestic product, the share of the agricultural labor force in the total labor force, the terms of trade between agriculture and industry, the ratio between rural and urban wages, and the share of labor in agricultural output were examined. These variables explain most of the variability of the share of GEA in the total government budget. It was found that public policies were designed to increase agricultural growth objectives and to reach some income distribution targets.

2

INTRODUCTION

Government Policies

In recent years there has been much concern about government policies toward agriculture and their relevance for various goals. Most studies of these policies have paid attention to price policies designed to control agricultural production. They have focused on income distribution issues, either within agriculture or between agriculture and the rest of the economy. Studies of developing countries have also put some emphasis on the effects of government policies on agricultural growth.

In many developing countries agriculture is thought to be the main source of growth for manufacturing, making its contribution mainly through price policies. These price policies have produced, in general, low growth of agricultural productivity, and because of them, few modern inputs have been incorporated.

Besides price policies, governments use expenditure policies. These have also affected production, employment, and income distribution. Many studies have analyzed the production effects of certain kinds of government expenditures on agriculture (GEA). But few studies have analyzed the effects of GEA as a whole.

The research and extension components of GEA have received the most attention, with emphasis on the effects of these components, through estimated rates of return, on production. There have been suggestions that other effects of research and extension expenditures be looked at. These include effects on employment caused by technological changes these expenditures introduce, effects on income distribution within agriculture, and effects on income distribution between consumers and producers and among groups with different incomes. There has also been some study of the influence of research expenditures on consumption patterns and their influence, in turn, on nutrition.

The effects of research and extension expenditures on production can be influenced by the price distortions produced by price policies. T. W. Schultz has suggested that estimates of social rates of return on these kinds of government expenditures may be biased and that the interaction between price and expenditure policies can explain the low response of agricultural productivity in many developing countries to investment in research.[1]

Some price and expenditure policies also interact through restraints on the size of the government's budget because many price policies, such as food subsidies, become effective through government expenditures. For example, in many countries in Latin America, Africa, and Asia, food subsidies compete for funding with government expenditures, such as those on irrigation.

The study of the effects of GEA on agriculture has been approached from many directions. Some studies, such as the work of Huffman and Evenson, have used farm data to look at the effects of research, some price policies, and output composition.[2] Others have used more aggregated data to see whether different components of GEA are close substitutes in their effects on production.

There is a general belief that price policies are far more important than expenditure policies in their effects on agriculture in Latin American countries, so that concentrating on expenditure policies may seriously bias the estimates of its effects. The results of this study make that hypothesis seem too strong.

There have also been suggestions that the institutional arrangements by which governments provide certain services be

[1] Theodore W. Schultz, "Uneven Prospects for Gains from Agricultural Research Related to Economic Policy," in *Resource Allocation and Productivity: National and International Agricultural Research,* ed. Thomas M. Arndt, D. G. Dalrymple, and V. W. Ruttan (Minneapolis: University of Minnesota Press, 1977), pp. 578-589.

[2] Wallace E. Huffman and Robert E. Evenson, "U.S. Agricultural Productivity and Public Policy: A Many Input-Many Output System," Yale University, Economic Growth Center, New Haven, Conn., December 1982 (mimeographed).

studied in greater detail. This raises questions about whether market or nonmarket solutions provide these services optimally and how government institutions should be organized.

Other studies have looked at what determines GEA, regarding GEA as an endogenous variable. They have tried to explain government behavior and the determinants of tariff structures using similar techniques. These studies can be considered as complementary to the others in their econometrics, as they have helped identify specification errors that could bias the results.

Purposes and Coverage

This study extends the work done in *Government Expenditures on Agriculture in Latin America.*[3] In that report, homogeneous series of data on GEA were created for nine Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, and Venezuela. These countries contain more than 80 percent of both the income and population of the continent. Data from them provide a good basis on which to identify what determines GEA and how GEA affects agriculture.

This study examines and compares data for each of these countries. It reveals the behavior of GEA and its composition between 1950 and 1980. It also yields an estimate of how effective GEA is in increasing agricultural productivity, and it examines whether public expenditures increase total expenditures on agriculture.

GEA is examined in the aggregate. But data for individual crops are also looked at, and the trends of different inputs are considered. Some estimates of subsidies made through credit policies are given, which should give an idea of how important the size of GEA is when compared to other kinds of government support.

It is hoped that other scholars will find the methodology of this report useful and that the results will improve evaluations of government expenditure policies.

Related Studies

Scholarly interest in the determinants of GEA and in GEA's effects on agriculture has grown in recent years. Studies have tried to determine the shares of different components of GEA in total government expenditures. They have related total government expenditures to private consumption, gross domestic product, and past government expenditures. And they have classified GEA and measured its size in comparison to net farm income, the number of farms, total harvested area, and agricultural employment.[4] Other studies have looked at how government policies have affected agriculture, either as a whole or in part, looking at its effects on the production of specific products.[5]

Floyd examined the incidence of farm programs that restrict production, creating a model important to any attempt to analyze the effects of price and expenditure policies.[6] Krueger and Ruttan emphasized assistance to agriculture in their evaluation of the effects of economic assistance on the development of less-developed countries.[7]

Recently the Food and Agriculture Organization of the United Nations (FAO) published a report on its study of public expen-

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[3] Victor J. Elías, *Government Expenditures on Agriculture in Latin America,* Research Report 23 (Washington, D.C.: International Food Policy Research Institute, 1981).

[4] Alan A. Tait and Peter S. Heller, *International Comparisons of Government Expenditure,* Occasional Paper 10 (Washington, D.C.: International Monetary Fund, 1982); and Helson C. Braga and F. A. de Carvalho, "An Empirical Study of Public Expenditures: Brazil 1947-1978," paper presented at the Third Latin American Regional Meeting of the Econometric Society, Rio de Janeiro, July 19-21, 1981; and Clifton B. Luttrell, *Down on the Farm with Uncle Sam,* Original Paper 43 (Los Angeles: International Institute for Economic Research, 1983).

[5] Studies looking at agriculture more generally include Bruce L. Gardner, *The Governing of Agriculture* (Lawrence: The Regent Press of Kansas, 1981), which emphasizes the effects of GEA on income distribution; and Huffman and Evenson, "U.S. Agricultural Productivity," mentioned above. Studies looking at the effects of government policies on specific products include Gary W. Williams and Robert L. Thompson, "Brazilian Soybean Policy: The International Effects of Intervention," *American Journal of Agricultural Economics* 66 (November 1984): 488; and George S. Tolley, Vinod Thomas, and Chung Ming Wong, *Agricultural Price Policies and the Developing Countries* (Baltimore, Md.: Johns Hopkins University Press, 1982), p. 210, in which a model of milk production in Venezuela is developed.

[6] John E. Floyd, "The Effects of Farm Price Supports on the Return to Land and Labor in Agriculture," *Journal of Political Economy* 73 (April 1965): 148.

[7] Anne O. Krueger and Vernon W. Ruttan, *The Development Impact of Economic Assistance to LDCs,* 2 vols. (Minneapolis: Economic Development Center, 1983), pp. 9-66.

ditures on agriculture in developing countries for the period 1978-82.[8] This study is based on a 1982/83 survey of 95 countries, of which 20 are from Latin America. The FAO survey used planned budget data, reported directly by the countries. It classified the public expenditures as expenditures on development programs, research, and training. It also included current and capital expenditures, categories not used in this study, and it used a cross-section approach to try to explain the behavior of GEA.

[8] Food and Agriculture Organization of the United Nations, Policy Analysis Division, *Public Expenditures on Agriculture in Developing Countries 1978-82* (Rome: FAO, 1984).

3

METHODOLOGY

Several methodologies are used. Taken together, the results they provide give a reasonably complete picture of the relationship between GEA and agriculture. The sources-of-growth methodology is used to identify the main determinants of agricultural growth. By defining GEA as a public input flowing into agriculture, it can be used to show how GEA contributes to agricultural production.

The same concept of GEA is one of two used in the production function approach. The other is a concept of GEA as a stock. This approach is used to check the results of the sources-of-growth methodology. It also shows the effects of GEA that shift the supply of agricultural products, and it provides estimates of the rates of return of the components of GEA. One part of the production function approach, the variable parameter model, shows how GEA interacts with inputs from the private sector.

Lastly, regression analysis is used to show the relationship between GEA and some of its own determinants, such as agricultural output, total government expenditures, and the terms of trade between agriculture and the rest of the economy.

The Sources of Agricultural Growth

The sources-of-growth methodology has been applied to several countries in Europe, Asia, and the Americas.[9] The effects of government expenditures have been incorporated into it in several ways. Expenditures on education have been captured through a labor quality component, defined by the number of years of education of the labor force weighted by the relative wages that groups with different amounts of education receive. Other expenditures, such as those on research and development, have been captured directly through expenditure flows. Expenditures on health have been captured by estimates of the amount of health capital. (Improved health is reflected in higher lifetime earnings, which are expressed here as capital values.)

The sources-of-economic-growth methodology basically says that the rate of growth of output should equal the weighted average of the rates of growth of inputs (with the weights equal to the shares of the inputs in total output, assuming that factor markets are competitive).

This equality comes about either because the value of output is specified as equal to the income paid to the inputs, or because the production function establishes an equality between output and inputs in agriculture.

The production function for agriculture can be defined as

$$A = f(H, L, K), \qquad (1)$$

where

A = output of agriculture,
H = land input,
L = labor input, and
K = capital input.

[9] The pioneering work on sources of economic growth is Edward F. Denison, *The Sources of Economic Growth in the States and the Alternative Before Us* (New York: Committee for Economic Development, 1962). A discussion of the basic methodology used in this study can be found in Dale W. Jorgenson and Zvi Griliches, "The Explanation of Productivity Change," *Review of Economic Studies* 34 (July 1967): 249-282. Also see Mieko Nishimizu, "On the Methodology and the Importance of the Measurement of Total Factor Productivity Change: The State of the Art," World Bank, Development Economics Department, Washington, D.C., October 1979 (mimeographed); Victor J. Elías, "Sources of Economic Growth in Latin American Countries," *Review of Economics and Statistics* 60 (August 1978): 362-370; Lucio G. Reca and Juan Verstraeten, "La Formación del Producto Agropecuario Argentino: Antecedentes y Posibilidades," *Desarrollo Económico* 17 (October-December 1977): 371-389; Alberto Valdés, "Commercial Policy and Its Effects on the External Agricultural Trade in Chile, 1944-65" (Ph.D. dissertation, London School of Economics and Political Science, 1971); Ramiro Orozco, "Sources of Agricultural Production and Productivity in Colombian Agriculture" (Ph.D. dissertation, Oklahoma State University, 1977); and Reed Hertford, *Sources of Change in Mexican Agricultural Production, 1940-65*, Foreign Agricultural Economic Report 73 (Washington, D.C.: U.S. Department of Agriculture, 1971).

Each variable is for time t.

Assuming competition in the factor markets, an expression for the rate of change of A can be derived:

$$a = w_H\, h + w_L\, l + w_K\, k + g, \qquad (2)$$

where

w_H = the share of land in agricultural output,
w_L = the share of labor in agricultural output, and
w_K = the share of capital in agricultural output.

The small letters h, l, and k represent the rates of change of the corresponding variables, defined as the change in the natural logarithm of a variable between periods t and t−1.

Equation (2) gives a basis for accounting for the growth of agriculture. The contribution of each input to the growth of output is measured by the product of the rate of change of the input in the corresponding period and the share of the input in total output.

The production function as defined in equation (1) includes only three traditional inputs: land, labor, and capital. A more complete account of agricultural growth should include other private inputs, such as fertilizers, irrigation, and new seeds. But this analysis will incorporate the other inputs later. This approach will not bias the results, which are additive, so the contribution of each input can be analyzed separately (except for some interactions not considered for lack of data).

The letter g in equation (2) represents the contribution that is not explained by the three inputs included. It may represent the contribution of other inputs; changes in the quality of land, labor, or capital; technological changes that are not included in the changes in the qualities of the inputs; characteristics of the production function, such as economies of scale; changes in the rate of use of the capacity of each input; externalities from other parts of the economy; or distortions in the factor markets.

The Public Input

The public input can be defined simply as a weighted average of past values of GEA, with the weights depending on the rate of depreciation of GEA. Geometrically declining weights can be used, with the rate of depreciation equal to 5 percent for all components of GEA. Then,

$$G(t) = G(t-1) + GEA(t) - 0.05\ G(t-1),$$

where G(t) is the public input in period t. To simplify it,

$$G(t) = 0.95\ G(t-1) + GEA(t). \qquad (3)$$

This method of defining the public input is similar to the inventory approach used to measure the stock of physical capital and such concepts as health capital and the stock of technology.

In order to estimate the annual public input, an initial value or a benchmark year is needed. The inventory approach suggests the use of a multiple of an average of GEA around the benchmark year. Which multiple is used depends on the rate of depreciation and on the rate of growth of the stock of the public input around the initial year.

The public input can be defined as simply aggregate GEA, including all expenditures. Each component of the public input can also be treated separately. The aggregate definition is acceptable if there are no big changes in the composition of GEA. Separate treatment of each component is proposed because rates of depreciation, or efficiency, differ and because the shares of the components in total GEA change. Another approach would be to separate current and capital expenditures. But the more detailed breakdown by component accomplishes the same thing this approach would.

The public input is depreciated because some of its components, such as irrigation, are physical capital. For other components, like research, the depreciation may represent a rate of obsolescence. The other possibility is to assume that, instead of depreciating, the components are suddenly retired. It is then necessary to define the year retirement occurs.

Other weights can be used. Some econometric studies of physical capital find it appropriate to use increasing weights during the first three years and decreasing weights thereafter.[10]

[10] Zvi Griliches, "Data and Econometrics: The Uneasy Alliance," paper presented at the Fourth Latin American Regional Meeting of the Econometric Society, Santiago, July 19-22, 1983 (mimeographed).

G is defined as aggregate GEA. If important changes occur in its composition, the sources-of-growth methodology provides a measurement of the contribution to growth of those changes. Defining each component of G as G_i, the services per unit of G_i as s_i, the weighted average of s_i as s, and the output-public input elasticity of G as w_G, the contribution of G to agricultural growth (a_G) is

$$a_G = w_G\, r(G) + w_G \Sigma_i (s_i/s)\, d(G_i/G), \qquad (4)$$

where r(G) is the rate of change of G and $d(G_i/G)$ is the change in the proportion of G_i in G.

The second part of the right-hand side of equation (4) measures the importance of the changes in the composition of G. The whole equation is similar to equations that measure changes in quality of land, labor, and capital.

The Production Function Approach

GEA includes several kinds of expenditures, all of which should be considered conceptually as inputs in agricultural production. The components of GEA are generally recognized as being related to production, either as additional inputs, or as parts of other inputs. In order to put GEA into the production function as an input, the concept of the public input, G, is used as it was above.

The Cobb-Douglas production function is used. So is a variable parameter model and a multiple production function. The variable parameter model provides an alternative way of incorporating the public input in the production function. The multiple production function tests the adequacy of aggregating crop and livestock production together.

Cobb-Douglas Production Function

The Cobb-Douglas production function, in logarithmic form, is

$$\ln A_i(t) = a_i + b_i \ln H_i(t) + c_i \ln K_i(t) + d_i \ln L_i(t) + \ldots + m_i \ln G_i(t) + u_i(t), \qquad (5)$$

where the variables have the same meaning as before. The subindex i stands for the countries (1 to 9), and the subindex t for the time period (1950-80). The variable u_i represents the stochastic term for country i. The coefficients—$b_i, c_i, \ldots m_i$— are the output-input elasticities.

Equation (5) is estimated separately for each country using ordinary least squares. Only land, labor, and capital are included at first; the remaining inputs are introduced later. When they are, they show the effects of the public input and of modern inputs.

Multiple Production Function

The multiple production function is used to verify specification errors in the production function estimates that arise from aggregating the components of agricultural production. One such error could lie in the assumption, implied by such an aggregation, that crops and livestock are perfect substitutes. The data from most of the countries disaggregate output by crops and livestock but not by inputs, except for some data on government expenditures on research and extension. So it is not now possible to estimate separate production functions for crops and livestock.[11]

This multiple production function follows the Cobb-Douglas specification:

$$\ln A(t) = a + b \ln H(t) + c \ln K(t) + d \ln L(t) + e \ln B(t) + u(t), \qquad (6)$$

where A is the output of crops and B is the output of livestock.

The Cobb-Douglas function for outputs is not appropriate for competitive markets such as agricultural markets because it has a convex form, whereas competitive markets require concave functions. But if agriculture is taken as an aggregate, a case can be made for accepting the Cobb-Douglas form. In similar cases the cost curve for an industry could decline even if the curves for the firms do not. Also, in the Houthakker case, even if each firm has a fixed coefficient production function, the industry as an aggregate could end up with a Cobb-Douglas form.

In order to fulfill the convexity assumption for multiple output, other production

[11] Orozco, "Sources of Agricultural Production," does estimate separate production functions for crops and livestock in Colombia.

functions are explored. The results of the CES (constant elasticity of substitution between outputs) form are no different than the results of the Cobb-Douglas function. The translog multiple production function, which is usually estimated indirectly through profit functions, requires data on the prices of the services of each input. Such data are not available.

Equation (5) is estimated using Klein's method.[12] This method is designed to produce consistent estimates of the corresponding parameters, and it uses the conditions for cost minimization in equation (6). A complete description of the method and other alternatives is presented in Appendix 1. To summarize, to obtain estimates of the different parameters, in cost minimization conditions, a relationship is established between the contributions of inputs to total output and the corresponding parameters. Then data on the income shares of land, labor, and capital are used to obtain consistent estimates of b/d and c/d. From these, the variable I(t), aggregate input, is constructed, based on equation (6):

$$I(t) = \ln L(t) + (b/d) \ln H(t) + (c/d) \ln K(t). \quad (7)$$

Applying ordinary least squares,

$$I(t) = -(a/d) + (1/d) \ln A(t) - (e/d) \ln B(t) - (1/d) \ln u(t), \quad (8)$$

and estimates of a, b, c, d, and e can be obtained.

Variable Parameter Model

An alternative way to introduce the public input in the production function is the variable parameter model. The public input, G, is entered in this model as a variable affecting the output elasticities of the other inputs.

A variable parameter model for the Cobb-Douglas production function has the following form:

$$\ln A_i(t) = [a_i + a_{iG} \ln G_i(t)] + [b_i + b_{iG} \ln G_i(t)] \ln H_i(t) + [c_i + c_{iG} \ln G_i(t)] \ln K_i(t) + [d_i + d_{iG} \ln G_i(t)] \ln L_i(t) + u_i(t). \quad (9)$$

All the parameters in equation (9) are variable and depend on G. According to this formulation, production can vary with time or between countries, and this variability is explained in part by G.

Equation (9) can be estimated using this form:[13]

$$\ln A_i(t) = a_i + a_{iG} \ln G_i(t) + b_i \ln H_i(t) + c_i \ln K_i(t) + d_i \ln L_i(t) + b_{iG} \ln G_i(t) \ln H_i(t) + c_{iG} \ln G_i(t) \ln K_i + d_{iG} \ln G_i(t) \ln K_i(t) + u_i(t). \quad (10)$$

The first part of equation (10) is like the common Cobb-Douglas production function. The second part includes the product of G and the other inputs, which can be considered as interaction terms.

Assuming that returns to scale are constant, the following conditions for the parameters should be included:

$$b_i + c_i + d_i + b_{iG} \ln G_i(t) + c_{iG} \ln G_i(t) + d_{iG} \ln G_i(t) = b_i + c_i + d_i + (b_{iG} + c_{iG} + d_{iG}) \ln G_i(t) = 1. \quad (11)$$

These mean that some connection between the coefficients of the interaction terms can be expected.

The random term $u_i(t)$ stands for differences through time and between countries that cannot be explained by G. The method of estimation chosen depends on the assumptions made about these differences.

Determinants of GEA

Some regression equations are used to verify the degree of exogeneity of expenditure policies. They also help find determinants of the ratio of GEA to total government expenditures.

[12]Lawrence R. Klein, *A Textbook of Econometrics* (New York: Row, Peterson and Company, 1953), p. 281.

[13]For a discussion of variable parameter models, see Yair Mundlak, "Models with Variable Coefficients: Integration and Extension," *Annales de L'INSEE* (No. 30-31, 1978): 483-509. See also Zvi Griliches, "Estimates of the Aggregate Agricultural Production Function from Cross-Sectional Data," *Journal of Farm Economics* 45 (May 1963): 419-428.

One such equation is

$$\ln(GEA/GE)_t = a + b\,(A/GDP)_t + c\,(P_A/P_I)_t + d(w_A/w_I)_t + e\,P_{AW_t} + f\,S_{LA_t} + g\,(L_A/L)_t + u_t. \quad (12)$$

where

GEA/GE = the share of GEA in total government expenditures,

A/GDP = the share of agriculture in the gross domestic product,

P_A/P_I = the terms of trade between agricultural and industrial products,

w_A/w_I = the ratio between agricultural and industrial wages,

P_{AW} = the world price of important crops in real terms,

S_{LA} = the share of labor in agricultural output, and

L_A/L = the share of the agricultural labor force in the total labor force.

The signs expected for the parameters in equation (12) depend on the objectives of the government. A government can set its policies to attain any of its objectives; for example, to promote agricultural growth; to equalize income distribution between agriculture and the rest of the economy; or to stabilize farm income. If the last is the objective, the effects of P_A/P_I and P_{AW} can be expected to be positive. If promoting growth is the objective, the coefficient for A/GDP, b, should be positive and greater than 1. The signs for the other parameters depend on how the objectives affect the income distribution. They will be negative if one objective is to support a given contribution of labor to agricultural output.

If government expenditures are not exogenous, the production function should be established jointly with equation (12). This may complicate the approach proposed.

The exogeneity of GEA can also be studied using causality tests suggested by Granger and Sims.[14] These tests are designed mainly for two variables, GEA/GE and A/GDP, for example, each regressed on its own past values and the future values of the other. Which variable causes the values of the other to be what they are is shown by the significance of the coefficients of the future values. Such an exogeneity test, however, is more appropriate for quarterly data. For more than two variables, the vector autoregression technique was proposed by Sims and by Sargent.[15] This approach is also more appropriate for quarterly data than for the annual data used here.

[14] See Christopher Sims, "Money, Income, and Causality," *American Economic Review* 62 (September 1972): 540-552; and C. W. S. Granger, "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica* 37 (July 1969): 424-438, cited in Sims, "Money, Income, and Causality."

[15] Ibid.; and Thomas J. Sargent, "Estimating Vector Autoregression Using Methods Not Based on Explicit Economic Theories," *Quarterly Review of the Federal Reserve Bank of Minneapolis*, Summer 1979, pp. 8-15.

4

GROWTH OF AGRICULTURE

Growth of Output

The growth of aggregate agricultural output (crops and livestock) in the nine Latin American study countries between 1950 and 1980 was moderate. The annual rate of growth ranged from 1.9 percent in Chile to 4.9 percent in Venezuela, and it averaged 3.2 percent for all nine (see Table 1). When broken down by decades, the range was 0.0 to 5.7 percent. These growth rates compare favorably with the rates of other regions. The growth rate of agricultural output between 1950 and 1980 was 3.4 percent in West Asia, 2.5 percent in Eastern Europe, 2.4 percent in South Asia, East Asia, and Africa, 2.2 percent in Western Europe, and 2.1 percent in the United States.[16]

The per capita growth rate of agricultural output compared less well. It was 1.8 percent in Eastern Europe and 1.5 percent in Western Europe, but only 0.5 percent in Latin America.[17] Four of the nine countries studied—Brazil, Colombia, Costa Rica, and Venezuela—had per capita growth rates higher than 1 percent. Bolivia, Chile, and Peru had negative per capita rates of growth (see Table 2).

Livestock production grew faster than crop production in Brazil, Mexico, Peru, and Venezuela, but the opposite was true in Argentina. Both sectors grew at similar rates in Colombia. Only Brazil and Mexico showed large discrepancies between the growth of both sectors (livestock increased its share in total agricultural output from 24 to 38 percent in Brazil, and from 28 to 42 percent in Mexico).

A crude measure of the variability of total agricultural output—the sign of the growth rate of output—shows that variability was high in Argentina, Bolivia, Chile, and Peru (in almost 30 percent of the years between 1950 and 1980 the growth rate was negative). But the variability was exceptionally low in Brazil, Costa Rica, Colombia, and Venezuela (the growth rate was negative in less than 10 percent of the years between 1950 and 1980).

Growth of Inputs

As in other parts of the economy, the basic inputs used in agriculture are land, labor, and capital. Other inputs in agriculture in-

Table 1—Average compound growth rate of agricultural output, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
		(percent/year)		
Argentina	1.6	2.3	2.5	2.1
Bolivia	0.0	1.6	5.1	2.0
Brazil	4.4	4.4	4.9	4.5
Chile	1.8	2.1	1.9	1.9
Colombia	3.3	3.5	5.1	3.9
Costa Rica	5.0	5.7	2.8	4.4
Mexico	4.4	3.8	3.0	3.8
Peru	2.0	3.2	0.9	2.0
Venezuela	5.4	5.3	4.0	4.9

Sources: Derived from Appendix 2, Tables 27-35.

Table 2—Average compound growth rate of agricultural output per capita, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
		(percent/year)		
Argentina	−0.2	0.9	1.2	0.6
Bolivia	−2.1	−0.9	2.4	−0.4
Brazil	1.4	1.5	2.1	1.6
Chile	−0.4	0.0	0.2	−0.1
Colombia	0.2	0.5	2.8	1.1
Costa Rica	1.3	2.3	0.3	1.9
Mexico	1.2	0.7	−0.3	0.6
Peru	−0.6	0.4	−1.8	−0.7
Venezuela	1.5	1.9	1.0	1.4

Sources: Derived from Appendix 2, Tables 27-35.

[16] U.S. Department of Agriculture, *World Indices of Agricultural and Food Production, 1972-81* (Washington, D.C.: U.S. Department of Agriculture, 1982).

[17] Ibid.

clude irrigation, fertilizers, seeds, tractors, education, research and extension, and draft animals. These can be used to indicate the quality of land, labor, or capital, but it is more convenient to consider them separately.

Basic Inputs

During the 1950-80 period, the amount of cropped land used in agricultural production grew at an annual rate of about 2 percent in most Latin American countries (see Table 3). It grew faster in Brazil, more than 3 percent, and more slowly in Argentina and Peru. Only in Chile did it not grow at all. Most countries added land to agricultural production at a faster rate during the 1950s than later. But Mexico added it at a faster rate in the 1960s, and Colombia added it at a faster rate in the 1970s.

The number of people in the agricultural labor force grew at an average rate of about 1 percent in most countries during the whole period (see Table 4). It grew about 2 percent annually in Brazil and Venezuela, but not at all in Argentina and Chile. The growth rate was positive for all countries during the 1950s, but negative for two in the 1960s and three in the 1970s.[18] These rates reflect the patterns of migration from rural to urban areas observed in most of these countries.

The amount of capital used in agriculture increased at an average rate of between 2 and 4 percent a year in all but three of the study countries between 1950 and 1980 (see Table 5). It grew at a faster rate in Mexico and Chile and at a slower rate in Peru. But the range of variation of the rates of growth of the three basic inputs was within the range of variation of the rate of growth of total output (between 1.9 and 4.9 percent).

Modern Inputs

Estimates of the rates of growth of modern inputs are much weaker than the estimates made for traditional inputs. The main problem is that the units of measure for modern inputs differ greatly, making them hard to compare. The number of tractors used grew rapidly in most countries, ranging from 3.4 percent per year in Bolivia to 12.6 percent per year in Brazil (see Table 6). This high rate of growth was particularly evident in the 1950s, when investment in tractors began. Similarly, the amounts of fertilizer used grew rapidly, between 5 and 17 percent annually over the whole period in all countries except Chile (see Table 7). The rates of growth of both inputs fluctuated widely,

Table 3—Average compound growth rate of the land input in agriculture, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
	(percent/year)			
Argentina	1.74	0.78	−0.34	0.73
Bolivia	n.a.	n.a.	3.10	2.33
Brazil	3.89	3.53	2.58	3.36
Chile	0.88	−0.90	0.00	−0.01
Colombia	2.28	0.98	2.58	1.92
Costa Rica	2.97	1.56	0.00	1.51
Mexico	2.32	2.69	1.25	2.09
Peru	1.82	0.90	0.03	0.94
Venezuela	2.79	2.12	0.62	1.84

Sources: Derived from Appendix 2, Tables 27-35.
Notes: Land was measured in hectares. In Argentina and Costa Rica, it included cropland and cultivated pasture land. In the other countries, it only included cropland. Most of the data were for harvested land only. Where n.a. appears, the data were not available.

Table 4—Average compound growth rate of the labor input in agriculture, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
	(percent/year)			
Argentina	0.52	1.29	−0.11	0.15
Bolivia	n.a.	1.25	1.33	1.29
Brazil	1.68	1.17	3.60	1.86
Chile	0.90	−1.34	−1.94	−0.88
Colombia	1.17	1.18	−0.65	0.65
Costa Rica	2.38	0.89	0.94	1.40
Mexico	2.42	−1.80	0.83	0.73
Peru	1.21	1.85	1.11	1.39
Venezuela	1.77	2.11	0.94	1.61

Sources: Derived from Appendix 2, Tables 27-35.
Notes: The labor input was measured as the number of people in the agricultural labor force. Where n.a. appears, the data were not available.

[18] Domingo Cavallo and Yair Mundlak, *Agriculture and Economic Growth in an Open Economy: The Case of Argentina*, Research Report 36 (Washington, D.C.: IFPRI, 1982); Juan Coeymans and Yair Mundlak, "Productividad Endogena y la Evolución de la Producción y Empleo Sectorial en Chile," paper presented at the Fourth Latin American Regional Meeting of the Econometric Society, Santiago, Chile, July 19-22, 1983 (mimeographed).

Table 5—Average compound growth rate of the capital input in agriculture, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
	(percent/year)			
Argentina	1.70	1.49	2.99	2.09
Bolivia	2.11	3.23	6.91	3.98
Brazil	1.78	1.63	5.49	2.94
Chile	8.37	3.71	2.00	4.69
Colombia	0.54	3.64	5.64	3.27
Costa Rica	n.a.	4.61	2.35	3.48
Mexico	4.56	5.11	1.56	4.14
Peru	0.35	0.08	2.46	0.97
Venezuela	4.38	4.69	1.23	3.59

Sources: Derived from Appendix 2, Tables 27-35.
Notes: The capital input is measured as the value of the stock of fixed capital. It includes agricultural equipment, farm construction, and land improvement. It does not include livestock. Where n.a. appears, the data were not available.

which can be explained, in part, by changes in trade policies. Another explanation for tractors is that, because they are durable goods, demand for their use is variable.

The annual rate of growth of the number of hectares irrigated was not as high in the countries for which data were available. In Chile and Peru the average annual rate of growth of irrigation for the whole period was about 1 percent (see Table 8). In Mexico and Colombia it was 4 percent. Other measures

Table 6—Average compound growth rate of the stock of tractors in agriculture, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
	(percent/year)			
Argentina	20.18	5.75	1.55	9.16
Bolivia	3.04	−0.12	7.34	3.42
Brazil	19.92	9.95	7.30	12.56
Chile	11.31	3.39	−0.39	4.77
Colombia	10.36	3.62	0.11	5.03
Costa Rica	21.97	0.75	1.62	8.11
Mexico	7.57	3.24	2.66	4.49
Peru	9.09	4.15	2.40	5.21
Venezuela	12.12	4.25	7.29	7.89

Sources: Derived from Appendix 2, Tables 27-35.
Notes: The data are for the number of tractors except for Argentina, where homogeneous horsepower is used.

Table 7—Average compound growth rate of fertilizer use, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
	(percent/year)			
Argentina	−4.63	15.39	5.11	7.77
Bolivia	n.a.	n.a.	n.a.	n.a.
Brazil	12.12	8.28	18.13	12.82
Chile	8.00	4.19	−2.71	3.16
Colombia	15.29	7.69	7.50	10.16
Costa Rica	n.a.	n.a.	n.a.	n.a.
Mexico	26.69	11.59	9.36	16.60
Peru	n.a.	n.a.	5.03	n.a.
Venezuela	n.a.	17.70	14.98	n.a.

Sources: Derived from Appendix 2, Tables 27-35.
Notes: Fertilizer use is measured in metric tons of nutrients per year. Where n.a. appears, the data were not available.

of irrigation than the number of irrigated hectares can be used, such as the amount of water provided per year. But they were not because less information was available.

The annual rate of growth of the number of draft animals was fairly stable. It was closer to that of output than the others. For the whole period, it fluctuated between 1.01 and 4.96 percent (see Table 9).

Share of Inputs in Output

Data on the shares of each input in agricultural output are used to aggregate the

Table 8—Average compound growth rate of irrigation, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
	(percent/year)			
Argentina	n.a.	n.a.	n.a.	n.a.
Bolivia	n.a.	n.a.	n.a.	n.a.
Brazil	n.a.	n.a.	n.a.	n.a.
Chile	1.55	0.64	1.31	1.28
Colombia	8.35	4.00	0.94	4.43
Costa Rica	n.a.	n.a.	n.a.	n.a.
Mexico	7.13	3.50	2.65	4.43
Peru	n.a.	n.a.	n.a.	0.84
Venezuela	n.a.	6.54	5.00	n.a.

Sources: Derived from Appendix 2, Tables 27-35.
Notes: Irrigation is measured as the number of hectares of irrigated land. Where n.a. appears, the data were not available.

Table 9—Average compound growth rate of the number of draft animals used in agriculture, 1950-80

Country	1950-60	1960-70	1970-80	1950-80
		(percent/year)		
Argentina	0.73	1.39	1.76	1.21
Bolivia	1.73	−1.42	5.54	1.95
Brazil	1.72	3.43	3.66	2.94
Chile	2.17	0.26	2.23	1.55
Colombia	0.78	2.98	3.25	2.30
Costa Rica	6.04	5.07	3.76	4.96
Mexico	1.17	3.80	3.00	2.63
Peru	2.11	1.34	−0.41	1.01
Venezuela	1.61	2.02	2.46	2.03

Sources: Derived from Appendix 2, Tables 27-35.

Table 10—Income distribution: share of labor in agricultural output, selected years, 1950-80

Country	1950	1960	1970	1980
		(percent)		
Argentina	34.3	22.2	31.7	n.a.
Bolivia[a]	n.a.	38.4	37.3	39.2
Brazil	34.9	34.9	34.9	n.a.
Chile	n.a.	38.2	45.3	n.a.
Colombia	37.9	31.8	30.1	25.3
Costa Rica	49.9	47.3	42.8	38.6
Mexico[a]	25.0	32.5	37.1	41.3
Peru	n.a.	n.a.	19.1	17.6
Venezuela[a]	48.0	48.7	42.7	41.9

Sources: Derived from Appendix 2, Tables 27-35.
Note: Where n.a. appears, the data were not available.
[a] These estimates are for the economy as a whole, not just agriculture.

inputs and to create a total input index. As the basic data come from national accounts, it is only possible to get estimates for the traditional inputs. The data for these are scarce.

In the national accounts the value of output was distributed between labor income, which includes only the wages and salaries of people formally employed, and nonlabor income. Although this classification may be useful for analysis of other parts of the economy, it creates problems when used for agriculture. In agriculture self-employed labor can be important, so this classification system may result in an underestimation of the share of labor.

The importance of the self-employed in the estimates of the contribution of labor to output can be seen in the share of the self-employed in the total agricultural labor force. In 1974-77 this was 46.8 percent for Argentina, 74.6 percent for Brazil, 38.2 percent for Chile, 51.0 percent for Mexico, 77.7 percent for Peru, and 72.3 percent for Venezuela.[19]

If the self-employed were taken into account, the contribution of labor, given in Table 10, would be more than 60 percent for most countries and more than 70 percent for some, such as Peru.

Partial Productivity: Output-Land Ratio

The partial productivity is the ratio between output and the corresponding input. It is a descriptive measure that gives an indication of the effects technological change have (assuming little change in the composition of inputs).

The output-land ratio is, by definition, a weighted average of the yields of different crops. It is, therefore, an average for all agriculture. It can show whether an increase in output is caused by an increase of the amount of land or of the land's productivity.

The annual rate of growth of the output-land ratio for the whole period 1950-80 was highest in Venezuela, more than 3 percent, and Costa Rica, 2.5 percent (see Table 11). It was 2 percent in Colombia and Mexico, and negative only in Bolivia. A comparison of the aggregate output-land ratios with the rate of growth of yields of some products can be used to check the former.

Indeed, the figures for the annual rate of growth of the yields for different products in Colombia, Mexico, and Venezuela are in

[19] See Lyn Squire, *Employment Policy in Developing Countries: A Survey of Issues and Evidence* (Oxford: Oxford University Press, 1981), p.86. See also similar estimates for urban areas in Philip Musgrove, *Consumer Behavior in Latin America* (Washington, D.C.: The Brookings Institution, 1978), pp. 41-44.

Table 11—Indexes of the output-land ratio in agriculture for selected years and the average compound growth rate of the output-land ratio, 1950-80

Country	1950	1960	1970	1980	1950-80
			(percent/year)		
Argentina	100.0	101.9	120.4	151.9	1.4
Bolivia	100.0	n.a.	n.a.	98.2	−0.1
Brazil	100.0	104.2	112.7	143.0	1.2
Chile	100.0	107.8	145.5	172.7	1.8
Colombia	100.0	111.7	145.8	187.1	2.1
Costa Rica	100.0	121.0	171.8	203.4	2.5
Mexico	100.0	127.2	140.8	183.2	2.0
Peru	100.0	104.5	133.1	142.5	1.2
Venezuela	100.0	147.2	194.5	272.4	3.3

Sources: Derived from Appendix 2, Tables 27-35.
Notes: For the indexes, 1950 = 100. Cropped land data were used for all countries except Argentina and Costa Rica because it is difficult to find good estimates of the amount of pasture. Where n.a. appears, the data were not available.

agreement with the estimates presented for all of agriculture (see Tables 11 and 12). The rates of growth of yields for the same product in different countries vary widely. So do the rates of growth of different products in a given country.

If the output-land ratio is computed for livestock alone, its behavior will not differ much from the figures presented in Table 11. But for livestock the rate of slaughter (the output-livestock ratio) is also important. In Argentina this rate varied about 20 percent in the period 1950-76, without showing any definite trend. Something similar happened in Costa Rica, where the rate of slaughter averaged about 15 percent.

The Sources of Agricultural Growth

The results of equation (2), presented in Table 13, show the contributions of land, labor, and capital to the growth of output by decades and for the whole 1950-80 period. These results are similar to the results of other studies of the United States and of economies in Europe, Asia, and Latin America.

The table shows that for six of the nine countries high values of the rate of growth of output are matched by high values of the rate of growth of total input. Countries with much higher rates of growth of total output have much higher rates of growth of individual inputs. There is some substitution between the different inputs, which is reflected in the variability of the capital-labor, capital-land, and land-labor ratios. Lastly, changes in the rate of growth of output and changes in the rate of growth of total input follow similar patterns.

Table 14 and Figure 1 show how important each input was in the growth of agriculture for the whole period 1950-80. Land contributed between 0.0 percent in Chile and 16.3 percent in Bolivia; growth of agricultural labor contributed between −18.4 percent in Chile (because the rate of growth of labor was negative) and 35.0 percent in Peru; and capital contributed between 11.7 percent in Brazil

Table 12—Average compound growth rate of the yields of selected crops, 1950-80

Country	Bananas	Coffee	Corn	Cotton	Rice	Sugarcane	Wheat
				(percent/year)			
Argentina	. . .	. . .	2.9	. . .	. . .	. . .	0.1
Bolivia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Brazil	. . .	−1.3	0.5	1.6	. . .	1.2	0.2
Chile	. . .	. . .	0.6	. . .	. . .	. . .	0.5
Colombia	. . .	0.5	1.8	. . .	2.6	2.8	2.0
Costa Rica	0.2	1.7	3.3	. . .	5.0	. . .	. . .
Mexico	. . .	. . .	2.4	3.9	2.1	. . .	5.2
Peru	. . .	1.4	1.1	1.1	0.4	. . .	0.0
Venezuela	. . .	. . .	1.7	3.4	4.1	1.3	. . .

Sources: Derived from Appendix 2, Tables 27-35.
Notes: Where . . . appear, the crop was not considered for that country. Where n.a. appears, the data were not available.

Table 13—Average annual growth rates of agricultural output, total inputs, and the contributions of traditional inputs and the residual, by decade, 1950-80

Output and Sources of Growth	Argentina	Bolivia	Brazil	Chile	Colombia	Costa Rica	Mexico	Peru	Venezuela
					(percent/year)				
1950-60									
Output	1.60	0.00	4.40	1.80	3.30	n.a.	4.40	2.00	5.40
Total inputs	1.94	n.a.	1.91	4.33	1.00	n.a.	1.20	0.96	3.00
Land	0.26	n.a.	0.35	0.12	0.36	0.36	0.35	0.22	0.36
Labor	0.18	n.a.	1.01	0.36	0.35	1.19	0.85	0.61	0.80
Capital	1.50	0.97	0.55	3.85	0.29	n.a.	2.00	0.13	1.84
Residual	−0.34	n.a.	2.49	−2.53	2.30	n.a.	3.20	1.04	2.40
1960-70									
Output	2.30	1.60	4.40	2.10	3.50	5.70	3.80	3.20	5.30
Total inputs	1.81	n.a.	1.53	1.04	2.48	2.39	0.54	1.07	3.20
Land	0.12	n.a.	0.32	−0.13	0.16	0.19	0.40	0.11	0.28
Labor	0.19	0.50	0.70	−0.54	0.35	0.45	−0.63	0.93	0.95
Capital	1.50	1.49	0.51	1.71	1.97	1.75	0.77	0.03	1.97
Residual	0.49	n.a.	2.87	1.06	1.02	3.31	3.26	2.13	2.10
1970-80									
Output	2.50	5.10	4.90	1.90	5.10	2.80	3.00	0.90	4.00
Total inputs	1.41	n.a.	n.a.	0.14	3.26	1.36	n.a.	1.49	3.00
Land	−0.05	0.43	0.23	0.00	0.41	0.00	0.19	0.00	0.08
Labor	−0.04	0.95	2.16	−0.78	−0.20	0.47	0.29	0.56	0.42
Capital	1.50	n.a.	n.a.	0.92	3.05	0.89	n.a.	0.93	0.52
Residual	1.09	n.a.	n.a.	1.76	1.84	1.44	n.a.	−0.59	1.00
1950-80									
Output	2.10	2.00	4.50	1.90	3.90	4.40	3.80	2.00	4.90
Total inputs	1.66	2.09	1.95	1.81	2.28	2.20	1.96	1.18	2.47
Land	0.11	0.33	0.30	0.00	0.31	0.18	0.31	0.11	0.24
Labor	0.05	0.53	1.12	−0.35	0.20	0.70	0.26	0.70	0.72
Capital	1.50	1.23	0.53	2.16	1.77	1.32	1.39	0.37	1.51
Residual	0.44	−0.09	2.55	0.09	1.62	2.20	1.84	0.82	2.43

Sources and notes: Derived from Appendix 2, Tables 27-35. Where n.a. appears, the data were not available. The contribution of each input (land, labor, and capital) to the growth of output is equal to the product of its rate of growth and its contribution to total output. The contributions of land, labor, and capital, respectively, for each country were for Argentina, 15, 35, and 50; for Bolivia, 14, 40, and 46; for Brazil, 9, 60, and 31; for Chile, 14, 40, and 46; for Colombia, 16, 30, and 54; for Costa Rica, 15, 35, and 50; for Mexico, 15, 35, and 50; for Peru, 12, 50, and 38; for Venezuela, 13, 45, and 42. The estimates for the contribution of labor are presented in Table 10. The estimates for the contribution of land come from many sources: for Argentina, they are taken from land prices in Norberto Ras and Roberto Levis, *El Precio de la Tierra (Su Evolución Entre los Anos 1916 y 1978)* (Buenos Aires: Sociedad Rural Argentina, 1982); for Brazil, from production function estimates in Mauro de Rezende Lopez and G. Edward Schuh, "The Mobilization of Resources from Agriculture: A Policy Analysis for Brazil," a paper presented at the Second Latin American Regional Meeting of the Econometric Society, Rio de Janeiro, July 14-17, 1981; for Colombia, from the work of Ramiro Orozco, "Sources of Agricultural Production and Productivity in Colombian Agriculture" (Ph.D. dissertation, Oklahoma State University, 1977); and for Mexico, from Reed Hertford, *Sources of Change in Mexican Agricultural Production, 1940-65*, Foreign Agricultural Economic Report 73 (Washington, D.C.: U.S. Department of Agriculture, 1971). The estimates for the remaining countries were made from data in national accounts.

The contribution of the capital input is the difference between one and the sum of the contributions of land and labor. The contribution of total inputs is the sum of the contributions of land, labor, and capital. The residual is the difference between the rate of growth of output and the contribution of total inputs.

and 114.2 percent in Chile. Capital made the largest contribution to agricultural growth in all countries except Peru and Brazil.

In seven of the countries the share of the residual (g) in the growth of output was high, between 21.0 and 56.8 percent. Also, the contribution of the residual to agricultural growth was larger in the countries with higher rates of growth of agriculture. The contribution of land to agricultural growth was low, except in Bolivia. The contribution of labor was highly variable between countries, and was negative only for Chile.

The value of the contribution of the re-

Table 14—Contributions of land, labor, and capital to the growth of agricultural output, 1950-80

Country	Output Growth Rate	Contributions to Output Growth				
		Land	Labor	Capital	Residual	Total
		(percent/year)				
Argentina	2.1	5.2	2.4	71.4	21.0	100.0
Bolivia	2.0	16.3	26.7	61.5	−4.5	100.0
Brazil	4.5	6.7	24.8	11.7	56.8	100.0
Chile	1.9	0.0	−18.4	114.2	4.2	100.0
Colombia	3.9	7.9	5.2	45.4	41.5	100.0
Costa Rica	4.4	4.1	15.9	30.0	50.0	100.0
Mexico	3.8	8.2	6.8	36.6	48.4	100.0
Peru	2.0	5.5	35.0	18.5	41.0	100.0
Venezuela	4.9	4.9	14.7	30.8	49.6	100.0

Sources: Derived from Appendix 2, Tables 27-35.

sidual to agricultural growth can be explained in part by errors in measuring the inputs. Changes in the quality of labor through education were not considered. Estimates of the changes in labor quality require data on the years of schooling of the agricultural labor force and on the wages earned by laborers with different amounts of education, but the data were not available. In Latin America, labor quality made up almost one-fourth of labor's contribution to the growth of the entire economy.[20] The education of the labor force seems to be particularly important in agriculture because many technological changes depend heavily on it.

Errors in measuring capital can also be important. Alternative estimates for Chile, where the contribution of capital was extraordinarily large, are given in Appendix 2, Table 30.[21] These estimates differ from the estimates in Table 13 mainly by showing a much lower rate of growth for the period 1950-60. They also increase the contribution of the residual and reduce the contribution of capital.

These results leave several questions unanswered. Two of the more important are: what is the residual made up of, and why is the rate of growth of capital so high. Some components of the residual were described above, and one of the main objectives of this research is to measure the contribution of government expenditure policies to the growth of agriculture.

As Mundlak suggests, there is a positive association between the rate of growth of capital and the contribution of the residual to agricultural growth (which represents, in part, the rate of technological change).[22] The high rate of growth of capital can be explained in part by a labor-saving bias in technological change, by rural-urban migration, and by differences in the rates of return to physical capital.[23]

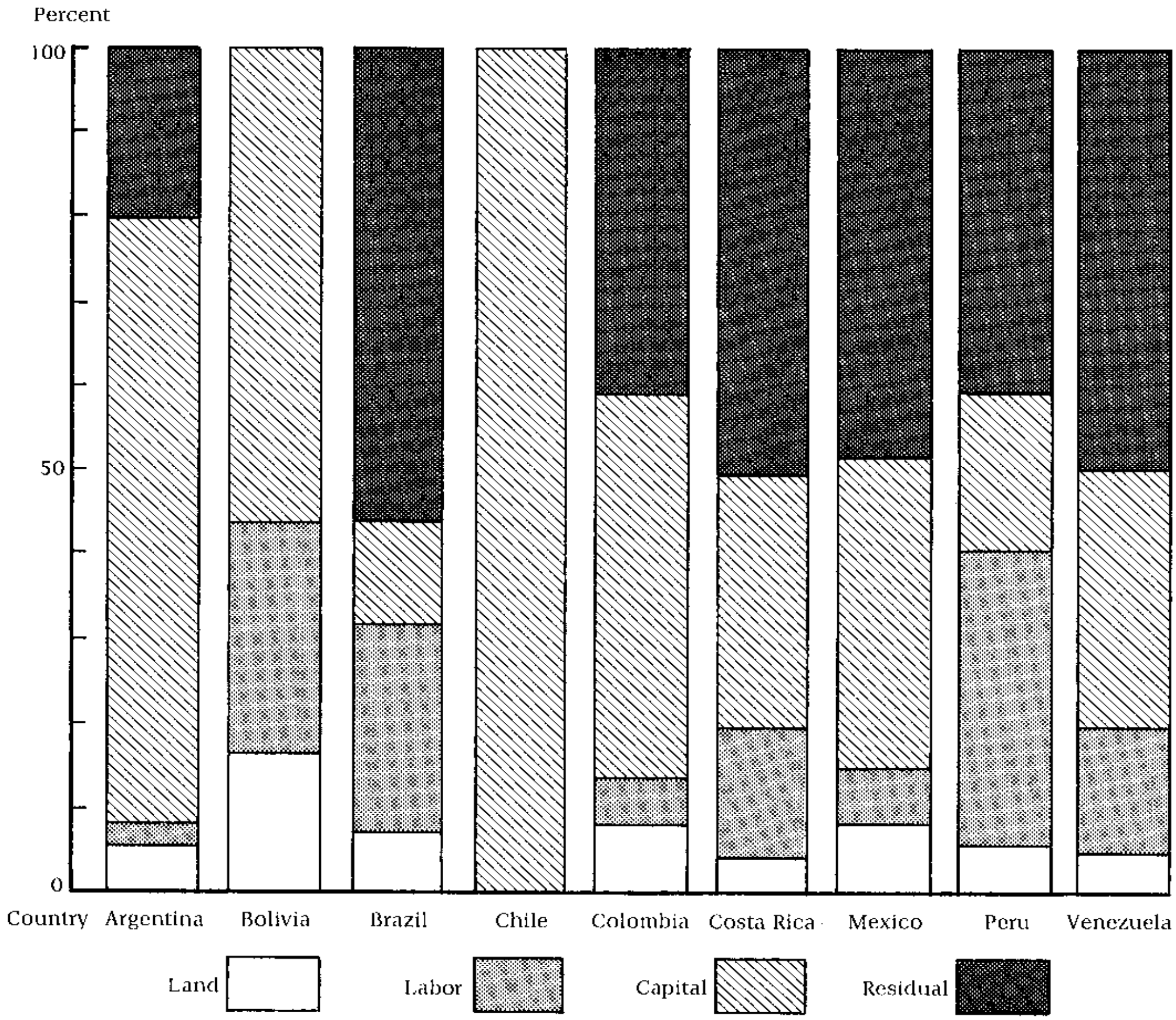
[20] See Elías, "Sources of Economic Growth in Latin American Countries," pp. 362-370.

[21] See Juan Pedro Garcés Voisenat, "Inversión y Capitalización en el Sector Agropecuario Chileno 1950-1980," Tésis de Ingeniero Comercial, Mención Economía, Pontificia Universidad Católica de Chile, 1983.

[22] See Yair Mundlak, "Capital Accumulation, The Choice of Techniques and Agricultural Output," Washington, D.C., October 1984 (mimeographed).

[23] Some of these arguments are made and verified empirically for Argentina in Cavallo and Mundlak, *Agriculture and Economic Growth in an Open Economy.*

Figure 1—Share of land, labor, and capital in the total output growth of agriculture, 1950-80



Sources: Derived from Appendix 2, Tables 27-35.

5

GOVERNMENT EXPENDITURES ON AGRICULTURE

GEA includes all expenditures of federal and state governments and of decentralized government agencies (agencies administered independently) that are used to increase agricultural production. These include expenditures on administration, irrigation, research and extension, education, health, marketing, and land reforms.

Size and Trend of GEA

GEA grew rapidly in Latin America between 1950 and 1980 (see Table 15). For the countries studied, its rate of growth was higher than the rate of growth of agricultural output. The average annual rate of growth of GEA in real terms for the whole period 1950-80 varied from 3.3 percent in Argentina to 14.8 percent in Bolivia.

GEA did not follow the same trend in all countries or in each decade. In Brazil, Chile, Colombia, and, especially, Venezuela, it increased in the 1950s. In Argentina, Mexico, and Peru it increased in the 1960s. The rate of growth of GEA declined slightly in the 1970s, but only after 1978.

Comparison with GEA in the United States

In order to evaluate the importance of GEA in Latin America, the data for GEA per hectare of cropped land and per person employed in agriculture were converted into current U.S. dollars using official exchange rates and compared with U.S. data. Doing this presented several problems.

Kravis, Heston, and Summers made some estimates of purchasing power for Brazil, Colombia, and Mexico.[24] In 1975 these exchange rates were almost twice the official exchange rate (1.58 for Brazil, 2.86 for Colombia, and 1.70 for Mexico). But estimates of purchasing power exchange rates were not available for the whole period, so official exchange rates were used. Because of this shortcoming, some of the figures for some countries should be multiplied by two to make them comparable.

Also, GEA data for the United States have greater coverage. They include expenditures on research and extension, crop insurance, conservation of land and water resources, rural electrification and telephones, farmers and rural development, food and nutrition

Table 15—Indexes of real government expenditures on agriculture and their average compound growth rates, selected years, 1950-80

Country	1950	1960	1970	1980	Average Annual Growth Rate 1950-80
					(percent/year)
Argentina	87.6	100.0	198.0	232.9	3.3
Bolivia	n.a.	100.0	1,103.4	1,910.8	14.8
Brazil	52.4[a]	100.0	166.3	266.8	5.8
Chile	51.6	100.0	256.3	206.6[b]	5.0
Colombia	52.9	100.0	766.1	488.6	7.4
Costa Rica	n.a.	100.0	320.3	332.2	5.7
Mexico	142.2	100.0	347.3	1,426.4	8.1
Peru	146.0[c]	100.0	676.7	860.2	6.1
Venezuela	26.1	100.0	125.3	259.4	7.7

Sources: Victor J. Elías, *Government Expenditures on Agriculture in Latin America*, Research Report 23 (Washington, D.C.: International Food Policy Research Institute, 1981), p. 17. The figures for 1980 are derived from Appendix 2, Tables 27-35.

Notes: For the indexes, 1960=100. Where n.a. appears, the data were not available.

[a] This figure is for 1952.

[b] This figure is for 1978.

[c] This figure is for 1951.

[24] See Irving B. Kravis, Alan Heston, and Robert Summers, *World Product and Income: International Comparisons of Real Gross Product*, United Nations International Comparison Project, Phase III (Baltimore, Md.: Johns Hopkins University Press, 1982).

programs, and stabilization of farm prices and income. The last two components made up half of GEA in 1980. Before 1970 the stabilization of farm prices and income made up more than 60 percent.

Despite these problems, the data do give an indication of how GEA in the United States and Latin America compare. GEA per hectare in the Latin American countries was similar to GEA in the United States in the years chosen for Table 16. GEA per hectare was higher than in the United States in Venezuela in all four years and higher in Mexico in 1980.

GEA per hectare was lower in Argentina than in the other Latin American countries studied. This is partly because the data for Argentina and Costa Rica include some pasture land, but the data for the other Latin American countries and the United States include only cropped land. The differences between countries in GEA per hectare cannot be explained by differences in the output-land ratio alone. The highest output-land ratios were in Chile, Colombia, Peru, and Venezuela and were almost three times the values for the other countries.

As the implicit GDP deflator of the United States increased 2.6 times between 1950 and 1980, real GEA per hectare increased in all the countries. The increase was especially high in Bolivia, Brazil, Mexico, Peru, and Venezuela.

There was a much greater disparity between the figures of the Latin American countries and the United States in GEA per person employed in agriculture. This disparity increased throughout the period, except in Brazil, Mexico, and Venezuela. Argentina and Venezuela had the highest GEA per person employed in agriculture in 1950, around U.S. $40 per year. By 1980, Brazil, Mexico, and Venezuela had the highest, followed by Chile and Colombia.

In 1980 the GEA per person employed in agriculture was almost 10 times greater in the United States than in Venezuela, which had the highest such GEA of the nine Latin American countries. As with real GEA per hectare, real GEA per person employed in agriculture increased over the period. And it increased faster than GEA per hectare in all the countries except Bolivia. This, of course, reflects a decrease of the labor-land ratio.

Table 16—Government expenditures on agriculture per hectare of cropland, selected years, 1950-80

Country	1950	1960	1970	1980
	(current U.S. $/hectare)			
Argentina	2	2	5	9
Bolivia	n.a.	n.a.	39	181
Brazil	5	8	15	169
Chile	11	25	94	163
Colombia	n.a.	49	217	195
Costa Rica	n.a.	18	75	119
Mexico	8	6	22	296
Peru	7	6	41	177
Venezuela	26	96	129	538
United States	21	41	70	244

Sources: The estimates for the Latin American countries were derived from Appendix 2, Tables 27-35. The data for the United States came from Clifton B. Luttrell, *Down on the Farm with Uncle Sam*, Original Paper 43 (Los Angeles: International Institute for Economic Research, 1983), p. 12.

Notes: Where n.a. appears, the data were not available. The data for the United States were given per acre in the original sources, but they have been converted. The data for Argentina and Costa Rica include some cultivated pasture land.

The recent FAO study on GEA in 57 countries estimates GEA per person employed in agriculture to be approximately U.S. $250.[25] This is an average for the period 1978-82. This estimate is lower than the average figures for 1980 presented in Table 17.

Composition of GEA

Changes in the composition of GEA can change the effects of the aggregate public input on agriculture and can reflect important changes in government policies. Table 18 presents estimates of some components of GEA for selected years, expressed in constant 1960 dollars. Mainly because of a lack of data, it includes only research and extension, irrigation, land reform, and education and health.[26] Later in this report, expendi-

[25] FAO, *Public Expenditures on Agriculture.*

[26] For alternative estimates on research expenditures, see Peter A. Oram and Vishva Bindlish, *Resource Allocation to National Agricultural Research: Trends in the 1970s* (The Hague and Washington, D.C.: International Service for National Agricultural Research and International Food Policy Research Institute, 1981).

Table 17—Government expenditures on agriculture per person employed in agriculture, selected years, 1950-80

Country	1950	1960	1970	1980
	(current U.S. $/person)			
Argentina	40	58	133	279
Bolivia	n.a.	n.a.	28	136
Brazil	9	18	44	485
Chile	14	50	194	393
Colombia	n.a.	73	317	377
Costa Rica	n.a.	20	81	143
Mexico	15	12	64	663
Peru	n.a.	5	35	137
Venezuela	45	184	284	1,004
United States	299	763	1,846	9,412

Sources: The estimates for the Latin American countries were derived from Appendix 2, Tables 27-35. The data for the United States came from Clifton B. Luttrell, *Down on the Farm with Uncle Sam*, Original Paper 43 (Los Angeles: International Institute for Economic Research, 1983), p. 12.

Notes: Where n.a. appears, the data were not available.

tures on administration, transportation, electricity, and marketing, and some transfer payments will be covered.

For most of the countries, education and health expenditures had the largest share of GEA. This component also had the lowest rate of growth. The other components grew at higher rates because education and health depended more than they on the expansion of the labor force; because the other components were smaller at the beginning of the period and could, therefore, expand at a faster rate more readily; and because an emphasis was put on modern inputs that demanded more support from the other components.

Irrigation was next in importance in most of the countries. This is in contrast to the importance of irrigation in Asian countries, where the share of irrigation in GEA between 1966 and 1975 commonly exceeded 60 percent and in some countries exceeded 90 percent.[27]

Research and extension expenditures increased almost 15-fold in most countries during the whole 30-year period. Expenditures on education and health and on irrigation increased during that period, but not as much. This shows a change in the composition of GEA in favor of research and extension.

The changes in composition differed between countries and times. Irrigation expenditures were highly variable; education and health expenditures were less so.

A more complete study of GEA should include other components, such as transfer payments. Transfer payments seem to have a large share in GEA in the United States, as food subsidies have in other countries, such as Brazil and Colombia. Transfer payments became large in Mexico in 1980, and Argentina implemented a food subsidy plan in 1984. They are discussed in more detail in the final chapter.

The composition of GEA can also be approached through employment in the public institutions connected with agriculture. Employment figures do not cover all kinds of expenditures, but they have an advantage in comparing countries because the homogeneity of their estimates is greatest. In Colombia the composition of employment in institutions changed much less than the composition of expenditures. Employment for research and extension was particularly high in Colombia and Argentina. In 1980 Colombia had a greater proportion of professionals with graduate degrees than Argentina. Employment in research and extension in Brazil was five times higher than in either Argentina or Colombia (25,000 in Brazil and 5,000 each in Argentina and Colombia).

Estimates of the Credit Subsidy to Agriculture

An analysis of the effects of GEA should include all government policies on agriculture. But some information that is not in government budgets is needed.

Most of the countries included in this study had high rates of inflation, so it was common for some parts of the economy to pay negative real rates of interest. This can be thought of as a kind of subsidy. This credit subsidy can occur in at least two ways: by paying a negative rate of interest (actually, just by paying less than the alternative cost), or by having the government pay the debt. To quantify this subsidy, data are needed on

[27] This is based on data for 12 countries from Asian Development Bank, *Asian Agricultural Survey, 1976* (Manila: Asian Development Bank, 1976). These data are not strictly comparable with the data for Latin America because they include current expenditures.

Table 18—Government expenditures on research and extension, irrigation, land reform, and education and health, selected years, 1950-80

Country/Component	1950	1960	1970	1980
		(1960 U.S. $ million)		
Argentina				
Research and extension	4.8	10.7	18.7	30.5
Irrigation	n.a.	n.a.	35.0	39.3
Land reform	n.a.	n.a.	n.a.	n.a.
Education and health	45.9	51.2	124.2	112.3
Total	94.3	106.5	280.9	353.5
Bolivia				
Research and extension	n.a.	0.3	0.3	0.1
Irrigation	n.a.	0.3	1.3	5.2
Land reform	n.a.	0.2	0.2	0.8
Education and health	n.a.	1.9	7.3	n.a.
Total	n.a.	3.4	23.9	n.a.
Brazil				
Research and extension	1.5	3.7	8.8	174.3
Irrigation	36.8	74.3	23.2	569.1
Land reform	n.a.	21.2	44.2	n.a.
Education and health	35.4	52.9	91.0	84.3
Total	146.5	264.7	532.4	1,504.0
Chile				
Research and extension	0.2	0.6	1.9	4.2
Irrigation	3.6	12.2	7.4	2.0
Land reform	n.a.	5.4	41.5	n.a.
Education and health	n.a.	n.a.	23.3	n.a.
Total	n.a.	n.a.	119.7	n.a.
Colombia				
Research and extension	2.6	4.1	8.9	8.1
Irrigation	n.a.	74.0	149.6	36.1
Land reform	n.a.	n.a.	33.8	13.1
Education and health	8.5	18.4	53.2	71.1
Total	50.5	124.5	590.8	710.3
Costa Rica				
Research and extension	n.a.	n.a.	2.8	1.6
Irrigation	n.a.	n.a.	0.1	0.2
Land reform	n.a.	n.a.	1.6	2.1
Education and health	n.a.	n.a.	9.5	17.3
Total	n.a.	n.a.	23.1	35.3
Mexico				
Research and extension	0.6	2.9	6.0	13.7
Irrigation	57.7	46.2	204.0	257.4
Land reform	2.3	5.1	7.6	83.4
Education and health	17.8	62.4	240.4	315.7
Total	106.9	134.2	489.6	721.3
Peru				
Research and extension	n.a.	1.5	4.0	3.3
Irrigation	3.9	1.0	6.4	38.4
Land reform	n.a.	n.a.	4.3	5.8
Education and health	n.a.	n.a.	n.a.	n.a.
Total	n.a.	n.a.	n.a.	n.a.
Venezuela				
Research and extension	n.a.	60.6	46.3	45.2
Irrigation	6.9	13.3	32.6	40.2
Land reform	n.a.	n.a.	n.a.	n.a.
Education and health	n.a.	n.a.	n.a.	n.a.
Total	n.a.	n.a.	280.9	393.4

Sources: Victor J. Elías, *Government Expenditures on Agriculture in Latin America*, Research Report 23 (Washington, D.C.: International Food Policy Research Institute, 1981); and Appendix 2, Tables 27-35.

Notes: Where n.a. appears, the data were not available. Total GEA includes education and health. The research and extension, irrigation, and land reform components come from direct estimates, including estimates from many institutions dedicated to agriculture. Other components, such as education and health, were not directly available, so they were estimated using the related series method (based on rural and nonrural variables such as student enrollment and social insurance data). The total GEA should include all components, but they were not estimated for some countries due to data unavailability. See Elías, *Government Expenditures on Agriculture in Latin America* for a complete explanation of how these series were built.

(continued)

Table 18—Continued

The 1980 figures for Brazil, Chile, Costa Rica, Mexico, Peru, and Venezuela that do not appear in the tables in Appendix 2 were estimated from the trend of the two or three years before 1980 for which figures were available. The totals for 1950 and 1960 for Colombia were estimated using a more restricted definition of GEA (see Elías, *Government Expenditures on Agriculture in Latin America*). The 1960 figures for Peru are the figures for the closest year for which data were available.

the interest rate on agricultural credits, the stock of agricultural credits, and the amount that is not paid. Some of this information is available from studies of Argentina and Brazil.[28]

As Table 19 shows, the credit subsidy in some years in Brazil and Argentina was almost as large or larger than GEA. The subsidy was smaller in Mexico than in most other study countries. This can be explained by differences in the rates of inflation. The rates of inflation, which vary widely, could also explain the high variability of the credit subsidy.

In Brazil the size of the credit subsidy can be estimated by a different method. Contador, in a study of the determinants of the real rate of return on farm investment, estimated that the availability of credit can increase the rate of return between 2 and 3 percent.[29] This means that the real rate of return to farm investment was between 2 and 3 percent higher than the average value. If the value of the stock of capital in agriculture was around NCr 2 billion in the period 1950-80 (in constant 1960 NCr), the annual credit subsidy was about NCr 30 million.

Table 19—Credit subsidies to agriculture, selected years, 1950-80

Country/Subsidy/Ratio	1950	1960	1970	1980
Argentina				
Credit subsidy (million 1960 new pesos)	2.0	108.9	31.9	115.7[a]
Ratio of credit subsidy to GEA (percent)	2.6	123.4	16.5	68.8
Brazil				
Credit subsidy (1960 NCr million)	9.2	18.3	11.6	283.3
Ratio of credit subsidy to GEA (percent)	n.a.	50.8	16.0	98.8
Chile				
Credit subsidy (million 1960 escudos)	n.a.	30.8[b]	70.4	n.a.
Ratio of credit subsidy to GEA (percent)	n.a.	54.6	75.5	n.a.
Colombia				
Credit subsidy (million 1960 Colombian pesos)	n.a.	n.a.	n.a.	60.7
Ratio of credit subsidy to GEA (percent)	n.a.	n.a.	n.a.	20.0
Mexico				
Credit subsidy (million 1960 Mexican pesos)	103.0	291.0	627.0	1,284.0
Ratio of credit subsidy to GEA (percent)	4.9	17.2	10.2	8.6
Venezuela				
Credit subsidy (million 1960 bolivares)	n.a.	9.6[c]	25.0	n.a.
Ratio of credit subsidy to GEA (percent)	n.a.	2.4	4.3	n.a.

Sources: Lucio G. Reca and José M. Frogone, *Rasgos Caracteristicos de la Ganaderia Vacuna Argentina* (Cali, Colombia: Centro Internacional de Agricultura Tropical, 1982), p. 35; Joao Sayad, *Crédito Rural No Brasil* (São Paulo: Instituto de Pesquisas Económicas, Universidad de São Paulo, 1980), p. 75; Joao do Carmo Oliveira, "An Analysis of Transfers from Agricultural Sector and Brazilian Development, 1950-1974" (Ph.D. dissertation, Wolfson College, Cambridge University, 1981); Ronnie Philipps F., "Protección o Discriminación: El Caso del Crédito Agrícola en Chile," Serie Tésis de Grado No. 19, Programa de Posgrado Economía Agraria de la Pontifica Universidad Católica de Chile, Santiago de Chile, 1976; and Appendix 2, Tables 27-35.

Notes: The credit subsidy for Argentina only includes credit for livestock. If crops receive a credit subsidy in proportion to their share of output, the figures should be almost doubled. Where n.a. appears, the data were not available.

[a] This figure is for 1974.

[b] This figure is for 1965.

[c] This figure is for 1962.

[28] See Lucio G. Reca and José M. Frogone, *Rasgos Caracteristicos de la Ganaderia Vacuna Argentina* (Cali, Colombia: Centro Internacional de Agricultura Tropical, 1982); Joao Sayad, *Crédito Rural No Brasil* (São Paulo: Instituto de Pesquisas Económicas, Universidad de São Paulo, 1980); and Joao do Carmo Oliveira, "An Analysis of Transfers from Agricultural Sector and Brazilian Development, 1950-1974" (Ph.D. dissertation, Wolfson College, Cambridge University, 1981).

[29] See Claudio R. Contador, *Tecnologia e Rentabilidade na Agricultura Brasileira, Relatorio de Pesquisa 28* (Rio de Janeiro: Instituto de Planejamiento Económico e Social, Instituto de Pesquisas, 1975), p. 56.

6

GOVERNMENT EXPENDITURES ON AGRICULTURE AND AGRICULTURAL GROWTH

Production functions and the sources-of-growth methodology are alternative ways of identifying the effects of GEA on agricultural production. GEA can be considered either as an input of a production function, or as a variable affecting the relationships of the other inputs with agricultural output.

In both approaches there are problems with defining GEA. They include: how aggregated should GEA be, and whether it is more appropriate to use the annual values of GEA directly or to use a concept such as the public capital input (which is a weighted average of past GEA). Both approaches are partial. A general equilibrium approach might be better because it can be used to analyze the interactions between agriculture and government expenditures.

Explanation of the Residual

The residual, g, in the sources-of-growth equation, can be accounted for by inputs that were omitted in the earlier analysis or by changes in the quality of the basic inputs. Table 20 shows the growth rates of the omitted inputs. Some of these, such as draft animals, were considered implicitly in the calculation of the sources of growth, so they are not parts of the residual.

If capital is defined to include both fixed components (machinery and land) and draft animal components, the rate of change of the capital input will equal the weighted average of the rates of change of the two components. If the rate of change of the fixed component is greater than the rate of change of the draft animal component, the rate of change of the previously estimated capital input will overestimate the rate of change of the newly defined capital input. It is in this respect that it can be said that the contribution of the draft animal component has already been taken into account.

The rate of change of the fixed component of the capital input was greater than the rate of change of the draft animal component in seven countries. In Brazil, the draft animal component grew faster than the fixed component, so that the estimated contribution of the capital input increased from 0.53 percent to 0.59, and the size of the residual decreased from 2.55 percent to 2.49. In Costa Rica the contribution of the capital input increased from 1.32 percent to 1.49, and the residual decreased from 2.20 percent to 2.03.

Table 20—Average compound rates of change of the residual and of modern inputs, 1950-80

Country	Residual	Draft Animals	Tractors	Fertilizer	Irrigation
			(percent/year)		
Argentina	0.44	1.21	9.16	10.25	n.a.
Bolivia	−0.09	1.95	3.42	20.00	n.a.
Brazil	2.55	2.94	12.56	12.82	n.a.
Chile	0.09	1.55	4.77	3.16	1.28
Colombia	1.62	2.30	5.03	10.16	4.43
Costa Rica	2.20	4.96	8.11	16.12	n.a.
Mexico	1.84	2.63	4.49	16.60	4.43
Peru	0.82	1.01	5.21	3.77	0.84
Venezuela	2.43	2.03	7.89	5.86	5.70

Sources: Derived from Appendix 2, Tables 27-35.
Note: Where n.a. appears, the data were not available.

The same criteria that were applied to the livestock component can be applied to the tractor input. In most of the study countries, tractors are already included in the estimates of capital stock. In Brazil the contribution of the capital input increased from 0.59 percent to 1.00 (as an upper estimate), so the residual ended up with a value of 2.08 percent. In Colombia the contribution of capital increased from 1.77 percent to 2.05, so that the residual decreased from 1.62 percent to 1.34.

Because of problems with choosing appropriate units of measure, it is difficult to estimate the contributions of fertilizer and irrigation to growth. By multiplying the rate of change of fertilizer times an estimated output-input elasticity of 0.03 (which is an estimate from many production function estimates), upper estimates of fertilizer's contribution can be made. These vary from 0.02 for Chile to 0.60 for Bolivia.

If the same calculations are made for irrigation, then its contribution will be much less, mainly because its rate of growth will be much lower. So, for most of the study countries, the contribution of the residual to agricultural growth remains high.

An alternative to considering each omitted input separately is to aggregate them. The aggregation of these inputs is suggested because most of them are modern inputs and are adopted by agriculture together. This hypothesis and the weights necessary to compute the aggregate input can be analyzed through estimates from production functions.

Using the figures for each input presented above and estimates of weight found in other studies,[30] it can be shown that the aggregate inputs will account for less of the residual than separate estimates of the contribution of each input. Modern inputs could have been included with basic inputs in determining the contribution of the inputs to agricultural growth. But they were not because calculating the contribution of basic inputs alone emphasizes the value of the residual or of technological change; the measurements of the modern inputs are less reliable than the measurements of the basic inputs; measuring the two sets of inputs separately gives a better idea of the relative importance of measuring the effects of government expenditure policies on agriculture; and, because the contributions of the inputs are additive, there is no specification error following the method used in two stages.

The Net Residual and GEA

To identify how GEA contributed to the residual left after the contributions of the other inputs into agriculture are identified, it is necessary first to define government expenditure policies. In this section two alternatives will be considered. Both treat GEA as an input in agricultural production that is combined with the inputs provided by agriculture itself.

One alternative is to treat GEA as a flow of services, measured by yearly expenditures. The other is to consider GEA as an investment in a public input, which can be treated in the same way as the concept of fixed capital. The public input can be constructed as a weighted average of past GEA, with the weights depending on the rate of depreciation (see Chapter 3).

Such a construction, equation (3) for example, can be applied to each component of GEA separately, with different values for the rate of depreciation, or to an aggregation of them. Applying the equation to the components separately and then aggregating them has advantages, because it can take each component a different amount of time to affect agricultural production, the efficiency with which each component is used can be different, and some components can have negative effects. But estimating the effects of the components of GEA is difficult and requires disaggregated data on the government budget and on the outputs and inputs of agriculture. It will not be attempted here, but it will be an important aspect of the next stage of this research project.

Both the aggregate and the component approaches for the study of GEA's effects on agricultural growth increase understanding of policy. The aggregate approach gives an estimate of the average effects of each component of GEA, which is an important indicator of policies for distributing the government budget. These are made in terms of the so-called economic classification of the budget into four components: agriculture,

[30] Reca and Verstraeten, "La Formación del Producto Agropecuario Argentina"; Orozco, "Sources of Production"; Hertford, *Sources of Changes in Mexican Production;* and Zvi Griliches, "The Sources of Measured Productivity Growth: United States Agriculture, 1940-60," *Journal of Political Economy* 71 (August 1963): 331-346.

health, education, and development. The component approach becomes more useful for other kinds of government decisions when it is important to know the specific expenditure the government wishes to support (irrigation, research, and so forth).

Table 21 gives estimates of the net residual, which is the residual in Table 20 minus the contributions of livestock, tractors, fertilizer, and irrigation. When inputs are considered, the residual decreases from 40 to 32 percent of the output growth. The residual becomes even smaller in Argentina, Brazil, and Colombia.

The average annual rates of growth of GEA and G, the public input, are close to each other, except for Argentina and Mexico. In annual data GEA is much more variable than G. But when the average for the whole period is used, it makes little difference whether GEA or G is used.

To evaluate the contribution of GEA to the residual, or to the growth of output, the output elasticity of government expenditures is needed. An indication of the contribution of GEA can be obtained if a low elasticity, such as 0.05, is assumed (this value is from earlier production function estimates). The average share of government expenditures in output growth would then be about 5 percent (see Table 22). This is similar to the value for land (see Table 14).

Alternative estimates increase confidence in the values shown in Table 22. The output elasticity of research and extension can be obtained from estimates of the rates of return of research and extension and the ratio of research and extension to output. Then the contribution of research and extension to agricultural output growth can be estimated using the average rate of growth of this expenditure component (see Table 23). These estimates are similar to the estimates in Table 22, except for Argentina and Brazil.

On average, expenditures on research and extension grew at a faster rate than expenditures on the other components, 9.4 percent per year compared to 5.5 percent. For most countries, then, the rate of growth of research and extension expenditures is an upper estimate of the rate of growth of aggregate GEA, which implies that the estimates in Table 23 are an upper bound of the contribution of GEA to agricultural growth.

The aggregate approach to GEA can include components with both positive and negative effects on agricultural growth. Land reform expenditures could be such a component, depending on how the reform is implemented: it could encourage the adoption of new technologies or simply transfer land. In general, the main objective of land reform in most countries was not to affect production. The credit subsidy could be another because it might require a rationing mechanism that favors less efficient farms.

Gross indicators, such as the average rate of inflation, can be used to check on errors in measurement. Larger errors can be expected in countries with higher inflation rates. But in comparing countries, the residual is not related to the average rate of inflation, which gives some confidence that this kind of error is not significant.

The contribution of GEA to output growth was higher in countries where agricultural output grew faster. The relationship between GEA per hectare and the contribution of GEA to agricultural growth complements this finding (Figure 2). The relationship between these two variables is positive, which also supports the finding about the role of GEA in agriculture. This result came from cross-country comparisons for the different decades and suggests hypotheses for further research.

Table 21—Average compound growth rates of the net residual, government expenditures on agriculture, and the public input, 1950-80

Country	Net Residual	Government Expenditures on Agriculture	Public Input
		(percent/year)	
Argentina	0.30	3.30	1.45
Bolivia	−0.40	14.80	n.a.
Brazil	1.88	5.80	3.20
Chile	−0.12	5.00	4.86
Colombia	1.20	7.40	7.15
Costa Rica	1.83	5.70	n.a.
Mexico	1.60	8.10	4.08
Peru	0.77	6.10	4.31
Venezuela	2.33	7.70	5.66

Sources: Derived from Appendix 2, Tables 27-35; and Victor J. Elías, *Government Expenditures on Agriculture in Latin America*, Research Report 23 (Washington, D.C.: International Food Policy Research Institute, 1981), p. 17.

Notes: The net residual was calculated from the total residual by subtracting the contribution of the modern inputs. The public input is based on GEA plus the weighted average of past values of GEA (see equation 3).

Table 22—Contribution of government expenditures to the net residual and to the growth of agricultural output, 1950-80

Country	Contribution of the Public Input to the Net Residual	Share of the Public Input in the Net Residual	Share of the Public Input in the Growth of Output
	(percent/year)		
Argentina	0.07	24.2	3.3
Brazil	0.16	8.5	3.6
Colombia	0.36	29.8	9.2
Costa Rica	0.29	15.6	6.6
Mexico	0.20	12.8	5.3
Peru	0.22	28.0	11.0
Venezuela	0.28	12.1	5.7

Sources: Derived from Appendix 2, Tables 27-35.

Notes: The public input is GEA plus the weighted average of past values of GEA (see equation 3). The calculations of the contribution of the public input used an elasticity of the public input of 0.05.

Bolivia is not included because some data were missing. Chile is not included because basic inputs explained almost all output growth.

Care should be taken in interpreting Figure 2. Because values of agricultural output differ between countries, the same rate of growth in two countries does not imply that their output has the same value. By the same logic, the positive relationship between GEA per hectare and the contribution of GEA to output does not imply that the relationship between the rate of return of GEA and GEA per hectare is positive. This can be easily seen by looking at the production function from which the marginal production of G can be derived.

The composition of GEA largely determines the size of GEA's contribution to agricultural growth. GEA contributes more when either irrigation or research and extension have a higher share of GEA (see Tables 18 and 21). Also, the low contribution of GEA to agricultural growth in Bolivia, Chile, and Peru can be explained in part by the share of land reform in GEA. These results suggest the need to analyze the composition of GEA in greater detail.

The negative relationship between the variability of the rate of growth of agricultural output and the rate of growth of GEA implies that GEA adds to the stability of agri-

Table 23—Estimates of the contribution of expenditures on research and extension to the growth of agricultural output, 1950-80

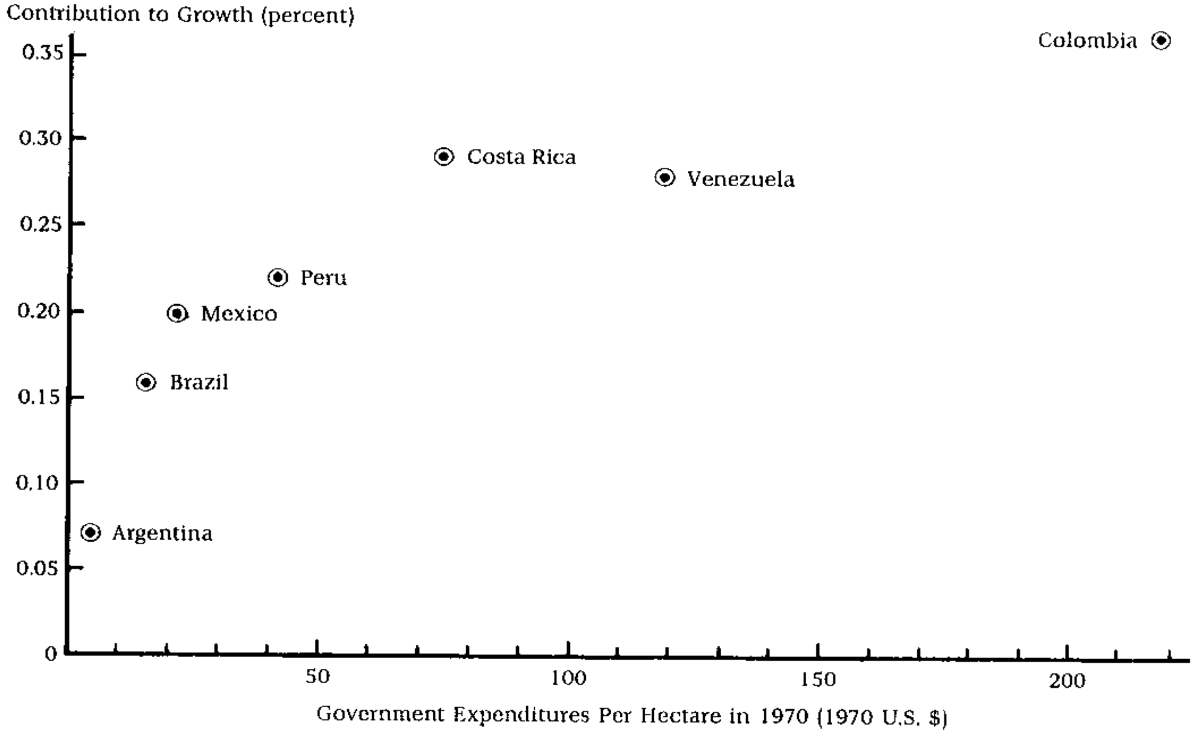
Country	Rate of Return	Output-Input Elasticity	Growth Rate of Research and Extension	Contribution of Research and Extension to Growth
			(percent/year)	
Argentina	40.0	0.088	6.2	0.55
Bolivia	44.1	0.014	0.0	0.00
Brazil	25.0	0.067	11.7	0.78
Chile	33.0	0.014	5.0	0.07
Colombia	60.0	0.080	3.8	0.30
Mexico	60.0	0.040	10.4	0.42
Peru	37.0	0.036	3.9	0.14

Sources: The rates of return are from Victor Palma, "Review of Evaluation Studies on Returns to Agricultural Research," paper presented at the Fourth Latin American Regional Meeting of the Econometric Society, Santiago, Chile, July 19-22, 1983; and Víctor M. Feijóo, "Contribución de la Investigación a la Productividad Agropecuaria," Serie Cuadernos, Instituto de Investigaciones Estadísticas de la Universidad Nacional de Tucumán, Tucumán, Argentina, May 1982 (mimeographed). The rates of growth of research and extension expenditures are from Victor J. Elías, *Government Expenditures on Agriculture in Latin America*, Research Report 23 (Washington, D.C.: International Food Policy Research Institute, 1981); other data are derived from Appendix 2, Tables 27-35.

Notes: The rate of return is the average value of the rates found for the output of a country. The rates of return for Brazil and Argentina are the research and extension expenditures made by Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) for Brazil and Instituto Normal de Tecnologia Agropecuaria (INTA) for Argentina. The output-input elasticities were estimated by multiplying the rates of return by their corresponding average input-output ratios.

Costa Rica and Venezuela are not included because estimates of their rates of return were not available.

Figure 2—Government expenditures per hectare in 1970 and the contribution of government expenditures on agriculture to the rate of growth of agricultural output, 1950-80



Sources: The estimates for the Latin American countries were derived from Appendix 2, Tables 27-35. The data for the United States came from Clifton B. Luttrell, *Down on the Farm with Uncle Sam*, Original Paper 43 (Los Angeles: International Institute for Economic Research, 1983), p. 12. Derived from Appendix 2, Tables 27-35.

cultural output. This is contrary to the expectation that government policies increase the variability of agriculture, an expectation more appropriate to price policies than to expenditure policies.

The relationship between the size of the residual and the rate of growth of the capital input is positive. This could support the hypothesis that technological change in agriculture requires the accumulation of capital.

When a value of the residual is low, so is the correlation between output growth and the share of research and extension expenditures in GEA. Finally, the size of the residual is higher the higher the rate of growth of output. This reinforces the result that GEA contributes more to output growth in countries with higher agricultural growth.

GEA and Input Growth

In addition to affecting the growth of agricultural output directly, GEA can affect it indirectly through the growth of inputs. Much of GEA is incorporated in the inputs used by agriculture. Some of these expenditures improve the quality of inputs, and others increase their quantity.

For a given increase of GEA, farmers can vary the quantity of inputs they use or they can change the composition of the inputs, reducing the amounts of some, that is, crowding them out. Because they have this choice, the final outcome of an increase of GEA on agricultural inputs is uncertain.

There are several ways to verify the relationship between private and public inputs. One is to compare the average annual rates of growth of the different inputs and components of GEA in all countries during the whole 1950-80 period. Following this approach, three sets of comparisons were made: between the fertilizer input and the research and extension component of GEA, between the land input and the irrigation and land reform components of GEA, and between the labor input and the education and health components of GEA. The comparisons were made between countries and decades using the estimates in Tables 3-9 and 18.

The irrigation input was not compared with irrigation expenditures because the former was measured by the number of hectares under irrigation. Such a comparison would overestimate their relationship. The corresponding tables show a close association between these two variables. So the irrigation input was compared with the land input and the land reform component of GEA.

The analysis showed that the relationship between the fertilizer input and the research and extension component of GEA was positive. Fertilizer can be used to represent modern inputs, which adds meaning to this relationship.

In six of the study countries a positive relationship was found between the land input and the irrigation and land reform components of GEA. In only one was a negative relationship found.

The ratio of government expenditures on education and health to the labor input grew at an average annual rate of 5 percent. Because the size of the agricultural labor force fell, this implies a negative relationship between the labor input and the education and health components of GEA.

These associations between the components of GEA and agricultural inputs indicate that GEA contributes to the growth of agriculture through the growth of inputs. Except for labor, the evidence found here does not show that inputs were crowded out.

These relationships can be seen more clearly by looking at the components of GEA in more detail. A study of the change of the composition of aggregate GEA is necessary to completely identify the effects on agriculture of the public input concept introduced here. An alternative approach is to define the public input as a weighted average of its components.[31]

Another approach to the study of the crowding out phenomenon is to look at the acceleration of public and private investment in agriculture. This analysis was made for a few countries. Crowding out was found only when public investment accelerated rapidly. This analysis also provides a reference for the study of the effect of expenditure policies on employment. Rural-urban migration caused agricultural employment to fall, which makes it difficult to identify the net effect of GEA.

Production Function Approach

The analysis using the production function approach begins with the results of equation (5). In this equation, only land, labor, and capital are included explicitly. In econometric estimation, the other inputs, such as fertilizer, tractors, irrigation, and draft animals, are incorporated as well. The public input, G, is entered in different forms: as a capital concept, as the flow of GEA, and as some of the components of GEA, such as research and extension and irrigation. The service concept for each input should be used, but the data do not allow it. Therefore, the estimates are based on gross measurements of the inputs, such as hectares harvested, employment, and the value of physical stocks, assuming constant proportionality between the quantities of the inputs and the amount of services they provide.[32]

Table 24 gives three kinds of results. The first includes only land, labor, and capital. The second adds G. The third includes the lagged public input.

The $\overline{R}^2$ for all the regressions is greater than 0.85. According to the Durbin-Watson test for autocorrelation, the hypothesis of zero first-order autocorrelation is rejected in six of eight countries when G is not included, and only in two countries when this variable is incorporated in the regression.

The estimates in Table 24 show that the parameters for the inputs differ between countries. The effects of G also vary between countries and are sometimes negative. But the addition of G to the regressions generally improves the estimates of the parameters of the traditional inputs, especially in Argentina and Chile. It also reduces the differences between the parameters for the different inputs.

[31] See Theodore W. Schultz, Foreword to Bruce Gardner, *The Governing of Agriculture.*

[32] See Griliches, "Sources of Productivity Growth," pp.331-346.

Table 24—Production function estimates for traditional inputs and the public input, 1950-80

Variables	Argentina	Brazil	Chile	Colombia	Costa Rica	Mexico	Peru	Venezuela
Regression I								
Land (H)	−0.097	1.340[a]	0.347	0.548[b]	0.608	−0.073	0.819[b]	0.174
Labor (L)	0.695[a]	1.297[a]	−0.592	0.472[b]	0.151	0.469	0.740[b]	0.833[b]
Capital (K)	0.381[b]	0.039	0.391[b]	0.419[b]	1.031[b]	0.896[b]	n.a.	0.777[b]
Regression II								
Land (H)	0.322	1.329[a]	0.586[b]	0.550[b]	0.801[a]	0.289	0.811[b]	0.099
Labor (L)	0.289	1.298[a]	0.520[a]	0.548[b]	0.171[a]	0.081	0.777[a]	0.401[a]
Capital (K)	0.225[a]	0.186	0.154[b]	0.351[b]	1.233[b]	0.994[b]	n.a.	0.758[b]
Public input (G)	0.468[a]	−0.105	0.299[b]	0.147	−0.124[a]	−0.270[a]	−0.020	0.186[a]
Regression III								
Land (H)	0.317	1.416[a]	0.564[b]	0.554[b]	0.802[a]	0.518	0.810[b]	0.199[a]
Labor (L)	0.318	1.181[a]	0.431	0.552[b]	0.177[a]	0.068	0.780[b]	0.321[a]
Capital (K)	0.241[a]	0.017	0.218[b]	0.359[b]	1.192[b]	0.942[b]	n.a.	0.651[b]
Public input (G[t−1])	0.456[a]	0.017	0.266[b]	0.135	−0.119[a]	−0.334[a]	−0.025	0.249

Sources: Derived from Appendix 2, Tables 27-35.
Notes: Bolivia is excluded because the regression estimation was not complete. Where n.a. appears, the data were not available.
[a]Statistically significant at 5 percent.
[b]Statistically significant at 1 percent.

When G is added to the regressions, the results agree with the results from the sources-of-growth methodology. With both methodologies the effects of G on agricultural growth are higher in countries in which agricultural output grew more rapidly.

Table 25 shows the results of regressions in which modern inputs are incorporated and in which the public input is represented by G, GEA, or one of GEA's components, either research and extension or irrigation. The alternatives to G give worse results than G does. In Brazil and Mexico, G's effects on agricultural output were negative. The effects became positive when research and extension was used instead of G. In Brazil the effects of G were also positive if irrigation was used, but this was not true for Mexico.

These results imply that some components of G reduce agricultural output. This could mean either that there is too much investment in some components or that there is inefficiency in the use of GEA. If this is true, it may be better to work with the components themselves or to define a weighted aggregate public input. Most estimates of the parameters of the modern inputs (tractors, fertilizer, and draft animals) are not statistically significant. This also agrees with results from the sources-of-growth methodology. It was shown that the residual of growth did not decrease much after the modern inputs were considered.

Multiple Production Function

If the production function of the outputs differ, changes in the composition of output could bias the estimates for the aggregate. The multiple production function provides a methodology for looking at the relevance of this bias. But to apply this approach, more information is needed.

The method is applied only to Argentina, the only country for which enough information could be obtained to apply Klein's method for the period 1950-73 (see Chapter 3 and Appendix 1). Assuming the cost minimization conditions of equation (6), equation (3) is estimated to be

$$I(t) = \ln L(t) + 0.593 \ln H(t) + 1.845 \ln K(t). \quad (13)$$

In the final step of Klein's method, I(t) is regressed on production of crops (A) and livestock (B). Their relationship, derived from equation (6), is

$$I(t) = \underset{(-1.876)}{-9.352} + \underset{(4.884)}{3.320} \ln A(t) + \underset{(0.327)}{0.371} \ln B(t); \quad (14)$$

$R^2 = 0.87.$

The numbers in parentheses are t-statistics.

Table 25—Production function estimates including modern inputs, 1950-80

Variable	Argentina	Argentina	Argentina
Land (H)	−0.034	−0.288	−0.217
Labor (L)	0.427[a]	0.611[b]	0.597[b]
Capital (K)	0.673	1.225[b]	1.190[b]
Tractors	0.057[a]	0.044	0.017
Fertilizer	...	...	...
Irrigation	...	...	...
Livestock	−0.186	−0.365	−0.348
Public input			
Total expenditures (G)	0.466[a]	...	...
Government expenditures on agriculture (GEA)	...	0.038	...
Research and extension	...	...	0.065

Variable	Brazil	Brazil	Brazil	Brazil
Land (H)	0.556[b]	0.552[b]	0.649[b]	0.661[a]
Labor (L)	0.715	0.972	0.716	0.544
Capital (K)	−0.026	−0.053	−0.045	−0.127
Tractors	0.056	0.008	0.004	0.020
Fertilizer	0.008	0.033	0.034	0.024
Irrigation	...	...	...	...
Livestock	0.079	0.206	0.160	0.252
Public input				
Total expenditures (G)	0.199	...	...	...
Government expenditures on agriculture (GEA)	...	−0.009	...	...
Research and extension	...	...	0.017	...
Irrigation	...	...	...	0.020

Variable	Chile	Colombia	Mexico
Land (H)	0.423	0.308[a]	−0.251
Labor (L)	−0.066	−0.157	0.008
Capital (K)	0.382[b]	0.017	0.542[a]
Tractors	...	0.156[a]	0.121
Fertilizer	...	−0.001	0.087
Irrigation	...	...	−0.008
Livestock	...	1.093[c]	...
Public input			
Total expenditures (G)	...	...	0.076
Government expenditures on agriculture (GEA)	0.031	...	...
Research and extension	...	0.003	...
Irrigation	...	...	...

Variable	Mexico	Mexico	Mexico	Peru
Land (H)	−0.239	−0.237	−0.254	0.380[a]
Labor (L)	0.023	−0.023	0.008	1.593[c]
Capital (K)	0.686[b]	0.622[b]	0.751[b]	−0.232
Tractors	0.019	−0.022	−0.050	...
Fertilizer	0.089	0.089	0.095	...
Irrigation	0.005	−0.000	0.020	...
Livestock	...	...	...	...
Public input				
Total expenditures (G)	...	...	...	...
Government expenditures on agriculture (GEA)	−0.002	...	...	−0.003
Research and extension	...	0.042	...	...
Irrigation	...	...	−0.019	...

(continued)

Table 25—Continued

Variable	Venezuela	Venezuela	Venezuela
Land (H)	0.236	−0.147	0.159
Labor (L)	0.760[b]	0.799[b]	0.794[b]
Capital (K)	0.682[b]	0.965[b]	0.817[b]
Public input			
Government expenditures on agriculture (GEA)	0.052	...	...
Research and extension	...	0.092	...
Irrigation	...	...	−0.011

Sources: Derived from Appendix 2, Tables 27-35.
Note: Bolivia and Costa Rica are excluded because the regression estimations were not complete.
[a] Statistically significant at 5 percent.
[b] Statistically significant at 1 percent.
[c] Statistically significant at 0.5 percent.

The coefficient of ln A(t) gives an estimate of l/d. Multiplying the estimates of the ratios b/d, c/d, and e/d by it gives estimates of the parameters: b = 0.179; c = 0.556; d = 0.301; and e = −0.112.

The results in these equations are similar to the results in the regression for Argentina that include G (Table 24). They are preliminary. Other econometric methods can improve results, but they require data not yet readily available.

It is necessary to investigate in more detail the relevance of the composition of output composition to have more confidence in the results on the effects of GEA on agriculture.

Equation (10) is estimated using ordinary least squares, pooling the data for all countries. Because data for some countries are missing, K is not included. The estimates are

$$
\begin{aligned}
\mathrm{Dln}\,A_i(t) = {} & \underset{(4.89)}{0.019} + \underset{(2.76)}{0.364}\ \mathrm{Dln}\ H_i(t) \\
& + \underset{(3.53)}{0.614}\ \mathrm{Dln}\ L_i(t) \\
& + \underset{(1.10)}{2.853}\ \mathrm{Dln}\ H_i(t)\ \mathrm{Dln}\ G_i(t) \\
& - \underset{(-1.34)}{1.999}\ \mathrm{Dln}\ L_i(t)\ \mathrm{Dln}\ G_i(t); \qquad (15)
\end{aligned}
$$

$R^2 = 0.354;$

where D stands for the first difference operator, and the numbers in parentheses are t-statistics. The estimates in equation (15) show that the interaction between land and the public input is positive and that the interaction between labor and the public input is negative. (The negative interaction with labor may reflect labor-saving technological change and migration.) The pooling of data among countries may introduce cross-country variability and require the introduction of some cyclical indicators because of their different positions in the business cycle. The gross investment-GDP ratio can be used as an additional variable in the model to capture this variability. This ratio for selected years and its value in those years compared to the average value for the whole period reveals some differences in the positions of countries in the business cycle. But systematic variability for the different countries was not found, so the variability does not change the results in equation (14) significantly. The ratio showed only small departures from the average. The cycle indicators might confirm this preliminary result.

The Effects of Government Expenditure on Agriculture

In the production function approach, the effect of GEA on agricultural production can either be measured directly as an additional input or considered as an effect on total productivity (defined by the ratio of output to an index of the other inputs). Each effect is similar, so the contribution of the public input to agricultural growth is the same as its contribution to agricultural productivity. In terms of equation (2), the public input contributes either to a (output growth) or g (total productivity growth).

Only the shares of the contribution of the public input to a or g are different as a is much bigger than g. The average share of the contribution of GEA to output growth was around 6 percent and its share in total productivity was about 20 percent (see Table 22).

If the public input is considered to be a perfect substitute for private capital, the contribution of the public input to agricultural growth should be computed using the output-input elasticity of private capital times the share of the public input in total capital (private plus public) as the output-input elasticity. This procedure, which produces an elasticity of 0.18 instead of 0.05, increases the contribution of the public input substantially. This alternative should be investigated in more detail, as the preliminary results on production function estimates do not completely favor this hypothesis.

An output-input elasticity of 0.05 for the public input implies that the rates of return to the public input are low (according to the observed output-public input ratios). The implicit rates of return are much lower than the ones found in other studies for some components of GEA (particularly research and extension). This result could favor the use of a much bigger output-public input elasticity, such as 0.18.

The effects of GEA on agricultural production can also be measured. The average annual rate of growth of agricultural output for 1950-80 and the contribution of the public input to this rate of growth leads to the conclusion that in a decade the value of agricultural output without the contribution of the public input will be less than 90 percent of its value with that contribution.

GEA can also affect the supply of private inputs (the crowding out hypothesis), their output-input elasticities, and their quality. GEA's effects on the first two were analyzed above. Its effects on the last, on the quality of the private inputs, can be very important, but analysis of them was not attempted in this report. For example, expenditures on education and health contribute to labor quality, irrigation and fertility contribute to land quality, and research and extension contribute to the quality of all the traditional inputs.

7

DETERMINANTS OF GOVERNMENT EXPENDITURES ON AGRICULTURE

There is a close relationship between GEA and total government expenditures, GE, but some variability in the ratio of the two.[33] The variability of this ratio can be used as an indicator of government behavior and as the variable to be explained.

The value and composition of GEA/GE can reflect different objectives of a government. These may include encouraging the growth of agriculture, stabilizing farm income, increasing the income of agricultural labor, and providing food subsidies for consumers.

A government's ability to reach its objectives is subject to a variety of influences, including the terms of trade of agricultural and nonagricultural products; the ratio of rural to urban wages; world prices of important agricultural export products; the share of agriculture in GDP; the share of agricultural labor in the labor force; and the contribution of labor to agricultural output. A government can affect some of these directly, using them to reach one or more objectives.

Some policies depend mainly on institutional factors, which are more difficult to quantify. A cross-country comparison can help identify them and should be taken into account.

It is important to know which of these influences affects government policy in order to know which variables can be used to indicate which objectives are chosen. The independent variables included in equation (12) can capture the effects of some of these influences.

The results of equation (12), estimated using ordinary least squares, are presented in Table 26. They show that L_A/L, A/GDP, and P_A/P_I affect GEA/GE positively, and that

Table 26—Regression estimates of the determinants of the ratio of government expenditures on agriculture to total government expenditures, 1950-80

Variable	Argentina	Brazil	Chile	Colombia	Mexico	Peru	Venezuela
L_A/L	0.010 (0.239)	0.029 (2.648)	0.095 (3.437)	−0.008 (−0.090)	0.062 (1.940)	−11.542 (−2.128)	−0.024 (−5.124)
A/GDP	0.022 (0.440)	0.018 (0.012)	−0.523 (−4.293)	−0.129 (−1.943)	−0.172 (−1.455)	0.482 (0.040)	0.049 (0.844)
P_A/P_I	0.004 (1.213)	−0.582 (−1.254)	−0.001 (−0.107)	. . .	0.004 (0.297)	0.008 (1.716)	. . .
P_{AW}	. . .	0.010 (2.877)	. . .	. . .	. . .	. . .	. . .
W_A/W_I	−0.063 (−0.070)	. . .	. . .	−0.045 (−3.311)	−0.074 (−3.140)	. . .	. . .
S_{LA}	1.071 (1.084)	. . .	. . .	−0.009 (−0.240)	. . .	. . .	. . .
R^2	0.346	0.824	0.536	0.537	0.568	0.877	0.512
D.W.	2.132	1.338	1.343	1.752	1.364	2.258	1.415

Sources: Derived from Appendix 2, Tables 27-35.
Notes: The values in parentheses are t-statistics. D.W. is the Durbin-Watson test for autocorrelation. Bolivia and Costa Rica are excluded because the regression estimations were not complete.

[33] Elías, *Government Expenditures on Agriculture.*

w_A/w_I affects it negatively in most countries.

Most variables have positive effects. The share of the agricultural labor force in the total labor force was the most significant, but because of the negative effect of the ratio of rural to urban wages, it is unclear whether the governments pursued income distribution or growth policies. A growth policy can be captured by the variable A/GDP. But it can also work through other variables. To draw clear conclusions from this, the information must be complete and a structural model used.

8

CONCLUSIONS AND POLICY IMPLICATIONS

More research is needed to make the results more definite, but the analysis in this report does yield some conclusions that are important for the design of expenditure policies.

First, an aggregate concept of GEA is more appropriate. In the estimates of the production function, the GEA for each component was less significant than the aggregate (this can be explained in part by the absence of big changes in GEA composition, which are needed to capture this effect). For more specific questions, the study of GEA's composition is needed. Second, dividing government agricultural policies into expenditure and price policies makes it easier to identify their effects. For example, expenditure policies affect agriculture mainly by shifting supply.

Third, a positive relationship was found between GEA per hectare and agricultural growth. On the average GEA caused agricultural output to increase about 0.2 percent. This was almost 8 percent of output growth, a contribution similar to the contribution of the modern inputs and to the contribution of education to the growth of the whole economy. The contribution of GEA was lower, the lower the rate of growth of agriculture. It was also found that the contribution of GEA to agriculture was not associated with the size of the contribution of any traditional input.

Fourth, the contribution of GEA to agricultural growth was higher, the higher the share of the irrigation or the research and extension components of GEA. Fifth, GEA contributed to the stability of agriculture. The rate of growth of GEA was negatively related to the variability of agricultural growth. This result is contrary to expectations and may imply an advantage that expenditure policies have over price policies.

Sixth, positive correlations were found between research and extension expenditures and the use of fertilizers and between land reform expenditures and the use of irrigation. A small negative association was found between education and health expenditures and the use of labor. Also, the crowding out hypothesis proves true only when public investment accelerates rapidly. It can be concluded, therefore, that the evidence does not favor the hypothesis that public investment increases are made at the expense of private investment, so the contribution of public investment to agricultural growth is not offset by its effects on private input, which could, in fact, be reinforced.

The analysis of the sources of growth shows that in three of the four countries with low rates of growth of output, capital contributed the most to that growth. In the three countries with high rates of growth, the residual contributed the most. The rate of growth of the capital input was positively associated with the size of the residual. This could imply a positive relationship between capital accumulation and technological change.

Some of the results also suggest topics for future research. It was found that some components of GEA increased at the expense of components appropriate to different kinds of objectives. This implies the need to work with a more complete model that would incorporate a budget restraint.

APPENDIX 1:
ESTIMATES OF MULTIPLE PRODUCTION FUNCTIONS

Professor Lawrence Klein proposed the method used in this report.[34] Important contributions to it were also made by Chipman; Christensen, Jorgensen, and Lau; Houthakker; Mundlak; Nerlove; Rao; and Vinod.[35]

The method begins with a Cobb-Douglas specification for outputs and inputs:

$$\ln A(t) = a + b \ln H(t) + c \ln K(t) + d \ln L(t) + e \ln B(t) + u(t), \quad (6)$$

where A and B represent outputs (crops and livestock), and H, K, and L inputs (land, capital, and labor).

The cost minimization conditions are

$$r(t)\ H(t)/w(t)\ L(t) = (b/d)\ v_1(t); \quad (16)$$

and

$$s(t)\ K(t)/w(t)\ L(t) = (c/d)\ v_2(t), \quad (17)$$

where r is the unit price of the land input, w is the unit price of the labor input, and s is the unit price of the capital input. The terms v_1 and v_2 are stochastic terms that are either derived from the cost minimization conditions related to the stochastic term u in equation (6), or they are derived directly from the conditions necessary for cost minimization. They can also be interpreted as parameters for variability.

First take the logarithm of equations (16) and (17):

$$\ln [r(t)\,H(t)/w(t)\,L(t)] = \ln (b/d) + \ln v_1; \quad (18)$$

and

$$\ln [s(t)\,K(t)/w(t)\,L(t)] = \ln (c/d) + \ln v_2. \quad (19)$$

Then, assuming that $\ln v_1$ and $\ln v_2$ are normal and independently distributed, ln (b/d) and ln (c/d) can be estimated, using the method of maximum likelihood, by the following equations:

$$\ln (b/d) = (1/n)\, \Sigma_i^m \ln[r(t)\,H(t)/w(t)\,L(t)], \quad (20)$$

and

$$\ln (c/d) = (1/n)\, \Sigma_i^m \ln [s(t)\,K(t)/w(t)\,L(t)], \quad (21)$$

where n is the number of observations. Equations (20) and (21) provide unbiased and consistent estimates of ln (b/d) and ln (c/d). The consistent maximum likelihood estimates of b/d and c/d are designated by b/d and c/d.

Equation (6) can be rearranged to produce

$$\ln L(t) + (b/d) \ln H(t) + (c/d) \ln K(t) = -(a/d) + (1/d) \ln A(t) - (e/d) \ln B(t) - (1/d) \ln u(t). \quad (22)$$

The left-hand side of equation (22) can be replaced by

$$I(t) = \ln L(t) + (b/d) \ln H(t) + (c/d) \ln K(t). \quad (23)$$

Nerlove proposed an alternative definition of I(t), using share ratios instead of maximum likelihood estimates:[36]

$$I(t) = \ln L(t) + [r(t)\ H(t)/w(t)\ L(t)] \ln H(t) + [s(t)\ K(t)/w(t)\ L(t)] \ln K(t). \quad (24)$$

[34] See Klein, *A Textbook of Econometrics.*

[35] John S. Chipman, "Returns to Scale in the Railroad Industry: A Reinterpretation of Klein's Data," *Econometrica* 25 (1957): 607; Laurits R. Christensen, Dale W. Jorgensen, and Lawrence J. Lau, "Transcendental Logarithmic Production Frontiers," *Review of Economics and Statistics* 55 (February 1973): 28-45; H. S. Houthakker, "The Pareto Distribution and the Cobb-Douglas Production Function in Activity Analysis," *Review of Economic Statistics* 23 (No. 1, 1955): 27-31; Mundlak, "Models with Variable Coefficients"; Marc Nerlove, *Estimation and Identification of Cobb-Douglas Production Functions* (Amsterdam: North Holland Publishing Co., 1965), Chapter 4; Potluri M. Rao, "A Note on Econometrics of Joint Production," *Econometrica* 37 (October 1969): 737; and H. D. Vinod, "Econometrics of Joint Production," *Econometrica* 36 (April 1968): 322.

[36] See Nerlove, *Estimation and Identification of Cobb-Douglas Production Functions,* Chapter 4.

I(t) can be estimated using ordinary least squares and the following equation:

$$I(t) = -(a/d) + (l/d) \ln A(t) - (e/d) \ln B(t) - (l/d) \ln u(t). \quad (25)$$

From this it is possible to estimate a/d, l/d, and e/d, and from them in turn, estimates of a, b, c, d, and e.

It was noted in the methodological chapter that the Cobb-Douglas form for outputs provides the wrong convexity for a competitive market. There are ways to solve this problem. Among them are the CES form proposed by Powell and Gruen and the translog form proposed by Christensen, Jorgensen, and Lau.[37]

The CES form for outputs is easy to estimate. A good approximation can be obtained by adding the term $[\ln A(t) - \ln B(t)]^2$ to equation (25). Estimating the translog function is more difficult. It is usually done using the profit function instead of estimating the multiple production function directly. The profit function requires the use of input prices. Some efforts along this line were made recently.[38]

Another alternative can be found in Mundlak and works on frontier production.[39]

[37] See P. Powell and F. H. G. Gruen, "The Constant Elasticity of Transformation Frontier and Linear Supply System," *International Economic Review* 9 (October 1968): 315; and Christensen, Jorgensen, and Lau, "Transcendental Logarithmic Production Frontiers."

[38] Huffman and Evenson, "U.S. Agricultural Productivity and Public Policy."

[39] See Yair Mundlak, "Endogenous Technology and the Measurement of Productivity," paper presented at the meeting on Developing a Framework for Assessing Future Changes in Agricultural Productivity, Resources for the Future, Washington, D.C., July 1984 (mimeographed). Also see D. H. Aigner and P. Schmidt, eds., "Specification and Estimation of Frontier Production, Profit and Cost Functions," *Journal of Econometrics* 13 (May 1980).

APPENDIX 2: BASIC DATA

Table 27—Basic data on agriculture in Argentina, 1950-81

Year	Value Added: Agriculture	Value Added: Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors	Fertilizer	Livestock	Contribution of Labor to Agricultural Output	Stock of Public Input
	(million 1970 new pesos)		(1,000 hectares)	(1,000 persons)	(million 1960 new pesos)	(1,000 horsepower)	(metric tons)	(1,000 head)	(percent)	(million 1960 new pesos)
1950	6,444	2,941	23,664	955	3,556	735	n.a.	42,275	34.3	1,783
1951	6,737	3,238	26,063	1,065	3,569	902	n.a.	42,042	37.8	1,791
1952	5,849	2,567	24,030	912	3,674	1,093	n.a.	42,583	36.1	1,794
1953	7,538	3,921	27,210	1,123	3,753	1,397	n.a.	43,438	37.3	1,809
1954	7,570	3,689	27,039	1,079	3,981	1,503	n.a.	45,376	37.3	1,814
1955	7,884	3,856	26,452	1,063	4,239	1,879	n.a.	47,516	34.3	1,816
1956	7,405	3,641	26,671	1,045	4,428	2,829	19,230	48,270	32.1	1,825
1957	7,442	3,730	28,793	1,016	4,372	3,542	12,523	47,534	27.2	1,727
1958	7,755	4,043	29,574	1,033	4,263	4,323	18,560	46,335	32.4	1,803
1959	7,746	3,942	29,215	982	4,090	4,909	12,470	44,547	23.8	1,793
1960	7,744	4,068	28,169	960	4,224	5,529	15,978	45,484	22.2	1,791
1961	7,681	4,031	27,364	925	4,530	6,329	20,064	47,494	25.6	1,807
1962	8,070	4,336	28,481	926	4,667	6,802	13,357	48,657	25.0	1,818
1963	8,319	4,283	27,107	937	4,582	7,318	33,861	49,520	21.3	1,826
1964	8,716	4,548	28,911	952	4,493	7,994	46,004	47,213	20.8	1,865
1965	9,328	5,068	28,308	966	4,643	8,579	46,604	49,173	25.2	1,901
1966	8,983	4,572	27,625	911	4,768	8,909	50,077	51,792	28.0	1,948
1967	9,416	5,020	28,351	989	4,855	9,248	51,841	53,120	28.2	2,011
1968	8,911	4,625	29,003	985	4,941	9,565	59,033	53,392	30.4	2,082
1969	9,312	4,751	30,730	1,049	4,967	9,711	68,269	53,291	30.3	2,163
1970	9,899	5,345	30,465	1,092	4,989	9,825	74,455	52,260	31.7	2,248
1971	9,914	5,243	28,054	1,050	5,038	10,072	76,120	51,877	29.0	2,288
1972	10,106	5,123	26,756	1,050	5,161	10,285	103,134	53,667	25.3	2,318
1973	11,161	6,026	28,437	1,170	5,332	10,779	81,383	54,837	26.6	2,384
1974	11,569	6,360	26,254	1,100	5,493	11,273	72,504	56,807	18.9	2,432
1975	11,271	5,986	25,955	1,035	5,639	11,471	40,516	58,722	22.8	2,472
1976	11,785	6,389	26,978	1,022	5,799	11,945	80,044	57,922	14.4	2,533
1977	12,049	6,805	27,788	1,010	6,019	12,445	72,220	58,991	13.6	2,619
1978	12,263	6,927	29,148	997	6,186	12,138	82,658	59,898	16.0	2,675
1979	12,739	7,364	30,792	988	6,398	11,887	137,498	58,836	16.6	2,690
1980	12,056	7,044	29,451	978	6,613	11,466	124,119	n.a.	22.4	2,716
1981	n.a.	n.a.	n.a.	n.a.	n.a.	10,968	85,360	n.a.	n.a.	n.a.

Year	Government Expenditures: Agriculture	Government Expenditures: Research and Extension	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry	Credit Subsidy
	(million 1960 new pesos)			(percent)		(index: 1970=100)	(million 1960 new pesos)
1950	40.1	4.0	19.4	18.6	0.484	63.2	2.0
1951	56.7	4.2	20.4	18.9	0.573	76.0	14.8
1952	53.7	4.2	18.0	17.4	0.553	76.7	32.3
1953	66.8	4.2	20.9	21.6	0.628	84.4	41.4
1954	50.5	4.3	19.5	20.6	0.592	77.8	27.8
1955	48.9	4.3	18.6	19.7	0.549	70.7	25.7
1956	58.2	4.3	17.8	18.8	0.559	81.3	25.1
1957	33.5	4.3	16.6	17.4	0.498	87.7	43.3
1958	39.0	5.8	16.1	16.5	0.581	82.7	57.5
1959	33.4	7.4	15.5	17.5	0.654	97.5	97.8
1960	45.8	n.a.	14.8	16.6	0.527	90.3	108.8

(continued)

Table 27—Continued

Year	Government Expenditures: Agriculture	Government Expenditures: Research and Extension	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry	Credit Subsidy
	(million 1960 new pesos)			(percent)		(index: 1970=100)	(million 1960 new pesos)
1961	52.1	8.9	13.9	15.6	0.476	78.3	99.0
1962	46.3	7.1	14.0	16.3	0.508	80.2	74.9
1963	44.1	7.1	14.1	16.9	0.493	89.7	46.2
1964	53.6	9.6	13.5	16.1	0.529	107.7	36.4
1965	53.5	8.0	13.1	15.8	0.551	88.6	35.3
1966	62.1	9.0	12.0	15.4	0.525	83.7	50.2
1967	74.6	14.6	12.4	16.0	0.478	82.7	63.0
1968	84.3	13.5	12.0	14.8	0.505	87.4	57.2
1969	86.6	15.2	12.0	14.5	0.512	95.2	38.0
1970	90.7	15.5	11.9	12.7	0.530	100.0	31.9
1971	74.5	12.9	11.5	12.3	0.581	119.9	48.8
1972	70.3	14.1	11.2	12.3	0.611	130.0	80.4
1973	66.5	18.4	10.9	13.1	0.603	137.3	116.2
1974	71.2	11.9	10.4	12.9	0.592	120.3	115.7
1975	68.3	17.6	10.0	12.6	0.592	81.5	n.a.
1976	78.1	14.9	10.0	13.2	0.592	79.8	n.a.
1977	92.4	13.1	9.9	12.7	0.592	89.0	n.a.
1978	81.2	18.5	9.8	13.4	0.592	76.2	n.a.
1979	95.2	20.8	9.8	13.0	0.592	88.7	n.a.
1980	106.7	25.0	9.5	12.2	0.592	82.2	n.a.
1981	n.a.	n.a.	n.a.	13.5	0.592	n.a.	n.a.

Sources: The figures for 1950-67 are from Víctor J. Elías, "Fuentes del Crecimiento Económico Argentino y Perspectivas Futuras," *Ensayos en Economía* 1 (December 1965); the figures for 1968-73 are from Lucio G. Reca and Juan Verstraeten, "La Formación del Producto Agropecuario Argentino: Antecedentes y Posibilidades," *Desarrollo Económico* 17 (October-December 1977): 371-389. For 1974-80, investments on physical capital in agriculture are estimated to be 9 percent of total investment using national accounts data.

Argentina, Ministerio de Economía, *Boletín Semenal de Economía*, various issues, 1982-83; Banco Central de la República Argentina, Gerencia de Investigaciones Económicas, "Agricultura, Caza, Silvicultura y Pesca: Producto Bruto a Precios Corrientes, Período 1970-80," *Serie de Trabajos Metodológicos y Sectoriales 22* (Buenos Aires: Banco Central de la República Argentina, 1982); Banco Central de la República Argentina, Gerencia de Investigaciones Económicas, "Estimacion Trimestrales y Anuales de la Oferta y Demanda Global a Precios de 1970: Metodología y Fuentes de Información y Resultados," *Serie de Trabajos Metodológicos y Sectoriales 12* (Buenos Aires: Banco Central de la República Argentina, 1980); Banco Central de la Republica Argentina, Gerencia de Investigaciones Económicas, "Origen del Producto y Distribución del Ingreso, Años 1950-69," *Boletín Estadístico*, Suplemento, Enero 1971; Banco Central de la República Argentina, Gerencia de Investigaciones Económicas, *Sistemas de Cuentas del Producto e Ingreso de la Argentina*, volumes 2 and 5 (Buenos Aires: Banco Central de la República Argentina, 1975 and 1976); Bolsa de Cereales, "Numero Estadístico 1980," *Revista Institucional* (Buenos Aires: Bolsa de Cereales, 1980); Luis Cuccia, *El Ciclo Ganadero y la Economía Argentina*, Cuaderno 43 (Santiago de Chile: Comisión Económica para América Latina, 1983); Víctor J. Elías, "Fuentes del Crecimiento Argentino y Perspectivas Futuras"; Víctor M. Feijóo, "Contribución de la Investigación a la Productividad Agropecuaria," Serie Cuadernos, Instituto de Investigaciones Estadísticas de la Universidad Nacional de Tucumán, Tucumán, Argentina, 1982 (mimeographed); Juan J. Llach and Carlos E. Sánchez, "Los Determinantes del Salario en la Argentina. Un Diagnóstico de Largo Plazo y Propuestas Políticas," *Estudios* 7 (January/March 1984): 3-47; Norberto Ras and Roberto Levis, *El Precio de la Tierra (Su Evolución Entre Los Años* 1916 y 1978) (Buenos Aires: Sociedad Rural Argentina, 1982); Lucio G. Reca and José M. Frogone, *Rasgos Característicos de la Ganadería Vacuna Argentina* (Cali, Colombia: Centro Internacional de Agricultura Tropical, 1982); and Lucio Reca and Juan Verstraeten, "La Formación del Producto Agropecuario Argentina."

Notes: The stock of physical capital includes tractors, livestock, construction, and the corporate sector. For 1974-80, investments on physical capital in agriculture were estimated to be 9 percent of total investment using national accounts data. The land includes the harvested hectares of crops and pasture. Tractors are defined in equivalent horsepower units. Fertilizers are measured in terms of nutrients. Where n.a. appears, the data were not available.

Table 28—Basic data on agriculture in Bolivia, 1950-79

Year	Value Added: Agriculture	Value Added: Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors
	(million 1958 Bolivian pesos)		(1,000 hectares)	(1,000 persons)	(1958 U.S. $1,000)	(index: 1960 = 100)
1950	1,000	n.a.	373	n.a.	20,000	62.0
1951	1,114	n.a.	n.a.	n.a.	20,000	63.4
1952	1,094	n.a.	n.a.	n.a.	19,978	65.2
1953	967	n.a.	n.a.	n.a.	20,149	67.0
1954	946	n.a.	n.a.	n.a.	19,815	68.4
1955	1,008	n.a.	n.a.	n.a.	21,485	75.4
1956	953	n.a.	n.a.	n.a.	26,069	91.3
1957	945	n.a.	n.a.	n.a.	25,895	93.8
1958	1,006	n.a.	n.a.	n.a.	25,816	96.6
1959	1,084	n.a.	n.a.	n.a.	25,052	98.1
1960	1,084	n.a.	n.a.	1,131	24,687	100.0
1961	1,137	n.a.	n.a.	n.a.	24,019	101.7
1962	1,126	n.a.	n.a.	n.a.	23,490	101.7
1963	1,189	n.a.	n.a.	n.a.	23,756	101.9
1964	1,213	n.a.	693	n.a.	23,880	102.3
1965	1,281	n.a.	688	n.a.	24,635	102.3
1966	1,328	n.a.	692	1,192	25,662	103.2
1967	1,289	n.a.	718	1,214	26,205	103.7
1968	1,352	n.a.	734	1,236	32,216	120.6
1969	1,239	n.a.	603	1,258	33,046	122.0
1970	1,294	870	613	1,281	34,109	123.8
1971	1,345	n.a.	616	1,306	36,036	129.0
1972	1,381	1,029	624	1,415	37,864	134.3
1973	1,340	1,021	n.a.	1,404	42,749	n.a.
1974	1,655	1,228	n.a.	1,442	46,346	n.a.
1975	1,913	1,418	n.a.	n.a.	54,183	n.a.
1976	2,009	1,482	683	n.a.	57,023	n.a.
1977	1,996	1,418	n.a.	n.a.	57,894	n.a.
1978	n.a.	n.a.	n.a.	n.a.	62,021	n.a.
1979	n.a.	n.a.	n.a.	n.a.	63,460	n.a.

Year	Livestock	Stock of Public Input	Government Expenditures: Agriculture	Government Expenditures: Irrigation	Share of Agriculture in the Gross Domestic Product	Terms of Trade Between Agriculture and Industry
	(1,000 head)	(million 1960 Bolivian pesos)			(percent)	(index: 1970=100)
1950	n.a.	n.a.	n.a.	n.a.	32.6	n.a.
1951	n.a.	n.a.	n.a.	n.a.	30.9	n.a.
1952	n.a.	n.a.	n.a.	n.a.	29.5	n.a.
1953	n.a.	n.a.	n.a.	n.a.	28.8	n.a.
1954	n.a.	n.a.	n.a.	n.a.	27.6	n.a.
1955	n.a.	n.a.	n.a.	n.a.	27.9	n.a.
1956	n.a.	n.a.	n.a.	n.a.	28.1	n.a.
1957	n.a.	n.a.	n.a.	n.a.	28.8	n.a.
1958	n.a.	n.a.	n.a.	n.a.	31.7	n.a.
1959	n.a.	n.a.	n.a.	n.a.	32.4	n.a.
1960	n.a.	350	17.9	3.4	31.0	n.a.
1961	n.a.	371	31.0	4.9	31.9	n.a.
1962	n.a.	389	36.3	4.2	29.9	n.a.
1963	n.a.	423	53.4	5.5	29.7	n.a.
1964	n.a.	463	61.2	4.6	28.9	n.a.
1965	n.a.	535	95.2	16.0	28.5	n.a.
1966	2,865	666	158.3	13.6	27.6	n.a.
1967	2,132	759	125.4	15.7	25.2	n.a.
1968	2,184	909	188.7	10.5	24.7	n.a.
1969	2,238	1,035	171.2	18.1	22.1	n.a.
1970	2,364	1,181	197.5	14.9	22.1	100.0
1971	2,200	1,297	175.4	50.3	22.1	99.7

(continued)

Table 28—Continued

Year	Livestock	Stock of Public Input	Government Expenditures Agriculture	Government Expenditures Irrigation	Share of Agriculture in the Gross Domestic Product	Terms of Trade Between Agriculture and Industry
	(1,000 head)	(million 1960 Bolivian pesos)			(percent)	(index: 1970=100)
1972	2,300	1,439	206.8	28.7	21.5	102.9
1973	n.a.	1,637	269.7	25.7	21.4	104.6
1974	n.a.	1,775	220.4	25.9	19.2	123.3
1975	n.a.	1,937	251.1	61.3	19.8	117.0
1976	n.a.	2,178	336.6	n.a.	19.7	114.5
1977	n.a.	2,444	374.9	n.a.	18.8	119.9
1978	n.a.	2,841	519.2	n.a.	18.5	119.7
1979	n.a.	n.a.	n.a.	n.a.	18.8	116.7

Sources: Banco Central de Bolivia, *Cuentas Nacionales,* Publicación No. 1, 1978; Banco Central de Bolivia, *Boletín Estadístico,* 1978; Food and Agriculture Organization of the United Nations, Secretariado de la Conferencia Mundial sobre Reforma Agraria y Desarrollo Rural, *Informe Nacional de Bolivia,* Informe Nacional No. 51 (Rome: FAO, 1978); U.S. Agency for International Development, Mission to Bolivia, *Agricultural Development in Bolivia: A Sector Assessment* (La Paz: USAID, 1974).

Notes: The stock of physical capital was constructed from the flow of imports of equipment and machinery for agriculture, applying the inventory approach with a rate of depreciation of 6 percent. The index of tractors is based on import of tractors. Where n.a. appears, the data were not available.

Table 29—Basic data on agriculture in Brazil, 1950-80

Year	Value Added Agriculture	Value Added Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors	Fertilizer	Livestock	Stock of Public Input
	(1960 NCr million)		(1,000 hectares)	(1,000 persons)	(1960 NCr million)	(1,000 units)	(1,000 metric tons)	(1,000 head)	(1960 NCr million)
1950	330.4	n.a.	17,123	9,887	286.1	8.4	89	46.9	n.a.
1951	332.7	n.a.	17,227	10,053	291.4	18.5	121	47.9	323
1952	363.0	n.a.	18,173	10,222	296.7	25.6	73	48.1	320
1953	363.7	n.a.	18,740	10,394	302.1	28.0	117	48.9	322
1954	392.3	n.a.	19,982	10,570	307.6	42.9	124	50.6	324
1955	422.6	n.a.	20,882	10,749	313.1	46.3	161	52.4	327
1956	412.5	n.a.	21,305	10,931	318.7	49.4	165	54.2	332
1957	450.9	n.a.	22,144	11,117	324.3	56.5	207	53.8	344
1958	460.0	n.a.	22,525	11,307	330.0	55.9	250	54.7	352
1959	484.4	n.a.	23,506	11,501	335.8	56.3	221	55.3	258
1960	508.2	n.a.	25,276	11,698	341.7	61.3	299	55.7	365
1961	546.6	n.a.	26,220	11,864	347.6	65.8	247	57.3	375
1962	576.6	n.a.	26,995	12,033	353.6	65.3	237	59.4	386
1963	582.4	n.a.	28,271	12,206	359.7	70.4	314	60.1	394
1964	590.2	n.a.	29,108	12,381	365.9	76.0	255	63.3	407
1965	671.6	n.a.	32,690	12,560	372.1	74.5	290	68.1	422
1966	650.5	n.a.	32,024	12,742	378.4	79.9	281	67.8	436
1967	687.3	n.a.	32,767	12,927	384.8	91.2	449	68.1	452
1968	696.7	n.a.	33,564	13,116	391.3	103.4	602	69.9	468
1969	738.4	n.a.	34,579	n.a.	402.1	n.a.	630	n.a.	484
1970	779.7	236.3	35,982	13,156	418.0	165.9	n.a.	78.5	501
1971	868.6	n.a.	37,295	n.a.	430.4	n.a.	n.a.	n.a.	516
1972	907.7	252.7	38,698	n.a.	460.0	201.0	1,624	n.a.	536
1973	936.4	290.3	39,425	n.a.	492.0	218.5	1,673	n.a.	554
1974	1,015.9	282.5	44,562	n.a.	528.0	236.0	1,825	n.a.	581
1975	1,050.3	312.5	40,688	15,754	565.2	254.0	1,978	100.8	608
1976	1,093.9	330.6	42,088	n.a.	598.0	270.0	2,528	n.a.	685
1977	1,225.8	363.6	44,137	n.a.	625.2	280.0	3,209	n.a.	767
1978	1,193.7	381.7	43,739	n.a.	650.8	300.0	3,222	n.a.	n.a.
1979	1.253.9	393.7	45,377	n.a.	n.a.	320.0	3,437	109.2	n.a.
1980	1,332.5	410.3	n.a.	n.a.	n.a.	n.a.	4,006	n.a.	n.a.

(continued)

Table 29—Continued

Year	Government Expenditures: Agri-culture	Government Expenditures: Research and Ex-tension	Government Expenditures: Irri-gation	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry	World Price of Coffee
	(1960 NCr million)				(percent)		(index: 1960 = 1.000)	(1960 U.S. cents/lb.)
1950	n.a.	0.2	4.7	57.76	n.a.	n.a.	1.181	69.63
1951	n.a.	0.3	4.7	57.11	n.a.	n.a.	1.190	66.67
1952	9.8	0.4	4.1	56.47	0.279	n.a.	1.269	68.81
1953	12.9	0.4	4.3	55.83	0.276	n.a.	1.244	77.55
1954	12.9	0.4	5.0	55.20	0.267	n.a.	1.226	75.47
1955	14.5	0.4	4.6	54.59	0.273	n.a.	1.210	56.94
1956	15.3	0.3	4.3	53.98	0.255	n.a.	1.128	58.19
1957	21.4	0.5	6.9	53.31	0.260	n.a.	1.043	52.67
1958	18.5	0.6	9.0	52.79	0.247	n.a.	0.966	41.03
1959	16.7	0.6	8.6	52.22	0.243	n.a.	0.892	36.66
1960	18.7	0.5	10.1	51.64	0.234	0.504	1.000	36.60
1961	20.1	0.5	11.2	50.29	0.228	0.451	0.946	35.66
1962	20.6	0.6	11.6	48.97	0.230	0.536	1.042	32.98
1963	19.3	0.6	11.4	47.69	0.226	0.586	0.942	32.69
1964	24.0	0.5	14.4	46.44	0.225	0.780	1.026	44.02
1965	25.0	0.9	15.5	45.23	0.247	0.837	0.904	41.32
1966	23.5	1.0	14.8	44.05	0.228	0.821	0.970	36.54
1967	27.8	0.9	19.6	42.91	0.231	0.827	0.961	32.87
1968	27.7	1.1	n.a.	41.80	0.214	0.844	0.865	31.17
1969	28.1	1.5	n.a.	n.a.	0.203	0.836	0.873	32.32
1970	31.1	1.2	29.0	39.33	0.194	0.900	0.962	41.14
1971	30.2	1.4	30.8	n.a.	0.195	0.938	1.027	32.13
1972	34.5	1.5	34.5	n.a.	0.142	n.a.	1.082	n.a.
1973	33.3	1.5	60.1	n.a.	0.145	n.a.	1.123	n.a.
1974	40.4	1.7	77.4	n.a.	0.126	n.a.	1.124	45.16
1975	42.2	10.8	n.a.	36.27	0.125	n.a.	1.078	35.61
1976	80.0	13.9	n.a.	n.a.	n.a.	n.a.	1.254	83.59
1977	88.2	16.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1978	125.3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1979	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Sources: Marvin Anderson, "The Planning and Development of Brazilian Agriculture, Some Quantitative Extensions" (Ph.D. dissertation, Cornell University, 1972); Comisión Económica para América Latina, *Anuario Estadistico de América Latina 1980* (Santiago de Chile: United Nations, 1981); Empresa Brasileira de Pesquisa Agropecuaria, Departmento de Diretrizes e Metodos do Planejamiento, *Taxas de Retorno dos Investimentos da EMBRAPA: Investimentos Totais E Capital Fisico* (Brasilia, D. F.: Departamento de Diretrizes e Metodos do Planejamiento, 1982); Fundação Getulio Vargas, "26 Años de Estadísticas Básicas de Economía Brasileira," *Conjuntura Economica* 27 (December 1973); Instituto Brasileiro de Estatistica, *Brasil: Series Estatisticas Retrospectivas* (Rio de Janeiro: Instituto Brasileiro de Estatistica, 1970); Instituto Brasileiro de Geografia e Estatistica, *Anuario Estatistico* (Rio de Janeiro: Instituto Brasileiro de Geografia e Estatistica, 1974); Carlos G. Langoni, "A Study of Economic Growth: The Brazilian Case" (Ph.D. dissertation, University of Chicago, 1970); Joao de Carmo Oliveira, "An Analysis of Transfers from Agricultural Sector and Brazilian Development, 1950-1974" (Ph.D. dissertation, Wolfson College, Cambridge University, 1981); Joao Sayad, *Credito Rural No Brasil* (São Paulo: Instituto de Pesquisas Económicas, Universidad de São Paulo, 1980); and World Bank, Latin American and the Caribbean Regional Office, *Brazil: A Review of Agricultural Policies* (Washington, D.C.: World Bank, 1982).

Note: Where n.a. appears, the data were not available.

Table 30—Basic data on agriculture in Chile, 1950-80

Year	Value Added: Agriculture	Value Added: Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors	Fertilizer	Irrigated Land	Livestock	Contribution of Labor to Agricultural Output	Stock of Public Input
	(million 1965 escudos)		(1,000 hectares)	(1,000 persons)	(index: 1960=100)	(1,000 units)	(1,000 metric tons)	(1,000 hectares)	(1,000 head)	(percent)	(million 1960 escudos)
1950	1,344	673	1,254	n.a.	43.3	n.a.	n.a.	923	n.a.	n.a.	360
1951	1,327	670	1,244	n.a.	50.7	n.a.	n.a.	932	n.a.	n.a.	361
1952	1,319	679	1,248	647.0	55.0	n.a.	n.a.	944	n.a.	n.a.	393
1953	1,406	679	1,268	n.a.	62.7	n.a.	n.a.	944	n.a.	n.a.	391
1954	1,433	697	1,263	656.0	72.7	n.a.	n.a.	962	n.a.	n.a.	388
1955	1,485	692	1,291	n.a.	87.6	n.a.	n.a.	962	2,512	n.a.	380
1956	1,515	724	1,290	n.a.	93.0	n.a.	n.a.	962	n.a.	n.a.	373
1957	1,485	735	1,249	n.a.	100.1	n.a.	n.a.	965	n.a.	n.a.	374
1958	1,641	757	1,308	n.a.	99.5	n.a.	n.a.	965	n.a.	n.a.	378
1959	1,568	759	1,385	n.a.	96.5	n.a.	n.a.	1,076	n.a.	n.a.	380
1960	1,577	746	1,369	695.5	100.0	n.a.	n.a.	1,078	n.a.	38.2	397
1961	1,639	768	1,270	674.9	109.0	n.a.	n.a.	1,080	n.a.	39.5	432
1962	1,597	775	1,250	671.5	113.1	n.a.	n.a.	1,081	n.a.	43.5	467
1963	1,675	807	1,220	675.0	118.1	n.a.	n.a.	1,084	n.a.	39.5	504
1964	1,762	808	1,211	674.2	120.1	22.5	122.9	1,102	n.a.	36.7	526
1965	1,728	844	1,174	675.5	124.3	22.9	122.0	1,113	2,870	42.6	556
1966	1,865	884	1,305	654.6	129.2	23.8	142.9	n.a.	2,869	43.6	597
1967	2,004	901	1,235	638.8	137.1	25.3	125.7	n.a.	2,884	37.3	644
1968	2,037	917	1,278	623.9	137.2	25.3	140.6	n.a.	2,911	44.4	713
1969	1,857	n.a.	1,208	625.1	140.1	25.9	157.5	n.a.	2,916	42.1	777
1970	1,949	1,182	1,251	608.0	144.9	26.7	158.0	n.a.	2,931	45.3	831
1971	2,072	n.a.	1,262	557.5	147.5	27.2	170.0	n.a.	2,891	n.a.	952
1972	1,889	959	1,292	511.5	165.0	30.5	158.2	n.a.	2,961	n.a.	1,060
1973	1,720	777	1,027	480.3	172.9	31.9	197.4	n.a.	3,165	n.a.	1,116
1974	1,995	862	1,349	488.5	171.4	31.6	169.8	n.a.	3,365	29.4	1,146
1975	2,061	895	1,192	497.5	178.3	n.a.	102.8	n.a.	n.a.	28.6	1,212
1976	2,086	957	1,297	505.1	177.6	n.a.	119.7	n.a.	3,389	22.2	1,225
1977	2,398	1,243	1,195	507.5	176.3	n.a.	105.0	n.a.	n.a.	20.1	1,248
1978	2,312	1,305	1,250	516.6	178.1	n.a.	127.2	1,320	3,487	25.4	1,274
1979	2,334	1,093	n.a.	510.5	180.8	n.a.	143.4	n.a.	n.a.	24.2	n.a.
1980	2,390	n.a.	n.a.	n.a.	184.4	n.a.	n.a.	n.a.	3,664	n.a.	n.a.

Year	Government Expenditures: Agriculture	Government Expenditures: Research and Extension	Government Expenditures: Irrigation	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry	Estimates of the Stock of Physical Capital: Agriculture	Estimates of the Stock of Physical Capital: Livestock	Estimates of the Stock of Physical Capital: Irrigation
	(million 1960 escudos)				(percent)		(index: 1960=100)	(million December 1977 escudos)		
1950	18.8	0.23	3.8	n.a.	0.129	n.a.	99.66	64.0	20.2	8.2
1951	19.1	0.27	n.a.	n.a.	0.121	n.a.	97.22	65.2	20.2	8.5
1952	49.6	0.25	n.a.	31.79	0.113	n.a.	107.49	66.5	19.9	8.7
1953	17.5	0.28	n.a.	n.a.	0.113	n.a.	110.13	68.3	19.7	8.9
1954	17.0	0.17	4.0	30.68	0.116	n.a.	116.01	70.2	19.6	9.2
1955	11.8	0.12	n.a.	n.a.	0.119	n.a.	114.23	72.4	19.8	9.5
1956	11.5	0.24	n.a.	n.a.	0.120	n.a.	99.05	73.6	19.9	9.8
1957	19.7	0.50	n.a.	n.a.	0.109	n.a.	93.42	74.7	20.1	10.2
1958	23.1	0.66	n.a.	n.a.	0.118	n.a.	81.76	75.8	20.2	10.5
1959	20.1	0.55	n.a.	n.a.	0.113	n.a.	89.34	75.8	19.6	11.1
1960	36.4	0.68	12.8	27.89	0.107	0.284	100.00	78.2	20.1	11.6
1961	54.5	0.74	16.8	26.48	0.105	0.314	99.90	81.9	20.3	12.1
1962	56.6	0.75	14.8	25.78	0.098	0.338	104.14	84.5	20.3	12.6
1963	61.1	0.79	23.9	25.35	0.098	0.332	97.60	89.0	21.9	13.3
1964	46.4	0.72	12.8	24.76	0.099	0.328	98.36	90.9	19.9	14.1
1965	56.4	1.13	14.9	24.27	0.092	0.337	108.65	98.2	20.3	14.9
1966	68.6	1.32	13.5	23.02	0.093	0.363	111.15	105.3	20.3	15.7

(continued)

Table 30—Continued

Year	Government Expenditures: Agriculture	Government Expenditures: Research and Extension	Government Expenditures: Irrigation	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry	Estimates of the Stock of Physical Capital: Agriculture	Estimates of the Stock of Physical Capital: Livestock	Estimates of the Stock of Physical Capital: Irrigation
	(million 1960 escudos)				(percent)		(index: 1960=100)	(million December 1977 escudos)		
1967	77.8	1.75	14.5	22.12	0.097	0.342	107.91	113.2	20.4	16.1
1968	100.7	2.31	8.4	21.51	0.096	0.402	102.84	120.2	20.6	16.4
1969	99.3	2.23	6.7	21.11	0.085	0.356	106.23	126.5	20.5	16.8
1970	93.3	1.98	7.8	20.19	0.086	0.370	106.11	131.5	20.7	17.2
1971	162.7	3.09	11.8	18.20	0.085	0.454	112.90	133.9	20.9	18.1
1972	155.5	3.15	14.2	16.80	0.077	0.400	138.61	140.0	21.2	23.4
1973	109.2	2.75	n.a.	15.50	0.073	0.400	119.77	144.6	21.7	24.2
1974	85.1	3.21	n.a.	15.01	0.080	0.485	79.90	146.2	22.6	24.9
1975	123.5	3.15	n.a.	15.38	0.093	0.592	89.99	146.7	23.1	24.8
1976	61.4	3.48	n.a.	15.76	0.091	0.422	96.94	149.9	22.3	24.4
1977	72.4	4.36	2.0	15.55	0.096	0.333	93.41	152.9	22.5	24.4
1978	75.2	n.a.	n.a.	15.31	0.087	0.381	88.01	160.2	23.2	24.6
1979	n.a.	n.a.	n.a.	14.59	0.083	n.a.	89.41	163.7	23.7	25.0
1980	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Sources: Chile, Ministerio de Agricultura, Oficina de Planificación Agrícola, *Chile: Estadísticas Agropecuarias 1965-1974* (Santiago de Chile: Ministerio de Agricultura, Oficina de Planificación Agrícola, 1976); Chile, Ministerio de Agricultura, Oficina de Planificación Agrícola, *Chile: Estadísticas Agropecuarias 1975-1979* (Santiago de Chile: Ministerio de Agricultura, Oficina de Planificación Agrícola, 1981); Chile, Oficina de Planificación Nacional (ODEPLAN), *Balances Económicos de Chile 1960-1970* (Santiago de Chile: Editorial Universitaria, 1973); ODEPLAN, *Metodología y Serie de Cuentas Nacionales 1974-1980* (Santiago de Chile: ODEPLAN, 1981); Juan E. Coeymans and Yair Mundlak, "Productividad Endogena y la Evolucion de la Producción y Empleo Sectorial en Chile," paper presented at the Fourth Latin American Regional Meeting of the Econometric Society, Santiago, Chile, July 19-22, 1983 (mimeographed); Juan Pedro Garcés Voisenat, "Inversión y Capitalización en el Sector Agropecuario Chileno, 1950-1980" (Tésis de Ingeniero Comercial, Mención Economía, Pontificia Universidad Católica de Chile, 1983); Eugenia R. de Muchnik, *El Rol de Los Factores Institucionales en la Generacion y Difusion de Innovaciones en la Agricultura Chilena*, Serie de Investigación 41 (Santiago de Chile: Departamento de Economía Agraria de la Pontificia Universidad Católica de Chile, 1983); Ronnie Philipps F., "Protección o Discriminación: El Caso del Crédito Agrícola en Chile," Serie Tésis de Grado 19, Programa de Posgrado Economía Agraria de la Pontifica Universidad Católica de Chile, Santiago de Chile, 1976; Universidad Católica de Chile, Programa Posgrado de Economía Agricola, *Chile Agricultural Sector: Overview 1964-1974* (Santiago de Chile: Pontifica Universidad Católica de Chile, 1976); Alberto Valdés, "Commercial Policy and its Effects on the External Agricultural Trade of Chile, 1945-65" (Ph.D. dissertation, London School of Economics and Political Science, 1971); N. Wollman, *The Water Resources of Chile* (Baltimore, Md.: Johns Hopkins University Press, 1968); Raul E. Yver, "El USO de Fertilizantes en la Agricultura Chilena: "¿Cambio Tecnico o Respuesta Económica?" *Cuadernos de Economía*, 5, N-16 (December 1968): 51-61; Eduardo Venezian, "La Investigación Agropecuaria en Chile," *Panorama Económico de la Agricultura* (March 1985).

Notes: The stock of capital includes machinery and equipment, most of which were imported. The figures for the stock of capital from 1950 to 1965 were taken from Valdés, "Commercial Policy and its Effects on Trade." The figures for 1966-80 were estimated from data on imported capital goods and investment figures from national accounts. An alternative estimate of the stock of capital comes from Garcés Voisenat, "Inversión y Capitalización en el Sector Agropecuario." The ratio of rural to urban wages is the ratio of labor's contribution to agricultural output to its contribution to the output of the whole economy multiplied by the share of agricultural labor in the labor force and by the share of agriculture in the gross domestic product.

Table 31—Basic data on agriculture in Colombia, 1950-80

Year	Value Added: Agriculture	Value Added: Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors	Fertilizer	Irrigated Land	Livestock	Contribution of Labor to Agricultural Output
	(million 1958 Colombian pesos)		(1,000 hectares)	(1,000 persons)	(million 1958 Colombian pesos)	(1,000 units)	(index: 1960 = 100)	(1,000 hectares)	(1,000 head)	(percent)
1950	4,812	3,046	2,410	1,811	3,849.4	6,537	26.8	32.2	13,879	37.9
1951	4,990	3,458	2,630	1,843	3,857.9	7,892	34.2	32.2	13,761	37.9
1952	5,325	3,754	2,778	2,041	3,826.2	8,798	31.1	32.2	13,599	35.4
1953	5,375	3,811	2,788	2,042	3,776.7	10,057	34.1	45.2	13,451	35.8
1954	5,475	3,865	2,927	1,981	3,779.1	12,163	64.5	74.2	13,466	32.7
1955	5,616	3,808	3,057	2,007	3,807.4	13,880	60.0	74.2	13,776	35.1
1956	5,817	3,915	2,950	2,056	3,837.0	15,403	76.2	74.2	14,233	31.6
1957	6,167	4,181	2,799	1,973	3,854.2	15,335	91.9	74.2	14,513	28.8
1958	6,418	4,377	2,862	2,135	3,901.9	16,272	100.0	74.2	14,749	29.8
1959	6,782	4,700	2,957	2,003	3,971.7	17,338	135.3	74.2	15,000	30.3
1960	6,759	4,562	3,036	2,036	4,063.8	18,426	123.7	74.2	15,000	31.8
1961	6,959	4,711	3,020	2,026	4,207.2	19,227	148.8	74.2	15,500	32.5
1962	7,261	4,887	3,112	2,013	4,351.2	20,128	175.0	82.2	16,000	33.9
1963	7,300	4,752	3,056	2,017	4,407.0	20,622	159.0	82.2	16,400	35.6
1964	7,734	5,143	3,242	1,916	4,502.8	20,876	190.4	82.2	16,700	30.5
1965	7,694	5,093	3,401	2,206	4,616.6	20,792	187.0	82.2	17,000	34.3
1966	7,932	5,322	3,459	2,009	4,763.4	21,294	244.7	82.2	17,300	32.3
1967	8,476	5,696	3,390	2,267	4,903.9	23,058	284.1	82.2	17,900	32.6
1968	9,060	6,106	3,397	2,350	5,125.3	25,110	305.9	91.7	18,700	30.2
1969	9,326	6,146	3,386	2,166	5,462.3	25,827	270.6	101.9	19,500	31.3
1970	9,734	6,395	3,338	2,292	5,850.4	26,475	267.0	110.7	20,200	30.1
1971	9,982	6,359	3,342	2,403	6,246.7	27,356	288.2	114.2	20,800	29.7
1972	10,543	6,969	3,430	2,489	6,710.5	28,035	299.7	114.2	21,400	27.1
1973	11,106	7,385	3,586	2,266	7,186.9	27,742	314.7	118.7	22,100	23.9
1974	11,825	7,840	3,668	2,157	7,644.6	23,753	327.3	121.1	23,032	25.5
1975	12,718	8,381	3,849	1,895	8,065.7	24,187	345.1	121.1	23,888	23.8
1976	13,100	8,581	3,946	2,097	8,408.2	24,621	399.1	121.1	24,676	21.1
1977	13,483	8,912	4,033	2,093	8,906.7	25,594	371.4	121.1	25,446	22.9
1978	14,884	9,779	4,341	2,175	9,386.1	26,700	340.7	121.6	26,255	25.3
1979	15,723	10,189	4,210	n.a.	9,839.7	27,714	341.3	121.6	27,060	26.0
1980	16,116	10,392	4,248	n.a.	10,279.3	28,796	368.5	121.6	n.a.	26.8

Year	Stock of Public Input	Government Expenditures: Agriculture	Government Expenditures: Research and Extension	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry	Stock of Agricultural Credit
	(million 1960 Colombian pesos)				(percent)		(index: 1958 = 100)	(million 1960 Colombian pesos)
1950	21,797	n.a.	16.9	51.6	37.8	70.0	79.2	264
1951	21,896	n.a.	19.4	50.8	37.1	71.0	86.4	327
1952	21,951	n.a.	26.1	54.8	37.3	61.0	87.8	353
1953	22,263	n.a.	22.8	53.3	35.2	58.0	94.1	316
1954	22,126	n.a.	27.5	50.4	33.8	58.0	108.7	355
1955	22,013	n.a.	29.7	49.7	33.3	58.0	97.0	378
1956	21,834	n.a.	29.6	49.5	33.1	54.0	104.6	341
1957	23,275	n.a.	22.3	43.2	34.3	46.0	103.2	259
1958	23,838	n.a.	25.9	48.8	34.6	48.0	100.0	245
1959	23,542	n.a.	25.8	44.6	33.8	49.0	97.8	427
1960	23,755	n.a.	26.1	44.1	33.8	46.0	94.4	301
1961	23,968	928.7	35.9	42.8	33.4	46.0	93.3	328
1962	24,163	1,114.9	32.2	41.4	32.8	49.0	86.6	352
1963	24,112	919.2	18.3	40.3	32.0	46.0	82.6	322
1964	23,969	810.2	19.2	37.3	31.9	48.0	96.7	250

(continued)

Table 31—Continued

Year	Stock of Public Input	Government Expenditures: Agri-culture	Government Expenditures: Research and Extension	Ratio of Agricul-tural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry	Stock of Agricul-tural Credit
	(million 1960 Colombian pesos)				(percent)		(index: 1958 = 100)	(million 1960 Colombian pesos)
1965	24,073	1,113.9	28.1	41.3	30.8	47.0	92.5	270
1966	24,063	986.4	24.1	37.2	30.2	48.0	94.8	258
1967	24,186	1,114.7	33.8	40.4	30.4	46.0	94.9	277
1968	24,776	1,593.1	47.0	40.7	30.5	48.0	97.4	355
1969	25,877	2,052.7	52.8	36.1	29.7	48.0	97.6	383
1970	27,427	2,494.2	57.2	36.7	28.6	44.0	96.8	375
1971	29,395	2,987.0	60.7	37.3	27.5	45.0	96.8	395
1972	30,768	2,537.2	100.8	38.0	27.6	52.0	111.5	395
1973	32,063	2,381.6	72.2	33.4	26.6	60.0	117.4	379
1974	33,060	2,035.1	55.6	31.5	26.5	64.0	107.4	636
1975	33,884	2,705.6	54.3	26.8	27.0	68.0	105.4	636
1976	34,342	1,809.9	50.1	29.2	26.4	69.0	110.1	604
1977	36,045	1,952.3	32.3	28.5	25.8	67.0	126.2	653
1978	36,275	2,392.8	47.0	28.8	26.0	66.0	92.4	668
1979	36,403	2,304.9	52.4	n.a.	25.8	61.0	90.0	685
1980	36,684	2,465.1	37.1	n.a.	25.5	61.0	77.4	726

Sources: Banco de la República, Departamento de Investigaciones Económicas, *Síntesis de las Cuentas Nacionales de Colombia, 1950-1971* (Bogotá: Banco de la República, 1973); Banco de la República, Departamento de Investigaciones Económicas, *Cuentas Nacionales de Colombia, 1970-1977* (Bogotá: Banco de la República, 1980); Banco Ganadero, Departamento de Estudios Económicas, División de Analisis Económico, *Informe Estadístico del Sector Agropecuario 1960-1977* (Bogotá: Departamento Económicos del Banco Ganadero, 1977); Colombia, Departamento Nacional de Planeación, *Diagnóstico del Sector Agrario* (Bogotá: Unidad de Estudios Agrarios del Departamento Nacional de Planeación, 1983); Saloman Kalmanovitz, *La Agricultura en Colombia 1950-1972* (Bogotá: Departamento Administrativo Nacional de Estadística, 1978); Luis Lorente, *Producción de Ganado de Carne en Colombia* (Bogotá: Banco Ganadero, 1978); Ramiro Orozco, "Sources of Agricultural Production and Productivity in Colombian Agriculture" (Ph.D. dissertation, Oklahoma State University, 1977); PREALC, *Empleo y Salarios* (Santiago de Chile: Organización Internacional del Trabajo, 1983); W. Thirsk, "The Economics of Colombian Farm Mechanization" (Ph.D. dissertation, Yale University, 1972); and Eduardo Trigo, Martin Pineiro, and Jorge Ardile, *Organizacion de la Investigacion Agropecuaria en América Latina* (San José de Costa Rica: Instituto Interamericano de Cooperación para la Agricultura, 1982).

Notes: Labor was estimated using benchmark years of the agricultural labor force and their ratios of total wages and salaries to unit wages to get the estimates for the intervening years. The stock of fixed capital was estimated using the flow of investments on land improvements, imported machinery, and some domestic production of machinery; then, using an inventory approach and a rate of depreciation of 6 percent, the stock of capital was estimated. The index of purchased inputs includes improved seeds, fertilizers, and pesticides. The indexes for 1950-71 were taken from Ramiro Orozco, "Sources of Agricultural Production" The indexes for 1972-80 were constructed using data on the consumption of fertilizers.

Table 32—Basic data on agriculture in Costa Rica, 1950-80

Year	Value Added: Agriculture	Value Added: Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors
	(million 1966 colones)		(1,000 hectares)	(1,000 persons)	(million 1966 colones)	(1,000 units)
1950	476	n.a.	1,815	259	n.a.	n.a.
1951	484	n.a.	n.a.	n.a.	n.a.	n.a.
1952	615	n.a.	n.a.	n.a.	n.a.	n.a.
1953	518	n.a.	n.a.	n.a.	n.a.	n.a.
1954	586	n.a.	n.a.	n.a.	n.a.	n.a.
1955	528	n.a.	n.a.	n.a.	n.a.	n.a.
1956	521	n.a.	n.a.	n.a.	n.a.	n.a.
1957	652	364	2,235	309	n.a.	n.a.
1958	687	390	2,298	316	n.a.	n.a.
1959	696	352	2,363	322	n.a.	n.a.
1960	781	414	2,467	328	n.a.	n.a.
1961	809	436	2,533	334	n.a.	n.a.
1962	859	480	2,600	331	n.a.	n.a.
1963	856	461	2,671	333	n.a.	n.a.
1964	894	481	2,706	344	1,000	n.a.
1965	912	510	2,780	315	1,019	n.a.
1966	994	566	2,814	351	1,052	4.9
1967	1,072	609	2,848	370	1,105	n.a.
1968	1,169	670	2,881	394	1,173	n.a.
1969	1,291	663	2,915	405	1,230	n.a.
1970	1,344	755	2,988	465	1,319	5.1
1971	1,406	791	3,020	392	1,396	5.3
1972	1,482	869	3,051	389	1,427	5.3
1973	1,566	949	3,122	443	1,440	5.4
1974	1,539	883	3,233	398	1,465	5.6
1975	1,586	940	3,184	479	1,483	5.5
1976	1,594	1,072	3,179	448	1,502	5.6
1977	1,629	n.a.	3,134	513	1,555	5.7
1978	1,689	n.a.	3,168	450	1,610	5.8
1979	n.a.	n.a.	n.a.	n.a.	n.a.	5.9
1980	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Year	Livestock	Contribution of Labor to Agricultural Output	Stock of Public Input	Government Expenditures on Agriculture	Share of Agriculture in the Gross Domestic Product	Terms of Trade Between Agriculture and Industry
	(1,000 head)	(percent)	(million 1960 colones)		(percent)	(index: 1966 = 100)
1950	n.a.	n.a.	n.a.	n.a.	29.0	n.a.
1951	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1952	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1953	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1954	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1955	n.a.	n.a.	n.a.	n.a.	23.1	n.a.
1956	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1957	n.a.	49.9	n.a.	n.a.	24.4	134.7
1958	n.a.	48.9	n.a.	n.a.	24.5	121.1
1959	n.a.	47.6	582	6.4	23.8	111.6
1960	901	47.3	582	6.4	25.2	100.9
1961	951	47.7	583	n.a.	26.4	92.3
1962	1,006	46.3	584	n.a.	25.9	94.0
1963	1,068	45.9	587	7.1	24.6	94.1
1964	1,135	44.7	591	7.3	24.7	94.7
1965	1,210	44.4	597	8.0	22.9	102.0
1966	1,294	45.9	605	8.3	23.2	100.0
1967	1,387	45.2	632	12.6	23.7	99.1
1968	1,355	43.5	694	20.6	23.8	99.8
1969	1,423	42.3	759	22.1	24.9	95.2
1970	1,496	42.8	814	20.5	24.1	95.1

(continued)

Table 32—Continued

Year	Livestock	Contribution of Labor to Agricultural Output	Stock of Public Input	Government Expenditures on Agriculture	Share of Agriculture in the Gross Domestic Product	Terms of Trade Between Agriculture and Industry
	(1,000 head)	(percent)	(million 1960 colones)		(percent)	(index: 1966 = 100)
1971	1,574	41.4	903	28.7	23.6	86.8
1972	1,655	39.8	1,008	30.1	23.0	88.8
1973	1,694	36.8	1,108	27.6	22.6	89.9
1974	1,767	39.1	1,237	29.7	21.0	94.2
1975	1,843	38.6	1,355	26.3	21.2	99.8
1976	n.a.	37.9	1,476	27.6	20.2	109.0
1977	n.a.	32.6	1,607	34.3	19.0	133.9
1978	2,002	38.6	1,771	38.0	18.6	130.1
1979	2,093	n.a.	n.a.	n.a.	n.a.	n.a.
1980	2,183	n.a.	n.a.	n.a.	n.a.	n.a.

Sources: Banco Central de Costa Rica, *Cuentes Nacionales* (San José de Costa Rica: Banco Central de Costa Rica, 1978); Banco Central de Costa Rica, Departamento de Investigaciones y Estadísticas, Sección Cuentas Nacionales, "Cifras de Cuentas Nacionales de Costa Rica, 1957-1977," San José de Costa Rica, 1980; Banco Central de Costa Rica, Division de Asuntos Economicas, *Información Económica Semenal*, various issues; Costa Rica, Ministerio de Agricultura y Ganaderia, Departamento de Economía y Estadísticas Agropecuarias, unpublished data; and Inter-American Development Bank, Division of General Studies, *Desarrollo Agropecuario y Rural de Costa Rica* (Washington, D.C.: Inter-American Development Bank, 1978).

Table 33—Basic data on agriculture in Mexico, 1950-80

Year	Value Added: Agriculture	Value Added: Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors	Fertilizer	Irrigated Land	Livestock	Stock of Public Input
	(million 1960 Mexican pesos)		(1,000 hectares)	(1,000 persons)	(million 1960 Mexican pesos)	(1,000 units)	(1,000 metric tons)	(1,000 hectares)	(1,000 head)	(million 1960 Mexican pesos)
1950	14,208	10,176	9,076	4,824	25,298	15,103	11.7	859	15,713	27,660
1951	14,534	10,263	9,866	5,002	26,688	18,581	19.8	1,089	n.a.	27,674
1952	14,923	9,961	9,910	5,125	28,093	19,836	32.2	1,119	n.a.	27,630
1953	15,918	10,495	9,450	5,250	29,424	21,028	37.3	1,215	n.a.	27,631
1954	17,954	12,330	10,103	5,379	30,729	22,702	51.7	1,444	n.a.	27,697
1955	19,149	13,092	10,696	5,510	32,331	25,182	76.8	1,534	n.a.	27,675
1956	19,081	12,665	10,860	5,646	33,205	26,824	100.4	1,710	n.a.	27,860
1957	20,506	13,563	10,934	5,784	35,108	27,951	109.1	1,775	n.a.	28,065
1958	21,831	14,619	10,681	5,926	36,547	29,336	129.9	1,649	n.a.	28,362
1959	21,317	14,054	11,735	6,072	38,111	30,656	164.6	1,678	n.a.	28,925
1960	22,756	14,790	11,444	6,144	39,805	32,202	168.8	1,752	17,669	29,156
1961	23,188	15,156	10,625	6,076	41,905	32,943	180.5	2,120	n.a.	30,117
1962	24,100	16,187	11,305	5,998	43,309	33,619	204.1	1,973	n.a.	30,871
1963	25,366	16,981	11,129	5,915	45,184	34,553	280.7	1,884	n.a.	32,874
1964	27,381	18,738	11,057	5,826	47,095	37,135	321.4	2,133	n.a.	36,306
1965	28,929	19,921	11,876	5,730	48,555	39,327	343.3	2,167	21,975	37,652
1966	29,326	20,214	11,793	5,626	50,055	41,594	390.0	2,152	22,965	38,597
1967	30,162	20,165	11,957	5,517	51,956	42,210	430.6	2,182	23,294	40,528
1968	31,160	20,489	12,911	5,400	56,403	44,894	498.7	2,356	23,628	42,881
1969	31,441	20,145	13,640	5,277	60,916	45,751	560.8	2,489	24,876	45,669
1970	32,988	21,245	14,975	5,132	66,474	48,506	537.7	2,485	25,124	49,482
1971	34,057	21,746	15,490	5,443	67,557	44,769	614.7	2,452	25,827	51,715
1972	35,244	22,486	15,243	6,571	68,658	45,270	679.2	2,646	27,335	55,948
1973	36,190	22,474	15,868	6,853	69,678	47,578	780.1	2,759	28,103	61,402
1974	37,674	22,906	14,924	6,675	70,770	46,483	864.5	2,972	28,816	68,094
1975	37,162	22,260	15,489	7,565	71,862	48,174	1,073.5	3,081	29,602	78,062
1976	37,030	21,440	14,743	n.a.	n.a.	51,342	1,135.7	2,896	30,461	83,170
1977	40,733	23,951	16,734	n.a.	n.a.	50,020	1,035.5	3,075	31,410	90,143
1978	43,202	25,014	16,554	n.a.	n.a.	54,442	n.a.	3,110	32,439	96,635
1979	42,519	24,789	14,874	n.a.	n.a.	55,373	n.a.	3,430	33,545	108,617
1980	45,538	n.a.	16,966	n.a.	n.a.	n.a.	n.a.	3,241	34,590	126,382

(continued)

Table 33—Continued

Year	Government Expenditures: Agriculture	Government Expenditures: Research and Extension	Government Expenditures: Irrigation	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Ratio of Agricultural Wages to Industrial Wages	Terms of Trade Between Agriculture and Industry
	(million 1960 Mexican pesos)				(percent)		(index: 1960 = 100)
1950	1,114	7.8	721	57.8	16.3	79.0	100.0
1951	1,127	8.6	861	57.7	15.6	79.0	96.9
1952	1,055	9.6	880	57.3	15.6	85.0	97.3
1953	1,063	9.7	821	56.8	15.7	85.0	94.6
1954	1,089	17.2	867	56.4	17.0	83.0	93.4
1955	995	20.7	778	56.0	16.7	83.0	91.7
1956	1,067	19.4	713	55.6	15.9	83.0	94.2
1957	1,018	27.0	722	55.2	15.9	83.0	94.8
1958	1,018	32.6	699	54.8	16.3	84.0	89.9
1959	1,120	33.4	780	54.4	15.2	84.0	98.7
1960	897	36.0	577	54.2	15.2	89.0	100.0
1961	1,228	41.6	912	52.7	15.1	89.0	102.2
1962	1,092	39.4	763	51.3	15.0	88.0	103.5
1963	1,634	36.4	1,286	49.8	14.5	88.0	105.6
1964	2,236	38.8	1,869	48.3	14.0	84.0	106.7
1965	1,328	38.8	932	46.9	14.1	84.0	102.0
1966	1,414	75.4	1,017	45.4	13.6	84.0	100.3
1967	2,245	100.0	1,850	43.9	12.7	84.0	99.4
1968	2,085	87.7	1,639	42.4	12.0	85.0	96.0
1969	2,437	108.8	1,970	41.0	11.4	85.0	96.8
1970	3,115	75.1	2,550	36.7	11.1	85.0	96.9
1971	2,517	83.1	1,776	n.a.	11.0	85.0	92.5
1972	3,831	131.8	2,423	n.a.	10.3	85.0	95.5
1973	4,882	123.5	2,721	n.a.	9.7	n.a.	101.2
1974	6,101	138.3	3,547	n.a.	9.4	n.a.	101.3
1975	8,358	190.6	4,797	41.0	9.2	n.a.	99.8
1976	5,632	171.2	3,218	n.a.	8.6	n.a.	96.0
1977	10,300	n.a.	n.a.	n.a.	9.3	n.a.	88.5
1978	10,098	n.a.	n.a.	n.a.	9.0	n.a.	103.2
1979	15,847	n.a.	n.a.	n.a.	9.4	n.a.	105.5
1980	22,110	n.a.	n.a.	n.a.	9.3	n.a.	97.3

Sources: Reed Hertford, *Sources of Change in Mexican Agricultural Production, 1940-65*, Foreign Agricultural Economic Report 73 (Washington, D.C.: U.S. Department of Agriculture, 1971); Mexico, Secretaría de Agricultura y Recursos Hidráulicos, Subsecretaría de Agricultura y Operación, "Consumos Aparentes de Productos Agrícolas, 1925-1982," *Econotecnia Agrícola* 7 (Setiembre 1983); Mexico, Secretaría de Agricultura y Recursos Hidráulicos, Subsecretaría de Agricultura y Operación, Dirección Nacional de Economía Agrícola, *Informe Estadístico* 127 (Febrero 1983); Nacional Financiera, *México en Cifras* (México, D.F.: Nacional Financiera, 1970, 1977).

Table 34—Basic data on agriculture in Peru, 1950-80

Year	Value Added: Agriculture	Value Added: Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors	Fertilizer
	(million 1973 soles)		(1,000 hectares)	(1,000 persons)	(million 1973 soles)	(1,000 units)	(1,000 metric tons)
1950	29,661	n.a.	1,311	1,483	38,033	n.a.	n.a.
1951	30,551	n.a.	1,367	1,495	38,060	n.a.	n.a.
1952	31,440	n.a.	1,396	1,509	38,538	n.a.	n.a.
1953	32,176	n.a.	1,433	1,522	38,906	n.a.	n.a.
1954	32,829	n.a.	1,440	1,537	38,675	n.a.	n.a.
1955	32,570	n.a.	1,407	1,554	38,793	n.a.	n.a.
1956	31,010	n.a.	1,379	1,575	38,991	n.a.	n.a.
1957	31,125	n.a.	1,404	1,598	39,740	n.a.	n.a.
1958	33,273	n.a.	1,427	1,623	40,183	n.a.	n.a.
1959	34,913	n.a.	1,503	1,649	39,347	n.a.	n.a.
1960	37,151	n.a.	1,572	1,674	39,078	n.a.	n.a.
1961	38,251	n.a.	1,582	1,704	39,389	n.a.	n.a.
1962	39,161	n.a.	1,601	1,735	39,718	n.a.	n.a.
1963	39,740	n.a.	1,614	1,765	40,074	n.a.	n.a.
1964	41,700	n.a.	1,641	1,798	40,398	n.a.	n.a.
1965	42,546	30,859	1,602	1,829	41,453	n.a.	n.a.
1966	44,826	n.a.	1,651	1,846	43,353	n.a.	n.a.
1967	46,570	n.a.	1,682	n.a.	43,605	n.a.	n.a.
1968	44,987	33,300	1,532	1,901	42,341	n.a.	n.a.
1969	47,956	35,481	1,710	n.a.	40,932	n.a.	n.a.
1970	51,701	38,569	1,719	2,012	39,734	10.9	81.5
1971	52,759	38,708	1,698	2,027	38,830	n.a.	n.a.
1972	51,490	36,764	1,544	2,043	38,591	11.5	n.a.
1973	51,687	36,698	1,749	2,068	39,400	11.8	121.8
1974	53,582	47,561	1,534	2,094	42,021	12.0	97.5
1975	53,564	36,424	1,717	2,120	47,110	12.5	142.0
1976	54,372	36,970	1,719	2,146	48,867	12.7	94.0
1977	54,302	36,697	1,774	2,172	49,906	13.0	119.8
1978	53,478	35,937	1,628	2,197	49,757	13.3	133.4
1979	55,575	38,069	1,723	2,222	48,927	n.a.	128.2
1980	52,339	n.a.	n.a.	2,248	50,804	n.a.	

Year	Livestock	Contribution of Labor to Agricultural Output	Stock of Public Input	Government Expenditures: Agri-culture	Government Expenditures: Research and Extension	Government Expenditures: Irrigation	Ratio of Agricultural Labor to Total Labor
	(1,000 head)	(percent)	(million 1960 soles)				
1950	2,830	n.a.	6,000	n.a.	n.a.	104.4	0.6100
1951	n.a.	n.a.	5,976	276	n.a.	n.a.	0.6033
1952	n.a.	n.a.	6,053	376	n.a.	n.a.	0.6017
1953	n.a.	n.a.	6,065	314	n.a.	n.a.	0.5950
1954	n.a.	n.a.	5,977	216	n.a.	346.7	0.5892
1955	n.a.	n.a.	6,115	437	n.a.	n.a.	0.5825
1956	n.a.	n.a.	6,367	557	n.a.	n.a.	0.5740
1957	n.a.	n.a.	6,393	345	n.a.	n.a.	0.5584
1958	n.a.	n.a.	6,630	556	n.a.	n.a.	0.5342
1959	n.a.	n.a.	6,463	165	19.4	n.a.	0.5240
1960	3,496	n.a.	6,329	189	n.a.	27.0	0.5294
1961	n.a.	n.a.	6,434	421	n.a.	72.3	0.5280
1962	n.a.	n.a.	6,453	341	41.4	98.0	0.5188
1963	n.a.	n.a.	6,550	420	n.a.	142.0	0.5126
1964	n.a.	n.a.	6,815	592	n.a.	98.8	0.5071
1965	3,644	n.a.	7,253	779	82.0	231.0	0.5004
1966	3,686	n.a.	7,774	884	122.4	403.4	0.4962
1967	3,800	n.a.	8,287	901	154.4	352.1	n.a.
1968	3,810	n.a.	8,842	970	87.0	242.5	0.4841
1969	4,060	n.a.	9,333	933	49.9	174.8	n.a.
1970	3,999	21.5	10,146	1,279	83.3	172.8	0.4805
1971	4,310	25.2	10,706	1,068	109.2	241.5	0.4724

(continued)

Table 34—Continued

Year	Livestock	Contribution of Labor to Agricultural Output	Stock of Public Input	Government Expenditures: Agri-culture	Research and Extension	Irrigation	Ratio of Agricultural Labor to Total Labor
	(1,000 head)	(percent)		(million 1960 soles)			
1972	3,784	26.6	11,426	1,255	111.8	349.4	0.4645
1973	n.a.	25.8	12,594	1,740	98.3	643.2	0.4566
1974	n.a.	25.8	14,087	2,122	97.7	1,037.0	0.4487
1975	n.a.	23.8	16,010	2,628	156.4	n.a.	0.4408
1976	n.a.	24.2	17,663	2,453	170.4	n.a.	0.4329
1977	n.a.	20.9	19,068	2,288	122.6	n.a.	0.4248
1978	n.a.	21.1	20,074	1,960	88.9	n.a.	0.4167
1979	n.a.	18.1	n.a.	n.a.	n.a.	n.a.	0.4085
1980	3,837	16.1	n.a.	n.a.	n.a.	n.a.	n.a.

Sources: Banco Central de la Reserva del Perú, *Cuentas Nacionales del Peru 1960-69* (Lima: Banco Central de la Reserva del Perú, 1970); Instituto Nacional de Estadística, *Cuentas Nacionales del Perú* (Lima: Dirección General de Cuentas Nacionales del INE, 1982); Instituto Nacional de Planificación, *Cuentas Nacionales del Perú 1950-79* (Lima: Oficina Nacional de Estadística, 1980); Estela Suárez, Gina Vargas, and Tomás Zapata, "El Sector Agropecuario en el Peru en el Período 1958-1968," *Critica 2* 1 (Setiembre-Diciembre 1978): 2-14; René I. Vandendreis, "Foreign Trade and the Economic Development of Peru" (Ph.D. dissertation, Iowa State University of Science and Technology, 1967); World Bank, *Peru: Major Development Policy Issues and Recommendations,* World Bank Country Study (Washington, D.C.: 1981).

Table 35—Basic data on agriculture in Venezuela, 1950-80

Year	Value Added: Agri-culture	Crops	Land Harvested	Labor	Stock of Physical Capital	Tractors	Fertil-izer	Irrigated Land	Live-stock
	(million 1968 bolivars)		(1,000 hectares)	(1,000 persons)	(million 1968 bolivars)	(1,000 units)	(1,000 metric tons)	(1,000 hectares)	(1,000 head)
1950	971	n.a.	1,103	635	5,922	n.a.	n.a.	n.a.	5,769
1951	1,107	n.a.	1,090	650	5,954	n.a.	n.a.	n.a.	n.a.
1952	1,186	n.a.	1,081	665	6,209	n.a.	n.a.	n.a.	n.a.
1953	1,225	n.a.	1,113	681	6,424	n.a.	n.a.	n.a.	n.a.
1954	1,229	n.a.	1,066	698	6,839	n.a.	n.a.	n.a.	n.a.
1955	1,294	n.a.	1,098	716	7,186	n.a.	n.a.	n.a.	n.a.
1956	1,384	n.a.	1,150	733	7,579	n.a.	n.a.	n.a.	n.a.
1957	1,443	n.a.	1,156	745	7,978	n.a.	n.a.	n.a.	n.a.
1958	1,509	n.a.	1,160	742	8,280	n.a.	n.a.	n.a.	n.a.
1959	1,572	n.a.	1,206	750	8,700	n.a.	n.a.	n.a.	n.a.
1960	1,890	n.a.	1,458	758	9,176	n.a.	n.a.	n.a.	n.a.
1961	1,910	n.a.	1,368	770	9,644	n.a.	12.6	n.a.	6,519
1962	1,983	936	1,448	784	10,219	n.a.	10.7	41.6	6,724
1963	2,082	977	1,422	797	10,784	n.a.	10.7	47.0	6,936
1964	2,256	1,025	1,486	810	11,429	n.a.	21.4	51.9	7,155
1965	2,378	1,097	1,559	824	12,085	n.a.	29.3	63.8	7,380
1966	2,494	1,138	1,537	813	12,808	16.2	33.7	52.9	7,612
1967	2,629	1,212	1,757	842	13,486	16.6	43.0	57.9	7,852
1968	2,716	1,407	1,744	872	14,200	17.0	48.2	64.9	8,102
1969	2,929	1,462	1,819	904	14,602	17.7	47.2	66.9	8,289
1970	3,087	1,593	1,802	936	14,670	19.2	62.0	70.3	8,485
1971	3,145	1,579	1,789	926	14,842	n.a.	68.8	71.2	8,549
1972	3,090	1,471	1,552	917	14,836	21.1	75.8	73.3	8,730
1973	3,258	1,574	1,559	915	14,806	25.3	85.3	78.7	8,843
1974	3,493	1,659	1,695	967	14,909	23.4	121.5	83.5	9,089
1975	3,779	1,821	1,727	1,111	15,458	28.6	135.2	87.8	9,404
1976	3,708	1,695	1,711	1,132	15,636	31.1	161.0	94.7	9,546
1977	3,995	1,926	1,838	1,114	16,040	33.8	176.9	96.3	9,919
1978	4,270	2,058	1,872	1,050	16,187	35.0	n.a.	104.8	10,249
1979	4,472	2,160	1,922	1,021	16,195	37.0	n.a.	n.a.	n.a.
1980	4,600	2,263	1,918	1,028	16,099	n.a.	n.a.	n.a.	n.a.

(continued)

Table 35—Continued

Year	Stock of Public Input	Government Expenditures: Agriculture	Government Expenditures: Research and Extension	Government Expenditures: Irrigation	Ratio of Agricultural Labor to Total Labor	Share of Agriculture in the Gross Domestic Product	Terms of Trade Between Agriculture and Industry
		(million 1960 bolivars)			(percent)		(index: 1968=100)
1950	3,184	122.1	n.a.	22.8	44.06	6.7	n.a.
1951	3,174	125.1	n.a.	27.3	43.73	6.8	n.a.
1952	3,185	146.3	n.a.	20.4	42.62	7.8	n.a.
1953	3,192	140.3	n.a.	24.9	42.15	7.2	n.a.
1954	3,201	142.1	n.a.	65.4	41.43	6.6	n.a.
1955	3,234	166.1	n.a.	98.8	41.32	6.2	n.a.
1956	3,252	152.7	n.a.	86.2	40.30	6.2	n.a.
1957	3,335	220.7	66.5	29.9	39.28	5.8	n.a.
1958	3,643	439.5	94.5	21.7	38.45	6.2	n.a.
1959	3,898	375.5	119.6	40.2	36.65	5.7	n.a.
1960	4,241	468.3	200.0	44.0	36.61	6.5	n.a.
1961	4,706	594.1	156.9	n.a.	36.52	6.5	n.a.
1962	4,959	403.2	134.7	86.3	35.93	6.6	n.a.
1963	5,153	347.8	101.0	71.1	35.30	6.7	n.a.
1964	5,461	445.9	131.2	n.a.	34.32	6.8	n.a.
1965	5,830	505.4	131.4	n.a.	33.69	6.8	n.a.
1966	6,133	467.6	144.5	n.a.	29.09	7.1	n.a.
1967	6,479	514.2	152.7	135.9	29.52	7.3	n.a.
1968	6,862	557.0	146.9	118.0	29.58	7.3	100.0
1969	7,229	541.7	145.2	127.3	29.34	7.4	103.2
1970	7,641	586.6	152.7	107.5	29.13	7.7	101.7
1971	8,127	667.8	117.8	99.4	28.00	7.1	100.3
1972	8,130	586.3	113.5	102.9	27.12	6.6	99.3
1973	8,988	636.4	99.3	89.5	26.14	6.5	105.1
1974	10,069	1,809.9	140.6	199.0	26.70	6.6	106.0
1975	11,857	1,499.6	122.7	149.8	n.a.	6.7	110.5
1976	13,386	1,401.2	142.3	132.5	n.a.	5.6	113.1
1977	14,688	1,260.1	149.1	n.a.	23.10	6.2	115.3
1978	15,320	1,219.6	n.a.	n.a.	22.30	6.7	115.3
1979	n.a.	n.a.	n.a.	n.a.	n.a.	6.2	120.7
1980	n.a.	n.a.	n.a.	n.a.	n.a.	6.3	124.8

Sources: Banco Central de Venezuela, *La Economía Venezolana en los Ultimos 35 Anos* (Caracas: Banco Central de Venezuela, 1970); Banco Central de Venezuela, *Informe Económico*, various issues, 1976-80; Banco Central de Venezuela, "Sector Agrícola de Venezuela," Caracas, 1982 (mimeographed); Inter-American Development Bank, *Venezuela 1950-1967* (Washington, D.C.: Inter-American Development Bank, 1968); Venezuela, Ministerio de Agricultura y Cría, Oficina de Planificación del Sector Agrícola, *Anuario Estadístico* Agropecuario, Volúmenes 1975-80 (Caracas: Dirección de Planificación Estadística, 1976-81.

BIBLIOGRAPHY

General

Aigner, D. H. and Schmidt, P., eds. "Specification and Estimation of Frontier Production, Profit and Cost Functions." *Journal of Econometrics* 13 (May 1980).

Asian Development Bank. *Asian Agricultural Survey. 1976.* Manila: Asian Development Bank, 1976.

Braun, Joachim von and Haen, Hartwig de. *The Effects of Food Price and Subsidy Policies on Egyptian Agriculture.* Research Report 42. Washington, D.C.: International Food Policy Research Institute, 1983.

Chipman, John S. "Returns to Scale in the Railroad Industry: A Reinterpretation of Klein's Data." *Econometrica* 25 (1957): 607.

Christensen, Laurits R.; Jorgensen, Dale W.; and Lau, Lawrence J. "Transcendental Logarithmic Production Frontiers." *Review of Economics and Statistics* 55 (February 1973): 28-45.

Denison, Edward F. *The Sources of Economic Growth in the States and the Alternative Before Us.* New York: Committee for Economic Development, 1962.

Elías, Victor J. *Government Expenditures on Agriculture in Latin America.* Research Report 23. Washington, D.C.: International Food Policy Research Institute, 1978.

______. "Sources of Economic Growth in Latin American Countries." *Review of Economics and Statistics* 60 (August 1978): 362-370.

Floyd, John E. "The Effects of Farm Price Supports on the Return to Land and Labor in Agriculture." *Journal of Political Economy* 73 (April 1965): 148-158.

Food and Agriculture Organization of the United Nations, Policy Analysis Division. *Public Expenditures on Agriculture in Developing Countries, 1978-82.* Rome: FAO, 1984.

Gardner, Bruce L. *The Governing of Agriculture.* Lawrence: The Regent Press of Kansas, 1981.

Griliches, Zvi. "Data and Econometrics: The Uneasy Alliance." Paper presented at the Fourth Latin American Regional Meeting of the Econometric Society, Santiago, Chile, July 19-22, 1983 (mimeographed).

______. "Estimates of the Aggregate Agricultural Production Function from Cross-Sectional Data." *Journal of Farm Economics* 45 (May 1963): 419-428.

______. "The Sources of Measured Productivity Growth: United States Agriculture, 1940-60." *Journal of Political Economy* 71 (August 1963): 331-346.

Houthakker, H. S. "The Pareto Distribution and the Cobb-Douglas Production Function in Activity Analysis." *Review of Economic Statistics* 23 (No. 1, 1955): 27-31.

Huffman, Wallace E. and Evenson, Robert E. "U.S. Agricultural Productivity and Public Policy: A Many Input-Many Output System." Yale University, Economic Growth Center, New Haven, Conn., December 1982 (mimeographed).

International Monetary Fund. *International Financial Statistics,* several issues. Washington, D.C.: International Monetary Fund.

Jorgenson, Dale W. and Griliches, Zvi. "The Explanation of Productivity Change." *Review of Economic Studies* 34 (July 1967): 249-282.

Klein, Lawrence R. *A Textbook of Econometrics.* New York: Row, Peterson and Company, 1953.

Kravis, Irving B.; Heston, Alan; and Summers, Robert. *World Product and Income: International Comparisons of Real Gross Product.* United Nations International Comparison Project, Phase III. Baltimore, Md.: Johns Hopkins University Press, 1982.

Krueger, Anne O. and Ruttan, Vernon W. *The Development Impact of Economic Assistance to LDCs.* 2 vols. Minneapolis: Economic Development Center, 1983.

Luttrell, Clifton B. *Down on the Farm with Uncle Sam.* Original Paper 43. Los Angeles: International Institute for Economic Research, 1983.

Mundlak, Yair. "Capital Accumulation, the Choice of Techniques and Agricultural Output." Washington, D.C., October 1984 (mimeographed).

_______. "Endogenous Technology and the Measurement of Productivity." Paper presented at the meeting on Developing a Framework for Assessing Future Changes in Agricultural Productivity, Resources for the Future, Washington, D.C., July 1984 (mimeographed).

_______. "Models with Variable Coefficients: Integration and Extension." *Annales de l'INSEE* (No. 30-31, 1978): 483-509.

Musgrove, Philip. *Consumer Behavior in Latin America.* Washington, D.C.: The Brookings Institution, 1978.

Nerlove, Marc. *Estimation and Identification of Cobb-Douglas Production Functions.* Amsterdam: North Holland Publishing Co., 1965.

Nishimizu, Mieko. "On the Methodology and the Importance of the Measurement of Factor Total Productivity Change: The State of the Art." World Bank, Development Economics Department, Washington, D.C., October 1979 (mimeographed).

Oram, Peter A. and Bindlish, Vishva. *Resource Allocation to National Agricultural Research: Trends in the 1970s.* The Hague and Washington, D.C.: International Service for National Agricultural Research and International Food Policy Research Institute, 1981.

Palma, Victor. "Review of Evaluation Studies on Returns to Agricultural Research." Paper presented at the Fourth Latin American Regional Meeting of the Econometric Society, Santiago, Chile, July 19-22, 1983 (mimeographed).

Powell, P. and Gruen, F. H. G. "The Constant Elasticity of Transformation Frontier and Linear Supply System." *International Economic Review* 9 (October 1968): 315-328.

Rao, Potluri M. "A Note on Econometrics of Joint Production." *Econometrica* 37 (October 1969): 737.

Sargent, Thomas J. "Estimating Vector Autoregression Using Methods Not Based on Explicit Economic Theories." *Quarterly Review of the Federal Reserve Bank of Minneapolis.* Summer 1979, pp. 8-15.

Schultz, Theodore W. "Uneven Prospects for Gains from Agricultural Research Related to Economic Policy." In *Resource Allocation and Productivity: National and International Agricultural Research,* pp. 578-589. Edited by Thomas M. Arndt, D. G. Dalrymple, and V. W. Ruttan. Minneapolis: University of Minnesota Press, 1977.

Scobie, Grant M. *Food Subsidies in Egypt: Their Impact on Foreign Exchange and Trade.* Research Report 40. Washington, D.C.: International Food Policy Research Institute, 1983.

Sims, Christopher. "Money, Income, and Causality." *American Economic Review* 62 (September 1972): 540-552.

Squire, Lyn. *Employment Policy in Developing Countries: A Survey of Issues and Evidence.* Oxford: Oxford University Press, 1981.

Tait, Alan A. and Heller, Peter S. *International Comparisons of Government Expenditure.* Occasional Paper 10. Washington, D.C.: International Monetary Fund, 1982.

Tolley, George S.; Thomas, Vinod; and Wong, Chung Ming. *Agricultural Price Policies and the Developing Countries.* Baltimore, Md.: Johns Hopkins University Press, 1982.

U.S. Department of Agriculture. *World Indices of Agricultural and Food Production, 1972-81.* Washington, D.C.: U.S. Department of Agriculture, 1982.

Vinod, H. D. "Econometrics of Joint Production." *Econometrica* 36 (April 1968): 322.

Williams, Gary W. and Thompson, Robert L. "Brazilian Soybean Policy: The International Effects of Intervention." *American Journal of Agricultural Economics* 66 (November 1984): 488-498.

Argentina

Argentina, Ministerio de Economía. *Boletin Semanal de Economia,* various issues, 1982-83.

Banco Central de la República Argentina, Gerencia de Investigaciones Económicas. "Agricultura, Caza, Silvicultura y Pesca: Producto Bruto a Precios Corrientes, Período 1970-80." *Serie de Trabajos Metodológicos y Sectoriales* 22. Buenos Aires: Banco Central de la República Argentina, 1982.

_______. "Estimación Trimestrales y Anuales de la Oferta y Demanda Global a Precios de 1970: Metodología y Fuentes de Información y Resultados." *Serie de Trabajos Metodológicos y Sectoriales* 12. Buenos Aires: Banco Central de la República Argentina, 1980.

_______. "Origen del Producto y Distribución del Ingreso, Años 1950-69." *Boletin Estadístico,* Suplemento, Enero 1971.

_______. *Sistemas de Cuentas del Producto e Ingreso de la Argentina.* Volumen 2 y 5. Buenos Aires: Banco Central de la República Argentina, 1975 y 1976.

Bolsa de Cereales. "Numero Estadístico 1980." *Revista Institucional.* Buenos Aires: Bolsa de Cereales, 1980.

Cavallo, Domingo and Mundlak, Yair. *Agriculture and Economic Growth in an Open Economy: The Case of Argentina.* Research Report 36. Washington, D.C.: International Food Policy Research Institute, 1982.

Cuccia, Luis. *El Ciclo Ganadero y la Economia Argentina.* Cuaderno 43. Santiago de Chile: Comisión Económica para América Latina, 1983.

Elías, Victor J. "Fuentes del Crecimiento Económico Argentino y Perspectivas Futuras." *Ensayos en Economía* 1 (December 1965): 1-46.

Feijóo, Víctor M. "Contribución de la Investigación a la Productividad Agropecuaria." Serie Cuadernos, Instituto de Investigaciónes Estadísticas de la Universidad Nacional de Tucumán, Tucumán, Argentina, 1982 (mimeographed).

Llach, Juan J. and Sánchez, Carlos E. "Los Determinantes del Salario en la Argentina. Un Diagnóstico de Largo Plazo y Propuestas Políticas." *Estudios* 7 (January/March 1984): 3-47.

Ras, Norberto and Levis, Roberto. *El Precio de la Tierra (Su Evolución Entre los Años 1916 y 1978).* Buenos Aires: Sociedad Rural Argentina, 1982.

Reca, Lucio G. and Frogone, José M. *Rasgos Característicos de la Ganadería Vacuna Argentina.* Cali, Colombia: Centro Internacional de Agricultura Tropical, 1982.

Reca, Lucio G. and Verstraeten, Juan. "La Formación del Producto Agropecuario Argentino: Antecedentes y Posibilidades." *Desarrollo Económico* 17 (October-December 1977): 371-389.

Bolivia

Banco Central de Bolivia. *Boletin Estadístico*, 1978.

_______. *Cuentas Nacionales.* Publicacion No. 1, 1978.

Food and Agriculture Organization of the United Nations, Secretariado de la Conferencia Mundial sobre Reforma Agraria y Desarollo Rural. *Informe Nacional de Bolivia.* Informe Nacional No. 51. Rome: FAO, 1978.

U.S. Agency for International Development, Mission to Bolivia. *Agricultural Development in Bolivia: A Sector Assessment.* La Paz: USAID, 1974.

Brazil

Anderson, Marvin. "The Planning and Development of Brazilian Agriculture, Some Quantitative Extensions." Ph.D. dissertation, Cornell University, 1972.

Braga, Helson C. and de Carvalho, F. A. "An Empirical Study of Public Expenditures: Brazil 1947-1978." Paper presented at the Third Latin American Regional Meeting of the Econometric Society, Rio de Janeiro, July 19-21, 1981 (mimeographed).

Comisión Económica para América Latina. *Anuario Estadístico de América Latina 1980.* Santiago de Chile: United Nations, 1981.

Contador, Claudio R. *Tecnología e Rentabilidade na Agricultura Brasileira.* Relatario de Pesquisa 28. Rio de Janeiro: Instituto de Planejamiento Económico e Social, Instituto de Pesquisas, 1975.

Empresa Brasileira de Pesquisa Agropecuaria, Departamento de Diretrizes e Metodos do Planejamiento. *Taxas de Retorno dos Investimentos da EMBRAPA: Investimentos Totais E Capital Fisico.* Brasilia, D. F.: Departamento de Diretrizes e Metodos do Planejamiento, 1982.

Fundação Getulio Vargas. "26 Años de Estadisticas Básicas de Economía Brasileira." *Conjuntura Economica* 27 (December 1973).

Instituto Brasileiro de Estatistica. *Brasil: Series Estatisticas Retrospectivas.* Rio de Janeiro: Instituto Brasileiro de Estatistica, 1970.

Instituto Brasileiro de Geografia e Estatistica. *Anuario Estatistico.* Rio de Janeiro: Instituto Brasileiro de Geografia e Estatistica, 1974.

Langoni, Carlos G. "A Study of Economic Growth: The Brazilian Case." Ph.D. dissertation, University of Chicago, 1970.

Lopez, Mauro de Rezende and Schuh, G. Edward. "The Mobilization of Resources from Agriculture: A Policy Analysis for Brazil." Paper presented at the Second Latin American Regional Meeting of the Econometric Society, Rio de Janeiro, July 14-17, 1981 (mimeographed).

Oliveira, Joao do Carmo. "An Analysis of Transfers from Agricultural Sector and Brazilian Development, 1950-1974." Ph.D. dissertation, Wolfson College, Cambridge University, 1981.

Sayad, Joao. *Crédito Rural No Brasil.* São Paulo: Instituto de Pesquisas Económicas, Universidad de São Paulo, 1980.

World Bank, Latin American and the Caribbean Regional Office, *Brazil: A Review of Agricultural Policies.* Washington, D.C.: World Bank, 1982.

Chile

Chile, Ministerio de Agricultura, Oficina de Planificación Agrícola. *Chile: Estadísticas Agropecuarias 1965-1974.* Santiago de Chile: Ministerio de Agricultura, Oficina de Planificación Agrícola, 1976.

______. *Chile: Estadísticas Agropecuarias 1975-1979.* Santiago de Chile: Ministerio de Agricultura, Oficina de Planificación Agrícola, 1981.

Chile, Oficina de Planificación Nacional. *Balances Económicos de Chile 1960-1970.* Santiago de Chile: Editorial Universitaria, 1973.

______. *Metodología y Serie de Cuentas Nacionales 1974-1980.* Santiago de Chile: ODEPLAN, 1981.

Coeymans, Juan E. and Mundlak, Yair. "Productividad Endogena y la Evolución de la Producción y Empleo Sectorial en Chile." Paper presented at the Fourth Latin American Regional Meeting of the Econometric Society, Santiago, Chile, July 19-22, 1983 (mimeographed).

Garcés Voisenat, Juan Pedro. "Inversión y Capitalización en el Sector Agropecuario Chileno, 1950-1980." Tésis de Ingeniero Comercial, Mención Economía, Pontificia Universidad Católica de Chile, 1983.

Muchnik de Rubenstein, Eugenia. *El Rol de los Factores Institucionales en la Generación y Difusion de Innovaciones en la Agricultura Chilena.* Serie de Investigación 41. Santiago de Chile: Departamento de Economía Agraria de la Pontifica Universidad Católica de Chile, 1983.

Philipps F., Ronnie. "Protección o Discriminación: El Caso del Crédito Agrícola en Chile." Serie Tésis de Grado 19, Programa de Posgrado Economía Agraria de la Pontifica Universidad Católica de Chile, Santiago de Chile, 1976.

Universidad Católica de Chile, Programa Posgrado de Economía Agraria. *Chile Agricultural Sector: Overview 1964-1974.* Santiago de Chile: Pontificia Universidad Católica de Chile, 1976.

Valdés, Alberto. "Commercial Policy and its Effects on the External Agricultural Trade in Chile, 1945-65." Ph.D. dissertation, London School of Economics and Political Science, 1971.

Venezian, Eduardo. "La Investigación Agropecuaria en Chile." *Panorama Económico de la Agricultura* (March 1985).

Wollman, N. *The Water Resources of Chile.* Baltimore, Md.: Johns Hopkins University Press, 1968.

Yver, Raul E. "El USO de Fertilizantes en la Agricultura Chilena: ¿Cambio Tecnico o Repuesta Económica?" *Cuadernos de Economía* 5, N-16 (December 1968): 51-61.

Colombia

Banco de la República, Departamento de Investigaciones Económicas. *Síntesis de las Cuentas Nacionales de Colombia, 1950-1971.* Bogotá: Banco de la República, 1973.

______. *Cuentas Nacionales de Colombia, 1970-1977.* Bogotá: Banco de la República, 1980.

______. *Síntesis de las Cuentas Nacionales de Colombia, 1950-1971.* Bogotá: Banco de la República, 1973.

Banco Ganadero, Departamento de Estudios Económicos, Division de Analisis Económico. *Informe Estadistico del Sector Agropecuario 1960-1977.* Bogotá: Departamento de Estudios Económicos del Banco Ganadero, 1977.

Colombia, Departamento Nacional de Planeación. *Diagnóstico del Sector Agrario.* Bogotá: Unidad de Estudio Agrarios del Departamento Nacional de Planeación, 1983.

Colombia, Ministerio de Agricultura, Oficina de Planeamiento del Sector Agropecuario. *Cifras del Sector Agropecuario 1979.* Bogotá: Ministerio de Agricultura, 1979.

Kalmanovitz, Salomon. *La Agricultura en Colombia 1950-1972.* Bogotá: Departamento Administrativo Nacional de Estadística, 1978.

Lorente, Luis. *Producción de Ganado de Carne en Colombia.* Bogotá: Banco Ganadero, 1978.

Orozco, Ramiro. "Sources of Agricultural Production and Productivity in Colombian Agriculture." Ph.D. dissertation, Oklahoma State University, 1977.

PREALC. *Empleo y Salarios.* Santiago de Chile: Organización Internacional del Trabajo, 1983.

Thirsk, W. "The Economics of Colombian Farm Mechanization." Ph.D. dissertation, Yale University, 1972.

Trigo, Eduardo; Pineiro, Martin; and Ardile, Jorge. *Organización de la Investigación Agropecuaria en América Latina.* San José de Costa Rica: Instituto Interamericano de Cooperación para la Agricultura, 1982.

Costa Rica

Banco Central de Costa Rica. *Cuentas Nacionales.* San José de Costa Rica: Banco Central de Costa Rica, 1978.

Banco Central de Costa Rica, Departamento de Investigaciones y Estadísticas, Sección Cuentas Nacionales. "Cifras de Cuentas Nacionales de Costa Rica, 1957-1977." San José de Costa Rica, 1980.

Banco Central de Costa Rica, División de Asuntos Económicas. *Información Económica Semanal,* various issues.

Costa Rica, Ministerio de Agricultura y Ganaderia, Departamento de Economía y Estadísticas Agropecuarias. Unpublished data.

Inter-American Development Bank, Division of General Studies. *Desarrollo Agropecuario y Rural de Costa Rica.* Washington, D.C.: Inter-American Development Bank, 1978.

Mexico

Hertford, Reed. *Sources of Change in Mexican Agricultural Production, 1940-65.* Foreign Agricultural Economic Report 73. Washington, D.C.: U.S. Department of Agriculture, 1971.

México, Secretaría de Agricultura y Recursos Hidráulicos, Subsecretaría de Agricultura y Operación. "Consumos Aparentes de Productos Agrícolas, 1925-1982." *Econotecnia Agrícola* 7 (September 1983).

México, Secretaría de Agricultura y Recursos Hidráulicos, Subsecretaría de Agricultura y Operación, Dirección Nacional de Economía Agrícola. *Informe Estadístico* 127 (Febrero 1983).

Nacional Financiera. *México en Cifras.* México, D. F.: Nacional Financiera, 1970, 1977.

Peru

Banco Central de la Reserva del Perú. *Cuentas Nacionales del Peru 1960-69.* Lima: Banco Central de la Reserva del Perú, 1970.

Instituto Nacional de Estadística. *Cuentas Nacionales del Perú.* Lima: Dirección Nacional de Cuentas Nacionales del INE, 1982.

Instituto Nacional de Planificación. *Cuentas Nacionales del Perú 1950-79.* Lima: Oficina Nacional de Estadística, 1980.

Suárez, Estela; Vargas, Gina; and Zapata, Tomás. "El Sector Agropecuario en el Perú en el Período 1958-1968." *Critica 2* 1 (September-December 1978): 2-14.

Vandendreis, René I. "Foreign Trade and the Economic Development of Peru." Ph.D. dissertation, Iowa State University of Science and Technology, 1967.

World Bank. *Peru: Major Development Policy Issues and Recommendations.* World Bank Country Study. Washington, D.C.: World Bank, 1981.

Venezuela

Banco Central de Venezuela. *La Economía Venezolana en los Ultimos 35 Años*. Caracas: Banco Central de Venezuela, 1970.

______. *Informe Económico,* various issues, 1976-81.

______. "Sector Agrícola de Venezuela." Caracas, 1982 (mimeographed).

Inter-American Development Bank. *Venezuela 1950-1967.* Washington, D.C.: Inter-American Development Bank, 1968.

Venezuela, Ministerio de Agricultura y Cría, Oficina de Planificación del Sector Agrícola. *Anuario Estadístico Agropecuario.* Volúmenes 1975-80. Caracas: Dirección de Planificación Estadística, 1976-81.

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