# AN ECONOMIC ANALYSIS OF THE GROWTH OF SELECTED LATIN AMERICAN EDUCATIONAL SYSTEMS: 1955-1965

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A Dissertation

Presented to

The Faculty of the Department of Economics

University of Houston

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In Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy in Economics

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by

Lucian Palmer

May, 1974

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## ABSTRACT

Various economists have pointed out several socio-economic factors which are alleged to have importance in the rise in educational enrollments. These factors include the ability of the educational system to produce an increased supply of teachers, the increasing level of gross domestic product, the increased entrance of female into the educational systems, rising retention rates in the educational systems, the increasing process of urbanization in the Latin American countries, and the increasing complexity of the production process. An attempt was made to quantify these factors for selected Latin American countries.

Since these factors are at best difficult to quantify, the problem was simplified by assuming that there exists an optimal teacher/student ratio which each educational system is trying to achieve. This optimal ratio is hypothesised to be a function of real per capita gross domestic product. Through these assumptions it became possible to develop a supply function for teachers in an educational system. Further the model developed to provide estimates of another parameter, lamda. Lamda is the speed or the rate of response an educational system makes in attempting to achieve an optimal teacher/student ratio.

The demand for education was considered to be a function of the size of the population, the social customs of the

society, and the rate of return to the individual from investment in education. The return to education was conceived to be a function of the out of pocket expenses of the student while he was attending school, and the expected increase in earnings on the part of the student from his increased educational level. The expected increase in earnings was assumed to be a function of the economy's demand for educated individuals, which in turn is determined by the degree of complexity of the production process.

For purposes of analysis proxy variables were selected to represent the factors determining the supply and demand for educational places. The number of teachers and the level of real per capita gross domestic product and the teacher/student ratio were chosen to represent the supply of educational places.

The rate of growth of the school age population, the rate of rural to urban migration, the sex composition of enrollments, the education retention rates, and the percentage of gross domestic product produced in the manufacturing sector were chosen to represent the factors determining the demand for education.

Time series data was developed for enrollments and the proxy variables in the selected countries. This data was subjected to simple regression between enrollments and each of the proxy variables in the selected countries. Multiple regressions were run using different combinations of the proxy variables as independent variables. In addition cross

sectional regressions for a single year were run by converting the proxy variables into a per capita form wherever possible, and treating the selected countries as a single unit. Finally other statistical snalysis was performed through the comparison of ratios, and rates of growth.

Two basic conclusion were reached in this study. Once dealt with the general aspects of the operations and problems of the educational systems under investigate, while the other dealt with the problems of making long run projections of educational enrollments.

It was established, but not conclusively, that there exist optimal teacher/student ratios which the educational systems in the selected countries try to achieve. In the short run the teacher/student ratio is the basic mechanism which the system uses to balance the supply of educational places with enrollments. In the long run the educational systems attempt to reach the optimal teacher/student ratio by adjusting the stock of teachers to enrollments. The ability of the educational systems of the selected countries to achieve optimal teacher/student ratios has not been outstanding due to an inability to produce sufficient quantities of teachers. If these countries and other countries in simiiiar situations expect to achieve optimal teacher/student ratios they must pay more attention and devote more resources to the portion of the educational system which produces their countries teachers.

It was established rather conclusively that educational planners must consider many socio-economic variables in long run projection of enrollments. Particularly important in long run projections of enrollments are the expected changes in the level of the per capita gross domestic product, possible increased proportions of females entering the educational system, the increasing complexity of the production process, changing retention rates within the educational system and possible changes in the rural/urban population distribution. In the selected countries changes in each of these factors were found to effect long run enrollment levels. Projections of enrollments which does not take into account these factors will likely prove to be quite incorrect.

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# CHAPTER I

## Summary and Conclusions

### I. Statement of the Problem

Since the mid 1950's economic growth has been an important social goal for virtually every nation in the world. In the countries of Latin America, the concept of economic growth is intertwined with national honor and glory. Latin American countries have been and are today actively seeking ways in which economic growth can be continued or stimulated.

It has become increasingly clear in the last twenty years, not only in Latin America but throughout the world, that the education of the labor force and the entire population of a country is an important factor in the process of economic development. The experience of the United States, the Soviet Union, and Western Europe has in effect served notice that rapid long run economic growth is simply not possible if there is not adequate investment in the process of education. Nations simply cannot develop an industrial economy if there does not exist a labor force with a skill level sufficient to operate in such an environment.

Most Latin American countries are persuing the goal of economic growth through the use of governmental planning and control of the areas which they deem to be critical to the process of economic development. In nearly every instance, the process of education is considered to be of great importance to the process of economic growth and the

national government is a major factor in the allocation of resources to education. By controlling the allocation of resources to education, economic planners attempt to control the output of the educational system. Control of educational output is attempted in two phases, by influencing the number of individuals entering the educational system, and then by influencing the students to follow particular lines of study.

If the process of education is to be carried out under the umbrella of a democratic or semi-democratic political process, educational planners and economic planners must work within certain social constraints. They cannot force individuals above the legal school age to attend school (and in some cases cannot even enforce compulsatory school attendance laws) nor can they restrict school enrollments to the point where there are large numbers of individuals who want access to education but cannot have it. The educational planner must tread a fine line. He must allocate a sufficient quantity of resources to education to assure the potential of economic development without overinvesting in education. At the same time he must recognize the desires of the people of his country for education.

While one is tempted to discuss the "Latin American" educational experience, there are in fact as many "Latin American" educational experiences as there are countries in Latin America. Each country is in a different stage of

economic/demographic development and the expansion or lack of expansion of the educational system at least in some way relates to this development. From the period 1955-1965, various Latin American Countries experienced a wide rante of rates of growth in their educational systems. One of the purposes of this paper is to examine this period of growth and to determine what economic/demographic factors were factors in the growth of educational systems in Latin America.

Various economists have pointed to several socio-economic factors which are alleged to have importance in the rise in educational enrollments. These factors include the ability of the educational system to produce an increase in the supply of teachers, the increase in the level of gross domestic product, increased in the entrance of females into the educational systems, rising retention rates in the educational systems, increase in urbanization in the Latin American countries, and the increase in the complexity of the production process. If the effects of these factors can be determined and, quantified, the educational planner will be in a much better situation with regard to the long run planning aspects of the growth of the educational system.

## II. Hypotheses

In order to measure the effect of the various social and economic factors effecting educational enrollments in Latin America the following hypotheses will be tested.

I. Each country has, for each level of education optimal teacher/student ratio it is trying to achieve.

II. The teacher/student ratio is a positive function of per capital gross domestic product.

III. The chief determinent of the level of education enrollments in any given time period is the level of enrollments of the previous period.

IV. Levels of educational enrollments are directly related to real per capita gross domestic product.

V. The increasing percentage of female enrollment in an educational system leads to increased educational enrollments.

VI. As the production process of a country becomes more complex as represented by the percentage of gross domestic product produced in the manufacturing sector, educational enrollments rise.

VII. As retention rates within the educational system rise, educational enrollments rise.

VIII. The greater the per capita income of a country, the greater the proportion of enrollments to school age population.

IX. The more urbanized a country becomes, the greater the proportion of enrollments to school age population.

X. The greater the ratio of teachers to school age population, the greater the proportion of enrollments to school age population.

## III. Summary

To test these gypotheses seven countries representatives of Latin America were chosen. The countries were Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. They were selected for several reasons. These countries made up the bulk of the population of Latin America. They were the relatively most developed countries but were certainly in different stages of economic development. In addition they had developed fairly comprehensive data series concerning their educational systems.

Initially the relationship between economic theory and educational and economic development was investigated. Particular emphasis was placed upon the relationship between educational planning and planning for economic development.

A conceptional framework was developed as a basis for discussing the supply and demand for educational places. The supply of educational places was considered to be a function of the quantity of goods and services a country could produce or borrow and its willingness of the society to invest in education. This is effected by the customs and the goals of the society, and the rate of return on investment in education.

Since these factors are at best difficult to quantify, the problem was simplified by assuming that there exists an optimal teacher/student ratio which each educational system is trying to achieve. This optimal ratio is hypothesized to be a function of real per capita gross domestic product. Through these assumptions it became possible to develop a supply function for teachers in an educational system. Further the model developed to provide estimates of another parameter, lamda. Lamda is the speed or the rate of response an educational system makes in attempting to achieve an optimal teacher/student ratio.

The demand for education was considered to be a function of the size of the population, the social customs of the society, and the rate of return to the individual from investment in education. The return to education was conceived to be a function of the out of pocket expenses of the student while he was attending school, and the expected increase in earnings on the part of the student from his increased educational level. The expected increase in earnings was assumed to be a function of the economy's demand for educated individuals, which in turn is determined by the degree of complexity of the production process.

For purposes of analysis proxy variables were selected to represent the factors determining the supply and demand for educational places. The number of teachers and the level of real per capita gross domestic product and the

teacher/student ratio were chosen to represent the supply of educational places. The rate of growth of the school age population, the rate of rural to urban migration, the sex composition of enrollments, the education retention rates, and the percentage of gross domestic product produced in the manufacturing sector were chosen to represent the factors determining the demand for education.

Time series data was developed for enrollments and the proxy variables in the selected countries. This data was subjected to simple regression between enrollments and each of the proxy variables in the selected countries. Multiple regressions were run using different combinations of the proxy variables as independent variables. In addition cross sectional regressions for a single year were run by converting the proxy variables into a per capita form wherever possible, and treating the selected countries as a single unit. Finally other statistical analysis was performed through the comparison of ratios, and rates of growth.

## IV. RESULTS OF THE STATISTICAL TESTING

Each of the hypotheses listed in Section II was tested using data from the period 1955 to 1965.

### The Existence of an Optimal Teacher/Student Ratio

It was shown that for an optimal teacher/student ratio

to make economic sense that the rate of response, i.e., the rate at which the system moves to the optimal level, (denoted by $\lambda$) must be between zero and one. It was not possible to statistically establish that the value of $\lambda$ was between zero and one for any country. It is interesting to note however, that for virtually every country the estimated value of $\lambda$ fell between the values of zero and one, but these values were not significantly significant. The failure of the model to conclusively establish the existence of an optimal teacher/student ratio could lie in the quality of the data and the limited amount of data available.

The Relationship Between the Teacher/Student Ratio and G.D.P.

It was shown that in primary education there existed a positive and significant correlation between the teacher/student ratio and G.D.P. in Argentina, Brazil, Colombia, and Mexico while there was a significant and negative relationship in Venezuela and no significant relationship in Peru. In secondary education Brazil, Peru and Venezuela had significant negative relationships while Mexico and a significnat positive relationship. In higher education there was no significant relationship for Argentina, Brazil, Peru, and Venezuela while the relationship for Colombia and Mexico was positive and significant.

The Relationship Between Enrollments and G.D.P.

It was hypothesized that there exists a positive relationship between enrollments and gross domestic product, with the exception of primary education in Chile, it was found that there exists a significant positive relationship for all of the countries tested, Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.

The Relationship Between Enrollments and the Percentage of Female Enrollments

It was found that there existed significant positive relationships between the two variables in primary education for Argentina, Colombia, and Peru, while the relationships were not significant in Chile and Venezuela. In secondary education the relation was significant and positive for Argentina and Venezuela, while it was not significant in Peru.

The Relationship Between Enrollments and the Percentage of Gross Domestic Product Produced in the Manufacturing Sector

It was hypothesized that there existed a significant positive relationship between increasing enrollments and the increasing complexity of the production process as represented by the percentage of gross domestic product produced in manufacturing sector. It was found that such a significant relationship existed between the two variables in all levels of education for Argentina, Colombia, Mexico, Peru, and Venezuela. In addition, the relationship was significant

in Chile for both secondary and higher education.

The Relationship Between Per Capita Enrollment and Per Capita Gross Domestic Product

It was hypothesized that the size of the absolute potential school age population in relationship to the per capita wealth of a country was a critical factor in determining the level of enrollments. Cross-sectional regression analysis confirmed that the richer a country, the greater the percentage of enrollments to potential enrollments.

The Relationship Between the Percentage of Enrollments and the Rural/Urban Population Distribution

It was hypothesized that the rural/urban population distribution was an important factor in determining the level of enrollments. Cross-sectional regression analysis established that there is a negative relationship between the ratio of rural to urban population of a country and the ratio of enrollments to school age population.

The Relationship Between Enrollments and Educational Retention Rates

Very limited information was available concerning the retention rates in the selected countries. It was however, found that there exists significant positive relationships between enrollments and the retention rate in primary and secondary education for Argentina, Brazil and Peru.

The Relationship Between Current Enrollments and the Previous Periods Enrollments

It was found for all countries that a very strong positive correlation exists between enrollments in any given time period and the enrollment of the previous period for all levels of education for all of the selected countries.

The Relationship Between the Percentage of Enrollments and The Teacher/School Age Population Ratio

It was hypothesized that there existed a positive relationship between the proportion of enrollments to school age population. Cross-sectional regression analysis showed that a relationship exists between the two variables but the relationship is in fact negative.

## V. Conclusions

Two basic conclusions were reached in this study. One dealt with the general aspects of the operations and problems of the educational systems under investigation, while the other dealt with the problems of making long run projections of educational enrollments.

It was established, but not conclusively, that there exist optimal teacher/student ratios which the educational systems in the selected countries try to achieve. In the short run the teacher/student ratio is the basic mechanism which the system uses to balance the supply of educational places with enrollments. In the long run the educational

systems attempt to reach the optimal teacher/student ratio by adjusting the stock of teachers to enrollments. The ability of the educational systems of the selected countries to achieve optimal teacher/student ratios has not been out-standing due to an inability to produce sufficient quantities of teachers. If these countries and other countries in similar situations expect to achieve optimal teacher/student ratios they must pay more attention and devote more resources to the portion of the educational system which produces their countries teachers.

It was established rather conclusively that educational planners must consider many socio-economic variables in long run projection of enrollments. Particularly important in long run projections of enrollments are the expected changes in the level of the per capita gross domestic product, possible increased proportions of females entering the educational system, the increasing complexity of the production process, changing retention rates within the educational system and possible changes in the rural/urban population distribution. In the selected countries changes in each of these factors were found to effect long run enrollment levels. Projections of enrollments which do not take into account these factors will likely prove to be quite incorrect.

## CHAPTER II

## REVIEW OF THE LITERATURE

This chapter lays the framework for the analysis of the causes of growth of educational enrollment in selected Latin American and Central American countries. It examines the place of education within economic theory, and describes attempts of economists to measure the contribution of education to economic development. The concept of educational planning within the overall context of development planning is investigated. Pragmatic problems of the development of educational systems are discussed.

### I. Economic Theory and Education

#### Education and Economic Theory

The process of education is one of the major aspects of the development of human resources. Economists with such diverse opinions as A. Smith, Thomas Malthus, David Ricardo, Alfred Marshall, A. C. Pigou, Frank Knight, Clarence E. Ayres, Benjamin Higgins, and T. W. Schultz agree that the quality of human resources and thus education is an important factor in economic growth. According to Adam Smith, the improvement of the skill and dexterity of the worker was a critical factor in the economic progress of a nation. In The Wealth of Nations, Smith wrote concerning education that the "expense is no doubt beneficial to the whole society and may therefore,

without injustice, be defrayed by the general contributions of the whole society".[1]

Within the systems of both Ricardo and Malthus, one short run solution to the improvement of the living conditions of the populace was controlling the rate of growth of population. Both men favored education as a method of developing habits which would lead to the development of family limitation.

> Malthus firmly put education into its proper context of the causes which tend to generate prudential habits, the most essential is civil liberty, and to the maintenance of civil liberty, political liberty is generally necessary.[2]

During the period of the writings of Alfred Marshall one of the great debates concerning education was the question of a technical education for the working class. Many individuals held that the only education necessary for the working man was a narrow, limited technical education which prepared the worker to perform one job efficiently.[3] Marshall while agreeing that a technical education was important to the increasing efficiency of production, argued that the whole of society would

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[1] Adam Smith, The Wealth of Nations, ed. C.J. Bullock, (New York: P.F. Collier and Son Company, 1909), p. 485.

[2] John Vaizey, The Economics of Education, (New York: The Free Press of Glencoe Inc., 1962), p. 19.

[3] Ibid., p. 19.

be benefited by a more general education of the work force. Marshall argued that there existed many jobs in his present day society that required many years to learn to do adequately. Certainly, for a man to enter into these professions he had to spend many years in a learning apprentiship. However, he went further to point out that such jobs were becoming fewer. "Some kinds of manual work require long-continued practice in one set of operations, but these cases are not very common, and they are becoming rare: for machinery is constantly taking over work that requires manual skill of this kind."[4]

There are two types of ability, Marshall argued, specialized ability, and general ability. Special ability is the manual dexterity necessary to perform specific activities for specialized trades. General ability is a combination of general knowledge and intelligence which is the common property of all students. General ability is enhanced by environment and education. Education allows the individual to use his facilities in a more efficient manner whether employed as a workman or in other pursuits.[5] Marshall emphasizes the importance of education and in particular general education by

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[4]Alfred Marshall, Principles of Economics, 8th ed. (London: MacMillan and Co., 1938), p. 206.

[5]Ibid., pp. 207-208.

saying:

> Manual skill that is so specialized that it is quite incapable of being transferred from one occupation to another is becoming a less and less important factor in production. Putting aside for the present the faculties of artistic perception and artistic creation, we may say that what makes the workers of one town or country more efficient than those of another, is chiefly a superiority in general sagacity and energy which are not specialized to any one occupation[6]

Pigou argued that the development of human resources was an important factor in economic development. Couching his analysis in terms of marginal analysis, he concluded that the marginal net product of resources invested in education was greater than the return to investments in physical capital. This is to say that expenditures on the health and welfare of people will lead to greater increases in productivity then will an equivalent expenditure on new capital creation.[7]

Frank H. Knight, writing in Risk, Uncertainty and Profit, recognized the ability of labor to improve its productivity over time through education. Because of the uncertainty of the return to education, and the fact that education is pursued for other reasons than profit, Knight was pessimistic concerning the ability of the competitive system to rationally allocate resources between investment in human and

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[6] Ibid., p. 206

[7] Vaizey, p. 42

physical capital.[8] In commenting on the investment in education in his own time he wrote:

> The fact that so many opportunities for the profitable investment of resources in the development of human potentialities are neglected, and so many wasteful investments of the same kind made, is persisting society.[9]

In The Theory of Economic Progress Ayers describes technology as the driving force of economic development. Within Ayers framework technology is "all human activities involving the use ot tools, all sort of tools ...".[10] Technology is neither tools nor human skill, but the activity of men operating tools. A change in technology is the combination of human skills and tools in new ways. To Ayers economic progress is dependent upon the reorganization of human skills, i.e., education.

> .....In short, capital equipment will work anywhere. But it will affect the lives only of those who are in direct contact with it. It does not automatically bring economic development to a whole people. Only education can do that ....The industrialization of Japan dates, as everyone knows from the Meiji revolution. What is not so widely appreciated is that the Meiji revolution not only transformed the power structure and the class system of Japanese society. It was an educational revolution which brought literacy to the Japanese people and so a solid foundation for the industrialization that followed. The same was true for Russia.[11]

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[8]Frank H. Knight, Risk, Uncertainty, and Profit, (New York, 1965: Harper and Row Publisher, Inc.) pp. 158-159.

[9]Ibid.

[10]C. E. Ayers, The Theory of Economic Progress, (New York: Schocken Books, Inc.), pp. vii.

[11]Ibid., p. xxiii.

Higgins, stressing the fact that education is important in economic growth, calls for treatment of education as an industry to which the principles of production theory may be applied. The production of the education industry would consist of trained and educated people and the input to this industry would be the intake of beginning students. These factors may be considered as the "variable factors of production." The "fixed factors of production" would consist of the classrooms and trained teachers. Using these factors a production function for education may be developed which could be used to determine the conceptually efficient level of operations of the educational system and in turn the optimal level of students for any stock of educational capital.

> Any society may choose within limits between more education and more of other components of national income. Investment in education can always be extended beyond the point where it will add still further to productivity, measured in terms of other goods and services. But education is also valued as a consumers' good in its own right; an optimal education program will accordingly involve more investment in education than would maximize output of other goods and services.[12]

The Measurement of the Contribution of Education to Growth

In the 1950's with reemergence of the field of economic development and the advent of more sophisticated statistical techniques and improved methods of data handling, economists

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[12] Benjamin Higgins, Economic Development, (New York: W. W. Norton, Revised ed., 1968), pp. 437-440.

began to try to measure the contribution of education to the growth of gross national product in the United States. Estimates were made either on a macro or micro-economic basis. The macro-economic approach attempts to relate direct changes in the educational level with changes in the level of gross national product. The micro-economic approach tries to calculate the rate of return to the individual for his investment in education and then to relate this rate of return to the growth in gross national product.

Theodore Schultz used the macro approach and based his work on the proposition that "people enchance their capabilities as producers and as consumers by investing in themselves and that schooling is the largest investment in human capital".[13] To Schultz education is an important aspect of economic growth for several reasons. Research done in educational establishments leads to overall advances in knowledge within the society. An educational system discovers and cultivates the capabilities of the children of society. Education increases the ability of individuals to adapt to changing economic structure and job opportunities which are always associated with economic progress. In addition the educational system stands as a storer of knowledges and replenishes the stock of professional educators.

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[13]. Theodore W. Schultz, The Economic Value of Education, (New York: Colombia Press, 1963), p. ix.

In order to calculate the rate of return from investment in education, Schultz estimated the increase in gross national product from the investment in education, and also the cost of that education. For purposes of estimation and analysis, he divided the cost of education into two parts. The conventional cost of education was conceived of being composed of the direct cost of education, that is cost of the services of teachers, librarians and administrators, and the cost of financing, building, operating and maintaining the physical facilities for education. Equally important but more difficult to estimate was the loss of income brought about by school attendance. Every individual who attends school gives up income he could have earned if he had taken a job rather than attended school. Schultz estimated the cost of foregone income as approximately one quarter of the total cost of education in 1900 and approximately forty percent of the total cost of education in 1956.[14]

Having developed an estimate of the stock of educational capital, Schultz offered an explanation of how education affected the labor force, and in turn the growth of gross national product. He found that years of schooling completed per person in the labor force rose from 8.4 in 1930 to 10.9 in 1957, simple rate of growth of about 1 percent a year. In

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[14] Theodore Schultz, "Capital Formation by Education", (Journal of Political Economy, Vol. 67, no. 6, 1960), pp. 574-578.

addition the days which students actually attended school rose considerably between the two periods. Adjusting the years of schooling completed by attendance, Schultz found that the years of schooling completed rose from 6.01 in 1930 to 10.43 in 1957, a rate of growth of slightly more than two percent. Schultz then calculated the contribution of the increase in schooling of the labor force in the following manner:

> The approach that I used rests on the estimate of the investment in schooling in people who are in the labor force and the rate of return earned on this investment. The first, expressed as stock of capital in 1956 dollars, came to 180 billion dollars for 1930 and to 535 billion dollars in 1957. (A simple adjustment for trend indicates a stock of 173 billion dollars in 1929). Thus, the increase in this stock of capital between 1929 and 1957 comes to 362 billion dollars. It should be noted that this approach allocates none of the costs of schooling in the labor force either to present or future consumption. These costs are treated as if all were solely an investment in future earnings. Three estimates of the rate of return were attempted. The two lower rates come to 9 and 11 percent. Applying these two rates to the increase in the capital stock of schooling of 362 billion dollars, I obtain slightly less than $33 billion and $40 billion respectively as the growth in national income from schooling. If the national product increased $200 billion, this additional schooling in the labor force accounts for 16.5 percent or 20 percent of the total growth depending upon whether the 9 percent or 11 percent rate of return is employed.[15]

Edward Denison has put forth another measure of the importance of education in the process of economic development. By determining what proportion of the growth in gross

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[15]Schultz, The Economic Value of Education, p. 44.

national product from 1930 to 1960 could be statistically attributed to increases in the capital stock and the size of the labor force, and then subtracting this proportion from the increase in gross national product, Denison calculated a residual. This residual was the proportion of gross national product increases which could not be explained by the increased magnitudes of the labor force and the stock of capital. The changes of the inputs of labor, capital and land account for only 30 percent of the growth of real national income, while the residual accounted for 70 percent.

Denison then calculates that annual average rate of growth of the real per capita income at a rate of 1.6 percent a year, which is equivalent to a 1.6 percent per year increase in the average productivity of a worker. Denison enumerated the various factors which might cause this increase in productivity. The factors were divided into two groups, the increase in total inputs, and the increases of output per unit of capital. The increases in inputs consisted of those things which directly effect the average and marginal productivity of labor such as improved education, length of the work week, composition and size of the labor force, and increases in the stock of capital. Increase in output per unit of capital included economies of scale, advance of knowledge (synonymous with innovation) restriction of efficient methods of production, and the shift from agriculture to manufacturing. The portion of the growth rate

of 1.6 percent which could be accounted by the various items was calculated by Denison.

The major contributing factors to the rate of growth were found to be economies of scale, advance of knowledge and education. Economies of scale due to increasing size of national market was to account for .34 of the percentage growth national product. This was composed of the portion of the growth rates accounted for by increases in the size of the national market, which is .27, and the proportion accounted for by economies of scale due to the independent growth of local market, which was .07. In order to calculate the returns to education, Denison estimated wage differentials between men of different educational levels. He estimated that 60 percent of the wage differential is accounted for by differences in education. On these bases he concluded that .67 of the 1.6 percent rate of growth was caused by increases in the educational level of the labor force. The advance of knowledge, which is a true residual being the remainder of the growth rate after all other factors have been accounted for is .58. From his study Denison concludes that since 1929 approximately 23 percent of the total growth of the gross national product of the United States can be explained by increases in the educational level of the labor force.[16]

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[16] Edward F. Denison, The Sources of Economic Growth in The United States and the Alternatives Before Us. (New York: Committee for Economic Development, 1962), Chap. 7 and 23. See also Edward F. Denison, L.A.G. Robinson and J.E. Vaizey (eds.), The Economics of Education, (London: St. Martins Press, 1964), pp. 198-206.

Selowsky notes that most studies to determine sources of economic growth have been carried out in the more developed countries. He attempts to analyze the contribution of education to economic growth in lesser developed countries., specifically, Chile, Mexico and India. Further he notes that studies have attempted to measure the contribution of education to economic growth in terms of effects of increases in the education of labor force and have neglected that part of the contribution of education that stems from maintaining the overall levels of schooling of the labor force. Selowsky feels that the neglect of this factor is a significant bias and causes substantial underestimation of the magnitude of the contribution of education to economic growth.[17]

A group of economists have attempted to measure the return to education on an individual basis. Working with a sample of individuals such people as Becker,[18] Hansen,[19] and

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[17]Marcelo Selowsky, "On the Measurement of Education's Contribution to Growth", Quarterly Journal of Economics, Vol. 3, No. 3, (August, 1969), pp. 449-463.

[18]Gary S. Becker, "Under-investment in College Education", American Economic Review, (Papers and Proceedings), Vol. 50, No. 2, (May, 1960), pp. 340-348.

[19]W. Lee Hansen, "Rate of Return to Investment in Schooling", Journal of Political Economy, Vol. LXXI, No. 2 (April, 1963), pp. 130-142.

Houthakker,[20] and Mincer[21] have attempted to relate years of schooling with income. These efforts have been muddled by the inability to differentiate between other factors which influence economic success and the effect of additional years of study. Such factors as intelligence level, motivation, quality of instruction, family background, social standing, and family wealth are extremely difficult to isolate and hold constant during testing. While the results of all of these studies are somewhat inconclusive, all show a rate of between 8 to 12 percent average return on a year of schooling, with a much larger return to years of high school study than to the elementary level.

Morgan and Sirageldin[22] were attempting to associate the amount of money which a school system spends on a student per year, and his earnings later in life. The increase in per capita expenditure per student was considered to be an investment in education (an increase in quality of education). Respondents were classified as to the level of education of the head of the family, whether the family grew up on a farm,

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[20] H. S. Houthakker, "Education and Income", Review of Economics and Statistics, Vol. 41, No. 1, (February, 1959), pp. 22-28.

[21] Jacob Mincer, "On the Job Training: Cost Returns and Some Implications", Journal of Political Economy, Vol. LXX, (No. 5, 1962), pp. 67-84.

[22] James Morgan and Ismail Sirageldin, "Return on Education Investment", The Journal of Political Economy, Vol. 76, (November, 1968), pp. 1069-1077.

the sex of the head of the family, the race and the age of the family head. The average hourly wage was computed for each group. Then the per capita expenditure per student on education of the state in which the family head grew up was regressed against the difference between the average hourly wage of the subjects group and the subjects own average hourly wage. The resulting regressions showed that differences in state expenditures per pupil accounted for approximately 7 percent of the individual residual earnings differences. The authors concluded that the margin of public investment in higher quality education pays for itself in higher individual earnings in a year or two after graduation.

The general consensus of the economics profession regarding education can be summarized. Education is an important aspect of economic growth. Economists have had difficulty in determining the exact rate of contribution to economic growth of investment in education over time, but all studies seem to indicate that the returns are relatively high.

## II. Education and Economic Planning

### The Concept of a Development Plan

In most underdeveloped countries of the world today, it is an accepted fact that the central government will attempt to plan all or most of the process of economic development. The government will work on the problems for development on

many different levels. The following passage is an illustrative description of how economic development planning is conceptualized as in the economic literature.

> A Project is the smallest unit of investment activity to be considered in the course of programming. It will, as a rule, be a technically coherent undertaking which has to be carried out, technically speaking independently of other projects. Examples of projects are the building of a factory, the construction of a bridge or a road, the reclaimation of a piece of land. A Programme is a coordinated set of projects. They will be located in the same country or in some smaller geographical unit (state, province, region, municipality). They will also be started in some specified period, which may be a year, a five-year span, or some other period. The degree of coordination in other respects may vary but the projects will have been considered by some authority with a view to coordinating them. An investment plan, in this context, is something arrived at "from above" through calculations referring either to the whole economy or to certain sectors in certain areas. It is not constructed by combining projects, but derived from the broad set development aims.[23]

The goals of economic development can be many and varied. One of the central most goals of course is a rapid increase in the material wealth of the country, but to many countries development means more than this one goal. It means the beginning of the process of erradicating ignorance, substituting men for machines, eliminating hunger and illness, and extending economic and political justice to all parts of the society. Because the goals of economic development are many and varied, they may conflict in their implementation.[24]

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[23] Higgins, Economic Development, p. 375.

[24] Louis J. Walinsky, The Planning and Execution of Economic Development, (New York: McGraw-Hill Book Company, Inc., 1963), pp. 21-26.

Once the various goals have been specified and their relative importance has been established, the country is faced with their implementation of the goals. In most plans of economic development, an increased education level of the populace generally is one of the important factors. It is then necessary to determine what sort of projects and programs will achieve the increase in the educational level set by the plan without conflicting with the other goals of the plan.

Formal educational planning is quite clearly a subset of a plan for the development of human resources. The overall plan of economic development must consider the planning of the formal education system as part of a systematic attempt to raise the productivity of the labor force of the country. The overall attempt to develop human resources includes not only the design of a program of formal education but also the establishment of on-the-job training, remedial education, training in the armed services, governmental sponsored training and adult education. Thus formal educational planning must be made in light of the overall plan of economic development but also in view of the relationships between formal educational and the other methods of developing human resources.[25]

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[25]Fredrick Harbinson and Charles A. Myers, Education Manpower and Economic Growth, (New York: McGraw-Hill Book Company, 1964), pp. 210-211

The Philosophy of an Education Program

In order to engage in education planning there must be an overall philosophy of education. There are two basic philosophies among the developed nations concerning who should be educated. The American approach (of which the Russian system is a modification) places great emphasis upon widespread education and public participation in the management of education. It aims at creating a popular mass culture, and then introducing within this culture ideas which are necessary and useful for economic growth. The process of economic growth becomes then a socially necessary and popular good. Usual results of this type of education seems to include high geographic mobility, a high degree of occupational mobility and more social mobility.[26]

In other English speaking and European countries, the philosophy of educations seems to be to create an elite subculture of better educated individuals. Popular culture is considered to be rather unimportant in terms of economic development. Most essential to economic development is an honest, highly competent, and stable central governmental administration generally in the form of a civil service. This civil service, it is felt, stands in the best position to take advantage of opportunities for economic growth. This philosophy seems to work well providing that social change

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[26]Richard L. Meier, Development Planning, (New York: McGraw-Hill Book Company, 1965), pp. 366-367.

is gradual, but it suffers from the inability to implement massive efforts, once it is generally agreed that a given objective should be pursued.[27]

There are two basic approaches for the planning of the development of the system of formal education. The first, and the one which seems to have been historically favored by educators, is the use of comparison. This approach is derived from the experience of more developed countries. Drawing from the writing of Marshall and other economists, it argues that it is neither necessary and/nor feasible to attempt to provide specific quantities of workers trained in specific skills for the economy in the future. This method evaluates the educational system in light of educational and social problems, and projects the needs of the educational system in terms of resources needed to achieve desired economic development. In order to judge the country's educational system it is compared with the educational systems of more economically developed countries. Such indices as expenditure per pupil, student/teacher ratio, drop-out rates, percentage of the school age population enrolled in the school, percentage of university enrollment in various areas of speciality, are used to set goals for the educational system. Under this method the developing countries attempt to

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[27] Ibid., pp. 366-368.

approximate the educational system of more developed countries.[29]

While this has been a rather popular method of educational planning for some time, unfortunately it has several flaws.

> This approach has been favored traditionally by educators. It bypasses completely the difficult determination of occupational requirements. But at the same time, it overlooks essential economic problems. If this approach is used, there is likely to be little integration of the work of the educational planners and the economic planners, and in the end the latter are likely to recommend that expenditures for education, along with other social activities, be given a lower priority than investments in projects which are clearly productive and appear to contribute more directly to economic growth.[30]

The manpower approach to developmental and educational planning attempts to overcome the flaws of planning by norms. Within the development plan goals or targets are established. These goals are simply estimates of the desired and/or feasible conditions in which the country would like to find itself somewhere in the future. Future goals might include levels of percapita income, amount of illiteracy, the structure of industrial or the composition of industrial and agricultural output, degree of rural integration, rate of birth of population, or many others. The system of education

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[29]Higgins, Economic Development, p. 434, and Harbison and Myers, Education, Manpower and Economic Growth, p. 199.

[30]Harbison and Myers, Education Manpower and Economic Growth, p. 199.

is then judged within the framework of the goals, and in light of the current status of the economy and the labor force.

Studies must be made to determine the size, composition and education level of the labor force. Special emphasis should be given to areas in which there is a surplus of labor, chronic unemployment, or scarcity of labor. Once the structure and ability of the labor force is known, it is necessary to determine what sort of skills the educational system is currently providing. Equipped with these two pieces of information a project of the skill and structure of the labor for the target year is made assuming that there is no change in the process of education.

Next the goals themselves are examined in terms of the paths which the country may take to reach the goals, and what the size composition and skill level of the labor force must be for the target goals to be maintained. This involves the study of current level structure and technology of production within the country,and how these factors will change over time as the country approaches its goals. Specifically how many people with specific skills will be needed to support the level and composition of economic activity which is called for in the goals.

The system of formal education must then be considered in relationship to how it can help to provide the skills necessary for reaching the goals of the country. What

portion of the job can the education system do in its present form? What new areas of study should be added to achieve the goals? In what areas should students be discouraged or encouraged to enter? Are there other ways in which the necessary skills can be provided beside through the systems formal education? Once these questions have been thoroughly explored, the implementation becomes a question of timing, resources, and the function of the political process.[31]

## III. Problems in Educational Planning

### The Language Problem

The three basic problems which must be faced in implementing plans for education are the language problem, the supply of teachers, and the prediction of educational demand. In many countries of Latin America large sections of the population do not speak the national language. In Guatemala, peru, Ecuador, and Bolivia over half of the population does not speak the Spanish Language. In Venezuela, Portugal and

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[31]The above description of the manpower strategy is composed from ideas presented by the following sources: Higgins, Economic Development, pp. 420-423; Harbison and Meyers, Manpower, pp. 200-208; W. Arthur Lewis, Development Planning, (New York: Harper and Row, 1966), pp. 222-230; Walinsky, The Planning and Execution of Economic Growth, pp. 33-42; J. D. Chesswas, Methodologies of Educational Planning for Developing Countries, (Paris: UNESCO, International Institute for Educational Planning, 1968), pp. 7-11; R. Poignant, The Relation of Educational Plans to Economic and Social Planning, (Peru: UNESCO, International Institute for Educational Planning, 1967).

Colombia much of the Indian population does not speak Spanish, while in Brazil half of the Indian population does not speak Portuguese. The question is of course, will the education system force these individuals to learn a new language in order to be educated, and if individuals are forced to learn a new language in order to attend school, how many people will choose simply not to go.[32]

The Supply of Teachers

Efficient education planning requires an analysis of the supply of teachers and also the technology of teaching. The results of this analysis can be translated into the estimated requirements for teachers by selecting the most promising of a series of possible modes of instruction. The modes of instruction would each represent a specific combination of resources; collectively the series of modes would make possible a wide variety of qualitative and quantitative end results with varying cost and efficiency factors. One techniques may make far more use of teachers through heavy capital investment than another which stresses a substantial investment of human resources and a lesser use of physical capital. Real or potential human resource capital is usually far more plentiful than physical capital in the less developed countries. There, the most appropriate mode of

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[32]Frank Tannebaum, Ten Keys to Latin America, (New York: Vintage Books, 1959), pp. 97-99.

instruction is likely to rely upon manpower a great deal more than physical capital particularly, the type of physical capital which can be,requires substantial expenditures of foreign exchange.

The alternatives of the mode of production can in part determine the rate at which the educational system must produce teachers. In countries in which it is impossible to adapt capital intensive methods of teaching, the first phase of expansion of the education system must be devoted to increasing the supply of teachers so that the education system may be expanded later.[33]

The ratio of the number of teachers to the number of students in the educational system is a second consideration when discussing the supply of teachers. An investigator argues that every educational system has an optimal teacher/student ratio which it either implicitly or explicity attempts to maintain.[34] If the system has not achieved the optimal stock of teachers in relationship to enrollments it will attempt to adjust the stock of teachers so that an optimal

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[33]W. Lee Hansen, in Education and Economic Development, Anderson and Bowman, eds. (Chicago: Aldine Publishing Company, 1963), pp. 63-71. Also Meyer, Development Planning, pp. 300-301; and also Kenneth L. Neff, Education and the Development of Human Technology, (Washington: United States Printing Office, 1962), pp. 22-24.

[34]Poignant, The Relation of Education Plans, p. 31.

teacher/student ratio is reached.

Factors Affecting the Demand for Education

The educational planner must attempt to determine what proportion of the school age population will desire to attend school given the socio-economic factors of the country. If all school age children attended school, then growth in the demand for enrollments would be relatively easy to predict. In elementary school for example, the planner could take the past year's enrollment, graduates and mortality and add the number of children arriving at school age in the population. The demand for education would grow at about the rate of the school age population, assuming of course that the other factors effecting the demand for education grew at the same rate.[35]

Unfortunately the condition "all other factors being equal" is not generally met. Some factors which might effect the demand for education include the level and distribution of income in a given country and the level of complexity of the production process, the geographic distribution of the school age population, the composition of enrollments between male and female, and the rate of retention of students in the educational system. The level of income and its distribution must be an important factor in the demand for education. A person must have a minimum level of income

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[35]Higgins, Economic Development, p. 438.

before he is able to forego employment and enroll in school.

Once there is a minimum subsistence level of income, the expected return to education can be expected to play a major part in the individuals decision concerning school attendance. The expected return to education is a function of the direct and indirect costs of attending school and the expected income which would accrue to the student because of the level of education achieved by the student. As the production process of the economy becomes more complex, increased demand for skilled workers could be expected to increase the demand for education. It would be expected that this increase in demand of skilled workers would lead to more jobs and/or higher wages and an increase in the demand for education.[36]

It has been hypothesized by investigators[37] that the geographic distribution of the school age population may be an important factor in the size of educational enrollments. That is to say that the greater the proportion of the population living in the urban areas, the greater the proportion of actual enrollments to the school age population. This increased proportion may be due to lack of interest in education by people who live in rural areas or the lack of

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[36]See for example: Theodore W. Schultz, "Resources for Higher Education-An Economic View", Journal of Political Economy, Vol. 76 ,(Jan./June, 1968), p. 327-348; Higgins, Economic Development, p. 417.

[37]For example: Higgins, Economic Development, p. 33; Poignat, The Relation of Educational Plans, p. 33.

educational facilities provided in these areas. Regardless, it does seem clear that in many of the countries of the world, as the percentage of urban dwellers has increased, so have educational enrollments.

Historically in most countries of the world, the proportion of males has been considerably greater than females in educational enrollments. In the past, there was little economic need for females in Latin America to obtain a secondary or University education since women did not participate greatly in the production process. However, it is argued[38] that in Latin America in the past thirty years, the social tradition that a women's place is in the home has broken down. As this tradition falls, there will be an increased demand for education on the part of females.

In the past, Latin American school systems have received much criticism because the rate of retention of students from one grade and/or one level of education was very low.[39] Students many times did not complete the fourth grade in primary education, a situation which generally will lead to illiteracy. Latin American educational systems have attempted

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[38]John P. Guillum, Social Changes in Latin America Today, (New York: Harper and Row, 1960), p. 35.

[39]Ibid., p. 40.

to combat this inefficiency by tactics designed to increase the retention rates. To the extent to which they are successful the demand of education will rise.

## IV. Summary

This chapter has surveyed some of the ideas and research concerning the role of education in economic development. It has shown that in the 18th and 19th century, major economists were interested in the effects of education of the process of economic development. Further they generally concluded that it was essentially a factor to long run economic growth. While the subject lay relatively dormant in the first half of the 20th century, it was a topic of revived interest beginning in the 1950's and continuing through today. While agreeing that education was important, modern day economists such as Higgins and Schultz have attempted to fit a theory of education into a more general theory of resource allocation, while others such as Denison have attempted to measure the contribution of education to long run economic growth.

The chapter has also shown that the resource planning for an education system must precede under the general frame work of a plan for economic development. In the process of the development and implementation of an educational plan, problems arise in the predication of the demand for education and the subsequent supplying of teachers and facilities to meet the projected educational enrollments.

It was suggested that school systems either implicitly or explicitly have an optimal teacher/student ratio which they attempt to achieve in the educational system. Can this hypothesis be substantiated, and if so, what are the implications for the operation of education systems operating under such a constraint?

It would seem that it was critical for educational planners to be able to project future demand for education. However, exactly what are the factors which influence the demand for education. There were suggestions that such factors as income level and distribution, rural/urban population distribution, the complexity of the production process, and changes in social traditions are all factors which determine the long run demand for education. Are these the factors educational planners should be evaluating in an attempt to predict long run demand for enrollments? The remainder of this paper will devote itself to an attempt to answer these two question.

# CHAPTER III

## An Analytical Framework

This chapter presents a model of the supply and demand for education. It describes the supply and demand functions for enrollments and a market clearing mechanism for educational places. It presents and discusses the statistical approximations of the variables affecting the supply and demand for educational places. It presents relevant hypotheses to be tested and develops models capable of testing these hypotheses.

### I. The Supply of Educational Places

Conceptually the supply of educational places is the quantity of students an educational system is willing to accomodate. The determinants of the supply of educational places are based on factors which reflect the ability and desire of a society to invest in education. The supply of educational places is a function of the ability of a society to produce or obtain resources (both physical and human), and the willingness and the ability of the society to invest these resources in the educational system. It should be noted now that no attempts will be made to measure the quality of education either on a intra-country or inter-country basis. The measurement of the quality of education, expecially inter-country differences goes far beyond the scope of this study.

The expected returns from an investment in education can be separated into two distinct forms, economic and social returns. Economic returns arise from the increased production and productivity on the part of the labor force brought about by an increase in the educational and skill level of the labor force. The expected economic return on educational investment will in a large part be determined by the desired or expected future structure of the production process. The more technologically advanced a society becomes, the greater becomes the need for a more highly educated labor force. Thus, the more complex the method of production, the greater the expected returns from education.[1]

The social returns to education investment are difficult to quantify, yet it is reasonably clear that they do exist. From the standpoint of an individual, education can be viewed as the process through which one's children are given the opportunity to acquire knowledge which will enable them to lead a more comfortable life. At least one investigator argues that investments made to enable a child to attend school are made by the parents via the perception of the parent as to how the child may best improve his

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[1]A. Pepelais, L. Mean, I. Adelman, Economic Development, (New York: Harper and Ros, 1968), p. 70-72.

future. In particular, rural families see education as the only direct route of escaping their environment.[2] The pleasure of a parent in seeing his child obtain an education, the possible increase in prestige which accrues to the more educated individuals in Latin America, or the gain in national pride or purpose which may result from a better educated populace cannot be ignored in calculating the expected return in educational investment.[3]

The ability of a country to finance an educational system depends for most part on its stage of development or its ability to obtain educational investment funds from outside the country.

An economy operating at a subsistence level will certainly not have sufficient income to generate and maintain educational facilities for much of its population. For a formal education system to be developed, there must be an income surplus above subsistence which can be used to finance education. None of the selected countries in this study, however, can be considered as a society at a subsistence level. There are resources available in these countries for

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[2]J. D. Conroy, "Private Demand for Education in New Guinea: Consumption or Investment", Economic Record, (Vol. 46, Dec., 1970), p. 490.

[3]Harvey Liebestien, in Education and Economic Development, edited by C. Arnold Anderson and Mary Jean Bowman (Chicago: Aldine, 1965), p. 61.

a range of investment projects including education. The question then becomes: What factors affect the determination of the level of investment via-a-vis other investment opportunities?

Either implicitly or explicitly, the decision to allocate a specified quantity of resources to education must be made on the basis of discounted expected future returns of investment in education. Whether or not the calculation of the expected return from education is actually made, any decision to expand, contract or maintain current levels of investment in education involves computing the net benefits (expected returns) of education as compared with the net benefits of other worthwhile investment projects.[4]

## II. The Demand for Educational Places

The demand for educational places for a given society is a function of the taste and preferences of the society, the distribution of the society's income and the expected return to the student from his investment in education. In Latin America over the past 60 years, the concept of who should be educated has been changing. In the past, it was the custom in Latin America that women remainde in the home and therefore needed little or no formal education. This

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[4]Benjamin Higgins, Economic Development, p. 411-12

lack of desire for an education on the part of females definitely restricted the demand for educational places. However, over the past sixty years the Latin American woman has begun to enter both the labor force and the educational system in ever increasing numbers.[5]

The distribution of income in the society is certainly important in determining the demand for education. Before an individual can attend school, he and/or his family must have a minimum on which he can live without the student devoting his full efforts to employment.

The expected return of education to the student is a function of the total cost of education, both out of pocket expenses, the opportunity cost of not working full time, the expected increase in income which would accrue to the student because of higher levels of education and the quality of the education.[6]

The advancing complexity of the production process and increasing demand for more highly skilled labor will increase the expected return to education. If the increased demand for skilled workers increases the real wage of workers, the opportunity cost of remaining in school would rise. However,

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[5]Guillum, Social Changes in Latin America Today, p. 35.

[6]This is a very traditional approach to take. See for example, Theodore W. Schultz, pp. 327-347.

the increased wages might tend to raise the expected returns to education. How the demand for education will change due to increase in the demand for more highly skilled labor force will depend upon how the change affects the opportunity cost of education in relationship to the expected income from education.[7]

## III. The Market For Educational Places

It is possible to construct a static equlibrium model of the market for educational places. Let the quantity of educational places be a function of the physical stock of educational capital K, the stock of teachers, T, the technology of educational process S, such that Qs = f(K,T,S). At a given point in time then, assuming that the stock of educational capital, the stock of teachers, and the technology of education are fixed, the quantity of educational places available is a linear function of the number of students which are assigned to the fixed teachers. There exists then a supply function which can be drawn relating the supply of educational places to the teacher/student ratio, (Figure 1). It

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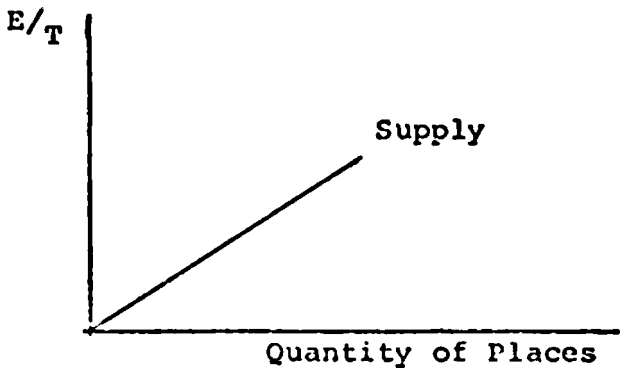
[7]Higgins, Economic Development, p. 417. Apparently in the academic sector of the U. S., the rates of return to advanced education approaches zero. See for example Duncan Bailey and Charles Schotta, "Private and Social Rates of Return to the Education of Academician", American Economic Review, Vol. LXII, No. 1, March, 1972.

Figure 1

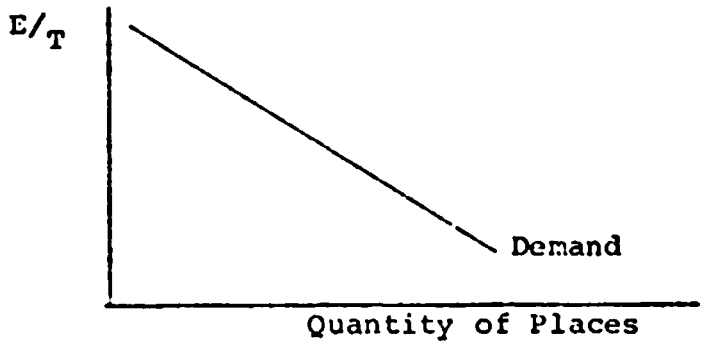



follows that an increase in the rate of return to education, the stock of teachers, the stock of educational capital, or the technology of education would shift the supply curve down and to the right.

The demand function for educational place is considered to be a function of student or family income, I, opportunity costs, O, expected returns to education for the students, $R_S$, the quality of education, Q, and the size of the school age population such that $q_b = f(I,O,R_s, Q,P)$. At a given point of time if I, O, $R_s$, P, are fixed and the quality of instruction is Q, a function of the teacher/student ratio, then the demand curve for education places sloped downward and to the right. An increase in any of the fixed factors would shift the demand curve upward and to the right, (Figure 2).

Figure 2

The Demand For Education

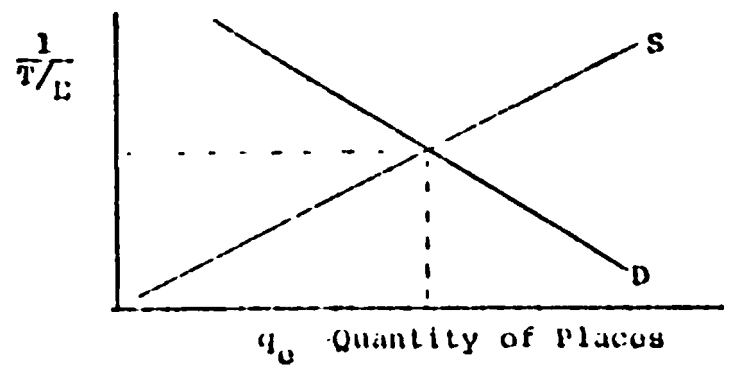



Short Run Adjustrent

For a given time period then the market for enrollments could be described as $q_s=f(E/_T,K,T,S,)$ and $q_d=f(E/_T,I,P,K_I)$, within this market the teacher/student ratio would act as the market clearing variable. The equilibrium condition would of course, be where the supply of educational places is equal to the demand for educational places as in Figure 3.

Figure 3

The Market For Educational Places

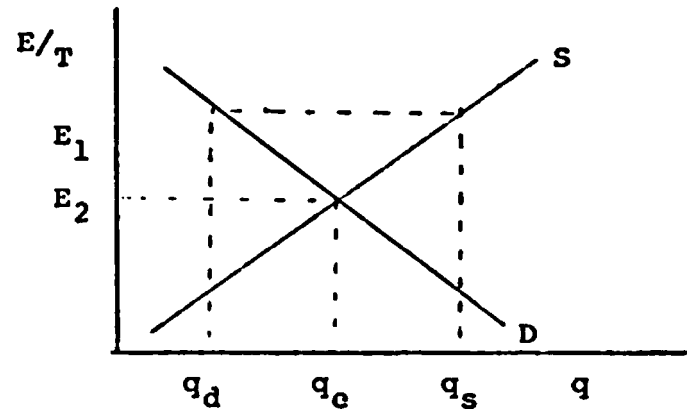


Short Run Adjustment

In the short run, the state will be committed to hire a given number of teachers. A condition of equilibrium would be achieved through the adjustment of the student/teacher ratio. Figure 4 below depicts a disequilibrium situation of

Figure 4

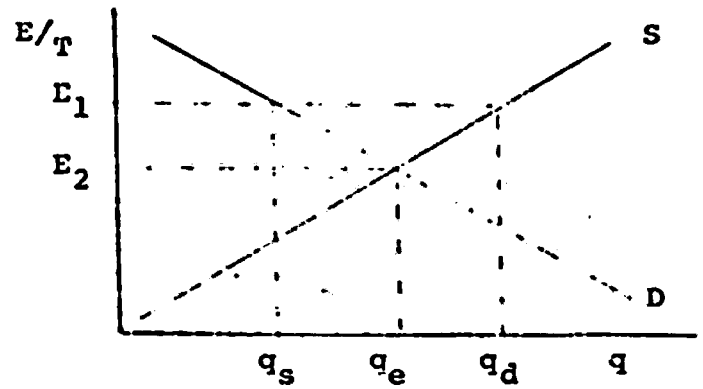
The Market Short Run Adjustment




excess class sizes. At the student/teacher ratio 1 , the quantity of educational places offered by educational authorities given intended class sizes is greater than demand; class size falls to the level of E2. Likewise a disequilibrium position such as depicted in Figure 5 will be altered though a changing teacher/student ratio. Figure 5 examines a situation of excess demand for educational places at the student/teacher ratio, E1, the demand for educational places exceeds the supply of educational places. The equilibrium teacher/student ratio is reached by the entrance of students into the system thereby increasing the teacher/student ratio.

Figure 5

The Market Short Run Adjustment




Long Run Adjustment

In the long run the educational authorities have the opportunity to maintain or adjust the teacher/student ratio to achieve an optimal ratio. Figures 7, 8, and 9 show possible long run adjustment paths which the student/teacher ratio might follow over time.

Figure 6

Long Run Adjustment

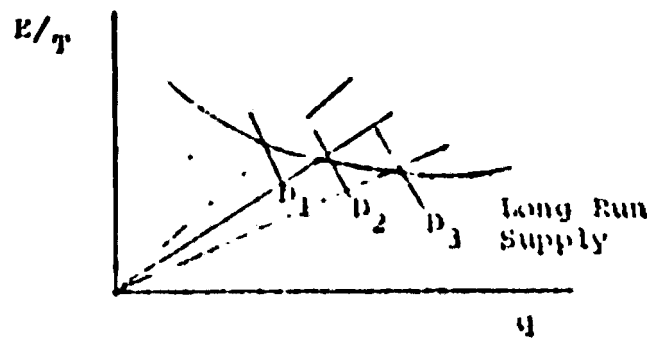


Figure 7

Long Run Adjustment

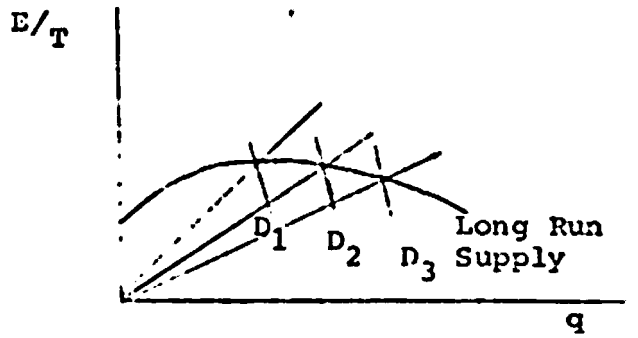



Figure 8

Long Run Adjustment

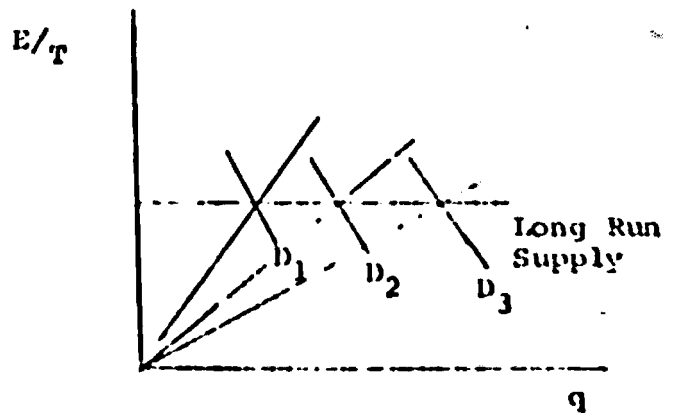


Figure 6 represents a situation where the educational system in the short run has a teacher/student ratio which is lower than the desired ratio and adjustments are made via allowing enrollments to rise faster than the supply of teachers, causing the student/teacher ratio to rise to the desired level. Figure 7 depicts a situation in which the short run student/teacher ratio is higher than optimal and the stock of teachers is increased more rapidly than the growth in enrollments so that the student/teacher ratio falls to the desired level. Figure 8 represents an educational system whose student/teacher ratio is optimal. Growth in the stock of teachers is proportional to the growth of enrollments such that the optimal student/teacher ratio can be maintained.

## IV Statistical Approximation of Variables Influencing the Supply and Demand for Educational Places

Thus far the possibility that several different variables affect the supply and demand for education has been developed. It is not possible to measure directly all of the variables which were considered to affect the supply and demand for education. In such cases, as in the measurement of the complexity of the production process, substitute or proxy variables are used to approximate the variable to be measured. In this section, the variables which will be tested with respect to their effect upon the supply or demand for education are presented and discussed.

The variables affecting the supply of education are the number of teachers, the level of real gross domestic product, and the student/teacher ratio. The variables representing the demand for education are separated into school age population, which represents the potential number of people who might enroll in school and those factors which, given the potential enrollment, determine the effective demand for education. Factors which were considered to possibly affect demand for education were the rural/urban distribution of the school age population, the relative number of females who attend school, the rate of retention, and the percentage of gross domestic product produced in the manufacturing sector.

THE SUPPLY FUNCTION

per capita income

Per capita income is a measure of the amount of potential resources, which, if a society desires can be channeled into the educational system. Changes in real per capita income reflect the changing wealth of a nation. Even in a country in which there is no charge for a student attending school, a "free" school system, education is not free. An educational system must be paid for. Resources must be sacrificed to be used in the educational system. A country which has a relatively small national income base in comparison to its population will find it relatively more difficult to build, maintain and expand its educational system

than a country which has a larger per capita income base.

It must be made clear that not only is the level of per capita income important, but also the percentage of that income which is channeled into the educational system. It is quite possible that even though per capita income within a country is remaining fairly constant the amount of income invested per student, and the total amount of resources invested within the school system can be changing dramatically. Through changes in the structure or level of taxes or through changing allocation of investment expenditures, the government can change the amount of resources from a given level of per capita income going to the educational systems.[8]

TEACHERS

The number of teachers employed by a school system is the critical factor in the long run adjustment process. While in the short run the number of teachers employed is fixed, educational authorities are free in the long run to adjust the stock of teachers so as to achieve the desired teacher/student ratio.

Consider an educational system in which the number of

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[8] Harbison and Myers, Education, Manpower and Economic Growth, p. 11. See also Hans Singer, International Development, (New York: McGraw Hill, 1964), p. 70.

students enrolled rises. The number of teachers may rise by a greater proportion than enrollments, rise by the same proportion as enrollments, rise by a proportion which is smaller than the proportion of growth in enrollments, or fall. If the quantity of teachers rises more proportionately than enrollments, that would be an indication that the current teacher/student was lower than desired, and the educational authorities are taking steps to increase the ratio. An equiproportional increase in teachers and students would be an indication that the current teacher/student ratio was that which was desired. If the number of teachers fell or was increased proportionately less than enrollments, it would be a sign that the teacher/student ration was larger than the desired optimal and thus being reduced.

Student/Teacher Ratio

The student/teacher ratio is critical in the short run adjustment of the educational system in dealing with changes in enrollments. Since the supply of teachers is relatively fixed in the short run, unexpected changes in enrollments can be absorbed through changes in the student/teacher ratio. However, the student/teacher ratio in the long run is based upon the production of education. Given a state of educational technology, a quantity of teachers, and an amount of physical resources, the central question becomes: How many students can be assigned to an instructor before the aggregate

quantity of knowledge gained by the student falls? It would seem that every educational system has at least implicitly a student/teacher ratio which it would like to see maintained.[9]

The Rate of Response of the Stock of Teachers

It is hypothesized that each country for each level of education has a desired number of teachers (T*) which is related to the level of enrollments (E). That is $T^* = KE$. A further definition can be made so that $\frac{T^*}{E} = K^*$ which can be considered a desired teacher/student ratio. It is assumed that K is dependent upon the amount of resources which a society is willing to put into the educational system. It is assumed that K is linearly related to $\frac{GDP}{Pop.}$ (a proxy for wealth) in the form $K^* = Ko + K_1 \frac{GDP}{Pop.}$ Thus, the desired level of teachers at any point in time can be shown by:

$T^* = (Ko + K_t\ GDP_t)Et\text{-}1$ or $T^* = Ko\ Et\text{-}1 + K_1\ GDP_{t1}E_{t-1}$

For the stock of teacher to change there must be a difference between the desired stock of teachers (T*) and the actual stock of teachers. So that $\Delta T_t = \lambda(T^* - T_{t-1})$. That is to say the $\Delta T$ is a function of two factors, the absolute difference between the desired and actual stock of teachers, and the rate $\lambda$ at which the system can move in closing the gap between the desired and actual stock of teachers. Ignoring the attrition rate of teachers from the system, an

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[9]Poignant, The Relation of Education Plans, p. 31.

estimating model can be developed.

Substituting $T_t - T_{t-1} = \Delta T$

we have $T_t - T_{t-1} = \lambda(T^* - T_{t-1})$

it follows that $T_t = \lambda(T^* - T_{t-1}) + T_{t-1}$

and $T_t = \lambda T^* - \lambda T_{t-1} + T_{t-1}$

then $T_t = T^* + (1-\lambda)\ T_{t-1}$

Substituting $T^* = (K_o + K_1\ GDP_{t-1})\ E_{t-1}$

the estimating equation becomes

$$T = K_o E_{t-1} + K_1\ GDP_{t-1}\ E_{t-1} + (1-\lambda)\ T_{t-1}$$

Estimation of this equation via regression analysis will provide the $\hat{B}_1$, $\hat{B}_2$, and $\hat{B}_3$. These estimates of Beta have the following values.

$$\hat{B}_1 = \lambda K_o$$
$$\hat{B}_2 = \lambda K$$
$$\hat{B}_3 = 1-\lambda$$

There exists then a system with 3 unknown and three equations to solve for the value. From this system the following values can be determination.

$$\lambda = 1-\hat{B}_3$$
$$KO = \hat{B}_1/(1-\hat{B}_3)$$
$$K_1 = B_2/(1-\hat{B}_3)$$

A dynamically stable adjustment process requires $0 < \lambda \leq 1$. If $\lambda$ takes a value in this range, the process represents a response of the educational system to reduce the value of the gap between desired stock of teachers and actual stock of teachers.

Several conditions can exist when $\lambda$ is negative

$$-\lambda = \frac{T_t - T_{t-1}}{(T^* - T_{t-1})}$$

(1) $T^* - T_{t-1} > 0$; and $T_t - T_{t-1} < 0$

(2) $T^* - T_{-1} < 0$, and $T_t - T_{t-1} > 0$

In first instance, the desired teacher stock is greater than the actual stock of teachers. The rational response would be to reduce the deficit, but a negative indicates that $T_{t-1}$ is greater than $T_t$ indicating a fall in the stock of teachers. The conclusion for negative values of $\lambda$ must be that the educational system acted irrationally or that the model does not correctly describe the behavior of the system.

In the second case, there exists a situation where there is a surplus of teachers. The rational response would be to reduce the stock of teachers to match the desired stock. However, there would exist a net positive increase in the stock of teachers. Again either the action is irrational or the behavior does not match a capital stock adjustment model.

If $\lambda$ assumes a value greater than one, the process adjusts the stock in the proper direction, but overcompensates for the discrepancy in making the adjustment. In the long run the behavior of the teacher/student ratio is explosively oscillatory.

## THE DEMAND FUNCTION

### School Age Population

The school age population is defined as the members of the population of legal school age. A growing school age population can be a significant factor in expanding demand for educational places. There are two methods in which population growth can be treated in the analysis of rising enrollments. It can be assumed that a rising school age population in itself is not a causative factor in increasing enrollments. This is simply to say that regardless of the potential school age population that enrollments are actually determined via the supply of available educational places allocated to the educational system via the cost-benefit analysis of the expected returns from education on the part of the government, and the level of the expected return to the student from education.[10]

An alternative method of viewing the growth of the school age population is to consider the process of education to be institutionalized with respect to increasing population. It is assumed that the government will provide as a minimum effort in educational investment a sufficient quantity of new educational places each year so as to absorb any increase in the demand for education resulting from increased population. More simply put, as a minimum effort the educational

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[10] Higgins, Economic Development, p. 438.

planning body will not allow the student enrollment ratio to fall. Thus implicitly it is being assumed that the demand for education, ceterus paribus, with regard to per capita income and other factors, will rise at the same rate of increase as the school age population.

Rural/Urban Population Distribution

An important factor which will modify changes in the demand for educational places is the geographic distribution of the school age population. Latin America as a whole has been experiencing a migration from rural areas of the country to urban areas. It is clear that Latin American educational systems have concentrated in the past in providing a greater proportion of classrooms to pupils in urban areas than in rural areas. The reasons for this may be the fact that it is less expensive to provide education in terms of building costs per student in more densely populated areas. There also seems to be an aversion on the part of educated Latins to working in rural areas. It may therefore be easier to attract teachers to urban rather than rural schools. At any rate, as a larger percentage of the population moves to urban areas, a greater proportion of the school age population will have access to school facilities.[11]

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[11] Ibid., p. 33.

Sex Distribution of Enrollments

The size of the legal school age population does not entirely reflect the number of persons socially eligible to attend school. Social customs and pressure determine to some extent social classes for which education is "necessary". In the past in Latin America, just as in the United States, there was little need for a woman to receive much of an education. The woman's place was not in areas of economic activity, but rather in the home. Women who were eligible to enter the educational system, did not do so because it was not customary.[12] As this social tradition breaks down, there is an effective increase in the number of people who demand educational places.

Percentage of Gross Domestic Product Produced in the Manufacturing

The complexity of the process of economic activity will influence the expected returns of education to the individual. The more complex the industrial process, i.e., the more industrialized the nation, the greater is the need for skilled individuals and thus the greater the return on a given level of education. The percentage of gross domestic product produced in the manufacturing and in the service sectors were

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[12]Guillum, "Social Changes in Latin America", p. 35.

chosen to represent the changing complexity of the society.[13]

An increase in the percentage of G.D.P. produced by the sector will influence the expected returns to education in one of two ways. If the percentage share of the sector expands, and the percentage of the labor force employed in the sector expands also there will be an increase in the demand for skilled labor. If the percentage share of G.D.P.; increases but the percentage of the labor force employed in these sectors does not increase then the productivity of the worker and most likely their wage will have increased. Either way, more jobs or more income, the expected returns from education should increase.[14]

Retention Rates

Latin American educational systems have been criticized in the past because of the fact that a large number of students who enter various levels of education do not complete their education.[15] An approximate rate of retention of students may be established in the following manner. Assume that in a primary education system of six grades that in 1960

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[13]If Latin American employees follow the path of U. S. employees, they may well require levels of educational achievement in jobs which are unrelated to the educational level necessary to perform the job.

[14]Vaezaz, The Economics of Education, p. 38

[15]Guillum, Social Changes in Latin America, p. 38

there were 100,000 students enrolled in grades one through five. In 1961 there were 80,000 students enrolled in grades two through six. The percentage of students retained by the system would be 80 percent. This crude retention rate can only be an approximation of the rate of retention of the system for two reasons. The measure ignores the problem of students repeating grades. A student who was in the first grade in 1960 and repeated the first grade in 1961 would tend to understate the rate of retention. A student who was in the sixth grade in 1960 and repeated the sixth grade in 1961 would tend to overstate the rate of retention. Another possible source of error would be re-entrants into the school system. An individual who was out of school in 1960 and re-entered grades two through six in 1961 would tend to inflate the rate of retention. If the rate of repeaters and re-entrants remain constant, then a change in the retention rate should be reflected in a change in the level of enrollment. A rise in retention rates would lead to rising enrollments, and a fall in retention rates to a fall in enrollments.

The Estimation of the Enrollment Function

The enrollment function will be estimated through the use of regression analysis. The regression analysis will be developed in two stages. First the variables per capita G.D.P., the number of teachers, the percentage of male enrollments, and the percentage of gross domestic product produced in the manufacturing sector of the economy will be

regressed against enrollments in the various levels of education. The second stage will be a multiple regression in which enrollments will be the dependent variables while the independent variables will be those variables found to be relevent in the regression in Stage 1 plus enrollments lagged one time period and the teacher/student ratio.

## V. Hypotheses to be Tested

Chapter II and III have laid the foundation for the testing of the following hypothesis for selected Latin American countries:

A. Each country has, for each level of education, an optimal teacher/student ratio it is trying to achieve.

B. The teacher/student ratio is a positive function of G.D.G.

C. The chief determinant of levels of educational enrollments in any given time period is the level of enrollments of the previous period.

D. Levels of educational enrollments are directly related to per capita gross domestic product.

E. The increasing percentage of female enrollment in an educational system leads to increase educational enrollments.

F. As the industrial process of a country becomes

more complex represented by the percentage of gross domestic product produced in the manufacturing sector, education enrollments rise.

G. As retention rates rise, educational enrollments rise.

H. The greater the per capita income of a country the greater the proportion of enrollments to school age population.

I. The more urbanized a country becomes, the greater the proportion of enrollments to school age populations.

J. The greater the ratio of teacher to school age population, the greater the proportion of enrollments to school age population.

# CHAPTER IV

## Historical Changes In Enrollments and Other Variables

## I. INTRODUCTION

In order to test the stated hypotheses concerning levels of educational enrollments, it was necessary to construct consistant estimates for the various countries over a period of time. This chapter will present and discuss the historical trend of enrollments and other data.

### Selection of Representative Countries

Enrollments and other data were collected for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. These countries were selected as samples for two reasons. First, while they represent only seven of the eighteen countries of Central and South America, the combined population of the seven represent more than two-thirds of the total population of Latin America. Secondly, these are among the more economically developed countries in Latin America, and economic development seemingly brings with it more complete collection and processing of data. Only for these countries is there available a sufficient amount of data necessary for the analysis. Data was collected for the period 1950 to 1965, however the period chosen for analysis was the years 1955-1965 because of the lack of sufficient data covering the early 1950's.

## II. Educational Enrollments

When the annual average rates of growth of enrollments in Table 3-1 are examined, some very distinct patterns emerge. Argentina stands out at first glance. In Argentina all levels of educational enrollments grew much slower than the enrollments of other countries.

At the other extreme, education enrollments on the average expended more rapidly in Venezuela than in any other country.

It is also clear that enrollments in higher education have grown at a faster rate than have enrollments in secondary education and those in secondary education have grown at a faster rate than in primary. It should be noted that higher education has grown from a much lower numerical base than secondary, and thus it takes a much smaller increase in the number of students in higher education than in secondary education to produce an equal rate of growth.

Clearly, though, the period 1950-1965 was one in which enrollments at all levels increased at a more rapid rate than did population. Brazilian enrollments in primary education grew at a steady rate over the entire period, but there was a distinct increase in the rate of growth of enrollments in both secondary and higher education after 1960. Chile showed a different pattern, with primary enrollments increasing rapidly after 1960, secondary enrollments have a lower rate of growth after 1960, and higher education growing faster in the same period. Colombia simply maintained high levels of growth

TABLE IV-1

Average Annual Rates of Growth of Educational Enrollments

| | Argentina | Brazil | | Chile | Colombia | Mexico | Peru | Venezuela | |
|---|---|---|---|---|---|---|---|---|---|
| PRIMARY | | | | | | | | | |
| Year | | Gen. | Av. | | | | | Gen. | Av. |
| 1950-65 | 2.4 | 5.6[4] | 6.1 | 4.4 | 7.5[1] | --- | 5.0 | 7.4 | --- |
| 1955-65 | 2.3 | 5.5 | 6.0 | 4.1 | 7.2 | 7.2 | 6.2 | 7.9 | 8.9[2] |
| 1960-65 | 2.0 | 5.8 | 7.1 | 5.8 | 7.0 | 7.2 | 7.4 | 3.6 | 3.5 |
| SECONDARY | | | | | | | | | |
| 1950-65 | --- | 9.7 | 10.5 | 7.7[3] | --- | 13.2 | 10.8 | 14.8 | --- |
| 1955-65 | 3.1[2] | 10.2 | 10.6 | --- | --- | 13.5 | 11.7 | 14.4 | --- |
| 1960-65 | 1.0 | 12.0 | 14.8 | 3.5 | --- | 16.3 | 13.9 | 10.4 | --- |
| HIGHER | | | | | | | | | |
| 1950-65 | --- | --- | --- | --- | 13.0 | --- | 8.6 | 13.1 | --- |
| 1955-65 | 5.0[2] | 8.1[4] | 7.2[5] | 10.8[6] | 13.3 | 11.3 | 11.1 | 18.4 | --- |
| 1960-65 | 7.1 | 10.5[4] | 9.2[5] | 14.7[6] | 12.6 | 11.3 | 13.3 | 12.6 | --- |

[1] All Colombian data goes to 1964.

[2] 1957-65.

[3] Data ends 1964.

[4] Data ends 1963.

[5] Data ends 1964.

[6] Data source Appendix Tables A-1, A-2, A-3.

in enrollments at all levels between 1950 and 1965. Mexico experienced a substantial increase in the rate of growth of enrollments after 1960 also. Peru had much the same pattern, with rapidly growing enrollments at all levels of education during the entire period, but with a burst in the rate of growth after 1960. The pattern of growth in Venezuela was unique. Between 1955-1965 there was a huge increase in the enrollments in all levels of education, concentrated mostly in the 1955-1965 period in secondary and university levels also.

## II. Per Capita Income

The average annual rates of growth of per capita income is shown in Table 4-2. Immediately apparent is the wide

TABLE 4-2

Average Annual Rate of Growth of Per Capita Gross Domestic Product (Constant Currency) for 1953-65.[1]

| Country | Rate of Growth | Income in 1963 U. S. dollars |
|---|---|---|
| Argentina | 1.8% | 616 |
| Brazil | 2.4% | 215 |
| Chile | 1.1% | 457 |
| Colombia[2] | 1.2% | 430 |
| Mexico | 3.1% | 390 |
| Peru | 2.5% | 247 |
| Venezuela | 2.5% | 881 |

[1] Computed from Data in Appendix Table A-4

[2] 1953-64

variety of rates of growth of per capita income among the various countries. The countries can be grouped into those which have had an annual average rate of growth exceeding 3 percent a year, those exceeding 2 percent a year, and those growing at less than 2 percent a year.

Mexico is the only country in the sample which has managed to increase its per capita income at more than 3 percent a year. If Mexico continues to grow at its present rate it would double its per capita income in 23 years. Venezuela, Peru and Brazil have all achieved a rate of growth greater than 2 percent a year over the 13 year period. These countries, if they continued their present rate of growth would double their per capita income in 30 to 40 years. Argentina, Chile and Colombia all have grown at rates of less than 2 percent a year. These countries, if they continued to grow at their present rates would double their level of income in 45 to 60 years.

The growth in income in these countries has not been a steady process. Only Brazil and Mexico have managed to sustain constantly increasing per capita income. Argentina had a virtual stagnation of growth from 1955 to 1960, due at least in part of political instability and inflation.

In Chile per capital income was lower in 1959 than it had been in 1951. Between 1958 and 1962, Venezuela witnessed a stoppage of growth of per capita income due perhaps to the reconsolidation of the country following the successful

revolution of 1957-1958.[2] In short the growth of per capita income in Latin America has not been particularly stable and seems in part to be influenced by the fluctuation in the political climate.

## III. Teachers

The number of teachers and the average annual rate of growth of teachers are presented in appendix tables A-5, A-6 and A-7 and Table 4-3. It is interesting that the rate of expansion of teachers varies greatly between countries and between level of education. For the most part the number of teachers in higher education has increased more rapidly than the number in secondary education. In turn the number of teachers in secondary education has grown more rapidly than the number of teachers in primary education.

In higher education the annual average rate of growth of teachers has been very high. Argentina has had the slowest rate of expansion, yet it supply of teachers is growing at a rate of expansion, yet its supply of teachers is growing at a rate of more than 6 percent a year. Colombia has expanded its supply of teachers the fastest, at a rate of nearly 16 percent, while the number of teacher in Venezuela grew at roughly 15 percent a year.

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[1]The Economic Development of Venezuela, Report of the Misson Organized by the International Bank for Reconstruction and Development, (Baltimore: John Hopkins Press, 1961) p.122.

The growth of teachers in the various countries has been somewhat disjointed. In Argentina the number of teachers in the primary system was less in 1957 than in 1956. In Venezuela the number of teachers in primary education grew at a very low rate after 1962. The number of teachers in the Brazilian secondary efucational system fell by 68 teachers between 1957 and 1958. In Venezuela the number of teachers in secondary education grew from 4,922 in 1958 to 7,185 in 1959 but then increased teachers from 1959 to 1960. In the universities the number of teachers in Argentina, Brazil, and Peru fell in 1959, 1961, and 1963 respectively. At the other extreme the number of professors in Mexico universities rose from 5,335 to 11,707 from 1960 to 1962.

TABLE 4-3

Average Annual Compound Rate of Growth of Teachers

| | Primary | | Secondary | Higher |
|---|---|---|---|---|
| Country | Years | Growth Rate | Growth Rate | Growth Rate |
| Argentina | 1953-65 | 3.1 | 6.7[1] | 6.2[2] |
| Brazil | 1953-62 | 7.3 | 6.9[1] | 7.1[3] |
| Chile | 1957-61 | 4.3 | | 8.3[4] |
| Colombia | 1955-63 | 8.6 | | 15.8[4] |
| Mexico | 1955-65 | 5.6 | 10.0 | 9.5 |
| Peru | 1955-65 | 6.2 | 12.1 | 11.1[5] |
| Venezuela | 1953-65 | 7.3 | | 15.1 |

1. 1953-63, 2. 1955-65, 3. 1956-63, 4. 1957-64, 5. 1955-64.

## IV. Student/Teacher Ratio

Colombia had the highest student/teacher ration in 1953 also had the highest rate of growth of teachers over the period. Argentina, which had the lowest student/teacher ration in 1953, experienced the slowest tate of growth of teachers. However among the other countries the differences in the rates of growth are not too great, and the relationship is not pronounced Appendix Table A-8.

In secondary education, where less data is available, this relationship is completely inverted (Appendix Table A-9). The countries with the highest student/teacher ratio, Argentina and Brazil, while they have been expanding their supply of teachers rapidly, have not been expanding their supply as rapidly as the increase in their enrollments, nor as rapidly as Venezuela (Appendix Table A-10).

## V. School Age Population

As can be seen in Appendix A-11, the rate of growth of school age population among the various countries has been quite rapid on the whole. For the most part, the primary school age population is growing faster than the secondary school age population and the secondary school age population is growing faster than that of higher education.

The primary school age population of Columbia and Venezuela has been growing at a rate greater than 4 percent a year. This is a high rate of growth and could not be expected to be maintained for prolonged periods of time. Chile

and Argentina have been the slowest growing countries at less that 3 percent.

Only Venezuela has had a secondary school age population which is growing at a rate exceeding a 3 percent a year. Chile, one of the countries with the lowest rate of growth of primary school age population has one of the higher growth rates for the school age population, and which exceeds that of its primary school age population. Only Argentina has experienced a rate of growth of less than 2 percent a year, with the other countries having rates of growth between 2 percent to 3 percent a year.

The rate of growth of higher school age population is subject to more variation than the other two groups. Rates of growth ranged from .8 percent in Chile to 2.8 percent in Mexico. Chile shows a large difference between the rate of growth of secondary and higher school age population while in Mexico and Colombia there is virtually no difference between the rate of growth of higher and secondary school age population.

## VI. Rural/Urban Population Distribution

Appendix table A-12 shows the rural/urban population of the selected countries for the two latest census periods, and the average annual rate of change of the rural/urban distribution between the two periods. All countries have experienced an increase in the percentage of its population which lives in urban areas. In Colombia, the percentage of urban

population rose from 36.13 percent to 52.8 percent in 1964, an an average annual rate of growth of 5.2 percent of the countries only Chile had a urban/population distribution of greater than 50 percent around 1950. By the 1960's Chile, Colombia, Mexico and Venezuela had more urban than rural residents, and in Brazil and Peru, roughly 48 out of every 100 individuals lived in an urban area.

## VII. Females

Latin America, as most of the other countries of the work, has experienced a changing pattern of female participation in the world of education. For the most part, however, the "female revolution" in primary education occured prior to the period under investigation. As can be seen in Appendix Tables A-13, A-14, A-15 between 1953 and 1965 Argentina, Brazil, Chile, Colombia, and Venezuela in primary education all had more than 48 percent of their enrollmants composed of females. Consequently there was not much room for growth in the proportion of female enrollmants. Peru has a much lower proportion of females enrolled in primary education than in any other country. Both Mexico and Peru have substantially lower female/enrollment ratios in secondary education and the ratio scarcly changed during the period under investigation. Venezuela had a female/enrollment ratio roughly equal to that of Peru and Mexico in 1953.

However, the percentage of females enrolled grew at a rate of 1.7 percent a year (see Table 4-4) so that by 1965, 48.4 percent of the Venezuelan secondary enrollment was

composed of females, while females still comprised only 39.9 percent of enrollments in Mexico and Peru.

TABLE 4-4

Average Annual Rate of Growth of the Percentage of Female Enrollment

| | Primary | | Secondary | | Higher | |
|---|---|---|---|---|---|---|
| Country | Year | Rate | Year | Rate | Year | Rate |
| Argentina | 1953-65 | .1 | 1953-63 | .7 | 1954-63 | 3.5 |
| Brazil | 1955-64 | .1 | N. A. | | N. A. | |
| Chile | 1953-64 | .1 | N. A. | | 1953-65 | .5 |
| Colombia | 1953-64 | .2 | N. A. | | 1953-65 | 2.6 |
| Mexico | N. A. | | 1954-64 | .1 | N. A. | |
| Peru | 1955-65 | 1.2 | 1956-65 | .2 | N. A. | |
| Venezuela | 1953-65 | 0.0 | 1953-65 | 1.7 | 1953-65 | 3.2 |

The increase in female enrollment in universities has been quite striking. It is here that the greatest rate of growth of female enrollments has occured. Only Chile, for reasons unknown has shown a decline in the number of females enrolled.

## VIII. The Percentage of Gross Domestic Product Produced in The Manufacturing

As shown in Table 4-5 and Appendix A-15 the size of the manfacturing and service sectors shares of gross domestic product vary considerable between different countries. This is true since some countries are more industrially developed than others and thus have a larger manufacturing and service sector.

In all countries except Peru, the percentage of G.D.P. produced in the manufacturing sector exceeds that generated in the service sector. Argentina has the largest proportion of G.D.P. produced in the manufacturing sector, 35.1 percent in 1965, while Venezuela had only 14.6 percent of its G.D.P. produced in the manufacturing sector in 1965. Peru has by far the largest proportion of its output produced in the service sector, 36.7 percent and Argentina being the lowest with 6.8 percent.

TABLE 4-5

Average Annual Rate of Growth of the Percentage of Gross Domestic Product, Manfacturing and Service Sectors, 1953-1965

| Country | Manfacturing Rate of Growth | Manfacturing Rate of Growth |
|---|---|---|
| Argentina | 2.0 | -0.9 |
| Chile | 0.0 | -0.6 |
| Colombia | 1.5 | 0.0 |
| Mexico | .9 | .9 |
| Peru[1] | 1.7 | 1.3 |
| Venezuela | 2.2 | 1.5 |

[1]1953-1964

All countries except Chile have experienced positive annual average rates of increase in the percentage of G.D.P. produced in manufacturing. The rate of growth has been highest in Venezuela, 2.2 percent and lowest in Chile were no change occured. Argentina and Chile has experienced a downward trend in the percentage of output generated by the service sector, the rates of growth being -.9 percent and -.6 percent

respectively. The service sectors of Mexico and Peru have been increasing at .9 percent and 1.5 percent respectively.

Retention Rates

Tables 4-6 and Appendix A-17 and A-18 present the average annual rate of growth of retention rates and the retention rates for primary and secondary education. The rate of retention has been increasing in primary education for all countries for which there is data. However is secondary education only Peru has had an increasing rate of retention. Argentina and Chile have had virtually no change in the rate of retention over the period, and both Brazil and Venezuela have experienced falls in the rate of retention.

TABLE 4-6

Annual Average Rate of Change of Retention Rates

| | Primary | | Secondary | |
|---|---|---|---|---|
| Country | Year | Rate | Year | Rate |
| Argentina | 1953-64 | .4 | 1953-63 | 0.0 |
| Brazil | | | 1955-63 | .5 |
| Chile | | | 1953-60 | 0.0 |
| Mexico | 1958-63 | 1.4 | | |
| Peru | 1953-65 | 1.2 | 1956-65 | 1.0 |
| Venezuela | 1958-65 | .4 | 1958-65 | -.9 |

TABLE IV-1

Average Annual Rates of Growth of Educational Enrollments

| | Argentina | Brazil Gen. | Brazil Av. | Chile | Colombia | Mexico | Peru | Venezuela Gen. | Venezuela Ave. |
|---|---|---|---|---|---|---|---|---|---|
| PRIMARY | | | | | | | | | |
| Year | | | | | | | | | |
| 1950-65 | 2.4 | 5.6[4] | 6.1 | 4.4 | 7.5[1] | --- | 5.0 | 7.4 | ---[2] |
| 1955-65 | 2.3 | 5.5 | 6.0 | 4.1 | 7. | 7.2 | 6.2 | 7.9 | 8.9 |
| 1960-65 | 2.0 | 5.8 | 7.1 | 5.8 | 7.0 | 7.2 | 7.4 | 3.6 | 3.5 |
| SECONDARY | | | | | | | | | |
| 1950-65 | ---[2] | 9.7 | 10.5 | 7.7[3] | --- | 13.2 | 10.8 | 14.8 | |
| 1955-65 | 3.1 | 10.2 | 10.6 | --- | --- | 13.5 | 11.7 | 14.4 | |
| 1960-65 | 1.0 | 12.0 | 14.8 | 3.5 | --- | 16.3 | 13.9 | 10.4 | |
| HIGHER | | | | | | | | | |
| 1950-65 | ---[2] | ---[4] | ---[5] | ---[6] | 13.0 | --- | 8.6 | 13.1 | |
| 1955-65 | 5.0 | 8.1 | 7.2 | 10.8 | 13.3 | 11.3 | 11.1 | 18.4 | |
| 1960-65 | 7.1 | 10.5 | 9.2 | 14.7 | 12.6 | 11.3 | 13.3 | 12.6 | |

1. All Colombian data goes to 1964
2. 1957-65
3. Data ends 1964
4. Data ends 1963
5. Data ends 1964

Data source Appendix Tables A-1, A-2, A-3

## Chapter V

## Results of Estimating Equations

This chapter presents the empirical estimates of the equations described in Chapter IV. It develops estimates of $\lambda$, $K_o$, $K_1$ derived from the estimates of the adjustment process of the stock of teachers and the regression results from stages I and II in the estimation of the quantity of enrollments.

### I. Estimates of the Stock of Teachers

Estimation of , $K_o$, $K_1$

Appendix Tables B-1, B-2 and B-3 present the complete regression results from the estimating equation $T_t = \hat{\lambda}\hat{K}_o E_{t-1} - \hat{\lambda}\hat{K}_1 G.D.\ P_{t-1}E_{t-1} + (1-\hat{\lambda})T_{t-1}$. From these tables, Table V-1 has been developed to present the values of $\hat{\lambda}$, $\hat{K}_o$, and $\hat{K}_1$ for each level of education in each country. Tables V-2, V-3, and V-4 present the values of $\lambda$, $K_o$, and $K_1$ by level of education.

Table V-1

Values of $\hat{\lambda}$, $K_o$, $K_1$

| Argentina | $\hat{\lambda} = (1-\hat{B})$ | $\hat{K}_o = \hat{B}_1/\hat{\lambda}$ | $\hat{K}_1 = \frac{\hat{B}_2}{\hat{\lambda}}$ |
|---|---|---|---|
| Primary | .101 | .0413 | .0000019** |
| Secondary | .010 | 6.390 | .00045* |
| Higher | .669 | - .00499 | .00714 |

(Continue Table V-1)

| | | | |
|---|---|---|---|
| Brazil General | | | |
| Primary | .138 | .000063 | .001202 |
| Secondary | .376 | .1840 | -.0000007 |
| Higher | | | |
| Brazil Average | | | |
| Primary | .139 | .000057 | .01084 |
| Secondary | .898 | .18005 * | -.0000084 * |
| Higher | .491 | .00490 | .0000026 |
| Columbia | | | |
| Primary | .564 | .02180 | .0000352 ** |
| Secondary | | | |
| Higher | .614 | .04415 * | .0000206 * |
| Mexico | | | |
| Primary | .229 | .048 ** | -.0000087 ** |
| Secondary | .631 | -.17781 | .000138 |
| Higher | .733 | -.2923 | .001286 |
| Peru | | | |
| Primary | .449 | .02815 ** | .00000167 |
| Secondary | 1.222 | .10063 | -.0000412 |
| Higher | .017 | 7.5058 * | .0004529 * |

*Indicates $\hat{B}_1$ or $\hat{B}_2$ value was significantly different than zero at alpha = .10.

**Indicates $\hat{B}_1$ or $\hat{B}_2$ value was significantly different than zero at alpha = .20.

(Continue Table V-1)

| | | | |
|---|---|---|---|
| Venezuela General | | | |
| Primary | 1.501 | - .02648 | -.0001028 |
| Secondary | .039 | 1.2397 | -.0003135 |
| Higher | - .434 | - .10458 | -.0000490 |
| Venezuela Average | | | |
| Primary | 1.224 | .04658 | -.0000236 |

Table V-2

Values of $\lambda$, $K_o$, $K_1$ For Primary Education

| | $\lambda$ | $K_o$ | $K_1$ | |
|---|---|---|---|---|
| Argentina | .101 | .041300 | .0000019 | ** |
| Brazil Average | .138 | .000063 | .001202 | |
| Brazil General | .139 | .000057 | .01084 | |
| Columbia | .564 | .02180 | .0000352 | ** |
| Mexico | .229 | .04812** | -.0000087 | ** |
| Peru | .449 | .02815** | .00000167 | |
| Venezuela Average | 1.501 | -.026480 | -.0001028 | |
| Venezuela General | 1.224 | .04658 | -.0000236 | |

---

*Indicates $\hat{B}$ associated with $K_o$ or $K_1$ significantly different than zero at alpha = .10

**Indicates $\hat{B}$ associated with $K_o$ or $K_1$ significantly different than zero at alpha = .20

Table V-3

Values of $\lambda$, $K_o$, $K_1$ for Secondary Education

| | $\lambda$ | $K_o$ | $K_1$ |
|---|---|---|---|
| Argentina | .010 | 6.938* | .00045* |
| Brazil Average | .376 | .1840 | -.0000007 |
| Brazil General | .898 | .18005* | -.0000084* |
| Mexico | .631 | - .17781 | .000138 |
| Peru | 1.222 | .10063 | -.0000412 |
| Venezuela | .039 | 1.2397 | -.0003135 |

*Indicates $\hat{B}$ values associated with $K_o$ or $K_1$ is significantly different than zero at alpha = .10

**Indicates that $\hat{B}$ values associated with $K_o$ or $K_1$ is significantly different than zero at alpha = .20

Table V-4

Values of $\lambda$, $K_o$, $K_1$ for Higher Education

| | $\lambda$ | $K_o$ | $K_1$ |
|---|---|---|---|
| Argentina | .669 | - .00499 | .00714 |
| Brazil | .491 | .00490 | .0000026 |
| Columbia | .614 | .04415* | .0000206* |
| Mexico | .733 | - .2923 | .00128 |
| Peru | .017 | 7.5058* | .0004519* |
| Venezuela | -.434 | -1.0458 | .0000490 |

---

*Indicates $\hat{B}$ values associated with $K_o$ or $K_1$ is significantly different than zero at alpha = .10

**Indicates that $\hat{B}$ values associated with $K_o$ or $K_1$ is significantly different than zero at alpha = .20

It is interesting to note that there is some consistency in the values which $\hat{\lambda}$ takes at different levels of education. In primary education, Table V-2, with the exception of Venezuela, all values of $\hat{\lambda}$ fall below .564. In secondary education, Table V-3, $\hat{\lambda}$ takes a wide range of values, from .010 in Argentina to 1.222 in Venezuela. However in higher education, Table V-4, with the exception of Peru and Venezuela, all other $\lambda$ values are greater than .491.

The Estimation of the Stock of Teachers

Appendix Tables B-1, B-2, and B-3 also present the results of the estimating equation for the supply of teachers. As an estimator of the supply of teachers employed within the educational system the model works reasonably well. For the most part the adjusted coefficient of multiple determination, $R^2$, is quite high, with correspondingly low standard errors around the regression line. Summary statistics by level of education are presented in Tables V-5, V-6, V-7.

Table V-5

$R^2$, Standard Error Around the Regression Line, and "F" Statistics for Teacher Supply Estimates in Primary Education

| | $R^2$ | $S_e$* | F |
|---|---|---|---|
| Argentina | .975 | 2574. | 194. |
| Brazil Average | .988 | 4334. | 297. |
| Brazil General | .988 | 4335. | 324. |
| Columbia | .969 | 1736. | 127. |
| Mexico | .994 | 1695. | 745. |
| Peru | .933 | 2284. | 64. |
| Venezuela | .831 | 2473. | 18. |

*Measured in units of 10 teachers

Table V-6

$R^2$, Standard Error Around the Regression Line and "F" Statistics for Teachers Supply Estimates in Secondary Education.

| | $R^2$ | $S_e$* | F |
|---|---|---|---|
| Argentina | .991 | 2234. | 389. |
| Brazil Average | .976 | 3082. | 154. |
| Brazil General | .937 | 4841. | 60. |
| Mexico | .903 | 1496. | 32. |

(continue Table V-6)

| | | | |
|---|---|---|---|
| Peru | .966 | 951. | 128. |
| Venezuela | .897 | 804. | 44. |

*Measured in Units of individual teachers

Table V-7

$R^2$, Standard Error Around the Regression Line and "F" Statistics for Teachers Supply Estimates in Higher Education.

| | $R^2$ | $S_e$* | F |
|---|---|---|---|
| Argentina | .920 | 552. | 53. |
| Brazil | .931 | 1195. | 41. |
| Columbia | .914 | 234. | 33. |
| Mexico | .906 | 496. | 32. |
| Peru | .953 | 346. | 83. |
| Venezuela | .927 | 229. | 45. |

*Measured in units of individual teachers.

Estimation of the Stock of Teachers: An Alternative Model.

It should be noted that there exists a great deal of multicollinearity in the regression results for the estimating function $T_t = \lambda K_o E_{t-1} + \lambda K_1 GDP_{t-1} E_{t-1} + (1-\lambda) T_{t-1}$. An attempt to eliminate this problem of multicollinearity was made by the development of a new estimation equation.

It was hoped that this new equation would reduce the standard errors around the $\hat{B}$s and thus produce better estimates of $\lambda$, $K_o$, and $K_1$. The original estimating equation was divided by $E_{t-1}$ arriving at the new estimating equation $\frac{T_t}{E_{t-1}} =$

$$\lambda K_o \frac{E_{t-1}}{E_{t-1}} + \lambda K_1 GDP_{t-1} \frac{E_{t-1}}{E_{t-1}} + (1-\lambda) \frac{T_{t-1}}{E_{t-1}} \text{ or } \frac{T_t}{E_{t-1}} = \lambda K_o +$$

$$\lambda K_1 GDP_{t-1} + (1-\lambda) \frac{T_{t-1}}{E_{t-1}}$$

The results of the regression equations are presented in Tables V-IV, V-V, V-VI. Unfortunately this new estimator did not produce significant improvements in the estimators. While the standard errors of the $\hat{B}$s are smaller in some instances, however in many others the standard errors increased. The equation as an estimator of the stock of teachers not superior to the original estimator. Thus it will not be discussed further.

## II. Estimates of Educational Enrollments

### Stage I Estimates

#### I. Argentina

There was found to exist a significant correlation between enrollments and the independent variables G.D.P., teachers, percentage female enrollment, and percentage manufacturing for primary education. (Appendix Table B-7) These

significant relationships also held true for both secondary and university in Argentina. (Tables B-8 and B-9) For the multiple regression these results were found. In primary education the variables G.D.P., percentage female, teachers, and percentage of manufacturing were used as independent variables. Of the four, only teachers was significant, (Table B-10) In secondary education, the same independent variables were used. Only G.D.P. was significantly related to enrollments, (Table B-11) In higher education, the same variables were selected but the results were different. The variables percentage sex, and percentage manufacturing were significant, (Table V-XII).

II. Brazil

There existed a significant correlation between all the tested independent variables, G.D.P., teacher and percentage sex for both average and general enrollments. (Table B-7) In secondary education G.D.P. and teachers were used as independent variables, along with the retention rate. There existed significant correlations between these variables and enrollments. (Table B-8) In higher education, the independent variables were G.D.P. and number of teachers. Both of these variables were significantly correlated to enrollments (Table B-9). In the multiple regression on primary and higher education only the number of teachers proved to

be sufficient, while in secondary education both proved to be significant (Tables B-10, B-11, B-12).

III. Chile

Only in higher education were significant correlations found between enrollments and the variables G.D.P., and the percentage of manufacturing, (Tables B-7, B-8, B-9). There was no significant relationship between the independent variables G.D.P., percentage female, and percentage manufacturing and the dependent variable primary enrollments (Table B-10). For both secondary and higher education the independent variables used were G.D.P., and percentage of manufacturing. In secondary education the coefficients of percentage of manufacturing was significant while G.D.P. was not. In higher education both G.D.P., and percentage of manufacturing coefficients were significant (Tables B-10, B-11, B-12).

IV. Colombia

All of the independent variables tested G.D.P., teachers, percentage females and percentage manufacturing had significant correlations with enrollments in primary education. For higher education a regression line was fitted between enrollments and the independent variables G.D.P., teachers, and percentage manufacturing. All of the three variables

proved to be significantly correlated with enrollments (Tables B-7, B-8). In the multiple regression the coefficients for teachers and percentage of manufacturing were significant in primary education, while the coefficients for all three variables were significant in higher education (Tables B-10, B-11).

V. Mexico

It was found that there existed significant correlation between primary enrollments and the independent variables G.D.P., teachers and the percentage manufacturing. In secondary education the variables G.D.P., and the percentage of manufacturing were regressed against enrollments. Both variables were significantly correlated with enrollments. It was possible to regress the variables G.D.P., teachers, and percentage of manufacturing against enrollments in higher education. It was found that all three variables were significantly correlated with enrollments. (Tables B-7, B-8, B-9) Like in primary education the coefficients of the variables of teachers and percentage manufacturing were significant. In secondary education the coefficients of the variables G.D.P., and the percentage manufacturing were significant, when the coefficients for the independent variables of teachers, G.D.P., and percentage of manufacturing were

significant. (Tables B-10, B-11, B-12)

VI. Peru

In primary education the independent variables used were G.D.P., the number of teachers, the percentage of female enrollment, the percentage of manufacturing, and the retention rate. G.D.P., teachers, percentage female, percentage manufacturing, and the retention rate all had a significant correlation with enrollments. The simple regressions dealing with secondary education used the same independent variables as those in primary education. With the data in absolute form, all variables except sex proved to be significantly correlated with enrollments. In higher education the variables G.D.P., teachers, and percentage of manufacturing were used as the independent variables. All three variables were significantly correlated with enrollments (Tables B-7, B-8, B-9). Only the coefficients of teachers and the retention rates were significant in primary education, while in secondary education the variables of teachers, the percentage of manufacturing and the retention rate was significant. In higher education the variables of teachers and percentage of manufacturing were significant. (Tables B-7, B-8, B-9)

VII. Venezuela

Three different regressions were run for Venezuela,

1953-1965 for general enrollments including kindergarden, 1957-1965 for general enrollments excluding kindergarden, and 1957-1965 for average enrollments. The independent variables used were G.D.P., teachers, percentage female, percentage manufacturing, and retention rates. For all three regressions the variables G.D.P., teachers, and percentage manufacturing were significantly correlated with enrollments. In secondary education multiple regression were run between both average and general enrollments for 1957-1965 and the independent variables G.D.P., teachers, percentage female, percentage manufacturing, and the rate of retention. All of the variables except the retention rate were significantly correlated with average and general enrollments. For 1957-1962 regressions were run between enrollments in higher education and the independent variables G.D.P., teachers, and the percentage of manufacturing. For 1953-1962 regression were run between enrollments and the independent variables G.D.P., and percentage of manufacturing. All variables were significantly correlated with enrollments (Tables B-7, B-8, B-9). In primary education only the coefficient of the variable teachers proved to be significant. In secondary education the coefficients for G.D.P., and teachers were significant while in higher education the variables teachers and percentage manufacturing proved to be significant (Tables

B-9, B-10, B-11).

Cross Sectional Regressions

Additional regressions were run treating all the selected countries as one group. The basic procedure was as follows. When possible, each of the independent variables were converted into a per capita form. For the year 1963, a regression was run with the student/school age population as the dependent variable, and per capita G.D.P., teachers/school age population, percentage of the population living in urban areas, percentage of female enrollment, and the retention rate. There was a high degree of positive correlation between all of the independent variables and the dependent variables in primary education (Table B-13). The independent variable retention rates were excluded in secondary education. Again, all of the variables were correlated with the independent variable (Table B-13). For the cross sectional regressions in higher education, the percentage of females enrolled was not used. All other variables were correlated with enrollments. (Table B-13)

Stage II Estimates.

Using the analytic framework developed in Chapter III the estimating model $E_t = \hat{a} + \hat{B}_1 (G.D.P.)_{t-1} + \hat{B}_2 (\% \text{ of manufacturing})_{t-1} + \hat{B}_3 (\text{teacher/student ratio})_{t-1} + \hat{B}_4 (E)_{t-1}$

was used to estimate enrollments. Tables B-14, B-15, B-16, present the results of the regression. Table V-8 summarizes the $R^2$ and "F" statistics for each country and each level of education.

Table V-8

$R_2$ and "F" Statistics For Estimates of Enrollments

| | Primary | | Secondary | | Higher | |
|---|---|---|---|---|---|---|
| | $R^2$ | "F" | $R^2$ | "F" | $R^2$ | "F" |
| Argentina | .969 | 81.* | .613 | 13.* | .801 | 9. |
| Brazil (Average) | .191 | 1.48 | .962 | 55.* | .995 | 353.* |
| Brazil (General) | -.30 | .54 | .916 | 45.* | .973 | 297.* |
| Chile | .932 | 48.* | .967 | 71.* | .977 | 117.* |
| Colombia | .981 | 92.* | | | .995 | 301.* |
| Mexico | .993 | 304.* | .982 | 82.* | .967 | 58.* |
| Peru | .985 | 152.* | .953 | 46.* | .992 | 194.* |
| Venezuela (Average) | .973 | 91.* | .972 | 79.* | .956 | 35.* |

*significant at alpha = .05

All of the estimating equations except for primary education in Brazil are significant. Further out of the twenty three $R^2$ developed, 21 are above .60, 20 are above .80, 19 are above .90 and 17 are above .95. Tables V-9, V-10, and V-11,

show which variables and the signs of the coefficients are significantly different than zero.

Table V-9

Sign of Regression Coefficients for Primary Education
(0 indicates not significant)

| | Constant | G.D.P.$_{t-1}$ | % of Manuf. | (Teacher/ Student)$_{t-1}$ | Enroll-ments$_{t-1}$ |
|---|---|---|---|---|---|
| Argentina | 0 | 0 | 0 | 0 | +* |
| Brazil (Average) | 0 | 0 | 0 | 0 | 0 |
| Brazil (Initial) | 0 | 0 | 0 | 0 | 0 |
| Chile | 0 | 0 | 0 | N.A. | +* |
| Colombia | 0 | -** | 0 | 0 | 0 |
| Mexico | 0 | 0 | 0 | 0 | +* |
| Peru | -* | - | - | +* | +* |
| Venezuela | -** | 0 | 0 | 0 | +* |

* significant at alpha = .05
** significant at alpha = .10

Table V-10

Sign of Regression Coefficients for Secondary Education
(0 indicates coefficient is not significant)

| | Constant | $(G.D.P.)_{t-1}$ | $(\% \text{ of Manuf})_{t-1}$ | $(\text{Teacher/Student})_{t-1}$ | $(\text{Enrollments})_{t-1}$ |
|---|---|---|---|---|---|
| Argentina | -** | 0 | +** | 0 | 0 |
| Brazil (Initial) | -** | 0 | 0 | 0 | +* |
| Brazil (Average) | -** | 0 | 0 | 0 | +* |
| Chile | 0 | 0 | N.A. | N.A. | +* |
| Mexico | -** | 0 | 0 | 0 | +* |
| Peru | 0 | 0 | 0 | 0 | +* |
| Venezuela (Average) | 0 | 0 | 0 | 0 | +* |
| Venezuela (Initial) | 0 | 0 | 0 | +** | +* |

* significant at alpha = .05
** significant at alpha = .10

Table V-11

Sign of Regression Coefficient for Higher Education
(0 indicates coefficient is not significant)

| | Constant | $(G.D.P.)_{t-1}$ | $(\% \text{ of Manuf.})_{t-1}$ | $(\text{Teacher/Student})_{t-1}$ | $(\text{Enrollments})_{t-1}$ |
|---|---|---|---|---|---|
| Argentina | 0 | 0 | 0 | 0 | 0 |
| Brazil (Initial) | -* | 0 | 0 | +* | +* |
| Brazil (Average) | -+ | 0 | 0 | +* | +* |
| Chile | 0 | 0 | -** | N.A. | +* |
| Colombia | -* | 0 | +* | 0 | +* |
| Mexico | 0 | 0 | 0 | 0 | +** |
| Peru | 0 | 0 | 0 | 0 | +* |
| Venezuela | 0 | 0 | 0 | 0 | +* |

It is clear that the most important factor in determing enrollments in time period T is enrollments in period T-1. While variables such as the teacher/student ratio can be a significant factor, the current level of enrollments is by far the most significant.

## CHAPTER VI

## Testing of Hypotheses

This chapter tests the hypotheses presented in Chapter III. Each hypothesis will be accepted or rejected on a country by country basis.

I. Every country at Every-Level of Education has an Optimal Teacher/Student Ratio

A Methodology For Testing

If a country has an optimal teacher/student ratio and acts rationally it follows that $0 \leq \lambda \leq 1$. To evaluate $\hat{\lambda}$ it is necessary to test the hypothesis $H_0$ $\lambda < 0$ $0\lambda > 1$

$H_1$ $0 \leq \lambda \leq 1$

Consider the likelihood function if $H_0$ is true. Maximizing $\ell(\lambda, Y, X)$ subject to $\lambda < 0$ or $\lambda > 0$ implies setting $\lambda = \hat{\lambda}$ which is the level squares estimate of $\lambda$ if $\hat{\lambda} < 0$ or $\lambda > 1$. Likewise if $H_0$ or $H_1$ is true, maximizing $\ell(\lambda, Y, X)$ without restrictions on $\lambda$ is what the regression program does so that $\lambda = \hat{\lambda}$, whatever the value of $\lambda$. The likelihood ratio

$$L = \frac{L(H_0)}{L(H_0)} \quad \text{or} \quad H_1 = \frac{\frac{1}{\sigma_\lambda \sqrt{2\pi}} e^{-1/2 \left(\frac{\hat{\lambda} - \lambda}{\sigma_\lambda}\right)^2}}{\frac{1}{\sigma_\lambda \sqrt{2\pi}} e^{-1/2 \left(\frac{\hat{\lambda} - \lambda}{\sigma_\lambda}\right)^2}}$$

exists such that $2 \ln \ell = \left(\frac{\hat{\lambda} - \lambda_0}{\sigma_\lambda}\right)^2$ which is a chi square distribution with 1 degree of freedom. Several examples of the hypothesis which could be tested can be developed. Selecting a level of alpha of .05 assumes $\hat{\lambda} = .7$, $\hat{\sigma}_\lambda = .1$. Set the hypothesis

$H_0$ $\lambda > 1$

$H_1$ $0 \leq \lambda \leq 1$ $\qquad \frac{(\hat{\lambda} - \lambda_0)^2}{\sigma_\lambda} = \frac{(.7 - 1.0)^2}{.1} = 9$

since $9 > 3.84$ rejects $H_o$ and accepts $H_1$. Assume that $\hat{\lambda} = .2$ and $\sigma_{\lambda} = .01$. Then set $H_o \lambda < 0$ $\quad X^2 = \left(\frac{\hat{\lambda} - \lambda}{\sigma_{\lambda}}\right) = \left(\frac{.2 - 0}{.01}\right)^2 = 4$

$H_1\ 0 < \lambda < 1$

Since $4 > 3.84$ rejects $H_o$, accpet $H_1$. Further if $0 > \lambda$ or $\lambda > 1$ then $H_o$ must be accepted.

Tables V1-1, V1-2, V1-3, present the test of the hypothesis $H_o$: $0 > \lambda > 1$; $H_1$: $0 < \lambda < 1$.

Table V1-1

Test of $H_o \lambda < 0, \lambda > 0$: Primary Education

| | $\hat{\lambda}$ | $\hat{\sigma}_{\lambda}$ | Chi Square | Accept/Reject |
|---|---|---|---|---|
| Argentina | .101 | .127 | .621 | Accept $H_o$ |
| Brazil (Average) | .138 | .432 | .101 | Accept $H_o$ |
| Brazil (Initial) | .139 | .329 | .178 | Accept $H_o$ |
| Colombia | .564 | .970 | .204 | Accept $H_o$ |
| Mexico | .229 | .1977 | 1.34 | Accept $H_o$ |
| Peru | .449 | .284 | 2.49 | Accept $H_o$ |
| Venezuela (Average) | 1.501 | .458 | - | Accept $H_o$ |
| Venezuela (General) | 1.224 | .927 | - | Accept $H_o$ |

*For an alpha risk of 5%.

Table V1-2

Test of $H_o: \lambda < 0; \lambda > 0$: Secondary Education

| | $\hat{\lambda}$ | | Chi Square | Accept/Reject |
|---|---|---|---|---|
| Argentina | .010 | .054 | .03 | Accept |
| Brazil (Average) | .376 | .468 | .82 | Accept |
| Brazil (General) | .898 | .293 | .34 | Accept |
| Mexico | .631 | .467 | .62 | Accept |
| Peru | 1.222 | - | - | Accept |
| Venezuela | .039 | .379 | .01 | Accept |

For Alpha = .05

Table V1-3

Test of $H_o: \lambda < c; \lambda > c$: Higher Education

| | $\hat{\lambda}$ | $\hat{\sigma}_{\lambda}$ | Chi Square | Accept/Reject |
|---|---|---|---|---|
| Argentina | .669 | .264 | 1.5 | Accept |
| Brazil | .491 | .783 | .37 | Accept |
| Colombia | .614 | .397 | .89 | Accept |
| Mexico | .733 | .467 | .57 | Accept |
| Peru | .017 | .404 | .001 | Accept |
| Venezuela | -.434 | - | - | Accept |

For Alpha = .05

As can be seen from these tables, the standard error of $\hat{\lambda}$ is so high that it cannot be clearly established that the rate of response, $\hat{\lambda}$, falls between zero and 1.0 at the 95 percent level of confidence. However, in only 4 out of 20 cases does the value of $\lambda$ fall outside the allotted range.

II. A Positive Relation Exists Between Real Per capita Gross Domestic Product and the Student/Teacher Ratio

Table VI-4 was developed from appendix tables B-4, B-5, and B-6, and show the coefficient of correlation between the Teacher/student ratio and real G.D.P.

Table VI-4
Coefficient of Correlation Between Teacher/Student Ratio and G.D.P.

| | Primary | Secondary | Higher |
|---|---|---|---|
| Argentina | .79 | -.09 | .16 |
| Brazil (Intitial) | .97* | -.77* | .55 |
| Brazil (Average) | .91* | -.81* | .51 |
| Colombia | .99* | - | .96* |
| Mexico | .99* | .82* | .93* |
| Peru | -.37 | -.72* | -.36 |
| Venezuela | -.87* | -.56* | -.42 |

*Significant at alpha = .05.

The results show that 13 of the 20 correlation coefficients are significant at an alpha level of .05. Even more important is that the sign of the significant correlation coefficients are positive for 9 of the 10 significant values. It

would be placed into the educational system and that the relationship between G.D.P. and the teacher/student ratio would be positive. It is interesting to note that in primary education, where the teacher/student ratio may be most critical in the learning process the sign of the correlation coefficient is positive in all significant cases except Venezuela.

III. The Principle Determinant of the level of Enrollments in any Given Period is the Level of Enrollments of the Preceding Time Period.

Tables B-9, B-10, and B-11 confirm this hypothesis. In every regression which was made in estimating enrollments, the one factor which was almost uniformly most significant was the variable of enrollments lagged by one time period. This predominance of evidence tends to confirm this hypothesis.

IV. Levels of Educational Enrollments are Directly Related to Levels of Real Per Capita Income.

Table VI-5 is constructed from appendix tables B-7, B-8 and B-9.

Table VI-5

Coefficients of Correlation Between Enrollments and G.D.P.

| | Primary | Secondary | Higher |
|---|---|---|---|
| Argentina | .61* | .87* | .72* |
| Brazil (Average) | .92* | .93* | .91* |
| Brazil (General) | .92* | .94* | .92* |
| Chile | .34 | .92* | .91* |
| Colombia | .83* | N.A. | .90* |
| Mexico | .94* | .92* | .94* |
| Peru | .83* | .94* | .95* |
| Venezuela | .77* | .79* | .66* |

*Indicates value is significant at alpha = .05.

In every country, except for Chilean primary, there existed a significant positive relationship between G.D.P. and enrollments. While the cause and effect relationship is somewhat middled, it is clear that the hypothesis should be accepted.

V. An Increase of The Percentage of Females Enrolled in the Educational System Leads to Increased Educational Enrollments

Table V1-6 is constructed from appendix Tables B-7, B-8, and B-9.

Table V1-6
Correlation's Between Enrollments and the Percentage of Female Enrollment

| | Primary | Secondary | Higher |
|---|---|---|---|
| Argentina | .88* | .76* | .93* |
| Chile | .25 | N.A. | N.A. |
| Colombia | .72* | N.A. | N.A. |
| Peru | .83* | .45 | N.A. |
| Venezuela | .31 | .88* | N.A. |

*Indicates value significant at alpha = .05.

A great deal of evidence was not available concerning this hypothesis. In primary education it is possible to accept the hypothesis for Argentina, Colombia, and Peru, but the hypothesis must be rejected for Chile and Venezuela. In secondary education the hypothesis is accepted for Argentina and Venezuela but rejected for Peru. It is interesting to note that the hypothesis is accepted for all three levels of

education for Argentina.

VI. As the Production Process of a Country Becomes More Complex, as Represented by the Proportion of Gross Domestic Product Produced in the Manufacturing Sector, Educational Enrollments Rise.

Table VI-7 is constructed from appendix Tables B-6, B-7, and show the correlation between the percentage of G.D.P. produced in the manufacturing sector and enrollments.

Table VI-7

Correlation Coefficients Between The Percentage of G.D.P. Produced In The Manufacturing Sector and Enrollments

| | Primary | Secondary | Higher |
|---|---|---|---|
| Argentina | .74* | .94* | .76* |
| Chile | .21 | .15 | .92* |
| Colombia | .88* | N.A. | .82* |
| Mexico | .79* | .99* | .88* |
| Peru | .83* | .91* | .99* |
| Venezuela | .86* | .95* | .94* |

*Indicates value is significant at alpha = .05.

At every level of education, for each country investigated, except Chile, the relationship between the percentage of manufacturing and enrollments proved to be significant. With the exception of Chile in primary and secondary education, the hypothesis cannot be rejected.

VII. As Retention Rates Within an Educational System Rise, the Levels of Enrollments Rise.

Although it is not possible to gather a great deal of information, concerning the rate of retention Table VI-8 which is developed from appendix Tables B-6, B-7 and B-8 present the available information.

Table VI-8
Correlation Coefficients Between the Retention Rates and Enrollments

| | Primary | Secondary |
|---|---|---|
| Argentina | .59* | .69* |
| Brazil | N.A. | .70* |
| Peru | .74* | .71* |

*Indicates the significant at alpha = .05.

Every country test shows a significant positive relationship between retention rates and enrollment. It is not possible to reject the hypothesis that the relationship exists.

VIII. The Greater the Per Capita G.D.P. of a country, the Higher the Proportion of Enrollments to the Legal School Age Population.

Appendix Table B-13 presents the results of the cross sectional analysis described in Chapter V. The correlation coefficient between (enrollments/school age population) and per capita G.D.P. are .67 for primary education, .95 for secondary education, and .84 for higher education, each of the correlations being significant at a level of alpha risk of .10. Clearly the richer the country, the greater proportion of the school age population attends school.

IX. The More Urbanized a Country Becomes, the Greater the Proportion of Enrollments to School Age Population.

Appendix Table B-13 presents the results of a cross sectional analysis between (enrollments/school age population) and the percentage of the population living in urban areas. The correlation between the two variables for primary education is .71, for secondary education .70 and for higher education .80, all values significant at an alpha risk of .10. Given these results, the hypothesis cannot be rejected, since a clear association exists between the degree of urbanization in a country and the percentage of legal school age population enrolled in every education level.

X. The Greater the Ratio of Teachers to School Age Population in a Given Country, The Greater the Ratio of Enrollments to School Age Population.

Appendix Table B-13 shows the correlation coefficients between the two variables. The results show that the correlation coefficient for all three levels of education are significant, -.87 for primary, -.73 for secondary, and -.77 for higher. The sign of the coefficient is the opposite of the hypothesized sign. For this reason the hypothesis is rejected.

# CHAPTER VII

## Conclusions

Previous chapters have described the place of education in economic theory and the problems of educational planning. They have developed analytical models which have enabled specified hypothesis to be either accepted or rejected. This chapter will discuss the acceptance or rejection of the various hypothesis in the context of economic theory and the possible policy conclusions which may be drawn.

## I. The Hypotheses

### The Optimal Teacher/Student Ratio

Higgins, Harbinson and Meyers, Hansen, Neff and Poignant[1] all alluded to the existence of a teacher/student ratio which they felt educational systems would desire to maintain. If this ratio is considered to be an optimal ratio, no matter how the ratio is considered to be an optimal ratio, no matter how the ratio is derived by the system, the supply of teachers can be treated as a stock adjustment model. That is if the teacher/student ratio is not at the optimal ratio, adjustments will be made in the stock of teachers in order to achieve the desired ratio. The existence of this optimal

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[1] Higgins, Economic Development, p. 434; Harbinson and Meyers, Education, Manpower, and Economic Growth, p. 199; Hansen, Education and Economic Development, p. 53-71; Neff, Education and Development, pp. 22-24; and Poignant, The Relation of Education Plans, p. 31.

ratio would be established by the statistical determination of $\lambda$ such that $0<\lambda<1$. It was however, impossible to statistically establish that the rate of response to the difference between the optimal ratio and the actual ratio was between 0 and 1.

The failure to confirm an optimal ratio may arise for several reasons. First, there may be no optimal ratio's which the systems try to achieve. Assuming however, that an optimal ratio exists, it may well be changing over time. If, due to changing educational practices and theory, or educational technology, the optimal ratio is changing, then estimators of the rate of response, $\lambda$, would not be valid. It is interesting to note however, that almost all of the estimates of $\lambda$, $\hat{\lambda}$, did fall within the range 0 to 1. However, the hypothesis that $0<\lambda<1$ could not be accepted since the standard deviation of $\lambda$ was simply too large. It is possible that the process of reaching an optimal ratio may be a long run process and that there simply was not sufficient data available to establish the existence of the optimal ratio. In summary, while it was not established that the optimal ratio existed, the model may have failed to establish its existence because of the limited amount of data available.

Teacher/Student Ratio and G.D.P.

In their discussion of the optimal stock of teachers,

Hansen, Meyer, and Neff[2] pointed out that the optimal supply of teachers and thus the teacher/student ratio should be considered in light of alternative modes of teaching and resources which could be available for the education system. This implies, that given a set of technology constraints, that one would expect the teacher/student ratio to vary with the resources available to the system; i.e., the more resources available, the greater the supply of teachers and the greater the teacher/student ratio.

This hypothesis was tested in the estimating model for $\lambda$ and the results shown in Table VI-4. G.D.P. may be considered as an approximation for the amount of funds available to the educational system if it is assumed that the proportion of G.D.P. going to education remains constant. In primary education the results show that for Argentina, Brazil, Columbia and Mexico the relationship was positive and significant, while the relationship was not significant in Peru, and significant and negative in Venezuela. In secondary education, Brazil, Peru, and Venezuela had significant negative relationships while mexico had a significant positive relationship. In higher education there was no significant

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[2]Hansen, Education and Economic Development, pp. 438, Meyer, Educational Planning, pp. 300-301, Neff, Education and Development, p. 38-39.

relationship for Argentina, Brazil, Peru, and Venezuela while the relationship for Colombia and Mexico was positive and significant.

Two possibilities exist for the negative relationship between the variables in secondary education. First, the respective systems may have felt the teacher/student ratio to be too high and put resources going into secondary education into other forms of capital. It may be possible that this negative relationship is reflective of a bottleneck in the education system in the supplying of teachers to secondary education. While it is possible that persons with a secondary education degree could teach in primary education, it seems unlikely that the same person would do so in secondary education. This would mean that the supply of teachers for the most part would come from the system of higher education. Thus, even though more resources were put into secondary education, the higher education system may not be able to supply teachers fast enough to prevent a falling teacher/student ratio.

Enrollments and G.D.P.

Schultz, Denison, and Selowsky[3] have pointed out the

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[3]Schultz,"Capital Formation", pp. 327-342, Denison, "The Sources of Growth", pp. 198-203, Selowsky, "On the Measurement", p. 450.

fact that G.D.P. and enrollments rise together. It does seem apparent that rising enrollments and increases in G.D.P. have a dual relationship. Rising enrollments lead to a more educated and better trained labor force thereby leading to a higher level of G.D.P. At the same time rising levels of G.D.P. and employment provide the necessary family income for children to enroll in and remain in the educational system for longer periods of time. While this analysis did not propport to be able to sort out the directional relationships between enrollments and G.D.P., it did test whether this relationship held true for the Latin American countries of Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. For every level of education in each of these countries there was indeed a positive, significant relationship, Table VI-5. It could be concluded that the Latin experience, at least in this instance, is similar to that of the United States and other more economically developed nations.

Enrollments and the Percentage of Female Enrollment

Guillum[4] has pointed that during the last sixty years more and more females have entered the educational systems in Latin America in increasing numbers. It was found that significant positive relationship existed in primary between the two variables for Argentina, Colombia, and Peru, while there

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[4]Guillum, Social Changes in Latin America, p. 35.

was no relationship in Chile, and Venezuela. Given the fact that the percentage of female enrollment in Chile and Venezuela approached .50, it is clear that the "female revolution" occurred before the time span of study. Since the percentage of female enrollment in Colombia and Argentina hovered between .47 and .50, it would seem that even though the relationship was significant it was not particular important for these countries. This is particularly pointed out by the fact that the estimated regression coefficient for the percentage of females was not significant in the multiple regressions in Appendix Table V-IX. Only in Peru where the percentage of female enrollments rose from .40 percent to .46 percent could it be considered that the increase in female enrollments was a significant factor in using enrollments.

In secondary education Argentina and Venezuela showed significant correlation between the two variables. In Venezuela the percentage rose from .38 to .48, while in Argentina the percentage rose from .52 to .56. In the multiple regressions Appendix Table B-7, the coefficients of the variable, percentage of female enrollment, proved to be significant, further identifying the increasing percentage as being important. The relationship in Peru was not significant nor was the coefficient in the multiple regression, which was expected since the percentage of females has not risen significantly in system.

G.D.P. Produced in the Manufacturing Sector

Pepelelais, Mean and Adelman, Higgins, Becker, and Mincer[5] have all associated the rate of return from education to the demand for education. Specially Pepelelais, Mean and Adelman point out that the more complex the production process becomes, the greater the expected return to education. The percentage of G.D.P. produced in the manufacturing sector was selected as being representative of the complexity of the production process of a country. It was found that significant correlation existed between the variable for all levels of education for Argentina, Colombia, Mexico, Peru and Venezuela. In addition, in multiple regression in Appendix Table B-9, B-10, and B-11 it was found that the regression coefficients were significant in primary education for Argentina, Colombia and Mexico, for Peru, Chile, and Mexico in secondary education. It is noteworthy that the coefficients of the simple and multiple regression for higher education were significant for all countries tested, Argentina, Chile, Colombia, Mexico, Peru, and Venezuela. It seems clear, that the increasing complexity of the production process is most

[5]Pepelelais, Mean and Adelman, Economic Development, pp. 70-72, Higgins, Economic Development, pp. 411-412, Schultz, Economic Development, p. 576, Becker, "Under-Investment in College Education", pp. 340-348, Mincer, "On the Job Training", pp. 67-84.

dramatically felt in the systems of higher education.

Percentage Enrollments and Per Capita G.D.P.

Higgins[6] implies that the size of the absolute potential school age population in relationship to the wealth of a country is a critical factor in determining the level of enrollments. Since data of the eligible school age population is available only through a national census it was necessary to attempt to test this hypothesis with a cross sectional analysis, Table V-XIV. The results do show that the richer the country, the greater the percentage of enrollment to potential enrollments. This result, while confirming the suggestion by Higgins, tends to reinforce the hypothesis accepted earlier, that enrollments as positively related to G.D.P.

Percentage of Enrollments and the Rural/Urban Population Distribution

Higgins[7] hypothesized that an important factor in the determination of enrollments is the rural/urban population distribution. Again, since the data for population distribution is available only from a census it was necessary to

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[6]Higgins, Economic Development, p. 438.

[7]Ibid., p. 33.

use cross sectional analysis. It was found that there was a strong, significant relationship between the ratio of enrollments/school age population and the percentage of the population that live in urban areas for all levels of education. This result shows that more urbanized countries have a higher porportion of enrollments to school age population than do countries with a lower percentage of urbanization. While this result does not necessary confirm the fact that the more urbanized a country becomes, the greater the level of enrollments, but does lend strong supporting evidence to such a hypothesis.

Enrollments and the Retention Rate

Guillum[8] criticized Latin American education because large numbers of students who enter the education system fail to complete their education. If the educational systems have been making progress in helping students stay in school for longer periods of time, this would show up in using retention rates, and therefore in increasing enrollments. In countries where information was available Argentina, Brazil and Peru, that progress was made in increasing the retention rate. This increase retention rate in primary and secondary education were significantly associated with increases in enrollments (Table V1-8). From these observations it can be concluded

[8]Guillum, Social Changes in Latin America Today, p. 38.

that at least for these countries, retention rates have been rising and have helped to create an increase in enrollments.

Relation Between Current and Past Levels of Enrollments

No specific mention was found in the literature that the level of enrollments in a given time period is principally determined by the level of enrollment in the previous periods. This simply implies that the stock of enrollments is relative to new entries into the system so that enrollments cannot change drastically from one period to another. Table V-9, V-10, V-11, clearly show that their hypothesis is correct. It is clear from this if one wishes to estimate enrollments for a given time period the starting point is the enrollment of the system in the previous period.

Percentage of Enrollments and the Teacher/School Age Population Ratio

No mention of the hypothesis was found in the literature. The author concluded that it might be expected that the proportion of enrollments to school age population might be resonably expected to be positively related to ratio of the number of teachers to the school age population. This would appear to suggest that a country with a relatively small proportion of students enrolled in school would attempt to supply more educational places for students, increase the stock of teachers. However, the resulting correlation done on a cross sectional basis showed a negative correlation. That is

the lower the enrollment/population ratio, the higher the teacher/population ratio, or conversely the higher the enrollment/population ratio, the lower the teacher/population ratio. This implies that countries with low enrollment/population ratio increase the ratio through decreases in the teacher/student ratio, that is through expanding enrollments faster than teachers. This would tend to indicate again that a limitation exists, especially in countries with relatively low enrollments, in the desire to or the ability to produce more teachers for the industrial system.

## II. POLICY CONCLUSIONS

The results of this study lend support for policy conclusions of two different types. First, conclusions can be reached on a general level regarding the problems and operations of the educational systems of the selected Latin American countries. Secondly, a general procedure can be developed for the predication of future educational enrollments of these countries.

In short run, the educational systems under study have been faced with a given number of people who wish to enroll in the educational system at some point in time. Given the emphasis placed upon economic growth and education in these countries, it would seem that it would be politically impossible for the educational system of a country to turn away a significant number of students who wanted to enter the

system on the grounds that there were not enough teachers or space. Nor is it possible to release teachers if fewer students than expected enroll. For these reasons then, the short run adjustment factor which balances the demand for educational places with the supply of educational places is the teacher/student ratio.

At any given time the system supplies a relatively fixed quantity of teachers. Hopefully this quantity of teachers when merged with the number of students enrolled in the system will produce the teacher/student ratio which the system feels is optimal for the education process. If the system has over estimated or underestimated the enrollments for the period then the teacher/student ratio will not be optimal. Likewise even if the estimates of enrollments are correct but the system lacks the ability to supply the appropriate quantity of teachers the student teacher ratio will not be optimal in the short run.

In the long run, the educational system moves towards an optimal teacher/student ratio through the adjustment of the stock of teachers. While this study does not conclusively show that educational systems have optimal teacher/student ratio which they are trying to achieve, it does present evidence which indicates that such a ratio may exist. The model developed to measure the rate which educational systems in the selected Latin American Countries move towards an optimal teacher/student ratio shows most of the countries

educational systems to have reduced the gap between the desired stock of teachers and the actual stock of teachers between 1 percent to 100 percent over the period of the study.

However, for the most part the educational systems have not been able to achieve a rapid rate of change between the desired and actual stock of teachers. This is due to the systems inability to increase the stock of teachers as rapidly as the growth in enrollments to achieve the optimal ratio. These countries, and others in similar situations would be well advised to concentrate more on the development of the production system of teachers if they care to achieve optimal teacher/student ratios in the long run.

In addition to increase attention to the development of teaching resources, it is necessary to develop long run projection models for educational enrollments. While this paper does not propose to develop a long run projection model for a specific country it does lay the foundation for a methodology for such a model. Educational planners must concentrate on a variety of factors in order to project enrollments in period $T_{10}$ the obvious starting point is the number of students enrolled in period T.

As a preliminary estimate one could take the proportion of currently enrolled students to the eligible school age population. Projections of the eligible school age population in period $T_{10}$ could be attained and the proportion of students enrolled in period $T_{10}$ applied to the population

projections of $T_{10}$ to achieve an estimate of enrollments in period $T_{10}$. Once this estimate is achieved, it must be modified so as to reflect the effects of socio-economic factors upon enrollments.

This study has shown that there are significant relationships between growth in enrollments and growth in gross domestic product, the entrance of females in to the educational system, the increasing complexity of the production process, and the rural/urban population distribution. Each of these factors must be considered in arriving at a final projection of enrollments. The planner should investigate effect of changes in G.D.P. on past enrollments and attempt to estimate how future changes in G.D.P. will effect enrollments.

By the same token, especially in higher education, changes in the composition of enrollments with respect to male and female should be considered. If a higher proportion of females can be expected to enroll in the educational system in the future then the projection must be adjusted accordingly.

The increased industralization of the country should be considered with respect to its influences upon enrollment. Generally speaking the more complex the production process becomes the greater the enrollment in the educational system and the longer the period of time a student continues his studies. Estimates of the effects of this upon enrollments via both increased entrance and longer periods of schooling

should be accounted for in the enrollment projections.

Changing patterns of the rural/urban population distribution should be explored. Historically as countries have become more urbanized a greater proportion of the eligible school age population have enrolled in the educational system. Allowances should be made in the enrollment projections which incorporate expected changes in the rural/urban population distribution.

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# APPENDIX A.

TABLE A-1

ENROLLMENT IN PRIMARY EDUCATION

| Year | Argentina | Brazil | | Chile | Colombia | Mexico | Peru | Venezuela | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | General | | | | | Average | General |
| 1950 | 2272018[1] | 3709887[3] | 4352043[5] | 797600[7] | 803494[10] | | | 515737[14] | |
| 1951 | 2359854 | 3891156 | 4545877 | 802700 | 874979 | | 1035006[13] | 536212 | |
| 1952 | 2461279 | 4034948 | 4743449 | 848600 | 923133 | | 1037523 | 570286 | |
| 1953 | 2559976 | 4212405 | 4902021 | 902800 | 1072536 | | 1046836 | 596382 | |
| 1954 | 2654829 | 4433820 | 5256685 | 942600 | 1125350 | | 1085619 | 623083 | |
| 1955 | 2735026 | 4772347 | 5610860 | 976000 | 1235484 | 3458204[12] | 1127605 | 646835 | |
| 1956 | 2723760 | 5183904 | 6094180 | 1007100 | 1311535 | 3588196 | 1204791 | 694193 | |
| 1957 | 2782524 | 5486470 | 6404486 | 1058800 | 1381290 | 3845260 | 1233937 | 751561 | 588903[14] |
| 1958 | 2859826 | 5882907 | 6803155 | 1094250[8] | 1403123 | 4105302 | 1308305 | 916764 | 727837 |
| 1959 | 2907516 | 6104393 | 7128955 | 1097270 | 1568572 | 4436561 | 1391952 | 1094604 | 861566 |
| 1960 | 2947066 | 6423199 | 7476080 | 1159720[9] | 1690631 | 4884988 | 1449009 | 1243948 | 973884 |
| 1961 | 3010715 | 6742398 | 7825774 | 1166064[9] | 1797813 | 5368247 | 1495047 | 1298426 | 1063824 |
| 1962 | 3036811 | 7363747 | 8517607 | 1232537 | 1948720[11] | 5620324 | 1553755 | 1339663 | 1083118 |
| 1963 | 3097240 | 8131422[4] | 9299441[6] | 1295146 | 2096408[11] | 6094850 | 1682365 | 1370665 | 1116443 |
| 1964 | 3186491[2] | 8909362[4] | 10217324[6] | 1340873 | 2213423 | 6530751 | 1932614 | 1421959[15] | 1158863[15] |
| 1965 | 3251469[2] | 9061530 | 9923183 | 1516252 | | 6916000 | 2054031 | 1481333[15] | 1224838[15] |

[1]Departamento de Estadística Educativa, Enseñanza Primaria Años 1940-1964. Suplemento Estadístico. (Buenos Aires: Secretaría de Estado de Cultura y Educacion, 1966), p. 12 for 1940-1964.

[2]Departamento de Estadística Educativa, Estadística Educativa Año 1966. (Buenos Aires: Secretaría de Estado de Cultura y Educación, 1966), p. 9 for 1965.

[3]Ministerio do Planejamento e Coordenaçao Ecònomica, Escritorio de Pesquisa Ecònòmica Aplicado, Plano Decenal do Desenvolvimento Econômico e Social, Educaçao (II). Diagnóstico Preliminar, (Rio de Janeiro: Ministerio do Planejamento e Coordenaçao Economica, 1966), p. 31 for 1950-1963. This is ending school enrollment.

TABLE A-1 Continued

Enrollment in Primary Education

[4]Instituto Brasileiro do Geografía e Estatística, Anuario Estatistico do Brasil, 1967, (Rio de Janeiro: IBGE, 1967), p. 552 for 1964-1965.

[5]Ministerio do Planejamento, Plano Decenal do ..., p. 65.

[6]Institute Brasileiro de Geografía e Estatística, Anuario ..., p. 564.

[7]Universidad de Chile. La Economía Chilena en el Periodo 1950-1963, Tomo II, (Santiago: Instituto de Economía, U. de Chile, 1963), p. 18 for 1950-1957.

[8]Instituto Latinoamericano de Panificación Económica y Social, Necesidades de Mano de Obra. Educación y Formación Profesional. Un Enfoque Global, (Santiago: ILPES, 1967), p. 58 for 1958-1960.

[9]Superintendencia de Educacion, Sección de Estadística, (Matrícula Ano 1966. Santiago: Superintendencia de Educación, 1967), p. 58 for 1961-1965.

[10]Instituto Colombiano de Especialización Técnica en el Exterior, Recursos y Requerimientos de Personal de Alto Nivel 1964-1975, (Bogota: ICETEX, 1965), p. 143 for 1950-1962.

[11]Inter-American Statistical Institute, America en Cifras, 1965. Situación Cultural: Educación y Otros Aspectos Culturales, (Washington, D.C.: Pan American Union, 1967), p. 58 for 1963-1964.

[12]Ibid., p. 60.

[13]Instituto Nacional de Planificación, Desarrolo Económico y Social, Recursos Humanos y Educación, (Lima: INP, 1965), p. 51.

[14]Dirección General de Estadística y Censos Nacionales. Anuario Estadístico de Venezuela, 1965, (Caracas: Ministerio de Fomento, 1966), p. 452 for 1950-1964.

[15]Ministerio de Educación, Memoria y Cuenta, Anuario Estadístico, Tomo II, (Caracas: Congreso Nacional de la República, 1967), p. 59 for 1965.

TABLE A-2

ENROLLMENT IN SECONDARY EDUCATION

| Year | Argentina | Brazil | | Chile | Mexico | Peru | Venezuela |
|---|---|---|---|---|---|---|---|
| | | Average[2] | General[2] | | | | |
| 1950 | | 492446 | 538346 | | 125468[5] | 81824[6] | |
| 1951 | | 530614 | 579518 | 139449[4] | 128732 | 79554 | 40640[7] |
| 1952 | | 562882 | 618049 | 148411 | 144913 | 94312 | 40640 |
| 1953 | | 621104 | 681258 | 160575 | 198915 | 101859 | 48290 |
| 1954 | | 676730 | 742889 | 177544 | 203039 | 104579 | 56913 |
| 1955 | 769101[1] | 732734 | 806553 | 194344 | 197156 | 112217 | 66395 |
| 1956 | 776910 | 769839 | 867131 | 211585 | 227336 | 121250 | 77138 |
| 1957 | 947548 | 855566 | 942394 | 234911 | 274588 | 136347 | 82811 |
| 1958 | 949340 | 934329 | 1032795 | 263618 | 275488 | 156631 | 111149 |
| 1959 | 948044 | 1008482 | 1106504 | 285828 | 309103 | 178311 | 147510 |
| 1960 | 995188 | 1110624 | 1334485 | 294691 | 376599 | 198359 | 180628 |
| 1961 | 1068233 | 1232769 | 1345892 | 301469 | 539950 | 227827 | 206444 |
| 1962 | 925252 | 1376554 | 1515834 | 315794 | 612701 | 239901 | 229723 |
| 1963 | 946513 | 1563856 | 1710589 | | 616285 | 252949 | 247990 |
| 1964 | 1020130 | 1818635[3] | 1892724[3] | | 707694 | 319351 | 272872 |
| 1965 | 1047635 | 2214305 | 2154430 | | 802615 | 379575 | 295872 |

[1]Intra-American Statistical Institute, America en Cifras, p. 104.

[2]Ministerio do Planejamento, Plano Decenalim, pp. 103-104.

[3]Instituto Brasileiro do Geografia, Aruario..., p.69.

[4]Instituo de Organización y Administracion. Estudio de Recursos Humanos de Nivel Universitario en Chile, III, (Santiago: Universidad de Chile, 1965), p. 109.

[5]Nacional Financiera, S. A. Statistics on the Mexican Economy. (Mexico: Nacional Financiera, S. A., 1966), p. 152.

[6]Ministerio de Educación Publica, La Educación en el Peru, (Lima: Dirección de Planeaminento Educativo, 1967), p. 247.

[7]Ministerio de Educacion, Memoria y Cuenta., p. 405.

TABLE A-3

ENROLLMENT IN HIGHER EDUCATION

| Year | Argentina | Brazil | | Chile | Colombia | Mexico | Peru | Venezuela |
|---|---|---|---|---|---|---|---|---|
| | | Average | General | | | | | |
| 1950 | | | | | 70916[5] | | 16468[7] | 6453[8] |
| 1951 | | | | | 99916 | | 14937 | 1671 |
| 1953 | | | | | 10333 | | 15157 | 4758 |
| 1954 | | | | | 108718 | | 15581 | 7148 |
| 1955 | 151127[1] | | | 16971[4] | 131598 | 46605[6] | 17867 | 7325 |
| 1956 | 145523 | 73528[3] | 77604[3] | 16596 | 153442 | --- | 20188 | 8834 |
| 1957 | 144270 | 78243 | 81991 | --- | 176964 | 47393 | 23234 | 10270 |
| 1958 | 144954 | 82201 | 86365 | 19084 | 192079 | 63899 | 26120 | 16126 |
| 1959 | 146862 | 86527 | 9003 | 21681 | 222614 | 71524 | 26840 | 21292 |
| 1960 | 174508 | 91969 | 96732 | 24663 | 243226 | 78787 | 30460 | 26477 |
| 1961 | 191310 | 99659 | 104924 | 25613 | 272383 | 88202 | 34556 | 31570 |
| 1962 | 192163 | 105337 | 110493 | 33112 | 303344 | 100519 | 38876 | 34368 |
| 1963 | 213484 | 119834 | 126405 | 36891 | 359879 | 110378 | 45428 | 35259 |
| 1964 | 218850[2] | | 144881 | 42709 | 390336 | 126118 | 50027 | 41372 |
| 1965 | 246477 | | | | | 134429 | 56893 | 46825 |

[1]Consejo Nacional de Desarrolo. Plan Nacional de Desarrollo, 1965-1969, (Buenos Aires: Presidencia de la Nacion Argentina, 1965), Table 44.

[2]Inter-American Statistical Institute, America En Cifras, p. 160.

[3]Ministerio do Planejamento, Plano Decenal ..., pp. 132-133.

[4]Inter-American Statistical Institute, America en Cifras, p. 160.

[5]Intituto Colombiano de Especializacion, Recusos y Requerimientos, p. 145.

[6]Inter-America Statistical Institute, America en Cifras, p. 160.

[7]Instituto Nacional de Planificacion, Desarrollo Economia y Social, p. 51.

[8]Direccion General de Estadistica, Anuario de Estadictico, p. 474.

TABLE A-4

Per Capita Gross Domestic Product[1]

(In Constant Prices)

| Year | Argentina | Brazil | Chile | Colombia | Mexico | Peru | Venezuela |
|---|---|---|---|---|---|---|---|
| 1953 | 40715 | 7462 | 674 | 1380 | 1603 | 4868 | 2881 |
| 1955 | 43498 | 8167 | 643 | 1441 | 1810 | 5024 | 3174 |
| 1956 | 43392 | 8048 | 631 | 1453 | 1870 | 5017 | 3375 |
| 1957 | 44935 | 8360 | 680 | 1439 | 1944 | 5107 | 3625 |
| 1958 | 47292 | 8645 | 689 | 1401 | 1985 | 5019 | 3538 |
| 1959 | 43793 | 8951 | 668 | 1481 | 1977 | 5079 | 3678 |
| 1960 | 46504 | 9216 | 695 | 1495 | 2061 | 5551 | 3597 |
| 1961 | 48951 | 9577 | 705 | 1520 | 2063 | 5890 | 3531 |
| 1962 | 47274 | 9725 | 733 | 1547 | 2094 | 6138 | 3631 |
| 1963 | 44896 | 9623 | 728 | 1549 | 2154 | 6174 | 3655 |
| 1964 | 47759 | 9682 | 740 | 1591 | 2293 | 6318 | 3813 |
| 1965 | 50702 | | 766 | 1589 | 2333 | | 3871 |

[1]Inter-America Economic and Social Council, El Futuro del DeSarrollo de La America Latina, (Washington: Pan America Union, 1966.) Table 49.

TABLE A-5

Number of Teachers In Primary Education[1,2]

| Year | Argentina | Brazil | Chile | Colombia | Mexico | Peru | Venezuela |
|---|---|---|---|---|---|---|---|
| 1950 | 96,274 | 112,499 | | | | | 14,697 |
| 1951 | 100,430 | 121,919 | | 21,713 | | | 15,924 |
| 1952 | 104,746 | 128,456 | | 22,690 | | | 16,726 |
| 1953 | 110,535 | 135,875 | | 25,208 | | | 17,436 |
| 1954 | 116,495 | 147,955 | | 28,939 | | | 18,278 |
| 1955 | 120,185 | 158,789 | | 32,197 | 85,797 | 29,753 | 19,222 |
| 1956 | 123,813 | 172,754 | | 33,874 | 89,931 | 31,679 | 20,221 |
| 1957 | 121,820 | 183,056 | 25,120 | 35,327 | 94,265 | 32,117 | 20,924 |
| 1958 | 126,821 | 197,983 | 25,860 | 38,061 | 99,434 | 35,258 | 24,856 |
| 1959 | 130,153 | 211,517 | 26,600 | 40,157 | 105,883 | 38,369 | 30,889 |
| 1960 | 135,710 | 226,581 | 27,340 | 44,910 | 112,900 | 40,700 | 25,267 |
| 1961 | 144,096 | 254,288 | 30,996 | 48,529 | 119,076 | 43,553 | 36,287 |
| 1962 | 151,480 | 274,500 | | 52,751 | 127,556 | 45,902 | 38,086 |
| 1963 | 154,312 | | | 62,158 | 137,308 | 48,405 | 39,629 |
| 1964 | 160,357 | | | | 146,989 | 52,662 | 41,469 |
| 1965 | 164,290 | | | | 151,654 | 57,310 | 43,387 |

[1]UNESCO, La, Situaccion Educativa en Latino. La Ensenanza Primaria: Estado, Problemas, Perspectivas, (Paris: UNESCO, 1960), bor 1950-1960, pp. 19-189.

[2]Inter-American Statistical Institute, America en Cifras, pp. 50-55.

TABLE A-6

Number of Teachers in Secondary Education[1,2]

| Year | Argentina | Brazil | Peru | Venezuela |
|---|---|---|---|---|
| 1950 | 87,188 | 50,683 | | 1,584 |
| 1951 | 89,489 | 52,963 | | 2,027 |
| 1952 | 88,896 | 57,053 | | 2,410 |
| 1953 | 101,911 | 63,094 | | 2,398 |
| 1954 | 114,370 | 69,087 | | 2,646 |
| 1955 | 126,032 | 71,850 | 9,034 | 3,966 |
| 1956 | 140,270 | 78,311 | 9,629 | 3,995 |
| 1957 | 147,797 | 90,137 | 10,435 | 4,157 |
| 1958 | 156,692 | 90,069 | 12,113 | 4,922 |
| 1959 | 168,215 | 98,937 | 13,044 | 7,186 |
| 1960 | 178,335 | 104,430 | 15,848 | 7,201 |
| 1961 | 186,665 | 106,934 | 17,219 | 7,681 |
| 1962 | 196,059 | 120,570 | 17,783 | 8,805 |
| 1963 | 207,281 | 132,384 | 18,338 | 9,598 |
| 1964 | | | 22,133 | 10,091 |
| 1965 | | | 25,845 | 10,515 |

[1]UNESCO, World Survey of Education, III Secondary, (New York: Unesco, 1961), pp. 19-189.

[2]Inter-American Statistical Institute, America en Cifras, pp. 83-100. For 1961-1965.

TABLE A-7

Number of Teachers In Higher Education[1]

| Year | Argentina | Brazil | Chile | Colombia | Mexico | Peru | Venezuela |
|---|---|---|---|---|---|---|---|
| 1955 | 4,918 | | | | 5,981 | 2,534 | |
| 1956 | 4,757 | 17,022 | | | 4,873 | 2,560 | |
| 1957 | 4,761 | 17,665 | 5,824 | 2,913 | 5,410 | 2,667 | 1,448 |
| 1958 | 5,248 | 18,831 | | 3,092 | 3,786 | 2,896 | 1,982 |
| 1959 | 4,535 | 20,003 | | 3,688 | 4,226 | 2,545 | 2,425 |
| 1960 | 6,551 | 23,035 | 6,397 | 4,177 | 5,335 | 3,378 | 2,884 |
| 1961 | 7,325 | 23,878 | | 4,079 | 7,324 | 3,708 | 3,129 |
| 1962 | 7,851 | 27,775 | | 4,522 | 11,707 | 4,485 | 3,296 |
| 1963 | 8,768 | 29,803 | 10,358 | 5,084 | 11,285 | 5,467 | 3,897 |
| 1964 | 8,965 | | 11,005 | 9,455 | 14,373 | 7,288 | 4,138 |
| 1965 | 9,750 | | | | 16,185 | | 4,451 |

[1]UNESCO, World Survey of Education IV. Higher, (New York: Unesco), 1967, pp. 19-189.

TABLE A-8

Student/Teacher Ratios and Rates of Growth of Primary Enrollments[1]

| Year | Argentina | | Brazil General | | Brazil Average | | Colombia | | Mexico | | Peru | | Venezuela | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Student/ Teacher Ratio | Rate of Growth of Enrollments | S/T | Rate | S/T | Rate | S/T | Rate | S/T | Rate | S/T | Rate | S/T | Rate |
| 1950 | 23.6 | 3.9 | 38.6 | 4.5 | 32.9 | 4.9 | 46.3 | 8.2 | | | | | 35.0 | 4.0 |
| 1951 | 23.4 | 4.3 | 37.2 | 3.7 | 31.1 | 3.7 | 40.2 | 5.5 | | | | | 33.6 | 6.4 |
| 1952 | 23.5 | 4.0 | 36.6 | 4.0 | 31.4 | 4.4 | 40.6 | 16.2 | | | | | 34.0 | 4.6 |
| 1953 | 23.2 | 3.7 | 36.0 | 7.2 | 31.0 | 6.4 | 42.5 | 4.9 | | | | | 34.0 | 4.5 |
| 1954 | 22.8 | 3.0 | 35.5 | 6.7 | 30.5 | 8.4 | 38.8 | 9.8 | | | | | 34.0 | 3.8 |
| 1955 | 22.7 | .4 | 35.5 | 8.6 | 30.0 | 8.6 | 38.3 | 6.2 | 40.3 | 4.6 | 37.8 | 6.8 | 33.6 | 7.3 |
| 1956 | 21.9 | 2.2 | 35.2 | 6.2 | 30.0 | 5.8 | 38.7 | 5.3 | 39.8 | 9.5 | 38.0 | 2.4 | 34.3 | 8.3 |
| 1957 | 22.0 | 2.8 | 34.9 | 4.8 | 29.9 | 3.8 | 39.1 | 8.1 | 40.7 | 17.5 | 38.4 | 6.0 | 35.9 | 22.9 |
| 1958 | 22.5 | 1.9 | 34.4 | 4.9 | 29.7 | 5.2 | 39.2 | 5.1 | 41.3 | 11.8 | 37.6 | 6.4 | 36.8 | 19.4 |
| 1959 | 21.3 | 1.4 | 33.7 | 4.7 | 28.8 | 5.0 | 39.0 | 7.8 | 41.9 | 6.6 | 36.7 | 3.5 | 35.4 | 13.6 |
| 1960 | 20.9 | 2.1 | 32.9 | 8.8 | 28.3 | 9.2 | 37.6 | 6.0 | 43.2 | 8.2 | 35.3 | 3.8 | 35.2 | 4.4 |
| 1961 | 20.9 | 0.9 | 34.8 | 9.2 | 29.8 | 10.4 | 36.9 | 8.8 | 45.0 | 7.2 | 34.3 | 3.9 | 35.7 | 3.2 |
| 1962 | 20.0 | 2.0 | 31.0 | 9.9 | 26.8 | 9.6 | 36.7 | 7.6 | 44.6 | 6.8 | 33.6 | 8.3 | 35.1 | 2.3 |
| 1963 | 20.0 | 2.9 | | -2.9 | | 1.7 | 33.7 | 5.6 | 44.3 | 6.2 | 34.7 | 14.9 | 34.5 | 3.7 |
| 1964 | 19.8 | 2.0 | | | | | | | 44.4 | 6.1 | 36.6 | 6.3 | 34.2 | 4.2 |
| 1965 | 19.8 | | | | | | | | | | | | | |

[1]The student/teacher ratio is for a given year, n. the rate of growth of enrollments is the average annual rate of growth between year n and n + 1.

TABLE A-9

Student/Teacher Ratio and Average Annual Rate of Growth of Secondary Education Enrollments

| YEAR | ARGENTINA | | BRAZIL | | | | PERU | | VENEZUELA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S/T ratio | growth | S/T ratio | growth | S/T ratio | growth | S/T ratio | growth | S/T ratio | growth |
| 1950 | | | 106.2 | 7.6 | 97.1 | 7.7 | | | 22.5 | 4.8 |
| 1951 | | | 109.8 | 6.6 | 100.1 | 6.1 | | | 21.2 | 2.7 |
| 1952 | | | 108.3 | 10.2 | 98.3 | 10.3 | | | 20.0 | 17.1 |
| 1953 | | | 107.9 | 9.0 | 98.4 | 9.0 | | | 16.8 | 13.7 |
| 1954 | | | 107.3 | 8.6 | 97.9 | 8.3 | | | 20.1 | 23.1 |
| 1955 | 61.2 | | 112.2 | 7.5 | 101.9 | 7.8 | 12.4 | 8.0 | 21.5 | 18.5 |
| 1956 | 55.3 | 1.0 | 110.7 | 8.7 | 101.3 | 8.7 | 13.0 | 12.5 | 16.7 | 5.5 |
| 1957 | 64.1 | 22.0 | 104.3 | 9.6 | 94.9 | 8.8 | 12.9 | 14.9 | 19.9 | 35.0 |
| 1958 | 60.3 | .2 | 114.6 | 7.1 | 103.7 | 7.9 | 13.5 | 13.8 | 22.5 | 32.4 |
| 1959 | 56.3 | -.1 | 111.8 | 10.7 | 101.9 | 10.1 | 12.5 | 11.2 | 20.5 | 20.4 |
| 1960 | 55.8 | 8.0 | 1117.2 | 9.9 | 106.3 | 11.0 | 13.2 | 14.9 | 25.0 | 13.2 |
| 1961 | 57.2 | 7.3 | 125.8 | 12.6 | 115.2 | 11.7 | 13.2 | 5.3 | 26.8 | 8.8 |
| 1962 | 47.1 | -13.4 | 125.7 | 13.4 | 114.2 | 13.6 | 13.1 | 5.4 | 26.0 | 5.5 |
| 1963 | 45.6 | 2.3 | 129.9 | 10.1 | 118.2 | 16.3 | 13.7 | 26.4 | 25.8 | 7.5 |
| 1964 | | | | | | | 14.4 | 18.7 | 27.0 | 5.5 |
| 1965 | | | | | | | 14.6 | | 28.1 | |

TABLE A-10

Student/Teacher Ratio and Average Annual Rate of Growth in Enrollments in Higher Education

| Year | Argentina | | Brazil | | | | Colombia | | Mexico | | Peru | | Venezuela | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Avg. | | Gen. | | | | | | | | | |
| | S/T | Pctg. growth | S/T | Pctg. growth | S/T | Pctg. growth | S/T | Pctg. growth | S/T | Pctg. growth | S/T | Pctg. growth | S/T | Pctg. growth |
| 1955 | 30.6 | -3.7 | 4.5 | | 4.3 | | | 7.8 | 7.8 | | 7.1 | 13.0 | | |
| 1956 | 31.3 | -.9 | 4.6 | 5.7 | 4.5 | 6.4 | | | 9.7 | 34.8 | 7.9 | 15.1 | | |
| 1957 | 32.8 | -4.8 | 4.6 | 5.3 | 4.4 | 5.1 | 5.5 | 17.8 | 11.8 | 11.9 | 8.7 | 12.4 | 7.3 | 5.7 |
| 1958 | 29.2 | -1.5 | 4.5 | 5.2 | 4.3 | 5.3 | 6 4 | 13.7 | 18.9 | 10.2 | 9.0 | 2.8 | 8.6 | 32.0 |
| 1959 | 37.3 | 10.2 | 4.3 | 6.4 | 4.1 | 6.3 | 5.8 | 10.3 | 18.5 | 11.9 | 10.5 | 13.5 | 9.5 | 24.4 |
| 1960 | 27.8 | -1.52 | 4.2 | 8.5 | 3.9 | 8.4 | 5.7 | 15.8 | 16.5 | 9.8 | 9.1 | 13.4 | 8.4 | 19.2 |
| 1961 | 24.5 | -5.6 | 4.3 | 5.3 | 4.2 | 5.7 | 6.6 | 16.0 | 13.7 | 74.7 | 9.3 | 12.5 | 9.3 | 8.9 |
| 1962 | 24.1 | 8.3 | 3.9 | 14.9 | 3.8 | 13.8 | 7.1 | 2.4 | 9.4 | 9.8 | 8.7 | 16.9 | 9.6 | 2.6 |
| 1963 | 23.4 | | 4.2 | 14.1 | 4.02 | | 6.4 | 13.4 | 11.2 | 14.7 | 8.3 | 10.1 | 9.0 | 17.3 |
| 1964 | | | | | | | 3.9 | | 8.7 | -.4 | 7.8 | 13.7 | 9.4 | 13.2 |

TABLE A-11

Legal School Age Population and Annual Average Rate of Growth[1]

| Country | Legal Age | Population 1950 | Population 1960 | Rate of Growth |
|---|---|---|---|---|
| | | Primary Education | | |
| Argentina | 5-11 | 2,189,694 | 3,605,500 | 2.6 |
| Brazil | 7-10 | 5,530,648 | 7,875,981 | 3.3 |
| Chile | 7-12 | 869,900 | 1,084,146 | 2.7 |
| Colombia | 7-11 | 1,563,368 | 2,800,931 | 4.3 |
| Mexico | 6-11 | 4,123,953 | 5,946,037 | 3.4 |
| Peru | 7-11 | 1,156,125 | NA | |
| Venezuela | 7-12 | 764,527 | 1,260,462 | 4.2 |
| | | Secondary Education | | |
| Argentina | 12-16 | 1,546,733 | 2,105,020 | 1.6 |
| Brazil | 11-17 | 8,180.154 | 10,945,329 | 2.7 |
| Chile | 13-18 | 729,500 | 915,470 | 2.6 |
| Colombia | 12-17 | 2,993,391 | 4,035,083 | 2.1 |
| Mexico | 12-16 | 2,953,100 | 4,028,659 | 2.8 |
| Peru | 12-17 | | | |
| Venezuela | 13-17 | 498,858 | 730,794 | 3.2 |
| | | Higher Education | | |
| Argentina | 17-21 | 1,541,390 | 1,889,990 | 1.1 |
| Brazil | 18-22 | 5,343,563 | 6,641,644 | 2.0 |
| Chile | 19-23 | 571,500 | 613,509 | .8 |
| Colombia | 18-22 | 1,082,978 | 1,417,375 | 1.9 |
| Mexico | 17-21 | 2,409,858 | 3,269,515 | 2.8 |
| Peru | | | | |
| Venezuela | 18-22 | 505,112 | 636,780 | 1.9 |

TABLE A-12

Urban/Rural Population Distribution
And Average Annual Rate of Change[1]

| Country | 1950 Population | Percentage Urban | 1960 Population | Percentage Urban | Average Annual Rate of Change |
|---|---|---|---|---|---|
| Argentina | 15,893,527 | 62.5 | 20,003,945 | n.a. | |
| Brazil | 51,944,397 | 36.2 | 90,110,071 | 46.3 | 2.2 |
| Chile | 5,941,750 | 59.9 | 7,374,115 | 68.2 | 1.4 |
| Colombia | 11,545,372 | 36.3 | 17,484,508 | 52.8 | 5.2 |
| Mexico | 25,791,017 | 42.6 | 34,923,129 | 50.7 | 1.2 |
| Peru | n.a. | | 9,906,764 | 47.4 | |
| Venezuela | 5,034,838 | 53.8 | 7,523,999 | 67.4 | 1.9 |

[1]Gabriel Cherin and Richard Hattwick, Manpower, Education, and Economic Development in Latin America, (National Science Foundation Grant GR 3, 1969), Table IV C1A.

TABLE A-13

Percentage Enrollment of Females in Primary Education

| Year | Argentina | Brazil | Chile | Colombia | Peru | Venezuela |
|---|---|---|---|---|---|---|
| 1950 | 47.4[1] | | 49.0[3] | 49.0[4] | | 50.1[6] |
| 1951 | 47.7 | | 49.0 | 49.3 | | 49.6 |
| 1952 | 47.8 | | 48.8 | 48.7 | | 49.5 |
| 1953 | 47.9 | | 48.4 | 48.9 | | 49.6 |
| 1954 | 47.9 | | 48.9 | 49.3 | | 49.5 |
| 1955 | 48.0 | 48.7[2] | 49.0 | 49.1 | 40.2[5] | 48.9 |
| 1956 | 47.9 | 49.1 | 48.0 | 49.1 | 41.1 | 49.2 |
| 1957 | 48.1 | 48.8 | 47.8 | 49.4 | 41.9 | 49.0 |
| 1958 | 48.2 | 49.1 | --- | 49.5 | 42.2 | 49.4 |
| 1959 | 48.3 | 49.1 | --- | 49.6 | 42.2 | 49.2 |
| 1960 | 48.4 | 49.1 | 49.3 | 49.9 | 41.5 | 49.2 |
| 1961 | 48.3 | 49.1 | 49.3 | 49.6 | 43.5 | 49.3 |
| 1962 | 48.4 | 49.1 | 49.2 | 49.8 | 43.3 | 49.3 |
| 1963 | 48.4 | 49.1 | --- | 49.7 | 43.9 | 49.4 |
| 1964 | 48.3 | 49.9 | 48.7 | 49.9 | 44.5 | 49.5 |
| 1965 | 48.4 | | | | 45.0 | |

[1]Departamento de Estatistica Educativa, Ensenanza Primaria, p. 18.

[2]Ministerio do Plamenjamento, Plano Decenal, p. 48.

[3]Instituto Latinamenicano de Panificacion Economico, Necessidalen ..., p. 29.

[4]Instituto Colombiano de Especializacion Tecnica, Recursos y Requerimentos, p. 148.

[5]Instituto Nacional de Planificacion, Desarrollo ..., p. 57.

[6]Ministerio de Educacion, Memoria y Cuenta, p. 62.

TABLE A-14

Percentage Enrollment of Females in Secondary Education

| Year | Argentina | Chile | Mexico | Peru | Venezuela |
|---|---|---|---|---|---|
| 1950 | 52.8[1] | 55.2[2] | | | 38.4[5] |
| 1951 | 52.5 | 55.3 | | | 37.1 |
| 1952 | 52.0 | 54.9 | | | 38.8 |
| 1953 | 52.6 | 54.7 | | | 38.1 |
| 1954 | 53.4 | 54.7 | 40.5[3] | | 38.9 |
| 1955 | 53.7 | 54.3 | 40.5 | 39.0[4] | 39.8 |
| 1956 | 56.5 | 57.1 | 41.1 | 37.3 | 39.6 |
| 1957 | 54.9 | 53.4 | 41.0 | 36.5 | 44.4 |
| 1958 | 51.9 | --- | 40.2 | 36.7 | 45.9 |
| 1959 | 55.5 | --- | 41.4 | 35.8 | 46.0 |
| 1960 | 56.0 | 49.6 | --- | 37.8 | 47.8 |
| 1961 | 56.0 | 50.3 | --- | 38.3 | 48.9 |
| 1962 | 56.7 | 48.9 | 40.1 | 38.6 | 49.6 |
| 1963 | 56.5 | 49.2 | 40.7 | 39.9 | 49.1 |
| 1964 | | | 39.9 | 40.0 | 48.3 |
| 1965 | | | | | 47.7 |

[1]Inter-America Statistical Institute, America en Cifras, p. 106.

[2]Instituto de Organizacion y Administracion, Estudio de Recursos Humanos, p. 111.

[3]Nacional Financiera, SA, Statistics on Mexican Economy, p. 157.

[4]Ministerio de Educativa Publica, La Educcacion in Peru, p. 249.

[5]Ministerio de Educacion, Memoria y Cuenta, p. 408.

TABLE A-15

Percentage of Gross Domestic Product Produced

In the Manfacturing and Service Sectors

| | 1953 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | | | | | | | | | | | | |
| Manufacturing | 28.1 | 30.1 | 31.0 | 31.8 | 32.6 | 31.8 | 32.2 | 33.3 | 32.1 | 31.8 | 33.9 | 3.5 |
| Service | 7.7 | 7.4 | 7.2 | 7.2 | 7.1 | 7.5 | 7.7 | 7.5 | 7.5 | 7.5 | 7.2 | 6.8 |
| Chile | | | | | | | | | | | | |
| Manufacturing | 17.5 | 19.3 | 18.9 | 19.0 | 18.8 | 18.4 | 18.4 | 17.3 | 17.0 | 17.2 | 18.4 | 17.6 |
| Service | 11.4 | 10.5 | 10.3 | 10.4 | 10.4 | 10.1 | 10.2 | 10.0 | 10.2 | 10.9 | 11.0 | 10.5 |
| Colombia | | | | | | | | | | | | |
| Manfacturing | 14.4 | 15.1 | 15.6 | 15.9 | 16.2 | 16.4 | 16.7 | 17.2 | 18.4 | 17.4 | 17.4 | 17.7 |
| Service | 7.5 | 7.4 | 7.6 | 7.6 | 7.7 | 7.5 | 7.6 | 7.8 | 7.5 | 7.6 | 7.4 | 7.6 |
| Mexico | | | | | | | | | | | | |
| Manfacturing | 23.9 | 23.7 | 18.6 | 20.6 | 21.8 | 22.5 | 26.2 | 26.4 | 26.6 | 27.2 | 28.1 | 28.5 |
| Service | 12.8 | 13.6 | 14.2 | 14.2 | 14.5 | 14.2 | 14.7 | 14.8 | 14.8 | 14.9 | 14.6 | 14.6 |
| Peru | | | | | | | | | | | | |
| Manfacturing | 12.3 | 14.7 | 14.5 | 16.0 | 14.9 | 15.8 | 16.5 | 16.8 | 17.1 | 17.5 | 17.9 | |
| Service | 31.6 | 36.0 | 37.9 | 35.8 | 36.8 | 36.4 | 34.3 | 35.3 | 36.1 | 36.8 | 36.7 | |
| Venezuela | | | | | | | | | | | | |
| Manfacturing | 10.9 | 11.7 | 11.6 | 11.6 | 12.3 | 13.1 | 12.5 | 12.8 | 13.8 | 13.4 | 14.1 | 14.6 |
| Service | 11.3 | 10.9 | 10.7 | 10.4 | 11.1 | 11.3 | na | na | na | 12.7 | 12.7 | 13.2 |

TABLE A-16

Retention Rates in Primary Education

| Year | Argentina | Brazil | Chile | Peru | Venezuela |
|---|---|---|---|---|---|
| 1950 | .76 | | .80[3] | | |
| 1951 | .82 | | .80 | | |
| 1952 | 1.00 | | .80 | | |
| 1953 | .73 | | .81 | | |
| 1954 | .72 | .80[2] | .82 | | |
| 1955 | .72 | .73 | .82 | | |
| 1956 | .78 | .75 | .81 | .78[4] | |
| 1957 | .67 | .77 | .82 | .78 | |
| 1958 | .71 | .75 | .81 | .83 | .76[5] |
| 1959 | .71 | .75 | .81 | .84 | .73 |
| 1960 | .72 | .78 | .79 | .82 | .71 |
| 1961 | .73 | .78 | | .85 | .69 |
| 1962 | .74 | .78 | | .79 | .69 |
| 1963 | .74 | .77 | | .81 | .66 |
| 1964 | | | | .92 | .73 |
| 1965 | | | | .86 | .70 |

[1]Departmento de Educativa Educativa, Ensenaza Primaria, p. 36.

[2]Ministerio do Planejamento, Plano Decal, p. 87.

[3]Universidad de Chile, La Economia Chilena, p. 38.

[4]Instituto do Planificacion, Desarollo ..., p. 82.

[5]Ministerio de Educacion, Memoria y Cuenta, p. 89.

# APPENDIX B.

TABLE B-1
Estimation of Teacher Supply Function
Primary Education

| Country | $\hat{B}_3=(1-\hat{\lambda})$ | $\hat{B}_2=\hat{\lambda}K_1$ | $\hat{B}_1+\hat{\lambda}K0$ | Simple Correlation | |
|---|---|---|---|---|---|
| Argentina $\hat{B}$ | .899 | .00000022 | .00418 | 1+2 | .987 |
| Standard Error | ( .1277) | ( .00000014) | ( .00582) | 1+3 | .919 |
| T-value | (7.041 )* | (1.588 )** | (-.718 ) | 1+4 | .984 |
| | | | | 2+3 | .892 |
| | | | | 2+4 | .973 |
| Standard Deviation = 2574 | $R^2$=.975 | F=194.22* | Duban-Watson=1.701 | 3+4 | .987 |
| Brazil | | | | | |
| Average $=\hat{B}$ = | .8611 | .00000087 | .000166 | 1+2 | .995 |
| Enrollment SE = | ( .4321) | (.00000106) | ( .007155) | 1+3 | .994 |
| T | (1.922 )* | (.85 ) | (-.023 ) | 1+4 | .998 |
| | | | | 2+3 | .996 |
| | | | | 2+4 | .986 |
| SD = 4334.4 | $R^2$=.988 | F=297.7* | DW=2.639 | 3+4 | .993 |
| Brazil | | | | | |
| General $+\hat{B}$ = | .8625 | .00000089 | .001507 | 1+2 | .995 |
| Enrollment SE = | ( .3296) | ( .00000083) | ( .00464 ) | 1+3 | .992 |
| T = | (2.616 )* | (1.082 ) | (-.324 ) | 1+4 | .983 |
| | | | | 2+3 | .992 |
| | | | | 2+4 | .987 |
| SD = 4335.4 | $R^2$=.988 | F=324.6* | DW=2.544 | 3+4 | .996 |
| Colombia $\hat{B}$ | .4364 | .0000199 | .012306 | 1+2 | .988 |
| SE = | (.9700) | ( .0000123) | ( .016155) | 1+3 | .989 |
| T = | (.450 ) | (1.619 )** | (-.762 ) | 1+4 | .987 |
| | | | | 2+3 | .996 |
| | | | | 2+4 | .995 |
| SD = 1736.5 | $R^2$=.969 | F=127.5* | DW=1.918 | 3+4 | .997 |

TABLE B-1 Continued
Estimation of Teacher Supply Function
Primary Education

| | | | | | | |
|---|---|---|---|---|---|---|
| Mexico | $\hat{B}$ | .77089 | -.0000020 | .011018 | 1+2 | .997 |
| | SE | ( .1977 ) | ( .00000125) | ( .00688 ) | 1+3 | .994 |
| | T | (3.90 )* | (-1.62 ) | (1.60 ) | 1+4 | .997 |
| | | | | | 2+3 | .999 |
| | | | | | 2+4 | .997 |
| | SD = 1695.0 | $R^2$=.994 | F=745.6* | DW=1.748 | 3+4 | .996 |
| Peru | $\hat{B}$ | .59988 | .00000754 | .01264 | 1+2 | .969 |
| | SE | ( .28463)* | (.0002157 ) | ( .00829) | 1+3 | .333 |
| | T | (2.108 )* | (.349 ) | (1.523 ) | 1+4 | .968 |
| | | | | | 2+3 | -.337 |
| | | | | | 2+4 | .978 |
| | SD = 2284.7 | $R^2$=.933 | F=64.37 | DW=2.594 | 3+4 | -.474 |
| Venezuela | $\hat{B}$ | - .50098 | .0001549 | .039435 | 1+2 | .978 |
| General | SE | ( .4584 ) | (.0003558) | ( .013411) | 1+3 | .991 |
| Enrollment | T | (-1.093 ) | (.435 ) | (2.94 ) | 1+4 | .989 |
| | | | | | 2+3 | .993 |
| | | | | | 2+4 | .992 |
| | SD = 1575.6 | $R^2$=.969 | F=161.2* | DW=.9844 | 3+4 | .996 |
| Venezuela | $\hat{B}$ | -.22412 | -.000029 | .05683 | 1+2 | .984 |
| Average | SE | ( .9237 ) | ( .000104) | ( .03341) | 1+3 | .988 |
| Enrollment | T | (-.243 ) | (-.282 ) | (1.701 ) | 1+4 | .983 |
| | | | | | 2+3 | .991 |
| | | | | | 2+4 | .991 |
| | SD = 2473.5 | $R^2$=.83 | F=18.1* | DW=.6436 | 3+4 | .993 |

*Significant at risk = .10

**Significant at risk = .20

TABLE B-2

Estimation of Teacher Supply Function

Secondary Education

$$T_t = \hat{\lambda}\hat{K}_0 E_{t-1} + \hat{\lambda}\hat{K}_1 (GOP_{t-1}) F_{t-1} + (1 - \hat{\lambda}) T_{t-1}$$

| Country | | $\hat{P}_3 = 1-\hat{\lambda}$ | $\hat{B}_2 = \hat{\lambda}\hat{K}_1$ | $\hat{B}_3 = \hat{\lambda}\hat{K}_0$ | Simple Correlation | |
|---|---|---|---|---|---|---|
| Argentina | $\hat{B}$ | (.99032) | (-.00000104) | ( .060398) | 1&2 | .996 |
| | SE | (.05469) | ( .00000045) | ( .023201) | 1&3 | .705 |
| | T | (18.108)* | (-2.314 )* | (2.603 )* | 1&4 | .751 |
| | | | | | 2&3 | .731 |
| | | | | | 2&4 | .769 |
| | SD = 2234.1 | $R^2$ = .991 | F = 389.8* | DW = 2.291 | 3&4 | .976 |
| Brazil General | $\hat{B}$ | ( .6246) | (-.00000034) | (.069258) | 1&2 | .972 |
| | SE | ( .468 ) | ( .00000050) | (.082409) | 1&3 | .965 |
| | T | (1.334 ) | -.674 ) | (.84 ) | 1&4 | .968 |
| | | | | | 2&3 | .976 |
| | | | | | 2&4 | .978 |
| | SD = 4841.4 | $R^2$ = .937 | F = 60.9* | DW = 2.883 | 3&4 | .999 |
| Brazil Average | $\hat{B}$ | (.10225) | (-.00000076) | (.161697) | 1&2 | .972 |
| | SE | (.29326) | ( .00000032) | (.053882) | 1&3 | .983 |
| | T | (.349 ) | (-2.413 )* | (3.001 ) | 1&4 | .988 |
| | | | | | 2&3 | .978 |
| | | | | | 2&4 | .980 |
| | SD = 3092.1 | $R^2$ = .976 | F = 154.7* | DW = 2.545 | 3&4 | .998 |
| Mexico | $\hat{B}$ | (.36954) | (.0000872) | (-.11224) | 1&2 | .946 |
| | SE | (.46763) | (.0000807) | ( .14302) | 1&3 | .967 |
| | T | (.790 ) | (1.081 ) | (-.785 ) | 1&4 | .966 |
| | | | | | 2&3 | .964 |
| | | | | | 2&4 | .959 |
| | SD = 1496.3 | $R^2$ = .901 | F = 32.93* | DW = 2.124 | 3&4 | .966 |

TABLE B-2 Continued

Estimation of Teacher Supply Function

Secondary Education

| Country | | $\hat{B}_3=1-\lambda$ | $\hat{B}_2=\lambda\hat{K}_1$ | $\hat{B}_3=\lambda\hat{K}_0$ | Simple Correlation | |
|---|---|---|---|---|---|---|
| | | | | | 1&2 | .977 |
| | $\hat{B}$ | (-.22268) | (-.0000504) | ( .12976) | 1&3 | .984 |
| Peru | SE | ( .60143) | ( .0000439) | ( .06677) | 1&4 | .986 |
| | T | ( ) | (-1.146 ) | (1.943 ) | 2&3 | .993 |
| | | | | | 2&4 | .994 |
| | SD = 951.2 | $R^2$ = .966 | F = 128.9* | DW = 2.534 | 3&4 | .998 |
| | | | | | 1&2 | .996 |
| | $\hat{B}$ | ( .96119) | (-.0000116) | (.04835) | 1&3 | .977 |
| Venezuela | SE | ( .3791 ) | ( .0000125) | (.05626) | 1&4 | .978 |
| | T | (2.535 )* | (-.932 ) | (.860 ) | 2&3 | .985 |
| | | | | | 2&4 | .987 |
| | SD = 804.1 | $R^2$ = 897 | F = 44.70* | DW = 2.134 | 3&4 | .998 |

TABLE B-3

Estimation of Teacher Supply Function Higher Education

$$T_t = \hat{\lambda}K_0 E_{t-1} + \hat{\lambda}K_1 (GDP_{t-1}) E_{t-1} + (1-\hat{\lambda})T_{t-1}$$

| Country | $\hat{B}_3=(1-\hat{\lambda}-)$ | $\hat{B}_2= K_1$ | $\hat{B}_1= K_0$ | Simple Correlation | |
|---|---|---|---|---|---|
| | | | | 1&2 | .927 |
| Argentina | $\hat{B}$ .330626 | .0000006 | -.003341 | 1&3 | .927 |
| | SE ( .264442) | ( .00000042) | ( .0202643) | 1&4 | .986 |
| | T (1.250 ) | (1.508 ) | (-.165 ) | 2&3 | .911 |
| | | | | 2&4 | .935 |
| | SD = 552.2 | $R^2$ = .920 F = 53.15* | DW = 1.66 | 3&4 | .987 |
| | | | | 1&2 | .970 |
| Brazil | $\hat{B}$ .509161 | .00000136 | .002417 | 1&3 | .981 |
| | SE (.783438) | ( .00000122) | (.148872) | 1&4 | .959 |
| | T (.650 ) | (1.12 ) | (.016 ) | 2&3 | .993 |
| | | | | 2&4 | .982 |
| | SD = 1195. | $R^2$ = .931 F = 41.61 | DW = 3.16 | 3&4 | .993 |
| | | | | 1&2 | .952 |
| Colombia | $\hat{B}$ .38678 | .00001207 | .0271191 | 1&3 | .982 |
| | SE (.39790) | (.00000812) | (.01678201) | 1&4 | .979 |
| | T (.972 ) | (-1.389 )* | (1.616 )* | 2&3 | .967 |
| | | | | 2&4 | .964 |
| | SD = 234.2 | $R^2$ = .914 F = 33.50 | DW = 2.1297 | 3&4 | .999 |
| | | | | 1&2 | .946 |
| Mexico | $\hat{B}$ .26754 | .000943 | -.214345 | 1&3 | .967 |
| | SE (.467630) | (.0000908) | ( .184724) | 1&4 | .966 |
| | T (.590 ) | (1.081 ) | (-.785 ) | 2&3 | .964 |
| | | | | 2&4 | .959 |
| | SD = 496.3 | $R^2$ = .901 F = 32.9* | DW = 2.124 | 3&4 | .995 |

TABLE B-3 Continued

Estimation of Teacher Supply Function Higher Education

| | | | | | | |
|---|---|---|---|---|---|---|
| Peru | $\hat{B}$ | .983862 | .0000257 | .127676 | 1&2 | .974 |
| | SE | ( .404722) | ( .00000775) | .0662072) | 1&3 | .965 |
| | T | (2.431 )* | (3.323 )* | (-1.928 )* | 1&4 | .955 |
| | | | | | 2&3 | .960 |
| | | | | | 2&4 | .957 |
| | SD = 346.3 | $R^2$ = .953 | F = 83.48 | DW = 2.841 | 3&4 | .996 |
| Venezuela | $\hat{B}$ | 1.43411 | -.0000213 | .04539027 | 1&2 | .987 |
| | SE | ( .338452) | ( .00002356) | (.1007603 ) | 1&3 | .988 |
| | T | (4.237 )* | (-.905 ) | (.450 ) | 1&4 | .982 |
| | | | | | 2&3 | .990 |
| | | | | | 2&4 | .980 |
| | SD = 229.0 | $R^2$ = .927 | F = 45.75* | DW = 2.262 | 3&4 | .997 |

TABLE B-4

Estimation of Teacher Supply Function Primary Education

Estimating Equation

$$\frac{T_t}{E_{t-1}} = \hat{\lambda}K_0 + \hat{\lambda}K_1(GDP_{t-1}) + (1-\hat{\lambda})\frac{T_{t-1}}{E_{t-1}}$$

| Country | | $\hat{B}_2=(1-\hat{\lambda})$ | $\hat{B}_1=\hat{K}_1\hat{\lambda}$ | $\hat{A}=\hat{K}_0\hat{\lambda}$ | Simple Correlation | |
|---|---|---|---|---|---|---|
| Argentina | $\hat{B}$ = | ( .7406) | ( .000021) | (.00459) | 1 & 2 | .94 |
| | SE $\hat{B}$ | ( .1677) | ( .000009) | (.00508) | 1 & 3 | .87 |
| | T | (4.414 )* | (2.3 )* | (.903 ) | 2 & 3 | .78 |
| | SD = .0008353 | $R^2$ = .91 | F = 53.27 | DW = 1.63* | | |
| Brazil Average | $\hat{B}$ = | ( .000050) | (-.0001184) | (.02321) | 1 & 2 | .92 |
| | SE $\hat{B}$ | ( .000040) | (-.002409 ) | (.01327) | 1 & 3 | .89 |
| | T | (1.25 ) | (-.049 ) | | 2 & 3 | .97 |
| | SD = .000848 | $R^2$ = .78 | F =13.88* | DW = 1.82 | | |
| Brazil Intial | B = | ( .9844) | (.000541) | ( -.001507) | 1 & 2 | .95 |
| | SE B | ( .4307) | (.000981) | ( .007629) | 1 & 3 | .90 |
| | T | (2.285 )* | (.552 ) | (-1.98 ) | 2 & 3 | .91 |
| | SD = .0007244 | $R^2$ = .87 | F =24.57* | DW = 2.77 | | |
| Colombia** | $\hat{B}$ = | ( .00000008) | ( -.00000047) | 0 | 1 & 2 | .79 |
| | SE $\hat{B}$ | ( .00000003) | ( .00000020) | | 1 & 3 | .80 |
| | T | (2.890 )* | (-2.369 )* | | 2 & 3 | .99 |
| | SD = .00281 | $R^2$ =-2.79 | F = 1.95 | DW = 2.165 | | |
| Mexico** | $\hat{B}$ = | ( .0000844) | ( -.00000067) | 0 | 1 & 2 | -.93 |
| | SE $\hat{B}$ | ( .0000098) | ( .00000010) | | 1 & 3 | -.93 |
| | T | (9.197 ) | (-6.764 )* | | 2 & 3 | .99 |
| | SD = .000786 | $R^2$ = .46 | F = 4.84* | DW = 2.631 | | |

TABLE B-4 Continued

Estimation of Teacher Supply Primary Education

Estimating Equation

| Country | | $\hat{B}_2=(1-\lambda)$ | $\hat{B}_1=K_1$ | $\hat{A}=K_0$ | Simple Correlation | |
|---|---|---|---|---|---|---|
| Peru** | $\hat{B}$ = | ( .0000731) | ( .00000048) | 0 | 1 & 2 | .60 |
| | SE $\hat{B}$ | ( .000023 ) | ( .00000011) | | 1 & 3 | .18 |
| | T | (-3.07 )* | (4.86 )* | | | |
| | SD = .0190 | $R^2$ = -.02 | F = .88 | DW = 3.181 | | |
| Venezuela** | $\hat{B}$ = | (-.0000299) | ( .00000383) | 0 | 1 & 2 | --- |
| | SE B | ( .000246 ) | ( .000246 ) | | 1 & 3 | --- |
| | T | (-.122 ) | (-2.003 ) | | 2 & 3 | --- |
| | SD = .008457 | $R^2$ = -.30 | F =-3.84 | DW = 1.68 | | |

*Significant at a 95% level of confidence.

**The determinant of the estimating process approached zero. Estimates presented force the regression equation through the origin.

TABLE B-5

Estimation of Teacher Supply Function Secondary Education

Estimating Equation

$$\frac{T_t}{E_{t-1}} = \hat{\lambda}\hat{K}_0 + \hat{\lambda}\hat{K}_1(GDP_{t-1}) = +(1-\hat{\lambda})\frac{T_{t-1}}{E_{t-1}}$$

| Country | | $\hat{B}_2 = (1-\hat{\lambda})$ | $\hat{B}_1 = \hat{K}_1\hat{\lambda}$ | $\hat{A} = \hat{K}_0\hat{\lambda}$ | Simple Correlation | |
|---|---|---|---|---|---|---|
| Argentina | $\hat{B}$ = | ( .98037) | (-.001102) | ( .06505) | 1 & 2 | .98 |
| | SE B | ( .06315) | ( .000516) | ( .00051) | 1 & 3 | -.14 |
| | T | (15.524 )* | (2.134 )* | (2.482 )* | 2 & 3 | -.09 |
| | SD = .0028 | $R^2$ = .97 | F = 123 | DW = 2.29 | | |
| Brazil Average | $\hat{B}$ = | (.11407) | ( -.000679) | ( .15320) | 1 & 2 | .69 |
| | SE B | (.3322 ) | ( .000314) | ( .05660) | 1 & 3 | -.84 |
| | T | (.343 ) | (-2.163 )* | (2.707 )* | 2 & 3 | -.77 |
| | SD = .00365 | $R^2$ = .61 | F = 7.43* | DW = 2.42 | | |
| Brazil General | $\hat{B}$ = | ( .48763) | (-.000437) | ( .09009) | 1 & 2 | .79 |
| | SE B | ( .43090) | ( .000419) | ( .07141) | 1 & 3 | -.78 |
| | T | (1.132 ) | (-1.043 ) | 1.262 ) | 2 & 3 | -.81 |
| | SD = .004444 | $R^2$ = .57 | F = 6.64* | DW = 2.86 | | |
| Mexico | $\hat{B}$ = | (.47817) | ( .09431) | (-.13810) | 1 & 2 | .79 |
| | SE B | (.49775) | ( .08925) | ( .15639) | 1 & 3 | .80 |
| | T | (.961 ) | (1.057 ) | (-.883 ) | 2 & 3 | .82 |
| | SD = .0174 | $R^2$ = .58 | F = 5.94* | DW = 2.073 | | |

TABLE B-5 Continued

Estimation of Teacher Supply Function Secondary Education

Estimating Equation

| Country | | $\hat{B}_2 = (1-\hat{\lambda})$ | $\hat{B}_1 = \hat{K}_1 \hat{\lambda}$ | $\hat{A} = \hat{K}_0 \hat{\lambda}$ | Simple Correlation | |
|---|---|---|---|---|---|---|
| Peru | $\hat{B}$ = | (-.21795) | ( -.04029) | ( .12813) | 1 & 2 | .26 |
| | SE $\hat{B}$ | ( .51105) | ( .03441) | ( .05467) | 1 & 3 | -.50 |
| | T | (-.426 ) | (-1.396 ) | (2.43 )* | 2 & 3 | -.72 |
| | SD = .0042 | $R^2$ = .06 | F = 1.32 | DW = 2.5 | | |
| Venezuela | $\hat{B}$ = | ( .59960) | ( -.02748) | ( .12302) | 1 & 2 | .67 |
| | SE $\hat{B}$ | ( .39112) | ( .01494) | ( .06518) | 1 & 3 | -.71 |
| | T | (1.533 ) | (-1.839 ) | (-1.88 ) | 2 & 3 | -.56 |
| | SD = .007529 | $R^2$ = .52 | F = 6.51* | DW = 1.841 | | |

TABLE B-6

Estimation of Teacher Supply Function University Education

Estimating Equation

$$\frac{T_t}{E_{t-1}} = \hat{\lambda}\hat{K}_0 + \hat{\lambda}\hat{K}_1(GDP_{t-1}) = +(1-\hat{\lambda})\frac{T_{t-1}}{E_{t-1}}$$

| Country | $\hat{B}_2 = (1-\lambda)$ | $\hat{B}_1 = \hat{K}_1\hat{\lambda}$ | $\hat{A} = \hat{K}_0\hat{\lambda}$ | Simple Correlation | |
|---|---|---|---|---|---|
| Argentina | $\hat{B}$= (.26437) | (.00097) | (-.01760) | 1 & 2 | .36 |
| | SE $\hat{B}$ (.27054) | (.00044) | ( .22136) | 1 & 3 | .64 |
| | T (.977 ) | (2.192 )* | (-.824 ) | 2 & 3 | .16 |
| | SD= .00306 | $R^2$= .34 | F=3.32 | DW= 1.685 | |
| Brazil Average | $\hat{B}$= (.28035) | ( .001108) | (.022318) | 1 & 2 | .61 |
| | SE $\hat{B}$ (.75304) | ( .001115) | (.132501) | 1 & 3 | .74 |
| | T (.372 ) | (1.534 ) | (.168 ) | 2 & 3 | .55 |
| | SD= .011347 | $R^2$= .32 | F=2.56 | DW= 3.067 | |
| Brazil General | $\hat{B}$=(-.49250) | (.004323) | (-.02539) | 1 & 2 | .23 |
| | SE $\hat{B}$ ( .64535) | (.001482) | ( .14926) | 1 & 3 | .80 |
| | T (-.763 ) | (2.91 )* | (-.170 ) | 2 & 3 | .51 |
| | SD= .01644 | $R^2$= .54 | F=4.60 | DW= .8865 | |
| Colombia** | $\hat{B}$=( .000365) | ( -.0000023) | 0 | 1 & 2 | -.82 |
| | SE $\hat{B}$ ( .000273) | ( -.00000056) | | 1 & 3 | -.85 |
| | T (1.33 ) | (-4.24 )* | | 2 & 3 | .96 |
| | SD= .00161 | $R^2$= -.72 | F= -.2 | DW= 1.652 | |

TABLE B-6 Continued

Estimation of Teacher Supply Function University Education

Estimating Equation

| Country | $B_2$= (1- ) | $B_1=K_1$ | A=$K_0$ | Simple Correlation |
|---|---|---|---|---|
| Peru | B = ( .89347) | ( .022528) | (-.09878) | 1 & 2 .44 |
| | SE B ( .33900) | ( .008112) | ( .06936) | 1 & 3 .48 |
| | T (2.636 )* | (2.77 )* | (-.1424 ) | 2 & 3 -.36 |
| | SD= .011865 | $R^2$= .5289 | F= 5.49* | DW= 3.027 |
| Venezuela | B = (1.2663 ) | ( .019081) | ( .00825) | 1 & 2 .96 |
| | SE B ( .23709) | (-.028802) | ( .11915) | 1 & 3 -.47 |
| | T (7.871 ) | (-.663 ) | (-.069 ) | 2 & 3 -.42 |
| | SD = .008443 | $R^2$= .92 | F =40.60 | DW= 2.65 |

Table B-7

Coefficient of Correlation

Between Selected Variables and Enrollments Primary in Education

| Country | Years | GDP | Teachers | Sex | Manu. | Ret. |
|---|---|---|---|---|---|---|
| Argentina | 1953-64 | .61 | .94 | .88 | .74 | .59 |
| Brazil | | | | | | |
| General | 1956-62 | .92 | .98 | | | |
| Average | 1956-62 | .92 | .98 | | | |
| Chile | 1953-64 | X | | X | X | |
| Colombia | 1953-63 | .83 | .98 | .72 | .88 | |
| Mexico | 1955-64 | .94 | .98 | | .79 | |
| Peru | 1953-65 | .83 | .96 | .83 | .83 | .74 |
| Venezuela | 1953-65 | .77 | .98 | X | .86 | |
| General | 1957-65 | .41 | .98 | X | .62 | |
| Average | 1957-65 | .43 | .98 | X | .66 | |

"X" represents no significant relationships at .95 level of confidence.

Table B-8

Secondary Education

Coefficient of Correlation

Between Enrollments and Selected Variables

| Country | Years | GDP | Teachers | Sex | Manu. | Ret. |
|---|---|---|---|---|---|---|
| Argentina | 1956-63 | .87 | .98 | .76 | .94 | .69 |
| Brazil | 1955-62 | .93 | .98 | | | .70 |
| General | 1955-62 | .94 | .99 | | | X |
| Chile | 1955-64 | .92 | | | X | |
| Mexico | 1955-65 | .92 | | | .94 | |
| Peru | 1955-64 | .94 | .99 | X | .91 | .71 |
| Venezuela | 1955-65 | .79 | .98 | .88 | .95 | |
| General | 1955-65 | .74 | .98 | .98 | .98 | X |

"X" indicates coefficients of correlation which were not significant at the 95% level of confidence.

TABLE B-9

Higher Education

Coefficients of Correlation

Between Enrollments and Selected Variables

| Country | Years | GDP | Teachers | Manu. |
|---|---|---|---|---|
| Argentina | 1955-65 | .72 | .98 | .76 |
| | 1955-63 | X | .92 | X |
| Brazil | | | | |
| General | 1956-63 | .91 | .98 | |
| Average | 1956-62 | .92 | .96 | |
| Chile | 1955-65 | .91 | .98 | .92 |
| Colombia | 1955-64 | .90 | .97 | .82 |
| Mexico | 1955-64 | .94 | .83 | .88 |
| Peru | 1955-64 | .95 | .94 | .99 |
| Venezuela | 1957-65 | .70 | .99 | .94 |
| | 1953-65 | .66 | | .95 |

"X" indicates coefficients of correlation which were not significant at the 95% level of confidence.

Table B-10

Multiple Regression Results Primary Education[1]
STANDARDIZED BETA VALUES[2]

| Country | Years | GDP | Teachers | Sex | Manu. | Ret. | $R^2$[3] | S.E.[4] | D.W.[5] |
|---|---|---|---|---|---|---|---|---|---|
| Argentina | 1953-64 | X | .64 | X | .28 | .16 | .994 | 10790 | 3.195 |
| Brazil | | | | | | | | | |
| General | 1956-62 | X | .83 | | | | .99 | 73531 | 2.886 |
| Average | 1956-62 | -1.02 | X | | | | .99 | 62072 | 1.621 |
| Chile | 1953-64 | X | X | X | X | | | | |
| Colombia | 1953-63 | X | .47 | X | .09 | | .99 | 12535 | 1.83 |
| Mexico | 1955-65 | X | .93 | | .07 | | .99 | 71790 | 2.198 |
| Peru | 1955-64 | X | .9 | X | X | .8 | .97 | 40735 | 1.57 |
| Venezuela | 1953-65 | X | .99 | X | X | | .99 | 26248 | .774 |
| General | 1957-64 | -1.35 | 1.07 | X | X | X | .99 | 8720 | 2.373 |
| Average | 1957-65 | X | 1.31 | X | X | X | .98 | 20897 | 2.034 |

1. All regression had a significant F statistic at the 95% level of confidence. Variables indicated with "X" represents variables which were used in the multiple regressions. However, these variables had T sufficiently low that the hypothesis that their regressions coefficients were equal to zero could not be rejected.

2. Standardized beta values are a measure of relative importance of the significant variables in a multiple regression. A standardized beta value is interpreted as follows: a change in an independent variable of one of the variables standard deviations will cause a change in the dependent variable of some percentage (the standardized beta value itself) of its standard deviation.

3. Coefficient of multiple determination adjusted for degree of freedom.

4. Standard error of estimate around the regression line.

5. Durbin-Watson statistic

6. Results of the Von Neuman test for serial correlation. 0 indicates no serial correlation. + indicates positive serial correlation, and - indicates negative serial correlation.

TABLE B-11

Multiple Regression Results in Secondary Education[1]

| | | Standardized Beta Values[2] | | | | | [3] | [4] | [5] |
|---|---|---|---|---|---|---|---|---|---|
| Country | Years | GDP | Teachers | Sex | Manu. | Ret. | $R^2$ | S.E. | D.W. |
| Argentina | 1956-64 | .15 | X | X | X | | .84 | 20846 | 2.563 |
| Brazil | | | | | | | | | |
| General | 1955-64 | .24 | .77 | | | X | .98 | 40266 | 2.349 |
| Average | 1953 | .25 | | | | | | | |
| Chile | 1953-64 | X | | | .54 | | .99 | 29042 | 2.55 |
| Colombia | | | | | | | | | |
| Mexico | 1955-65 | .75 | | | .68 | | .93 | 14289 | 2.76 |
| Peru | 1955-65 | X | .7 | X | .21 | .12 | .99 | 4289 | 3.295 |
| Venezuela | 1953-65 | .2 | .88 | X | X | X | .99 | 6351 | 2.33 |

[1] See Table B-10
[2] See Table B-10
[3] See Table B-10
[4] See Table B-10
[5] See Table B-10

TABLE B-12

Results of Higher Education
Multiple Regression

Standardized Beta Values[2]

| Country | Years | GDP | Teachers | Sex | Manu. | $R^2$ | SE | DW |
|---|---|---|---|---|---|---|---|---|
| Argentina | 1955-65 | X | .98 | .83 | X | .97 | 6258 | 1.87 |
| | 1955-63 | X | X | .83 | .20 | .93 | 5992 | 1.69 |
| Brazil | | | | | | | | |
| General | 1955-63 | X | .98 | | | .96 | 3119 | 3.07 |
| Average | 1955-63 | | | | | .97 | 2917 | 2.90 |
| Chile | 1953-64 | 1.16 | | | .41 | .86 | 1229 | 2.18 |
| Colombia | 1956-64 | .41 | .26 | | .39 | .96 | 1939 | 2.86 |
| Mexico | 1955-64 | .69 | X | .33 | .33 | .93 | 8313 | 1.09 |
| Peru | 1955-64 | X | .56 | | .46 | .96 | 224 | 2.59 |
| Venezuela | | | | | | | | |
| General | 1957-65 | X | .76 | | .25 | .99 | 759 | 2.69 |

[1]See Table B-10
[2]See Table B-10
[3]See Table B-10
[4]See Table B-10
[5]See Table B-10

TABLE B-13

Crossectional Regression Results

Coefficient of Correlation between Enrollments/School Age Population and The Proxy Variables in Per Capita Form

| | G.D.P. Per Capita | Teachers/ School Age Population | % Population Urban | %Enrollment Female | Rentention Rate |
|---|---|---|---|---|---|
| Primary[1] | .67 | -.87 | .71 | .30[z] | .86 |
| Secondary[2] | .95 | -.73 | .70 | .41[z] | --- |
| Higher[3] | .84 | -.77 | .80 | --- | |

[1]
[2]Includes Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.
[3]Includes all in 1 except Colombia.
Includes all in 1.

z Not a significant relationship at a 90% level of confidence.

TABLE B-14

Estimation of the Demand Function for Primary Education

Estimating Equation

$$E_t = \hat{a} + \hat{B}_1 (GDP)_{t-1} + \hat{B}_2 (\% \text{ of manufacturing})_{t-1} + \hat{B}_3 (\text{Student/teacher ratio})_{t-1} + \hat{B}_4 (\text{Lagged enrollments})_{t-1}$$

| Country | | $\hat{a}$ | $\hat{B}_1$ | $\hat{B}_2$ | $\hat{B}_3$ | $\hat{B}_4$ | Simple Correlation | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1&2 .76 | 2&4 -.66 |
| | Value | (-1385.259) | (.0937) | (1.0121) | (3.2240) | (1.418 ) | 1&3 .84 | 2&5 .74 |
| | SE | ( 1083.914) | (.1026) | (2.1121) | (2.8455) | ( .19317) | 1&4 -.90 | 3&4 -.75 |
| Argentina | T | ( -1.278) | (.037 ) | ( .479 ) | (1.133 ) | (5.911 )* | 1&5 .98 | 3&5 .82 |
| | | | | | | | 2&3 .91 | 4&5 -.94 |
| | SD = 30.8760 | | $R^2$ = .969 | | F= 81.18* | DW = 2.773 | | |
| | | | | | | | 1&2 .26 | 2&4 .78 |
| Brazil | Value | (87492.640) | (-4097.0097) | ( 9289.765 ) | (-25100.072) | ( .5627) | 1&3 .054 | 2&5 .15 |
| Average | SE | (96872.451) | ( 2758.6928) | (29216.18 ) | ( 23737.44 ) | ( .3814) | 1&4 .122 | 3&4 .97 |
| Enrollment | T | ( .87 ) | ( -1.485 ) | ( .288 ) | ( -1.05 ) | (1.475 ) | 1&5 -.23 | 3&5 .08 |
| | | | | | | | 2&3 .76 | 4&5 -.12 |
| | SD = **** | | $R^2$ = .1926 | | F = 1.48 | DW = 1.415 | | |
| | | | | | | | 1&2 .29 | 2&4 .78 |
| Brazil | Value | **** | (3684.36 ) | (-14415.79 ) | (13173.57) | (-.0092) | 1&3 -.56 | 2&5 .15 |
| Initial | SE | **** | (3394.42 ) | ( 86473.77 ) | (62163.76) | ( .8747) | 1&4 -.56 | 3&4 .97 |
| Enrollment | T | 1.940 | ( 1.085) | ( -.167) | ( | (-.384 ) | 1&5 .002 | 3&5 .08 |
| | | | | | | | 2&3 .76 | 4&5 .12 |
| | SD = **** | | $R^2$ =-.30 | | F = .54 | DW = 1.82 | | |
| | | | | | | | 1&2 .94 | 2&4 - |
| | Value | ( -562.252 ) | (10.553) | ( .02094) | Not available | ( .8879) | 1&3 -.73 | 2&5 .94 |
| | SE | ( 863.291 ) | ( 9.581) | (3.0227 ) | | ( .3007) | 1&4 - | 3&4 - |
| Chile | T | ( -.651 ) | ( 1.101) | ( .007 ) | | (2.95 ) | 1&5 .97 | 3&5 .76 |
| | | | | | | | 2&3 -.78 | 4&5 - |
| | SD = 41.0500 | | $R^2$ = .932 | | F = 48.28* | DW = 1.61 | | |

TABLE B-14 Continued

Estimation of the Demand Function for Primary Education

Estimating Equation

| Country | | $\hat{a}$ | $\hat{B}_1$ | $\hat{B}_2$ | $\hat{B}_3$ | $\hat{B}_4$ | Simple Correlation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1&2 | .85 | 2&4 | -.90 |
| | Value | (3503.007) | (-15.557) | (8.1869) | (-5.5062) | ( .7384) | 1&3 | .89 | 2&5 | .89 |
| Colombia | SE | (2104.945) | ( 8.244) | (6.1443) | ( 3.9307) | ( .4020) | 1&4 | -.91 | 3&4 | -.64 |
| | T | ( 1.664) | ( -1.887) | (1.332 ) | (-1.401 ) | (1.664 ) | 1&5 | .99 | 3&5 | .89 |
| | | | | | | | 2&3 | .76 | 4&5 | -.92 |
| | SD = 38.9240 | | $R^2$ = .9813 | | F = 92.70* | | DW = 2.63 | | | |
| | | | | | | | 1&2 | .96 | 2&4 | .82 |
| | Value | (-2573.685 ) | ( 8.3743) | (3.4674) | (2.8379) | ( .81406) | 1&3 | .95 | 2&5 | .95 |
| Mexico | SE | ( 3969.0235) | (12.1484) | (5.6789) | (8.5352) | ( .15607) | 1&4 | .91 | 3&4 | .96 |
| | T | ( -.648 ) | ( .689 ) | ( .611 ) | ( .332 ) | (5.216 )* | 1&5 | .99 | 3&5 | .92 |
| | | | | | | | 2&3 | .91 | 4&5 | .89 |
| | SD = 83.3756 | | $R^2$ = .993 | | F =304.31* | | DW = 3.421 | | | |
| | | | | | | | 1&2 | .90 | 2&4 | -.77 |
| | Value | (-1620.276) | (.3496) | (-1.9966) | ((3.3970) | (1.4416) | 1&3 | .78 | 2&5 | .94 |
| Peru | SE | ( 508.563 ) | (.6225) | ( 1.5477) | ( .9202) | ( .1731) | 1&4 | -.54 | 3&4 | -.56 |
| | T | ( -3.186 )* | (.56 ) | (-1.297 ) | (3.69 ) | (8.320 ) | 1&5 | .98 | 3&5 | .82 |
| | | | | | | | 2&3 | .77 | 4&5 | -.69 |
| | SD = 29.411 | | $R^2$ = .985 | | F =152.59* | | DW = 2.423 | | | |
| | | | | | | | 1&2 | .78 | 274 | .09 |
| | Value | (-1709.77 ) | ( .4785) | (3.9515) | (3.6190) | ( .84759) | 1&3 | .91 | 2&5 | .74 |
| Venezuela | SE | ( 792.162 ) | (1.6553) | (4.6945) | (2.0640) | ( .12237) | 1&4 | -.10 | 3&4 | -.25 |
| | T | ( -2.158 )* | ( .289 ) | ( .82 ) | (1.753 ) | (6.850 )* | 1&5 | .98 | 3&5 | .91 |
| | | | | | | | 2&3 | .80 | 4&5 | -.21 |
| | SD = 50.8891 | | $R^2$ = .973 | | F = 91.42* | | DW = 1.394 | | | |

*Indicates significance at a .95 level of alpha risk.

TABLE B-15

Estimation of the Demand Function for Secondary Education

Estimating Equation

$$E_t = \hat{a} + \hat{B}_1 (GDP)_{t-1} + \hat{B}_2 (\% \text{ of manufacturing})_{t-1} + \hat{B}_3 (\text{Student/teacher ratio})_{t-1} + \hat{B}_4 (\text{Lagged enrollments})_{t-1}$$

| Country | | $\hat{a}$ | $\hat{B}_1$ | $\hat{B}_2$ | $\hat{B}_3$ | $\hat{B}_4$ | Simple Correlation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1&2 | .72 | 2&4 | -.03 |
| | Value | (-3268.338) | (-.2698) | (16.585) | (.0390) | (.1189) | 1&3 | .88 | 2&5 | .67 |
| Argentina | SE | ( 1561.466) | ( .2714) | ( 8.649) | (.4445) | (.4085) | 1&4 | .11 | 3&4 | .09 |
| | T | ( -2.093) | (-.994 ) | ( 1.918) | (.088 ) | (.29 ) | 1&5 | .56 | 3&5 | .63 |
| | | | | | | | 2&3 | .92 | 4&5 | -.55 |
| | SD = 50.8414 | | $R^2$ = .613 | F = 13.74 | | DW = 2.57 | | | | |
| | | | | | | | 1&2 | .94 | 2&4 | .99 |
| Brazil | Value | (-480.276) | (.6850) | (-6.2001) | (7.8875) | ( .8394) | 1&3 | .90 | 2&5 | .86 |
| Average | SE | ( 711.141) | (.9703) | ( 4.354 ) | (4.6318) | ( .2018) | 1&4 | .89 | 3&4 | .85 |
| Enrollment | T | ( -2.082) | (.706 ) | (-1.424 ) | (1.703 ) | (4.158 )* | 1&5 | .97 | 3&5 | .91 |
| | | | | | | | 2&3 | - | 4&5 | .94 |
| | SD = 72.949 | | $R^2$ = .962 | F = 55.77* | | DW = 2.426 | | | | |
| | | | | | | | 1&2 | .92 | 2&4 | .99 |
| Brazil | Value | (-1648.132) | (-8.713) | NA | (9.6654) | ( .9348) | 1&3 | .95 | 2&5 | .88 |
| Initial | SE | ( 801.01 ) | ( 5.431) | NA | (6.7153) | ( .2930) | 1&4 | .91 | 3&4 | .86 |
| Enrollment | T | ( 2.01 ) | ( 1.63 ) | NA | (1.43 ) | (3.15 )* | 1&5 | .93 | 3&5 | .91 |
| | | | | | | | 2&3 | .87 | 4&5 | .92 |
| SD = 87 | SD = 87.494 | | $R^2$ = .916 | F = 45.73* | | DW = 2.143 | | | | |
| | | | | | | | 1&2 | .87 | 2&4 | - |
| | Value | ( 5.1998) | (1.1485) | Not Available | | ( .8397) | 1&3 | -.85 | 2&5 | .85 |
| Chile | SE | (256.252 ) | (-.1440) | | | ( .1453) | 1&4 | - | 3&4 | - |
| | T | ( .20 ) | (-.146 ) | | | (5.777 )* | 1&5 | .99 | 3&5 | -.85 |
| | | | | | | | 2&3 | -.80 | 4&5 | - |
| | SD = 8.010 | | $R^2$ = .967 | F = 71.07* | | DW = 1.058 | | | | |

TABLE B-15 Continued

Estimation of the Demand Function for Secondary Education

Estimating Equation

| Country | | $\hat{a}$ | $\hat{B}_1$ | $\hat{B}_2$ | $\hat{B}_3$ | $\hat{B}_4$ | Simple Correlation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1&2 | .94 | 2&4 | .70 |
| | Value | (-294.925) | (-.2293) | ( .9885) | (2.102 ) | (1.0356) | 1&3 | .94 | 2&5 | .97 |
| Peru | SE | ( 241.814) | ( .9885) | (1.272 ) | (1.1855) | ( .4071) | 1&4 | .78 | 3&4 | .65 |
| | T | ( -1.220) | (1.2723) | ( .777 ) | (1.773 ) | (2.544 )* | 1&5 | .98 | 3&5 | .94 |
| | | | | | | | 2&3 | .94 | 4&5 | .71 |
| | SD = 14.298 | | $R^2$ = .953 | F = 46.93* | | DW = 2.386 | | | | |
| | | | | | | | 1&2 | .79 | 2&4 | .6 |
| | Value | (214.517) | (.2076) | (1.1194) | ( .2219) | ( .7713) | 1&3 | .95 | 2&5 | .7 |
| Venezuela | SE | (110.029) | (.2573) | ( .8227) | ( .1761) | ( .1324) | 1&4 | .90 | 3&4 | .8 |
| Average | T | ( -1.950) | (.807 ) | (1.361 ) | (1.260 ) | (5.823 )* | 1&5 | .99 | 3&5 | .9 |
| Enrollment | | | | | | | 2&3 | .80 | 4&5 | .8 |
| | SD = 8.438 | | $R^2$ = .988 | F = 212.01* | | DW = 1.486 | | | | |
| | | | | | | | 1&2 | .93 | 2&4 | .7 |
| Venezuela | Value | (-320.848) | (-.3656) | (1.2642) | (2.4096) | (1.1202) | 1&3 | .91 | 2&5 | .9 |
| Initial | SE | ( 217.983) | ( .3226) | (1.2232) | (1.1628) | ( .2800) | 1&4 | .90 | 3&4 | .8 |
| Enrollment | T | ( -1.472) | (-1.133) | (1.033 ) | (2.072 )* | (4.00 )* | 1&5 | .98 | 3&5 | .9 |
| | | | | | | | 2&3 | .94 | 4&5 | .9 |
| | SD = 13.584 | | $R^2$ = .972 | F = 79.82* | | DW = 2.873 | | | | |

TABLE B-16

Estimation of the Demand Function for University Education

Estimating Equation

$$E_t = \hat{a} + \hat{B}_1 (GDP)_{t-1} + \hat{B}_2 (\% \text{ of manufacturing})_{t-1} + \hat{B}_3 (\text{Student/teacher ratio})_{t-1} + \hat{B}_4 (\text{Lagged enrollments})_{t-1}$$

| Country | | $\hat{a}$ | $\hat{B}_1$ | $\hat{B}_2$ | $\hat{B}_3$ | $\hat{B}_4$ | Simple Correlation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1&2 | .46 | 2&4 | -.64 |
| | Value | ( 84.267) | ( -.0675) | (1.2690) | ( -.3694) | ( .5876) | 1&3 | .38 | 2&5 | .38 |
| Argentina | SE | (203.764) | ( .0661) | (1.1544) | ( .2369) | ( .4027) | 1&4 | -.86 | 3&4 | -.39 |
| | T | ( .414) | (-1.021 ) | (1.09 ) | (-1.559 ) | (1.459 ) | 1&5 | .91 | 3&5 | .29 |
| | | | | | | | 2&3 | .87 | 4&5 | -.81 |
| | SD = 11.667 | | $R^2$ = .801 | F = 9.22* | DW = 1.711 | | | | | |
| | | | | | | | 1&2 | .89 | 2&4 | .8 |
| Brazil | Value | (-100.686) | (-.0194) | (-1.0555) | (2.6371) | ( 1.6289) | 1&3 | -.52 | 2&5 | .9 |
| Average | SE | ( 32.602) | (-.0258) | ( .7279) | ( .9281) | ( .1044) | 1&4 | -.70 | 3&4 | .9 |
| Enrollment | T | ( -3.088)* | (-.751 ) | (-1.450 ) | (2.841 )* | (15.593 )* | 1&5 | .98 | 3&5 | -.6 |
| | | | | | | | 2&3 | -.72 | 4&5 | -.8 |
| | SD = .94 | | $R^2$ = . 995 | F = 353.94* | DW = 3.161 | | | | | |
| | | | | | | | 1&2 | .93 | 2&4 | .89 |
| Brazil | Value | (-125.872) | (-.0091) | (-1.0040) | (2.7851) | ( 1.4357) | 1&3 | -.62 | 2&5 | .95 |
| Initial | SE | ( 45.602) | ( .0110) | ( .6987) | (1.0010) | ( .1001) | 1&4 | -.80 | 3&4 | .90 |
| Enrollment | T | ( -2.804)* | (-.831 ) | (-1.48 ) | (2.782 )* | (14.354 )* | 1&5 | .90 | 3&5 | -.65 |
| | | | | | | | 2&3 | .68 | 4&5 | -.78 |
| | SD = .9964 | | $R^2$ = .973 | F = 297.83* | DW = 2.9918 | | | | | |
| | | | | | | | 1&2 | .88 | 2&4 | .- |
| | Value | (35.952) | ( .3635) | (-.3008) | Not | ( .8472) | 1&3 | -.91 | 2&5 | .82 |
| Chile | SE | (39.614) | ( .2723) | ( .1487) | Available | ( .1407) | 1&4 | - | 3&4 | - |
| | T | ( .908) | (1.335 ) | (2.022 )* | | (6.021 )* | 1&5 | .97 | 3&5 | .85 |
| | | | | | | | 2&3 | -.82 | 4&5 | - |
| | SD = 1.373 | | $R^2$ = .977 | F = 117.79* | DW = 3.056 | | | | | |

TABLE B-16 Continued

Estimation of the Demand Function for University Education

Estimating Equation

| Country | | $\hat{a}$ | $\hat{B}_1$ | $\hat{B}_2$ | $\hat{B}_3$ | $\hat{B}_4$ | Simple Correlation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1&2 | .86 | 2&4 | -.28 |
| | Value | (-388.055) | (.5662) | (2.4429) | ( -.3570) | ( .7782) | 1&3 | .89 | 2&5 | .85 |
| Colombia | SE | ( 126.903) | (.8394) | ( .5904) | ( .3299) | ( .1103) | 1&4 | -.42 | 3&4 | .066 |
| | T | ( -3.058)* | (.674 ) | (4.137 )* | (-1.082 ) | (7.051 )* | 1&5 | .99 | 3&5 | .82 |
| | | | | | | | 2&3 | .75 | 4&5 | -.50 |
| | SD = 5.098 | | $R^2$ = .995 | F = 301.66 | | DW = 2.824 | | | | |
| | | | | | | | 1&2 | .96 | 2&4 | .82 |
| | Value | (-199.981) | (.5842) | (-.0137) | (.2896) | ( .6244) | 1&3 | .94 | 2&5 | .96 |
| Mexico | SE | ( 242.399) | (.7547) | ( .3419) | (.4893) | ( .3430) | 1&4 | .90 | 3&4 | .96 |
| | T | ( -.825) | (.774 ) | (-.040) | (.592 ) | (1.820 )* | 1&5 | .98 | 3&5 | .93 |
| | | | | | | | 2&3 | .91 | 4&5 | .88 |
| | SD = 5.334 | | $R^2$ = .967 | F = 58.36* | | DW = 2.5792 | | | | |
| | | | | | | | 1&2 | .97 | 2&4 | -.41 |
| | Value | (-12.461) | (.0283) | (.0524) | (-.0516) | ( .8631) | 1&3 | .94 | 2&5 | .95 |
| Peru | SE | ( 12.168) | (.0285) | (.1023) | ( .0585) | ( .1428) | 1&4 | -.34 | 3&4 | -.24 |
| | T | ( -1.024) | (.995 ) | (.513 ) | (..881 ) | (6.042 ) | 1&5 | .99 | 3&5 | .93 |
| | | | | | | | 2&3 | .94 | 4&5 | -.29 |
| | SD = 1.031 | | $R^2$ = .992 | F = 194.63* | | DW = 2.819 | | | | |
| | | | | | | | 1&2 | .72 | 2&4 | .40 |
| | Value | ( 4.440) | (-.1073) | (.3099) | (.0366) | ( .7830) | 1&3 | .94 | 2&5 | .75 |
| | SE | (48.765) | ( .1677) | (.3590) | (.2424) | ( .2027) | 1&4 | .73 | 3&4 | .79 |
| | T | ( .091) | (-.640 ) | (.863 ) | (.151 ) | (3.862 )* | 1&5 | .98 | 3&5 | .9 |
| | | | | | | | 2&3 | .80 | 4&5 | .6 |
| | SD = 2.369 | | $R^2$ = .956 | F = 35.85* | | DW = 2.393 | | | | |