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THE PUERTO RICO WAGE RATE SUBSIDY
FOR AGRICULTURAL LABOR

By

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A DISSERTATION

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ABSTRACT

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The decline in production of the agricultural sector of Puerto Rico is due primarily to the sector's inability to adjust to the rapid increases in the minimum wage rates for farm laborers that have accompanied Puerto Rico's rapid industrialization. Both the United States and Puerto Rican minimum wage authorities set minima on an industry by industry basis and have vigorously pursued a policy of narrowing the gap between wage rates on the island and the standard federal minimum wage rate applied on the mainland. Puerto Rico's production of foodstuffs has historically been minor due to the island's ability to import the lower cost United States mainland foods. Thus, Puerto Rican agriculture has been dominated by three export crops which are heavily dependent on low cost supplies of labor.

The Wage Rate Subsidy Program was implemented in 1969 for the express purpose of reviving the agricultural sector by retaining the sector's labor force by raising the laborers' wage rates without raising the farm operators' hourly wage costs. This is accomplished by setting higher guaranteed wage rates and subsidizing the increases over the pre-program minimum wage rates.

The program's effects in increasing agricultural production and employment are explained in terms of the relative cheapening of farm labor as the costs of other production inputs continued to rise over

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time. A two equation model is used to estimate the net effects of the program on agricultural production and employment.

The Index of Agricultural Production equation is an adaptive expectations model that reflects the sequential nature of farm decision making. The farm decision making process is sequential because of the biological processes involved and because the process of investing or disinvesting in the fixed assets of agricultural production places limits on the extent to which a farm operation may be changed in the short run in response to changing price relationships. Thus, decisions concerning fixed assets, and therefore annual operating levels, must be based on the farmers' expectations of future price relationships.

The Employment equation includes the Production Index as an independent variable (since the adaptive expectations model did not give results consistent with theoretical expectations) as a means of reflecting the mutual dependence of the production and employment decisions of the farm operator on his farm's profit function. A single Employment equation is used instead of a labor demand and supply model because the employment of farm laborers is shown to be demand determined as a result of the minimum wage policies in Puerto Rico.

In order to exclude any effects of errors in specifying the statistical model, the net effects of the program are estimated by taking the difference between the model's predictions of the with and without program values of production and employment. The with program predictions are estimated by using the observed values of the independent variables (the "fitted" values). The without program predictions are estimated by substituting an assumed behavior of the wage rate variable in place of the observed wage rate data. It was assumed that the wage rate

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variable would have continued to increase at a rate equal to its average annual rate of increase during the years prior to the start of the program. The predicted without program values for the production index and employment are then obtained by adding the net effect of the program to the observed with program values in each case. The net effect on the Production Index is converted into nominal dollar values for comparing with program costs. The program's effects on both production and employment were found to be positive, even though both of these indicators continued to decline. Although the program did not fulfill its stated purpose of reviving the agricultural sector, it did slow the sector's decline.

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CHAPTER I

INTRODUCTION

Background and Problem Setting

The agricultural sector was the dominant sector in the Puerto Rican economy until 1955 when the industrial development programs, begun in the 1940s, finally pushed the manufacturing sector into the forefront. Agricultural production activities were concentrated in producing sugar cane, coffee and tobacco for export to the United States and the world markets. These labor intensive crops came under serious economic pressure when the rapidly developing industrial and commercial sectors began to offer higher wage employment and when large numbers of Puerto Rican began migrating to the United States in search of higher wage employment there. Even though the wage rates in Puerto Rico were still lower than in the United States, the island's agricultural producers were unable to offset the rising wages, either through mechanization or other means of increasing productivity, to the extent required to remain competitive in the United States market. The requirement that they compete in the United States market, for both their exports and their foodstuffs, is due to the free trade provisions of the Commonwealth status. Sugar production began declining sharply in 1953 and although aggregate agricultural production continued to increase temporarily, it too began declining rapidly in 1964. The only major sub-sector that continued to increase its production was the animal products

subsector, due to its relatively protected local market and its lesser dependence on labor.

By the late 1960s, official concern about the conditions in the agricultural economy were reaching high levels in the government. In 1967 and 1968, growth rates of the real gross product of Puerto Rico were lower than those of previous years and the efforts to find ways to return to a more rapid rate of growth naturally included a serious look at the agricultural sector. It was believed that the sector possessed unused resources, especially land, that could be used to increase the island's gross product and, since agriculture was relatively labor intensive, a revival of the agricultural sector could help alleviate the severe unemployment problem.

The role of labor in the decline of the agricultural sector was not perceived to be a problem of the high cost of labor. It was, instead, perceived to be a problem of a shortage of laborers willing to work at the current minimum wage rates, since at that time the farm laborer wage rates were about 40% of the non-farm laborer wage rates. The combination of the perceived shortage of laborers and the high rates of unemployment on the island naturally led to the idea of a program that would raise the wage rates actually received by the laborers, while at the same time avoiding any increase in the wage rates paid by the farm operators through the use of a government subsidy.

Thus, in 1969, the Puerto Rican government, through its Department of Agriculture, instituted the "Guaranteed Income for Agricultural Workers"¹ program. Since the program is, in fact, a wage rate subsidy

¹Translated from Ingresos Garantizados a Trabajadores Agrícolas.

rather than an income guarantee program, it will be referred to in this report as a wage rate subsidy program. As of 1975, when this research was begun, the program had not been evaluated.

Research Objectives

The objectives of this research are:

- 1) to describe the economic conditions in Puerto Rico that led to the wage rate subsidy program and that constitute the environment within which the program operates,
- 2) using existing economic data, to estimate the program's effects on the two principal goals of the program--increasing agricultural production and employment of farm labor, and
- 3) to consider the implications of the analysis for the agricultural sector policy of the Puerto Rican government.

This research was limited to these three objectives due to the lack of the financial resources that would have been required to obtain data directly from the farm operators and laborers. Thus, questions concerning the responses to the program by individual farm operators and laborers could not be answered.

Data Sources

The Puerto Rico Planning Board prepares, and publishes on a regular basis, the general macroeconomic and selected sectoral measures of economic activity. The Bureau of Labor Statistics of the Puerto Rico Department of Labor conducts a monthly survey similar to the Current Population Survey of the United States Department of Labor and publishes

estimates of employment, unemployment and median weekly wages in a variety of regular publications. The Office of Agricultural Statistics of the Puerto Rico Department of Agriculture conducts semi-annual surveys of agricultural production and prices received by farmers and also compiles estimates of local consumption of foodstuffs. These data are published annually in the "Facts and Figures on Puerto Rican Agriculture."

In addition to these published sources, this author was able to obtain additional data from the files of the Bureau of Labor Statistics, the Office of Agricultural Statistics and the Wage Rate Subsidy Program Office.

Analytical Procedures and Organization of the Dissertation

The history of the recent economic growth of the Puerto Rican economy is examined in Chapter II in order to determine how the structural changes have affected the local markets within which the agricultural sector operates. This analysis reveals the significant change in the conditions of the labor market that has accompanied the growth of the industrial sector.

The agricultural sector is examined in Chapter III in order to document the changes that have occurred in recent history, to determine the relative influence that the sector has had in its principal product and factor markets, and to isolate the causal relationships that appear to have been the principal determinants in the decline of the agricultural sector. This analysis reveals the primary influence of the local market and the general inability of the sector to adjust to the changing labor market.

The Wage Rate Subsidy Program is examined in Chapter IV to document the reasons for which it was developed, the rules under which it is implemented and the direct costs which it represented for the Puerto Rican government for the first five years of operation.

Chapter V presents a theoretical analysis which is used to establish expectations for the program's effects on production and employment. Static production theory is used in showing that no effects should be observed in the short run. A dynamic analytical framework is developed to be used as the basis for the empirical model. This theoretical construct is used to establish the expectation that both production and employment should be smaller without the program than was observed with the program.

Equations for the prediction of production and employment are developed and their coefficients are estimated using multiple linear regression techniques in Chapter VI. The production equation requires the use of the Cochrane-Orcutt procedure due to the use of the lagged dependent variable as an explanatory variable.

The equations of the model are then used to predict what production and employment would have been if the farm operators' wage costs had continued to increase at an assumed rate of growth in the absence of the program. These predictions are presented in Chapter VII. The sensitivity of the assumed rate of growth is also tested. The equations are also used to predict production and employment using the observed data and the difference between the two sets of predictions is used as the estimate of the effect of the program in order to eliminate the model's own error from the results.

Chapter VIII summarizes the research and presents the conclusions drawn from the analysis. In recognition of the interest that has been shown in the United States in the use of a general wage rate subsidy program as an income maintenance program, Appendix A provides a brief review of the history of the negative income tax and wage rate subsidy concepts, a few lessons from the Puerto Rican experience, a theoretical comparison of the effects of the two programs, and a proposal for a program which combines the two concepts.

CHAPTER II

THE ECONOMY OF PUERTO RICO

Trends in the Island Economy

The economic development of Puerto Rico in recent decades is a well-documented success story. Real per capita personal income has increased from \$213 in 1940 to \$1,106 in 1974--an average annual growth rate of 4.96%. Tables 1 and 2 on the following pages illustrate the results of this development with selected economic indicators.

As part of the development process, the economic structure of the island has undergone very significant changes. The manufacturing sector had replaced agriculture by 1960 as the most important sector, on the basis of Net Income. The trade sector has maintained a relatively constant share of the economy over the years, maintaining its second place ranking until a few years ago when the growing government sector surpassed it. As will be shown in greater detail later, the agricultural sector has declined in both relative and absolute terms since the early 1960s, leaving it last among the major sectors. Table 3 provides the breakdown by sector of Net Income by Industrial Origin with the corresponding percentages and rankings.

Relationship with the United States

This rapid rate of industrialization and the accompanying growth is attributable primarily to the many advantages that Puerto Rico has

Table 1. Economic Growth of Puerto Rico.

	Units	1940	1950	1960	1970	1974
Nominal Gross Product	\$Mill.	286.7	754.5	1,676.4	4,621.9	6,806.1
Real Gross Product	\$Mill.	499.3	878.7	1,473.2	2,835.7	3,390.6
Nominal Net Income	\$Mill.	225.3	613.6	1,348.5	3,748.5	5,724.3
Real Per Capita Gross Product	\$	269	399	630	1,044	1,133
Real Per Capita Personal Income	\$	213	347	530	988	1,106
Population	Thous.	1,859	2,206	2,342	2,716	2,992

Source: P.R. Junta de Planificación, Informe Económico al Gobernador, 1974, Statistical Appendices.

Table 2. Average Annual Rates of Growth in the Puerto Rican Economic Indicators.

	1940-1950	1950-1960	1960-1970	1970-1974
Real Gross Product	10.16%	8.31%	10.67%	10.16%
Real Per Capita Gross Product	5.82%	5.30%	6.67%	4.57%
Real Per Capita Personal Income	5.00%	4.33%	6.43%	2.86%
Population	1.73%	0.60%	1.49%	2.45%

Source: P.R. Junta de Planificación, Informe Económico al Gobernador, 1974, Statistical Appendices.

Table 3. Net Income by Industrial Origin, Puerto Rico, Selected Years.

	1 9 4 0			1 9 5 0			1 9 6 0			1 9 7 0			1 9 7 4		
	* Value	% of Total	Rank	Value	% of Total	Rank	Value	% of Total	Rank	Value	% of Total	Rank	Value	% of Total	Rank
Agriculture	70	31.1	1	149	24.3	1	180	13.3	3	178	4.7	8	277	4.8	8
Manufacturing	27	12.0	2	89	14.5	3	289	21.4	1	955	25.5	1	1831	32.0	1
Mining and Construction	3	1.3	8	28	4.6	8	89	6.6	8	352	9.4	6	479	8.4	7
Transportation & Public Utilities	18	8.0	7	49	8.0	6	123	9.1	7	348	9.3	7	534	9.3	6
Trade	26	11.6	3	102	16.6	2	237	17.6	2	697	18.6	2	1031	18.0	3
Finance and Real Estate	25	11.1	4	52	8.5	5	141	10.5	5	505	13.5	4	812	14.2	4
Services	21	9.3	5	44	7.2	7	130	9.6	6	470	12.5	5	718	12.5	5
Government	19	8.4	6	70	11.4	4	175	13.0	4	611	16.3	3	1101	19.2	2
Rest of World	16			31			-16			-368			-1058		

* Value in Millions of Dollars.

Source: P.R. Junta de Planificación, Informe Económico al Gobernador, 1974, Statistical Appendices.

enjoyed under its relationship with the United States. The major features of this relationship include: 1) free movement of goods, services and capital between the island and the mainland, 2) exemption of Puerto Rico from U.S. Federal taxation, 3) a common currency, and 4) United States citizenship for Puerto Ricans. In addition, the Puerto Rican government has carried out an aggressive industrial promotion policy which has included a number of economic and tax incentives (see following section). Several analyses of Puerto Rican economic growth have suggested that the public works, other anti-depression programs and the Second World War all played significant roles in the pre-Commonwealth stages of Puerto Rico's economic development (Reynolds and Gregory, p. 5, and Friedlander, p. 158).

The advantages of this relationship, now called Commonwealth status, have made it possible for Puerto Rico to attract outside investment, giving it an advantage over both foreign countries and the fifty states in the attraction of industrial investment. With no trade barriers, Puerto Rican production can enter the large United States market easily and, of special interest to potential investors, United States equipment and raw materials enter Puerto Rico freely (Riley, p. 41), although Puerto Rico does impose excise taxes on most goods which are imported. The use of dollars as a common currency provides advantages over foreign countries due to the free movement of currency and freedom from problems of depreciation of currency. Exemption from federal taxes is advantageous in their competition with the fifty states to attract capital and plants since Puerto Rico can offer a tax-free environment, as they do for limited periods.

The free migration of Puerto Ricans to the mainland due to both the cheap air fares and the common citizenship has played an important role in Puerto Rico's growth and development. Although the net migratory flow in recent years has been returning people to the island, the massive migrations of the 1940s and 1950s had numerous effects on economic growth. Studying these effects in the early 1960s, Stanley Friedlander found that the emigration: 1) had a significant impact on the rate of growth of per capita income, 2) had a significant effect on the age structure and thus on future growth of the population, 3) contained a considerably higher proportion of labor force members to non-members than the proportion of labor force members to non-members on the island, 4) in combination with the increased investment, probably contributed to the reduction of disguised unemployment on the island, 5) contributed to the upgrading of the quality of the labor force by reducing the proportion of unskilled laborers, and 6) contributed indirectly to raising the educational attainment of the population by easing the pressure on the school system (Friedlander, pp. 157-164).

Governmental Development Efforts

Although Puerto Rico has only had Commonwealth status since 1952, active government promotion of industrialization began in 1942 with the creation of the Puerto Rico Planning Board, the Government Development Bank for Puerto Rico (GDB) and the Puerto Rico Industrial Development Company (PRIDCO). Although originally PRIDCO created and operated manufacturing enterprises, it now provides a wide range of services to potential investors and newly established plants. PRIDCO has constructed over 962 factory buildings which may be sold or leased to firms, with

lease rates depending on geographic location. During a plant's start-up period, Cash Incentive Grants are available to help defray the cost of training supervisory personnel, building rental, transportation of equipment and machinery to the plant site, feasibility studies and others. For plants requiring a work force of 300 or more workers, the Pre-Employment Training Program will pay the entire cost of recruiting and training the workers so that they will be available on the day the plant opens. PRIDCO may also provide secondary financial assistance through loans or minority equity investments to financially sound ventures when private financing is not otherwise available. The Government Development Bank may provide loans through mortgages on buildings or chattel mortgages on machinery and equipment if a firm is unable to secure financing on reasonable terms. Firms may also receive financial assistance through loans from the U.S. Federal Economic Development Administration for both fixed and working capital. PRIDCO also operates a 32-acre free trade zone near Mayaguez where industrial operations may avoid import duties until the products are sent to the United States or Puerto Rican markets.

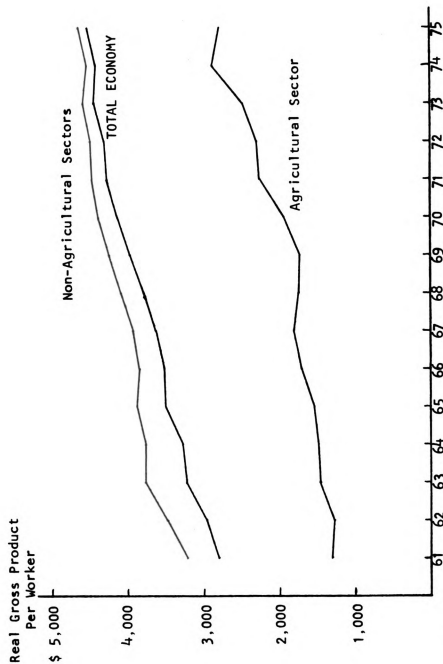
Since Puerto Rico is exempt from Federal taxes, except specified ones such as Social Security taxes, the government can use exemption from local taxes as a means of inducing investors to establish plants in Puerto Rico. Through Section 931 of the U.S. Internal Revenue Code, Puerto Rican subsidiaries of U.S. firms can eventually repatriate their earnings without incurring Federal taxes on those profits. Since 1954, Puerto Rico has exempted qualifying manufacturing and some non-manufacturing firms from both Commonwealth and local taxes on corporate earnings, property and licenses. The program permits 100% exemption

for periods of 10, 15, 25, or 30 years depending on the location of the plant. Through an arrangement for paying partial taxes during the initial period, firms can receive an extended period of partial exemption. The varying periods of exemption were instituted to induce a more even distribution of plants around the island since a high concentration of plants was building up in the main metropolitan areas. In addition, there are tax exemptions for individual investors on dividends and income from machinery leased to tax-exempt firms. Even without the local exemptions, a tax advantage exists since the Puerto Rican corporate taxes are slightly less than the Federal taxes--ranging from 22% to 45% (Picó, pp. 290-308, and The Witcom Group, pp. 35-48).

Labor Output Trends

The transformation into a primarily industrial economy, due in part to the migration and the outside investment, has been accompanied by significant increases in labor productivity. Figure 1 and Table 4 show these increases for the 1961 to 1975 period. Data for prior years consistent with these data are unavailable due to changes in statistical reporting. The labor productivity figures are computed by dividing Real Gross Product (in constant 1954 dollars) by the number of employed workers. Over this fourteen year period, total economy labor productivity had a 3.46% average annual growth rate, while agricultural and non-agricultural labor productivity had growth rates of 5.56% and 2.26% per year, respectively, but in absolute values, non-agricultural labor productivity remained much higher than agricultural labor productivity.

Figure 1. Real Gross Product Per Worker in Puerto Rico, 1961 to 1975.



Source: Table 4.

Table 4. Employment and Real Gross Product Per Worker in the Agricultural and Non-Agricultural Sectors of Puerto Rico, 1961 to 1975.

Fiscal Year	E M P L O Y M E N T (in Thousands)			REAL GROSS PRODUCT PER WORKER (in Dollars)			Ratio of Agri/NonAg Gross Prod Per Worker
	Total	Agri.	NonAg	Total	Agri.	NonAg	
1961	556	135	431	\$2,808	\$1,306	\$3,214	.406
1962	568	135	433	2,963	1,288	3,487	.369
1963	563	132	432	3,233	1,455	3,778	.385
1964	583	122	461	3,287	1,478	3,765	.363
1965	604	108	495	3,449	1,542	3,870	.398
1966	634	99	535	3,509	1,714	3,839	.446
1967	643	88	555	3,637	1,805	3,927	.460
1968	654	85	569	3,778	1,738	4,081	.426
1969	675	78	597	3,955	1,726	4,246	.407
1970	686	68	618	4,134	1,930	4,378	.441
1971	700	61	639	4,262	2,262	4,452	.508
1972	737	58	679	4,301	2,288	4,472	.512
1973	757	50	707	4,432	2,478	4,569	.542
1974	775	53	721	4,408	2,870	4,521	.635
1975	738	50	688	4,518	2,786	4,644	.600

Sources: Employment, revised data, P.R. Bureau of Labor Statistics, 1976 (sectors may not add to totals due to rounding); Real Gross Product Per Worker is computed by dividing Real Gross Product (rounded to nearest hundred thousands) by Employment (rounded to nearest thousands); Real Gross Product, revised data, P.R. Junta de Planificación, 1976.

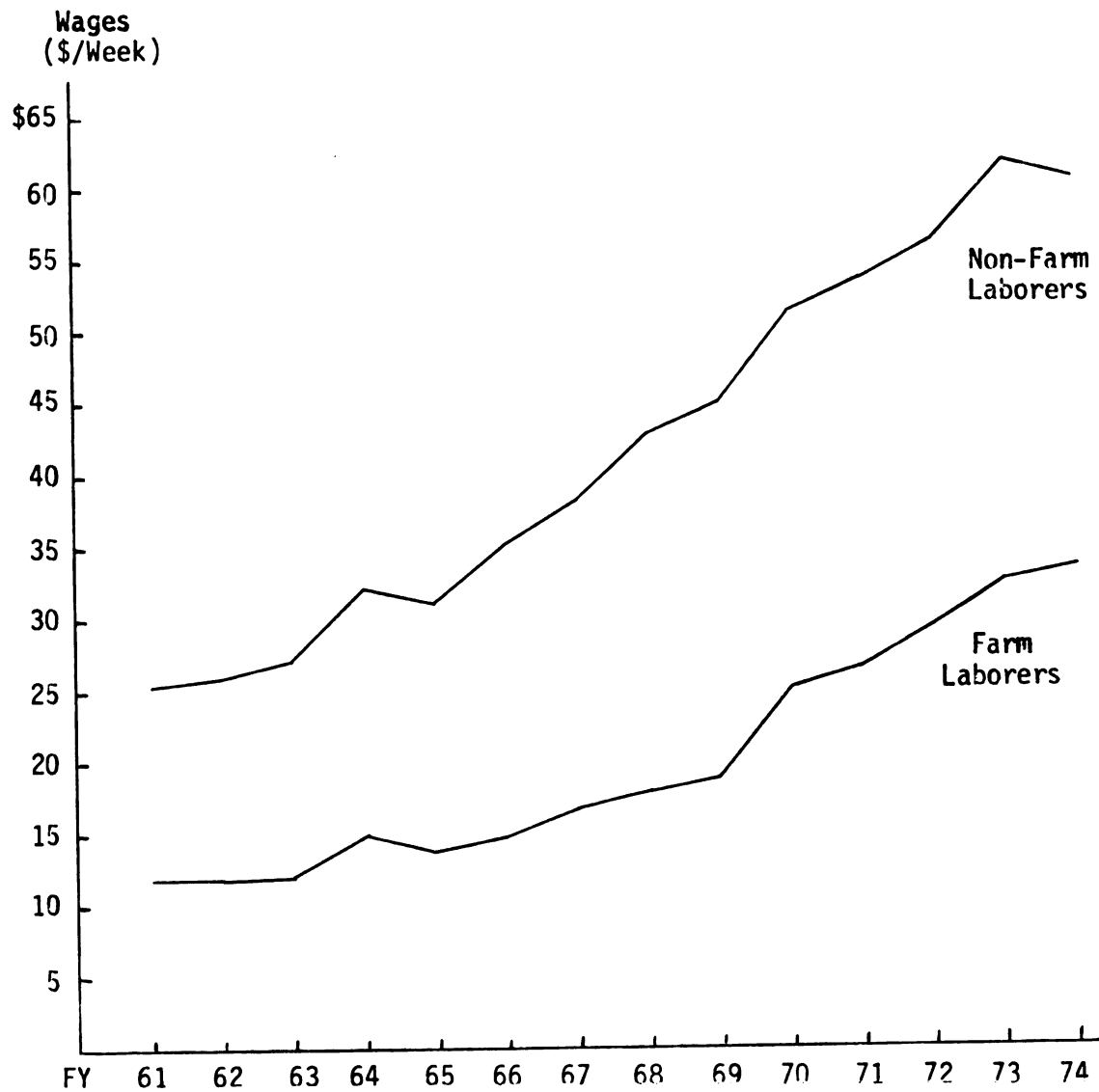
Minimum Wage Legislation in Puerto Rico

The impact of minimum wage legislation has been important in the island economy. While minimum wages in the United States are imposed by legislative action, Puerto Rico received a special provision in an amendment to the Fair Labor Standards Act of 1938 which permitted the Administrator of the Wage and Hours Division of the U.S. Department of Labor to promulgate lower minima for individual industries after hearing the recommendations of a tripartite committee appointed by him, with members from both the mainland and the island (Reynolds and Gregory, p. 44). The Puerto Rican government also established a Minimum Wage

Board in 1941 which began establishing minimum wage rates using a similar tripartite committee system, but this Board could also establish different rates for different occupations in an individual industry and it could vary these rates on a region by region basis. In a number of instances the Minimum Wage Board even imposed higher minima than those set by the Administrator of the Wage and Hours Division. Thus, with vigorous and frequent increases in minimum wage rates on an industry by industry basis, Reynolds and Gregory found that it has been the increases in minimum wage rates which have been forcing the increases in average wage rates in Puerto Rico (Reynolds and Gregory, p. 60). This is in sharp contrast to the manner in which minimum wage rates in the United States tend to have only a marginal effect on the wage rate structure (Reynolds and Gregory, p. 53). Although it could have been that the minimum wage rate increases were a response to higher profit margins resulting from spontaneous productivity increases, Reynolds and Gregory thought that it was more likely that an industry with a substantial profit margin would have its minimum raised, temporarily cutting its profits, and it would then seek productivity improvements to restore the profit level (Reynolds and Gregory, pp. 60-61). Although they did not believe that this was the only cause of productivity increases, they did consider it important.

Regardless of whether the profits or the productivity increases came first, minimum wage rates in Puerto Rico have risen rapidly and have been accompanied by relatively high unemployment rates. Figure 2 shows the upward trend in wage rates for laborers in Puerto Rico. The data which are plotted are the annual averages of the quarterly reported median weekly wages of the farm and non-farm laborers of the Bureau of

Figure 2. Median Weekly Wages for Non-Farm and Farm Laborers,
Fiscal Years 1961 to 1974.



Source: P.R. Bureau of Labor Statistics.

Labor Statistics survey (see Appendix B.2 for data). The average annual growth rates for the period 1961-1969 were 7.45% for the non-farm laborers and 5.96% for the farm laborers. For the 1969-1974 period, the median weekly wages of the non-farm laborers increased at the rate of 6.03% and the wages of the farm laborers increased at the rate of 11.97% under the wage rate subsidy program.

Summary

Puerto Rico's rapid economic growth has resulted from its relationship with the United States and its own governmental programs. Pressure from the mainland for the inclusion of Puerto Rico under the Fair Labor Standards Act resulted in a compromise which produced a flexible system whereby minimum wage rates could be set on an industry by industry basis rather than the inflexible coverage of the FLSA's standard minimum wage rate. Puerto Rico itself then set up its own Minimum Wage Board with a similar flexibility and proceeded to raise minimum wage rates in a vigorous manner. In addition to responding to the demands of the Puerto Rican labor force, the Minimum Wage Board probably tended to undercut the pressure from mainland manufacturers and unions by pursuing vigorous increases before the outsiders could pressure for even larger increases under the federal system. Although the non-agricultural economy of Puerto Rico has been able to adapt to the rapidly shifting economic structure, albeit with social and political problems, the agricultural sector has had a much more difficult adjustment. The next chapter reports the problems that Puerto Rican agriculture has experienced.

CHAPTER III

THE AGRICULTURAL ECONOMY

Production History

Until the late 1950s, the production of sugar, along with coffee and tobacco, was the mainstay of Puerto Rico's economy. Early in this century, these exports were profitable enough to permit a dependence on the importation of food for the large and growing population. During the Depression, Puerto Rico suffered greatly when the terms of trade in the external market changed, since there had not been a sufficient degree of diversification into local food production to provide protection against the changing price relationships. Early during World War II, the shipping blockade affected imports, especially inputs such as feed and fertilizer. Later during the War, a renewed emphasis on export crops was possible since the end of the blockade relieved the pressure on foodstuffs. In 1951 and 1952, Puerto Rico's sugar production exceeded its United States quota and local consumption requirements, but since then both cane acreage and sugar production have declined, with sharp drops since the early 1960s. After the War, the tobacco market fell off and coffee was hit by the dry weather. Pineapple exports improved with a shift to local canning instead of the direct exportation of fresh pineapples (Koenig, pp. 35-44).

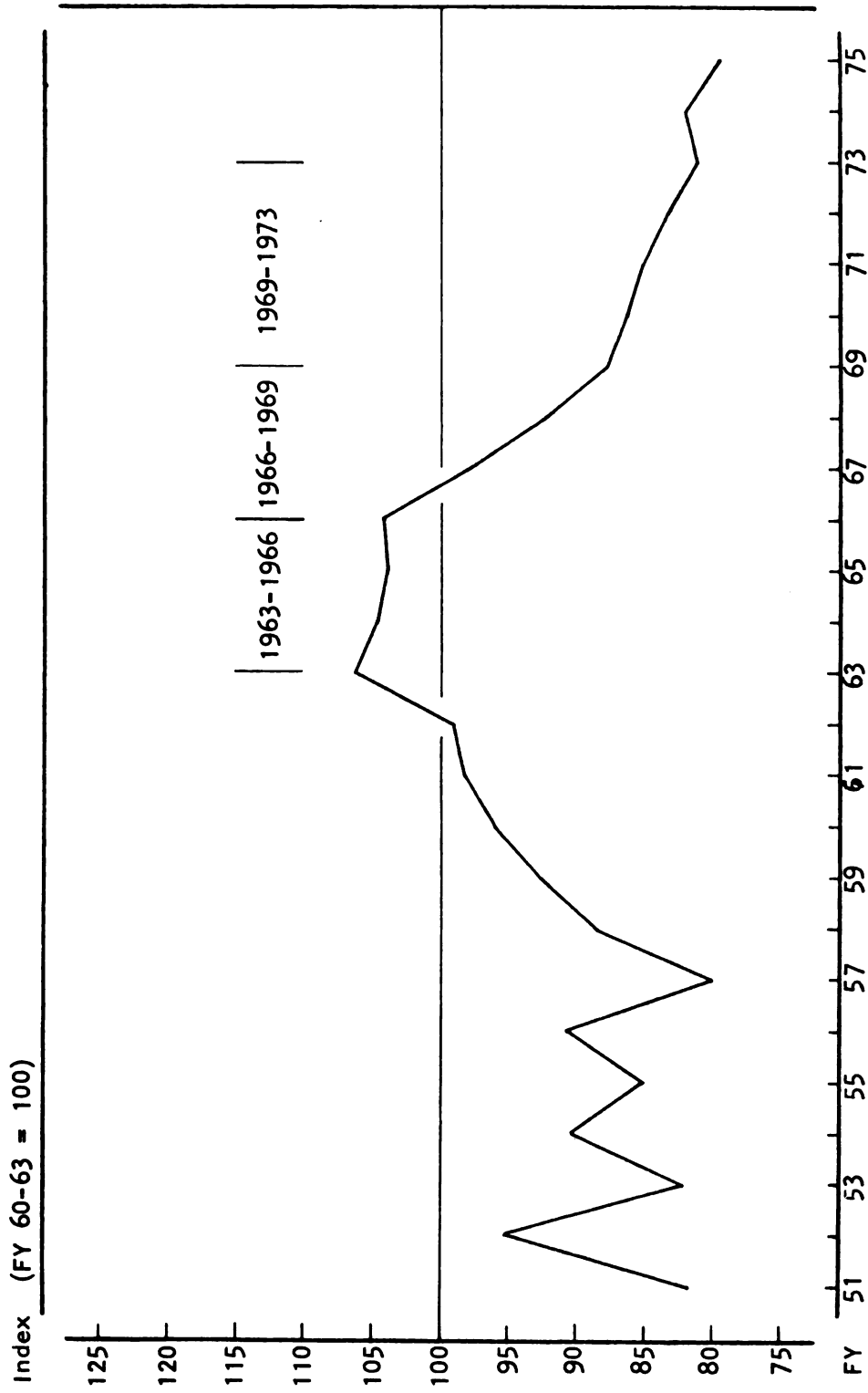
Detailed data on production beginning in 1951 show an irregular pattern until about 1957. This is due in part to the two year coffee

cycle and, in the case of sugar cane, the 1952 surplus and the 1956 hurricane "Santa Clara." From 1957 to 1963, production increased steadily in the agricultural sector, but at a declining rate. Since its peak in 1963, production has steadily declined. The index of physical production (Figure 3) shows three distinct periods within this decline, each with an almost constant rate of decline. Although the period 1963-1966 had a very slow rate of decline of 0.66% per year, in 1966-1969 the decline was 5.55% per year. Between 1969 and 1975, the rate of decline was 1.61% per year. These rates of decline, however, are the aggregated figures of widely differing production performances of the subsectors. During these periods, the only increase in production by a subsector was in the "animal products" subsector (see Figure 4). The decline in the "principal crops" subsector (cane, coffee and tobacco) pulls down the sector-wide index due to its importance in the index base (1959/60-1962/63), but the "other crops" subsector also experienced a decline.

Among the animal products, milk, pork and beef showed good growth from 1963 to 1969, but then slowed down from 1969 to 1975. Poultry products showed an opposite growth pattern with slow growth during 1963-1969 and then strong growth during 1969-1975. The growth in broiler production has come about almost entirely from commercial operations while the growth in egg production has come about equally from the commercial and non-commercial egg sectors. In milk, the commercial sector (first class dairies) has experienced the growth.

For several reasons, this analysis is based on the index of physical production rather than on the Gross Product statistics. First, the Gross Product statistics are aggregated for the whole sector and do not

Figure 3. Index of Physical Production of Agriculture in Puerto Rico, 1951 to 1975.



Source: P.R. Department of Agriculture.

Figure 4. Indices of Agricultural Production by Subsectors and Products, 1963, 1969 and 1975.

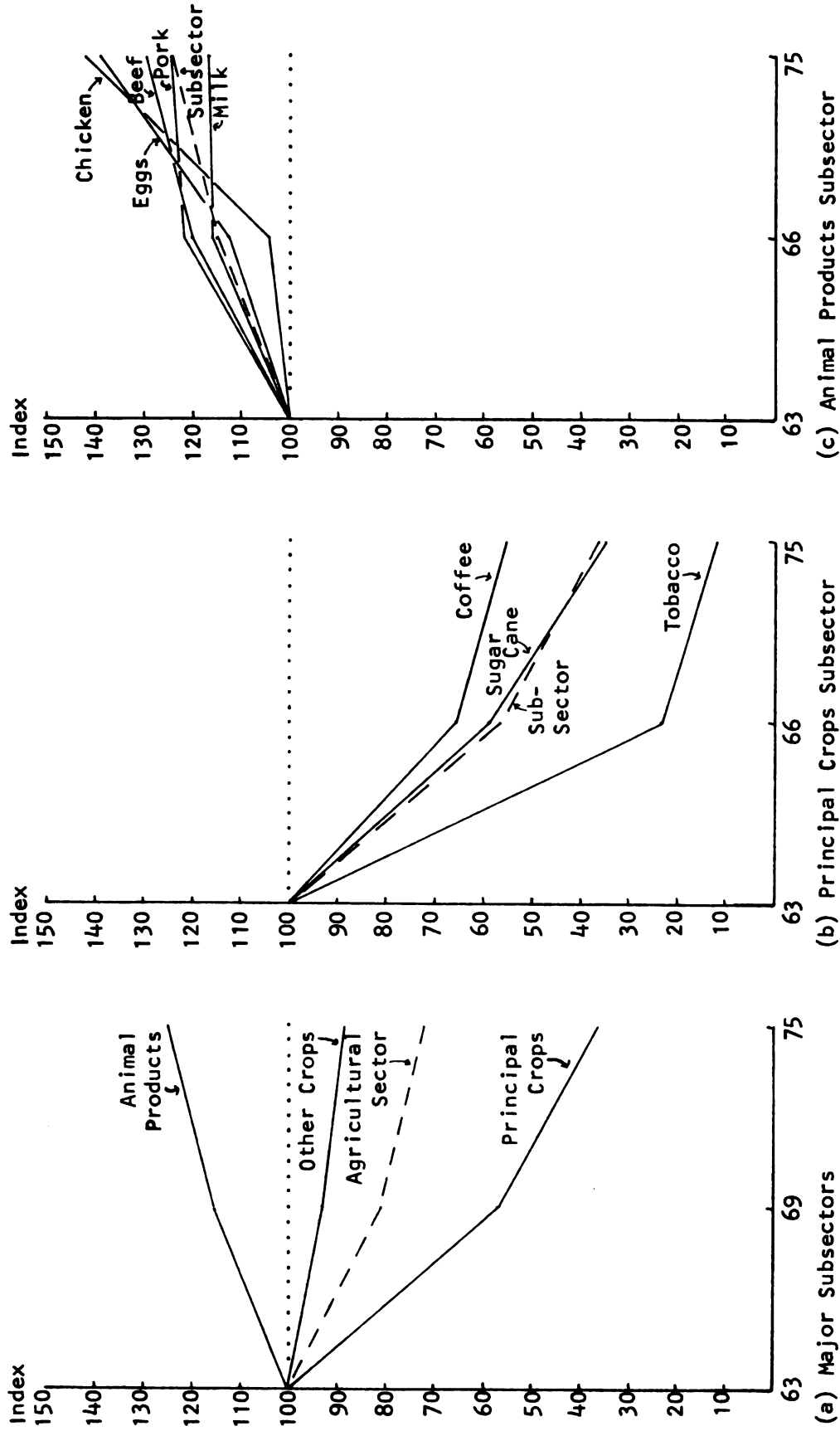
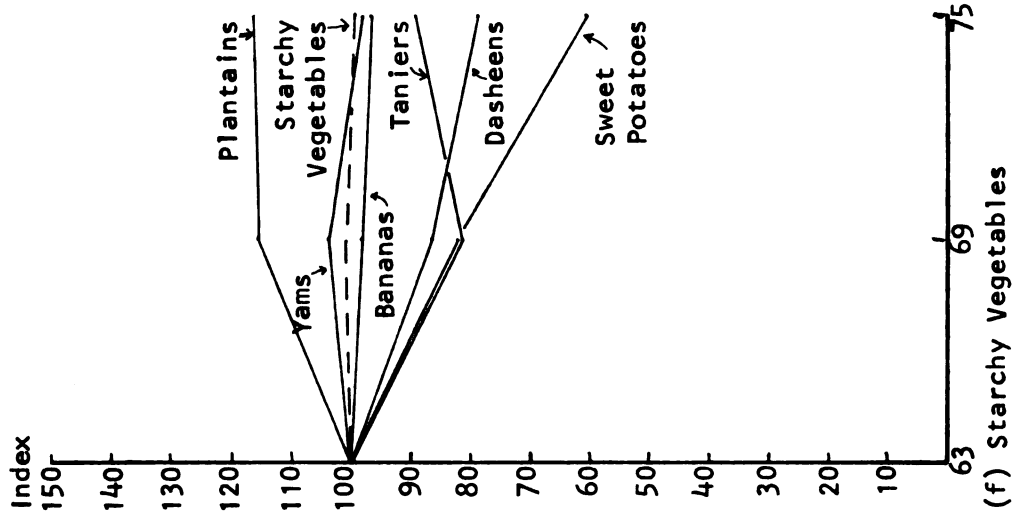
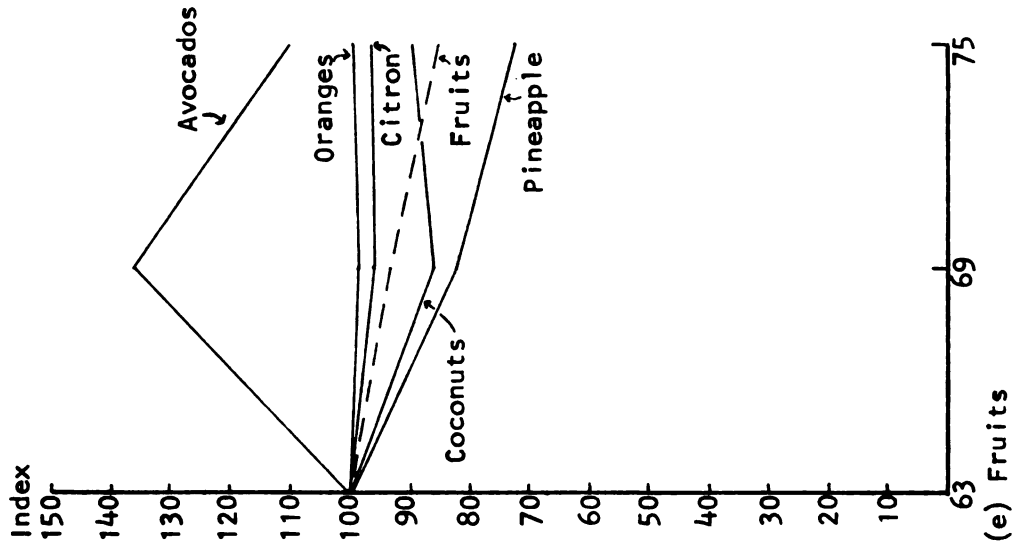
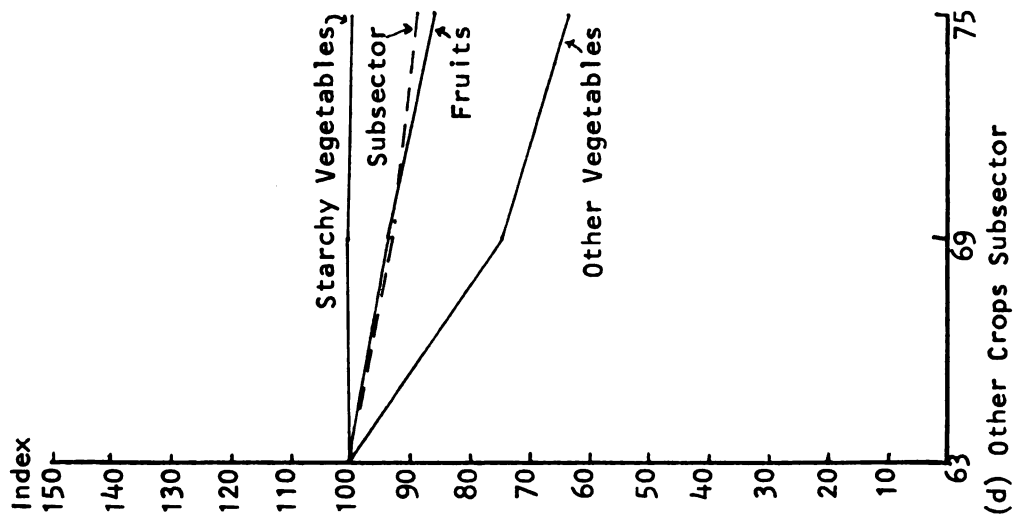


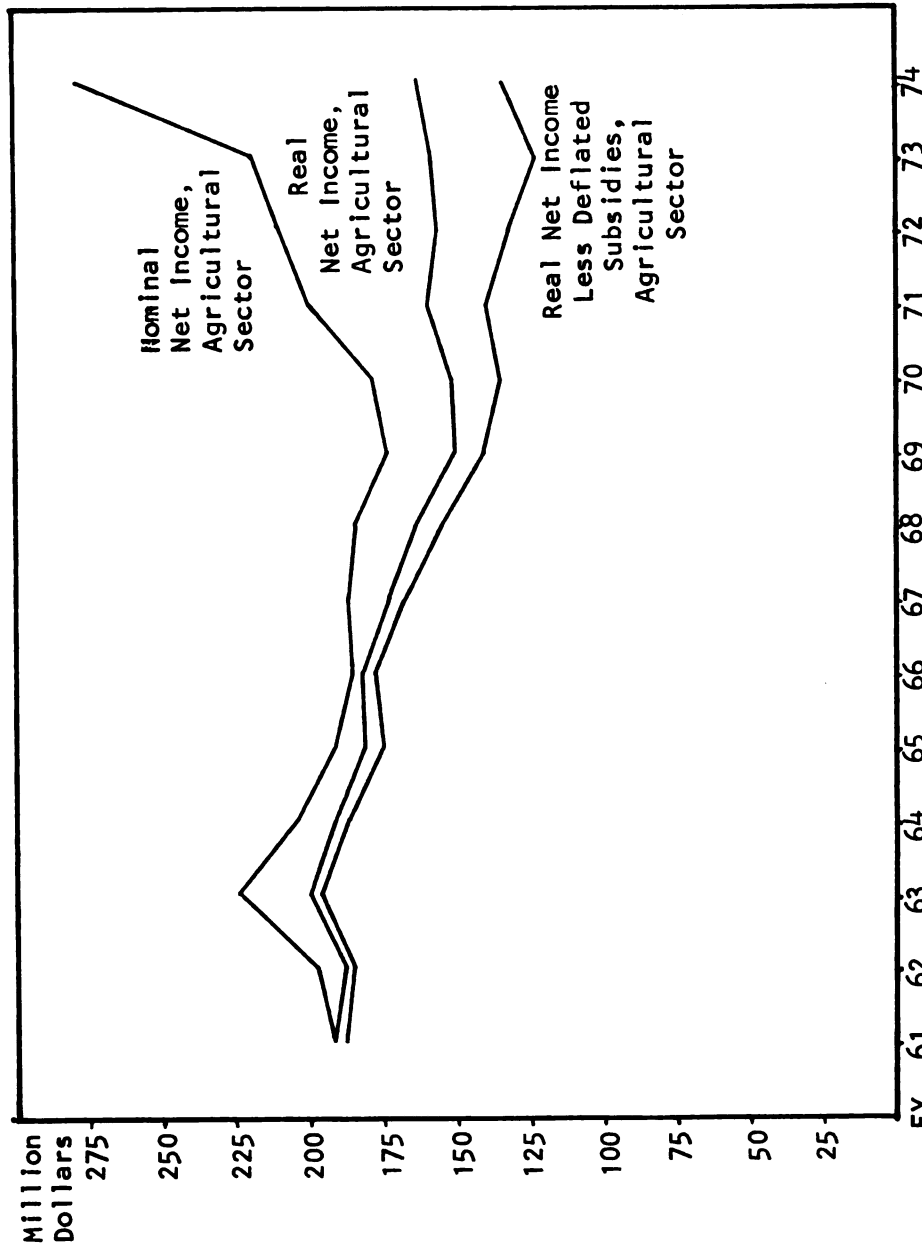
Figure 4. Indices of Agricultural Production by Subsectors and Products, 1963, 1969 and 1975 (Continued).



permit the examination of underlying trends. Secondly, the Gross Product statistics include forestry and fishing and are deflated by an index based on selected products rather than on all products, as is the case in the production index. This analysis was not based on the use of Net Income statistics because their use would lead to a misinterpretation of the actual performance of the sector. This is due to the fact that subsidies to the sector add directly into Net Income and to the extremely large increases in subsidies that the sector has received since 1968 and 1970. In 1967, the agricultural sector received \$5.455 million in recorded subsidies. By 1968, they had almost doubled to \$10.009 million and have since risen to \$50.392 million in 1975 (including the wage rate subsidy). Thus, while physical production has continued to decline since 1963, the figures on Real Net Income level off beginning in 1970. However, if the deflated value of subsidies is subtracted from Real Net Income, the resultant figures of Real Net Income (from Production) continue to decline at more or less the same rate since 1963 (see Figure 5).

The sugar cane subsector is very labor intensive and the natural topographic limits to its mechanization have prevented it from keeping up with advancing technologies in competing world regions, except on the best level lands (Ballinger, p. 22). Coffee, on the other hand, while also very labor intensive, has not experienced much mechanization and has had to compete with low-wage producers in South America and Africa. Much of the foodstuffs are produced on small farms since much of the best land belongs to the larger sugar producing farms.

Figure 5. Agricultural Net Income in Puerto Rico, 1961 to 1974.



Sources: Net Income, P.R. Planning Board; Subsidies, Office of Agricultural Statistics, P.R. Department of Agriculture.

Product and Factor Price Determination

Puerto Rican farm operators are generally price-takers in both their product and input markets. On the input side, most of their non-labor inputs, including fuel, fertilizers, feeds and machinery, are imported. The wage rates for agricultural labor, both skilled and unskilled, are set by either the Administrator of the Wage and Hours Division of the U.S. Department of Labor or the Puerto Rico Minimum Wage Board. In the case of sugar cane workers, the Minimum Wage Board adjusts the minimum wage rates every 28 days based on the average New York raw sugar price (U.S. Department of Labor, p. 17).

On the product side, the prices for sugar cane, coffee and tobacco are determined in the respective world markets since the Puerto Rican share of these markets is quite small. With the exception of fresh milk and fruit, much of the local consumption of foodstuffs is imported from the U.S. mainland. Data for the 1961-1974 period from the Consumption Section of the Puerto Rico Office of Agricultural Statistics show that imports of starchy vegetables were between 16% and 36% of consumption, imports of eggs were between 34% and 55% of consumption, imports of leafy vegetables were between 30% and 67% of consumption and imports of legumes were between 79% and 88% of consumption. In short, any significant change in the production of Puerto Rican agriculture will have very little, if any, effect on market prices due to the relatively large quantities of products which are exported or imported.

Product and Factor Price Trends

Table 5 reports the average annual growth rates for the index of agricultural product prices and for the available factor prices for the

Table 5. Product and Factor Price Growth Rates in Puerto Rican Agriculture, Selected Periods, 1961-1974.

Period	Product Prices	Fertilizer Prices	Feed Prices	Wage Rates Paid
1961-1963	5.00%	3.11%	4.60%	1.34%
1963-1966	-3.07%	2.07%	3.36%	6.36%
1966-1969	2.97%	0.31%	3.28%	8.75%
1969-1973	4.49%	3.23%	3.65%	*
1973-1974	75.26%	26.75%	21.57%	*

* Wage Rates were held constant by the Wage Rate Subsidy Program.

periods in which the shifts in production trends are most visible. The actual prices are listed in Appendix B. This table shows that the rates of increase in wage rates paid by the farm operators were considerably greater during the two periods of sharp decline in production (1963-1966 and 1966-1969) than were the rates of increase in feed and fertilizer prices.

Labor Market Conditions

Trends in Agricultural Employment

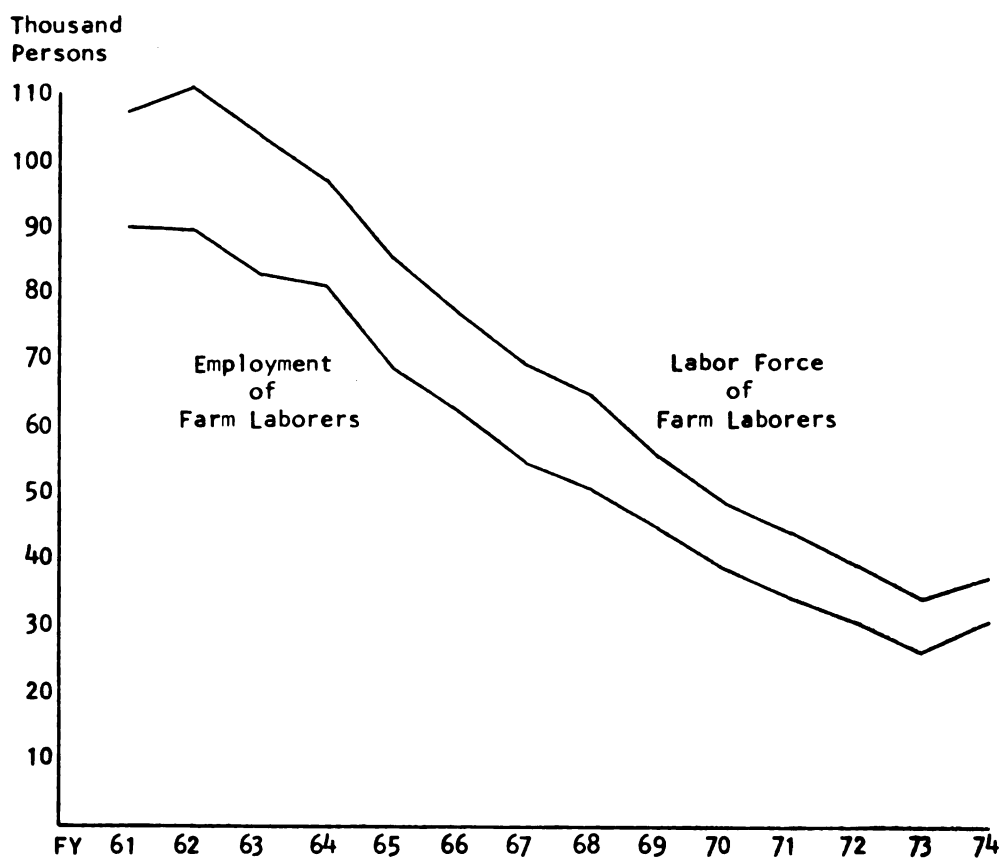
Table 6 documents the significant loss in employment in agriculture during the period of decline in agricultural production. Sixty-nine thousand jobs were lost between 1964 and 1974. Almost 50% of this decline has come in the sugar cane subsector and 30% has come in the coffee and tobacco subsectors. Thus, almost 80% of the decline in employment has been in the export crops subsectors. As would be expected, most of the lost jobs have been those of farm laborers. This category declined by 50,000, or 72% of the 69,000. Figure 6 illustrates

Table 6. Employment in Puerto Rican Agriculture, 1964 to 1975, in Thousands.

Fiscal Year	Agri. Sector	Sugar Cane	Coffee	Tobacco	Livestock	Pineapple	Other Agri.
1964	122	43	21	11	4	2	39
1965	108	32	21	12	4	*	36
1966	99	31	18	7	4	*	36
1967	88	28	18	4	4	*	32
1968	85	22	19	4	5	*	31
1969	78	21	16	2	4	*	33
1970	68	18	12	*	4	*	32
1971	61	13	12	*	4	*	30
1972	56	11	9	2	4	*	29
1973	50	11	9	2	3	*	23
1974	53	9	11	*	3	*	28
1975	50						

* Less than 2, estimates unreliable. Total excludes Forestry and Fisheries. P.R. Department of Labor, revised data.

Figure 6. Labor Force and Employment of Farm Laborers in Puerto Rico, 1961 to 1974.



Source: Puerto Rico Bureau of Labor Statistics

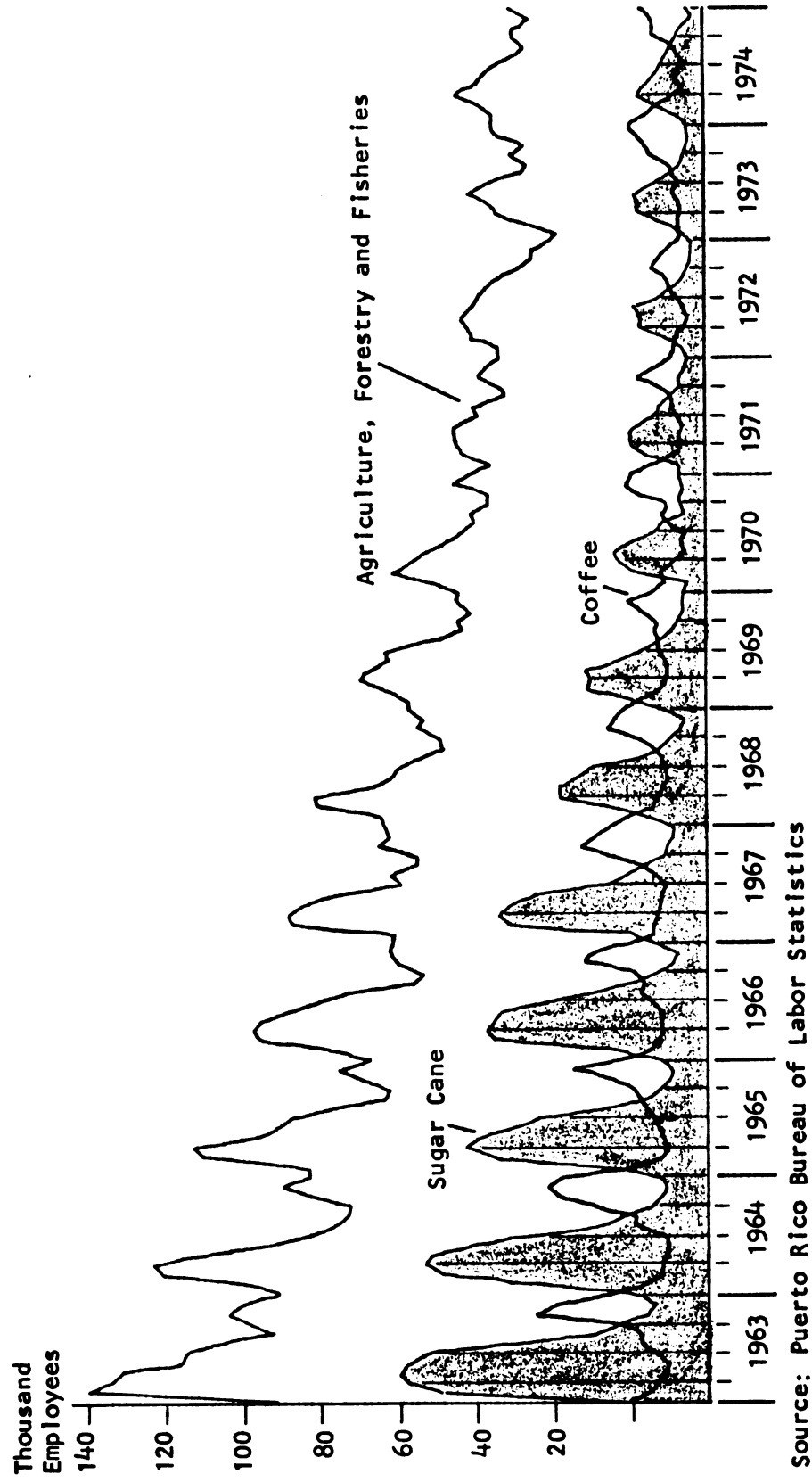
the decline in employment and in the labor force of agricultural laborers. These data, however, are the annual averages and do not reflect the high degree of seasonality of employment, primarily in the export crops. The seasonal increases correspond directly to the harvest periods of both sugar cane and coffee, and are illustrated in Figure 7.

Although the average value of output per worker for agriculture increased rapidly between 1961 and 1975 (see Figure 1, page 14, and Table 4, page 15), it seems probable that much of this increase simply reflects the large decline in the employment of farm laborers, particularly for the unskilled export crop harvest laborers. An additional factor would be the expectation that much of the decline in production would have come from the termination of the least efficient farms, thereby also tending to raise the average output per worker.

Demand Determined Employment

Due to the operation of the minimum wage laws in Puerto Rico, employment of agricultural laborers appears to depend solely on the demand for labor of the farm operators. In studying the 1952-1962 period, Reynolds and Gregory found that increases in wage rates for farm laborers were " . . . probably attributable in good measure to the island's minimum wage law . . ." since even at peak employment seasons agricultural unemployment was sufficiently high to avoid any serious pressure on wages to increase due to labor shortages (Reynolds and Gregory, p. 62). The direct implication is that the minimum wage rates were above the equilibrium wage rates, and the quantity of labor being employed was the quantity which the farm operators could profitably use.

Figure 7. Agricultural Employment in Puerto Rico, 1963 to 1974, by Month.



Source: Puerto Rico Bureau of Labor Statistics

More recent data tend to confirm this finding. Unemployment rates for farm laborers averaged 19.2% between 1961 and 1969 (when the subsidy program began). The annual average unemployment rate was also relatively stable during this period. The lowest monthly unemployment rate was 7.5% in March of 1969, one of the sugar cane harvest months. Even if one considers that the non-farm labor unemployment rate averaged 21.9%, the higher wage rates of this category (see Figure 2, page 17) should more than compensate for the lower probability of finding employment as a non-farm laborer.

Perceived Labor Shortages

The finding that unemployment rates were high before the enactment of the wage rate subsidy program presents a direct conflict with the complaints of the farm operators that they were unable to obtain adequate amounts of labor. The only explanation of this paradox is that the farm operators, faced with higher operating costs for all of their inputs, could no longer afford to hire as much labor as they had previously employed when labor was relatively cheaper. Since the prices paid for their non-labor inputs are determined outside of Puerto Rico, their only feasible alternative was to influence the price of labor by resorting to the political arena. Their appeal via the Department of Agriculture is logical in that the Minimum Wage Board is under the Department of Labor and both of these are concerned with the welfare of the labor groups.

The concept of the reservation wage rate does not provide a logical explanation of this paradox. The reservation wage rate is the lowest wage rate which someone will accept for a specific task. For

the menial tasks of the farm laborer (cutting sugar cane, picking coffee, etc.), it seems quite plausible that the reservation wage rate would be rising, given the rising affluence and standards of living in Puerto Rico. However, if the reservation wage rate for most farm laborers were above the minimum wage rates, it would be irrational for the laborers to remain unemployed in the agricultural labor force when they could seek employment in the other occupational and industrial categories. The large movements into and out of the farm labor force, which are documented in the next section, suggest that the farm laborers do remove themselves from the farm labor force rather than remain unemployed in this category, but that they also return to the farm labor force when they expect to find employment during the harvest periods.

Seasonal Responsiveness of the Farm Labor Force

An examination of the monthly data on the farm labor force reveals large movements into and out of the farm labor force. Looking at the movements of calendar year 1968 as an example, Table 7 gives the net changes in employment of farm laborers and foremen and shows the origins of the increases in employment and the destinations of those employees that left the ranks of the employed when there were decreases.

In nine of the twelve monthly changes, the change in the labor force was greater than the change in the number of unemployed persons. In seven of the twelve monthly changes, the change in the labor force was greater than the change in employment. Further analysis of this table suggests that there is a tendency for laborers to enter into or exit from the labor force in anticipation of an increase or decrease in

Table 7. Changes in Employment of Farm Laborers in Calendar Year 1968 and the Origins and Destinations of the Net Movements.

Between the Months of:	Employment	Unemployment		Labor Force	
	Change	Change	Percent Of Change In Employ	Change	Percent Of Change In Employ
Jan-Feb '68	+ 17,229	- 8,805	51.1%	+ 8,424	48.9%
Feb-Mar	+ 1,095	- 2,325	212.3%	- 1,230	112.3%
Mar-Apr	- 12,246	+ 4,678	38.2%	- 7,568	61.8%
Apr-May	+ 888	- 2,736	308.1%	- 1,848	208.1%
May-Jun	- 6,235	+ 1,341	21.5%	- 4,894	78.5%
Jun-Jul	- 5,287	+ 2,115	40.0%	- 3,172	60.0%
Jul-Aug	- 6,208	- 1,591	25.6%	- 7,799	125.6%
Aug-Sep	+ 495	+ 2,265	457.6%	+ 2,760	557.6%
Sep-Oct	+ 7,238	+ 732	10.1%	+ 7,970	110.1%
Oct-Nov	- 1,106	+ 394	35.6%	- 712	64.4%
Nov-Dec	- 2,377	- 783	32.9%	- 3,160	132.9%
Dec-Jan '69	+ 1,875	+ 259	13.8%	+ 2,134	113.8%
Numbers and Totals of:					
Increases	(6) + 28,820	(7) + 11,784		(4) + 21,288	
Decreases	(6) - 33,459	(5) - 16,240		(8) - 30,383	
Net Change	- 4,639	- 4,456		- 9,095	

Source: Derived from unpublished data from files of the Puerto Rico Bureau of Labor Statistics.

employment (Feb-Mar, Apr-May, Aug-Sep, and Dec-Jan'69), and, in those months when a large decrease in employment does occur, for most of the laborers to leave the labor force rather than remain unemployed for several months (Mar-Apr, May-Jun, Jun-Jul, Jul-Aug, Oct-Nov, and Nov-Dec).

A comparison of the monthly changes in the total labor force of Puerto Rico and the monthly changes in the farm laborer labor force shows, initially, a different seasonal pattern (Table 8). A further look, however, reveals that of the months in which the total labor force declined, five of the six declines in total labor force were greater than the decline in the farm laborer labor force. Thus, the net flows in those five monthly changes were from the farm laborer and

Table 8. Monthly Changes in Total and Farm Laborer Labor Forces in Calendar Year 1968.

Between the Months of:	Changes in Labor Force	
	Total	Farm Laborers
Jan-Feb '68	- 2,333	+ 8,424
Feb-Mar	- 2,820	- 1,230
Mar-Apr	- 15,242	- 7,568
Apr-May	+ 1,696	- 1,848
May-Jun	+ 22,954	- 4,894
Jun-Jul	- 9,283	- 3,172
Jul-Aug	- 11,603	- 7,799
Aug-Sep	+ 7,089	+ 2,760
Sep-Oct	+ 13,314	+ 7,970
Oct-Nov	- 3,075	- 712
Nov-Dec	+ 145	- 3,160
Dec-Jan '69	+ 12,916	+ 2,134
Totals of:		
Increases	+ 58,114	+ 21,288
Decreases	- 44,356	- 30,383
Net Change	+ 13,758	- 9,095

Source: Unpublished data from files of the Puerto Rico Bureau of Labor Statistics.

other occupation labor forces completely out of the total labor force. Although positive proof that the people leaving the farm laborer labor force also left the total labor force cannot be derived from the available statistics, the fact that the net flows resulted as they did is suggestive of the possibility that there is a large movement into and out of the farm laborer labor force in response to the seasonal demands of agriculture.

Summary of Conditions in the Agricultural Economy

The current state of the Puerto Rican agricultural sector may be traced to its past history of concentration on the labor dependent

export crops and the rapid increases in wage rates which have accompanied the rapid industrialization of the island economy. The concentration on export crops was possible due to the island's access to the mainland United States market for foodstuffs. The vulnerability of the sector to increasing labor costs was compounded by natural topographical limits to mechanization in sugar cane which might have allowed it to remain competitive in both its factor and product markets. No such technological advances were available for the coffee farms. The island's mountainous terrain makes it difficult for Puerto Rico to compete with mainland producers in the provision of foodstuffs to all of its population. Although it does seem to be responding in the area of livestock products, especially fresh milk and eggs, this subsector will continue to be dependent upon imported animal feeds.

The Puerto Rican farm operators find themselves to be price-takers in virtually all of the factor and product markets. Their non-labor inputs are mainly imported and their labor input prices are controlled under both the federal and the island's own minimum wage establishments. The rapid industrialization and the burgeoning population are also acquiring the prime agricultural lands which are concentrated along the coastal areas where most of the population lives. On the product side, export prices are determined in the world markets and the foodstuff prices are heavily influenced by the large imports of food from the United States.

In short, Puerto Rican agriculture has been unable to compete effectively in any of its markets, with the result that production has declined sharply since 1963. Its dependence on labor makes governmental subsidization of wage rates an obvious alternative in an attempt to

revive the agricultural sector, or at least to soften the transition required of the farming population. The following chapter describes the wage rate subsidy program and the manner in which it was implemented in Puerto Rico.

CHAPTER IV

THE WAGE RATE SUBSIDY PROGRAM IN PUERTO RICO

Background of the Program

In May of 1969, the Senate of Puerto Rico passed Senate Resolution #91, which authorized a study by the Agriculture Committee, jointly with the Labor and Cooperative Development Committee, to investigate the shortage of cane cutters in the 1968 and 1969 harvests and its presumed connection with the program which places island residents in migrant labor jobs on the mainland. Eight meetings were held between May and October and much of the discussion revolved around the reconciliation of the Association of Farmers' claim that they could not find people willing to work and the Labor Department statistics on unemployment among farm workers. The idea of bringing in thousands of laborers from a less developed country (to be paid for by the government) was discussed and later rejected.

In June of 1969, the Commonwealth of Puerto Rico passed a law to create the wage rate subsidy program for hired agricultural laborers. In testimony before the Agriculture Committee of the Puerto Rico House of Representatives, then Secretary of Agriculture, Luis Rivera Brenes, listed four basic objectives of the proposed program. These were: 1) to increase the income of the farm workers, 2) to attract and conserve a labor force, 3) to stimulate the attendance at work and to discourage absenteeism, and 4) to achieve an increase in agricultural production

(Commonwealth of Puerto Rico, Camara de Representates, p. 6). The statement of legislative intent for the program includes the following paragraphs:²

By this law, it is declared as being public policy of the Government of Puerto Rico, the guarantee for agricultural workers of an income greater than the one they are receiving at present, which will persuade them to continue working in the agricultural sector in order to ease the shortage of manpower encountered by this industry, without raising the costs of production. Likewise, it is expected to raise the standards of living of the workers so that they may enjoy a more rewarding experience.

Therefore, the purpose of this act is to increase the income of the worker, thereby reducing his absenteeism in agricultural activities, thus increasing the agricultural production through a more intensive labor in planting, cultivation and harvesting.

However, the economic situation of the agricultural enterprise does not permit the farmers at present to pay wages in an amount equal to or greater than the income desired to be guaranteed to these workers.

For this reason and with the intention of aiding agriculture to regain its prosperity and to be able to pay wages equal to or greater than the incomes guaranteed by this act, a supplement is hereby established to the income at present received by certain agricultural workers to be determined in accordance with the provisions of this act, to be defrayed by the Government of the Commonwealth of Puerto Rico, by using the farmer as intermediary so that the income supplement will reach the workers through the mechanism established by this act.

The objective of increasing agricultural production hopefully leads to or is concurrent with lower food costs (if a sufficient proportion of local consumption is locally produced), lower food imports, higher agricultural exports, increased income for the island economy and maximum utilization of resources. The objective of an improvement in the standard of living of the rural population will hopefully reduce

²Law 142 of the 29th of June of 1969. Translated from Spanish by the author. See Appendix C for the Spanish version.

the rural to urban migration of people, thereby also reducing the social tension in urban centers and the pressure for government-provided services. In addition, one would expect improved nutrition, housing facilities, choice in consumption and leisure opportunities to result from the higher incomes. Nevertheless, conversations with officials of the Puerto Rican government lead to the belief that the objective of increasing agricultural production (by means of improving and increasing the supply of labor at then current labor costs) was at least of equal importance and probably of greater importance than the objective of increasing the social welfare of the hired farm laborers. This belief is supported by the fact that the program was designed and operated by the Agriculture Department rather than the Labor Department and by the fact that when the federal minimum wage coverage was extended in Puerto Rico, the Puerto Rican government passed Law #20 of 1972, to compensate the affected farm operators by absorbing this increase in minimum wages through the wage rate subsidy program.

Operation and Procedures of the Program

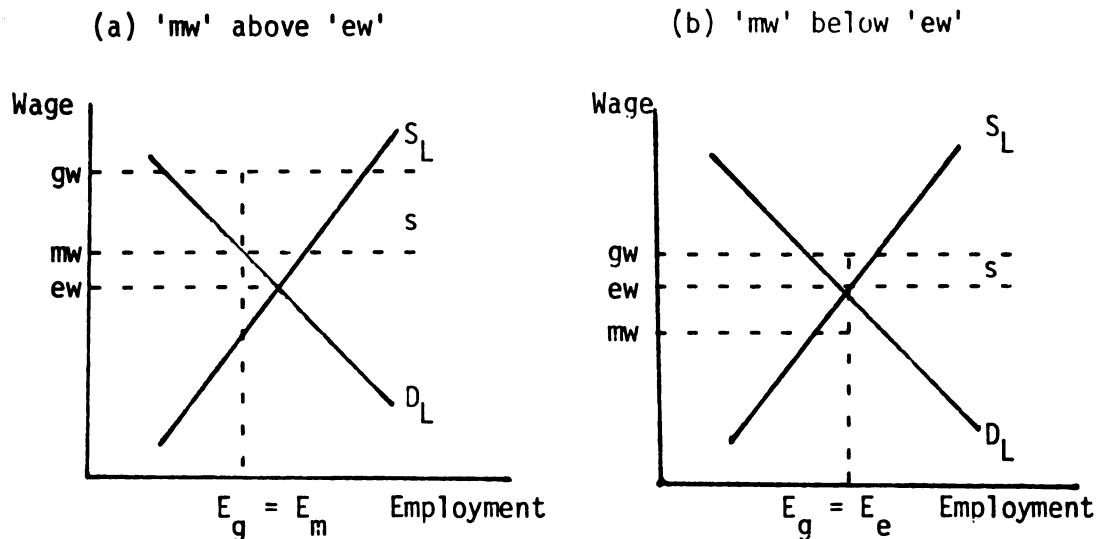
The program operates by setting a new and higher minimum wage rate for farm laborers and then reimbursing the farm operators for this increase in wage costs. The specific rules are that the program will reimburse to the farmer the difference between the new program minimum wage rate (hereafter referred to as the guaranteed wage rate) and the higher of either the regular minimum wage rate as set by the Puerto Rico Minimum Wage Board, or the wage rate at which the farm operator contracted the laborer.

As an illustration, assume that the guaranteed wage rate established by the program for dairy workers is \$1.05 per hour. If a dairy farmer employs two workers, one of whom he hired at a wage rate of \$0.85 per hour and the other whom he hired at the \$0.70 minimum wage rate, he would be reimbursed \$0.20 per hour worked by the former and \$0.35 per hour worked by the latter.

This system of implementation was designed to use the farm operator in the distribution of the benefits, without themselves benefiting directly. If one assumes that the regular minimum wage rate, 'mw' in Figure 8(a), is above the equilibrium wage rate, 'ew', as appears to be the case in Puerto Rico, then the farm operator is forced into passing all of the benefits of the program directly to the workers. Although the amount of labor supplied at the guaranteed wage rate increases, the farmer is already employing the amount of labor, ' E_m ', that he could afford at the regular minimum wage rate. If the regular minimum wage rate is below the equilibrium wage rate and the guaranteed wage rate is above the equilibrium wage rate, the benefits are less than the first case, but they are still passed completely to the worker--since the farmer had to have contracted the workers at the equilibrium wage rate which was above the minimum wage rate. If the guaranteed wage rate is set at a level below the equilibrium wage rate, then the program would receive no legitimate claims for benefits.

At first, the program only covered the hourly wage workers, but in 1971, it was extended to piece-rate coffee pickers and in 1972, to piece-rate tobacco stemmers. Law #141, which covers workers in the agricultural phases of the sugar industry, imposes minimum wage rates but instead of reimbursing the farm operators on the basis of hours and wage

Figure 8. Effect on Employment of the Relationship between the Equilibrium and Minimum Wage Rates.



rates of the individual workers, it pays an amount based on the tonnage of cane delivered to the sugar mills and which of the six methods were used to harvest the cane. In the last few years, payments to dairy farmers have been converted to the basis of delivered milk rather than hours on the payroll.

To be eligible to receive the reimbursements, each farm operator must submit an annual application. This form requests the following information:

- 1) Name, address, farm locations and Social Security Number,
- 2) Employer identification numbers for the State Insurance Fund, Social Security, Unemployment Compensation and the A.S.C.S. Sugar Program,
- 3) Number of permanent and temporary employees,
- 4) Farm size,
- 5) Area, estimated payroll, estimated production and value for each of the farm enterprises,
- 6) If a union contract determines the regular wage rate,
- 7) Number of animals, and
- 8) Sources of borrowed capital.

After each quarter, the farm operator applies for the reimbursement on a form which requests, for each worker:

- 1) Name and Social Security number,
- 2) Work done or farm enterprise,
- 3) Hours worked,
- 4) Regular wage rate and earnings,
- 5) Supplement to wage rate and total supplement (subsidy),
- 6) Social Security tax deducted, and
- 7) Total received by the worker in the quarter.

Separate forms are used for reimbursement for the piece-rate workers and for the subsidies paid on the basis of production (sugar and milk). The applications are checked at the regional program offices and then sent to San Juan where the information is punched on cards. Since the program pays the Social Security and State Insurance Fund taxes on the reimbursed supplements (subsidy) and interest on the total (the farmers are presumed to have borrowed money to pay the supplements), these amounts are automatically added to the total by the computer.

Regular visits are made to the farms to assist the farmers in making the applications, explain the rules and regulations and to verify the claims for reimbursement. Arrangements are made with the farm operators who have received overpayments due to improper claims for reimbursement. If the amount to be returned is large, the recovery of these funds may be spread over a number of quarters by reducing future reimbursements, thereby reducing the cash flow impacts on the farm operation.

A number of problems have resulted in the implementation of the program. First, many of the workers will not give their correct Social Security number to the farm operators. Some of these do not give any number at all so that the tax will not be deducted from their wages, and others will give false numbers in the expectation that other welfare or assistance benefits they might receive will be terminated or reduced. Strict enforcement of the use of Social Security numbers would, in all

probability, result in extensive use of false numbers. A second problem which is common is the absence of adequate farm records, especially payroll records. Many of these farmers employ only two or three workers and claim that they know how many hours each one has worked during the quarter. This makes verification of the reimbursement requests extremely difficult, although the claims are normally paid. A third problem, and the one which results in the largest adjustments, results from the automatic inclusion of the Social Security and State Insurance Fund taxes with the reimbursements rather than the payment of these claims upon presentation of records by the employer showing taxes actually paid to the two systems. Due to the lax enforcement by the State Insurance Fund, many of the farmers will declare only the minimum payroll so as to comply with the requirements (cover his workers) and avoid paying the full amounts due. No effort is made to force the farm operators to comply fully with the Social Security and State Insurance Fund requirements. If an investigation shows that the farmers did not pay the proper amounts of these taxes, the overpayments under the program are returned to the program instead of requiring the farmers to comply with the other institution.

A fourth problem, stated by the Acting Program Director, is the payment of supplements for workers who are receiving a wage rate above the program's minimum wage rate (the program's breakeven wage rate). This occurs when the farm operator reports a pre-supplement wage rate which is lower than the program minimum wage rate, even though he is paying a higher wage rate. The farm operator thereby requests a reimbursement for the worker by intentionally underreporting the wage rate actually paid. Although the program was designed to provide a larger

supplement for lower wage rate workers, the incentives (inherent in the design) for farmers to declare the regular minimum wage rate (of the Minimum Wage Board) as the market rate being paid the workers naturally lead to the farm operators being reimbursed the maximum amount in most cases. This case can also be seen as a simple extension of underdeclaring wage rates when the actual wage rate paid is below the program minimum wage rate. Both cases are illegal, but in the latter the farm operator would qualify for some amount of reimbursement anyway. No clear indication is available as to the extent of underdeclaring of pre-supplement wage rates and such situations are often overlooked due to a perceived unfairness and since it is in accord with the original intent of relieving wage costs in the agricultural sector.

Wage and Subsidy Rates Under the Program

The magnitude of the subsidy in terms of hourly wage rates can be seen in Table 9 for the lowest occupational categories ('other laborers') in each of the agricultural industries except sugar cane. The minimum wage rates in effect in 1969 as set by the P.R. Minimum Wage Board are listed first, followed by the Wage Rate Subsidy Program's guaranteed wage rates (by period of applicability) and the percentage increase that the guaranteed wage rates represented over the minimum wage rates. The Minimum Wage Board has not revised its minimum wage rates since the inception of the Program.

In 1972, the Federal minimum wage rates were raised to a level above the guaranteed wage rates, thereby making the farmers subject to the Federal rates ineligible for the subsidy. The Puerto Rican government responded by passing Law #20 of June of 1972 which created an

Table 9. Puerto Rico Minimum Wage Rates and the Wage Rate Subsidy Program's Guaranteed Wage Rates for General Laborers Not Covered by the Federal Minimum Wage Rates, 1969 to 1975.

Agricultural Industry	Coffee		Tobacco		Fruit	Poultry Beef & Dairy	Pine- apple	Flowers	Other
	Almud*	Hour	Varilla*	Hour					
P.R. Minimum Wage	1.00	.50	.0175	.55	.55	.65	.66	.63	.57
7/1969 to 6/1970									
Guaranteed Wage		.80		.80	.80	.80	.80	.80	.80
% Increase		60%		45%	45%	23%	21%	27%	40%
7/1970 to 6/1971									
Guaranteed Wage	1.35	.90		.90	.90	.90	.90	.90	.90
% Increase	35%	80%		64%	64%	38%	36%	43%	58%
7/1971 to 3/1972									
Guaranteed Wage	1.50	1.00		1.00	1.00	1.00	1.00	1.00	1.00
% Increase	50%	100%		82%	82%	54%	52%	59%	75%
4/1972 to 6/1974									
Guaranteed Wage	1.50	1.05	.03	1.05	1.05	1.05	1.05	1.05	1.05
% Increase	50%	110%	71%	91%	91%	62%	59%	67%	84%
7/1974 to ---									
Guaranteed Wage	1.50	1.17	.03	1.17	1.17	1.17	1.17	1.17	1.17
% Increase	50%	134%	71%	113%	113%	80%	77%	86%	105%

*The almud and the varilla are the piece-rate units in the coffee and tobacco harvests, respectively.

Note: Certain skilled workers had higher minima but the guaranteed wage rates were the same as for unskilled workers with the exception of milkers since 7/1974.

Source: Oficina de Ingresos Garantizados a Trabajadores Agrícolas, "Ingresos Garantizados Aplicables a los Trabajadores Empleados en Actividades Agrícolas Cubiertos por la Ley Num. 142 de Junio 29 de 1969, Segun Enmendada," mimeographed, no date.

equivalent subsidy for the affected farmers. Within months of the 1972 and 1974 changes in the Federal minima, the Program's guaranteed wage rates were raised to meet the Federal minima.

Program Costs and Workers Benefited

Table 10 reports the amounts expended under the program for the first six years of operation. The Supplements represent the reimbursements made to the farm operators for having paid the guaranteed wage rate. The "additional costs" represent reimbursements made to the farm operators to offset their increased liabilities of Social Security and State Insurance Fund taxes and payments for the interest on the farm operators' funds used to pay the supplements and the taxes on the supplements.

For the six years as a whole, the administrative costs represent 4.52% of total costs and the additional costs represent 8.89% of total costs.

Table 11 reports the payments made under the sugar cane law (Law 141 of 1969), the tons of cane milled, the supplements paid and the additional costs. Table 12 reports the number of workers, hours worked, total payments, hours per worker and supplement per worker for the non-sugar-cane laws (Laws 142 of 1969 and 20 of 1972). The data on payments and participation under the program are not fully consistent. Nevertheless, they are presented in order to convey the general magnitudes involved in the program.

Table 10. Direct Treasury Program Costs

(in Thousands of Dollars)

Type of Cost and Law	1970	1971	1972	1973	1974	1975	Total
SUPPLEMENTS							
Law 141		2,705	3,148	2,389	2,731	2,657	13,630
Laws 142 and 20	3,601	7,064	12,019	15,383	17,497	20,615	76,179
Subtotal	3,601	9,769	15,167	17,772	20,228	23,272	89,809
ADDITIONAL COSTS*							
Law 141		376	440	326	382	377	1,091
Laws 142 and 20	344	655	1,110	1,424	1,749	2,041	7,323
Subtotal	344	1,031	1,550	1,750	2,131	2,418	9,224
ADMINISTRATIVE COSTS							
Law 141	40	177	189	334	325	305	1,370
Laws 142 and 20	315	387	485	625	652	859	3,323
Subtotal	355	564	674	959	977	1,164	4,693
TOTAL COSTS							
Law 141	40	3,258	3,777	3,049	3,438	3,339	16,901
Laws 142 and 20	4,260	8,106	13,614	17,432	19,898	23,515	86,825
GRAND TOTAL	4,300	11,364	17,391	20,481	23,336	26,854	103,726

*Additional Costs include payments for Social Security and State Insurance Fund employer taxes on the supplements and interest expense on the delay in reimbursing the farm operators.

Source: Unpublished data from the Oficina de Ingresos Garantizados a Trabajadores Agrícolas, P.R. Department of Agriculture.

Table 11. Selected Program Participation Data - Sugar Cane Portion
(Law 141 of 1969).

Fiscal Year	1971	1972	1973	1974	1975
For Harvest Year	69/70	70/71	71/72	72/73	73/74
Tons of Milled Cane*	5,839	4,593	3,313	3,690	3,582
Supplements (\$'000)	2,705	3,148	2,389	2,731	2,656
Additional Costs ("	377	440	326	382	377
Total Payments (\$'000)	3,082	3,588	2,715	3,113	3,033

* In thousand tons.

Source: Unpublished table from the Oficina de Ingresos Garantizados a Trabajadores Agrícolas, no date.

Table 12. Selected Program Participation Data - Non-Sugar Cane Portion (Laws 142 of 1969 and 20 of 1972)

Fiscal Year	1970 ¹	1971 ²	1972 ³	1973 ³	1974 ⁴
Workers Benefitted	25,896	28,000	34,000	36,000	37,000
Hours Worked ('000) ⁵	20,445	24,864	29,564	34,155	39,162
Total Payments (\$'000)	3,945	7,730	13,108	18,480	19,246 ⁶
Hours per Worker	790	794	956	1,052	n.d.
Supplement per Worker	139	251	339	449	n.d.

¹Source: Departamento de Agricultura, "Informe Sobre Los Ingresos Suplementarios A Los Trabajadores Agrícolas Provistos Por Las Leyes Num. 142 de 1969 y Num. 20 de 1972," Agosto de 1973, first page of "Appendice".

²Source: Ibid., 3rd page of "Appendice".

³Source: Departamento de Agricultura, Oficina de Ingresos Garantizados a Trabajadores Agrícolas, "Compendio Estadístico," Julio de 1974, pp. 8-9.

⁴Source: Unpublished Table, Oficina de Ingresos Garantizados a Trabajadores Agrícolas, no date.

⁵Includes almudes of coffee picked at the rate of 2/3 hours per almud and varillas of tobacco sewn at the rate of 1/30 hours per varilla.

⁶Total payments in 1974 represents the supplement only and does not include the additional costs.

CHAPTER V

A FRAMEWORK FOR THE ANALYSIS OF THE PROGRAM'S EFFECTS

Introduction

In Chapter III an intuitive analysis of the conditions in the agricultural sector of the Puerto Rican economy showed that the decline in agricultural production was due mainly to the changing price relationships over time and a general inability of Puerto Rican agriculture to adopt newer technologies and mechanization in order to overcome these changing price relationships. This analysis implies the need for a dynamic framework of analysis upon which to develop a model which may be used to estimate the magnitudes of the effects of the program on production and employment. The second section of this chapter develops such a framework.

The first part of this chapter presents an analysis of the effects to be expected in a short run time frame, utilizing conventional short run microeconomic theory. The instructive aspect of this analysis is the conclusion that the subsidy program should not have any impact on production or employment in the short run.

Effects in the Short Run Under Competitive Conditions

Assumptions

The assumptions of microeconomic theory which are critical to this analysis are:

- 1) Product prices are given to the farm operator and are not affected by a change in his level of production.
- 2) Factor prices are also given to the farm operator and are not affected by a change in the quantities purchased by him.
- 3) Both product and factor prices remain constant in the short run.
- 4) The farm operator possesses perfect knowledge of the prices, his production function (i.e., the least-cost combination of inputs for each level of production) and the availability of inputs. Although the Puerto Rican farm operator cannot possess perfect knowledge, it must be assumed that he possesses a reasonable level of knowledge about the forces which may affect his operation.

For this analysis to be generalizable to the agricultural sector as a whole, these same assumptions must hold for the sector. That this is generally true has been shown by the finding that: 1) most inputs except labor are imported from the U.S. mainland, 2) the production is either sold for export in quantities insufficient to significantly affect prices or is sold on the island for local consumption in a market dominated by imported foodstuffs, and 3) the wage rates paid by farm operators are determined by the Minimum Wage Board or the Administrator of the Wage and Hours Division of the U.S. Department of Labor.

Production Theory

Under the assumptions of pure competition, a firm will select its levels of production and of input use so as to maximize its profit function. Profit equals Total Revenue (TR) minus Total Costs (TC):

$$(5.1) \quad \text{Profit} = \text{TR} - \text{TC}.$$

Total revenue equals the Product Price (P_y) multiplied by the quantity produced (Y), which is a function (the production function) of the input combinations ($X_1, \dots, X_n$). Total Costs equals the sum over all the

inputs of Unit Price (P_{x_i}) multiplied by the quantity used (x_i), for inputs 1, . . . , n. Thus, equation 5.1 may be expressed as:

$$(5.2) \text{ Profit} = P_y f(x_1, \dots, x_n) - \sum_{i=1}^n P_{x_i} x_i.$$

Profit is maximized when the first order conditions ($\partial \text{Profit} / \partial x_i = 0$, $i=1, \dots, n$) are met.³ Thus,

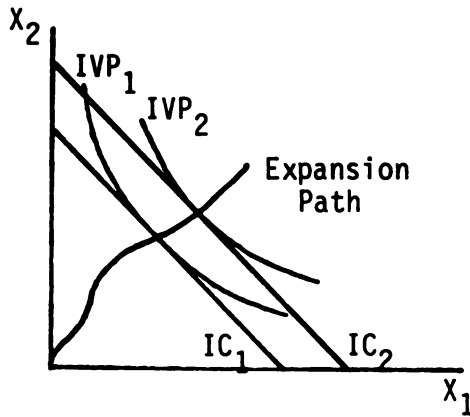
$$(5.3) \text{ Profit} / x_i = P_y f_{1:x_i} - P_{x_i} = 0,$$

for $i=1, \dots, n$, and where $f_{1:x_i}$ is the first derivative of the production function with respect to x_i . Since $P_y f_{1:x_i}$ is the Marginal Value Product of Y for x_i ($MVP_{x_i:Y}$), then profit is maximized when all inputs are used at levels which equate the $MVP_{x_i:Y}$ and the factor cost, P_{x_i} . For fixed input prices, the case of a two variable input profit function may be shown graphically using Iso-Value-Product and Iso-Cost lines (Figure 9). The slopes of the Iso-Cost Lines are equal to the ratio of the factor prices (P_{x_2} / P_{x_1}) or of the Marginal Physical Products ($MPP_{x_2:Y} / MPP_{x_1:Y}$). For any given output, the profit maximizer will select the combinations of input quantities which lie on the Expansion Path since these combinations represent the least cost combinations. The selection of the optimum level is dependent upon the product price, such that the Marginal Value Product of Y for x_1 and x_2 in least cost combination is equal to Product Price.

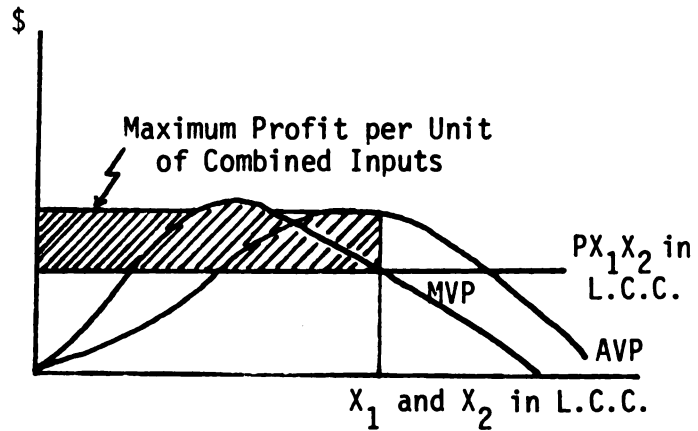
³The second order conditions are met if the law of diminishing returns holds.

Figure 9. Diagrammatic Representation of Production Decision

(a) Factor-Factor Space



(b) Cost and Revenue Curves

The Demand for Labor

A firm's demand for labor, or any input, is derived from its profit function. Since the profit function is maximized when the partial derivatives with respect to each of the inputs is equal to zero (the first order conditions), we have a system of equations:

$$\begin{aligned}
 (5.4) \quad \frac{\partial \text{Profit}}{\partial X_1} &= P_y f_{1:X_1} - P_{X_1} = 0 \\
 &\vdots \\
 &\vdots \\
 &\vdots \\
 \frac{\partial \text{Profit}}{\partial X_n} &= P_y f_{n:X_n} - P_{X_n} = 0,
 \end{aligned}$$

which when solved for $X_1, \dots, X_n$, gives the demand schedule for X_i in terms of P_{X_i} when all the other variables are held constant:

$$(5.5) \quad X_i = g_i(P_y, X_1, \dots, X_{i-1}, X_{i+1}, \dots, X_n, P_{X_1}, \dots, P_{X_n}).$$

Although the precise equation cannot be determined without knowledge of the production function, if the production function behaves according to the law of diminishing returns (i.e., meets the second order conditions),

the producer's input demand function may be shown to be always downward sloping (Henderson and Quandt, p. 70). From this result, we can see that if the price of an input increases with all other prices remaining constant, the quantity demanded will be decreased, and vice-versa.

Theoretical Impacts of the Program in the Short Run

Under the wage rate subsidy program in Puerto Rico, the farm operator is required to pay the guaranteed wage rate (g) to his laborers and subsequently is reimbursed for the difference between this rate and the legally established minimum wage rate (W)--this difference being the subsidy rate (S). The profit equation may be rewritten as:

$$(5.6) \text{ Profit} = P_y f(X_1, \dots, X_m, L) - \sum_{i=1}^m P_{X_i} X_i + SL - gL$$

where $X_1, \dots, X_m$ are the quantities of non-labor inputs used and L is the quantity of labor used. The first term of the equation is total revenue expressed as product price times the production function, the second term represents the sum of all non-labor input costs, the third term represents the subsidy payment received and the last term is the cost of labor at the rate the farmer paid (the guaranteed rate). However, since the subsidy rate equals the difference between the guaranteed rate and the minimum wage rate ($S = g - W$), it follows that:

$$(5.7) \quad SL - gL = gL - WL - gL = WL$$

and since L is an input quantity and W is its price, the profit equation can be rewritten as:

$$(5.8) \text{ Profit} = P_y f(X_1, \dots, X_n) - \sum_{i=1}^n P_{X_i} X_i,$$

where WL is simply included in the general input cost term $P_{X_i} X_i$. Since

this equation is identical to equation (5.2), we find that under short run competitive conditions the farm operator's production and employment decisions are derived from identical profit equations whether or not the subsidy exists and therefore the wage rate subsidy program should not affect either the level of production or the level of employment.⁵

Effects in the Intermediate Run Under Competitive Conditions

Review of the Agricultural Sector, 1961 to 1969

Puerto Rican farm operators are generally price takers in both their input and product markets. Thus, they determined production and input use in accordance with these prices and their particular production function. The unfavorable changes in the relative price relationships and their inability to adopt more productive technologies, especially labor saving technologies, appear to be the primary causes of the sharp decline in agricultural production. Given the high degree of dependence on hired farm laborers, the rapid rises in minimum wage rates appear to be of greater importance.

The Farm Decision Making Setting

The biological process of agricultural production requires that decisions concerning desired or planned output levels be made at or by the beginning of a planting-harvesting cycle or period. The existence of fixed assets in the farm firm make this decision making process a

⁵This would not be true under a general wage rate subsidy program in which the subsidy rate is a proportional function of the difference between the guaranteed wage rate and the equilibrium or minimum wage rate, whichever is higher.

serial one--decisions for the current period are dependent or conditional upon previous decisions, since by definition of asset fixity, investment and disinvestment decisions can only affect future time periods. Thus, the previous decisions, as embodied in the fixed assets of the firm, establish a range within which rational economic decisions may be made for the current period.

The decision at each planting time may be to increase, maintain or decrease output levels. To increase output requires additional investment and to decrease output permits disinvestment of currently fixed assets. The decision will be made based on the current financial structure of the farm and the operator's expectations of what product and input prices will be during the following periods. In particular, the operator will increase his investment in fixed assets if the expected product and input prices will result in total revenues equal to or in excess of total costs over the life of the fixed assets in which he must invest. Conversely, he will begin the process of disinvesting his fixed assets if expected product and input prices will result in total costs in excess of total revenues. If his expected revenue is in excess of his variable costs, he will continue to utilize his fixed assets until such time that he may dispose of them and if his variable costs are expected to exceed his revenues, he will leave the assets idle until he can dispose of them.

The process of disinvesting one's fixed assets is commonly more difficult than the process of investing in fixed assets. The salvage value of farm assets, as determined in the market of alternative uses of the asset, will often be below the capitalized value of the asset's ability to produce an income stream in its present use (its Marginal

Value Product). For example, a producing stand of sugar cane or coffee has no alternative use and a trailer for hauling sugar cane is not likely to be usable except as scrap metal. Thus, the farm operator will continue to use these assets until his marginal variable costs exceed his marginal revenues or until the asset is no longer usable.

The Puerto Rican agricultural sector had clearly been undergoing a process of disinvestment between 1966 and 1969 when the subsidy program began and for three years prior to 1966 had been almost maintaining its level of investment. Although no data are available on the value of farm assets, the data on agricultural production suggest that this has been the case. The changing price relationships, as shown in Table 5, page 25, also lend support to the possibility that for many farmers, total costs may have been larger than total revenues, thereby also supporting the apparent process of disinvestment. Although individual farmers may have been increasing their investment, in the aggregate it has probably declined.

The apparent topographical and farm size limitations on the adoption of newer technologies also has played an important role in the decline of agricultural production in Puerto Rico. Had it been possible to invest in newer technologies which would have increased the productivity of the variable inputs (particularly labor), the variable costs of a farm could have been lowered to a point which would have justified the new investment and a subsequent increase in production. Given the limitations on the adoption of newer technologies, the Puerto Rican farm operators were generally unable to achieve the significant increases in input productivity which would be necessary to offset the unfavorable change in relative prices.

Although the farm decision making setting described here deals with the relationships between output and fixed assets, it is still the prices of products and variable inputs which most directly affect the year-to-year fluctuations in output. The effect of the asset fixity is to introduce a sequential process to farm decision making, which requires the introduction of future expectations into the model which is developed in the following chapter.

Theoretical Effects of the Program in the Intermediate Run

The change in the time frame of the analysis to the intermediate run does not permit such a simple and determinate analysis as was possible in the short run analysis. This is due to the introduction of changes in the fixed asset structure of the farm or in the combination of variable inputs, either of which represents a change in the technological package being used, and therefore changes in the production function itself.

Since the wage rate subsidy holds the farm operator's wage rate constant over time, and since the prices of the other variable inputs have continued to rise over time, the price of labor has become cheaper relative to these other inputs. This change in the relative prices of inputs means that the Iso-Cost lines of Figure 9(a), page 53, change in slope. Thus, a different combination of inputs will be the least cost combination of inputs for each level of output and the expansion path for each year or period will be different. In particular, the relative cheapening of labor should result in a more labor intensive technology through time as the originally fixed assets may be changed, in which case both production and employment should be greater than the levels

which would have obtained without the subsidy. It does not seem probable that a relative cheapening of labor would be followed by a move to a more capital intensive technology, especially in view of the natural limits to mechanization of sugar cane in Puerto Rico.

CHAPTER VI

DEVELOPMENT OF THE MODEL: METHODOLOGY AND STATISTICAL ESTIMATION

Introduction

In order to estimate the effects of the program on production and employment, it will be necessary to develop a model which relates these two measures to the wage rate and then to use the model to predict how these measures would have resulted if the wage rate paid by farmers had taken certain assumed values for the "without subsidy" case. After presenting a brief description of the available data, this chapter will develop and statistically estimate the two equations of the model. The final section of this chapter summarizes the model and the following chapter applies the model, using a set of assumptions concerning the wage rate, to estimate the effects of the program on production and employment.

The Available Data

The Index of Agricultural Production (AGPROD) and the Index of Product Prices (AGPRCE)

These two variables are measured by the Puerto Rico Department of Agriculture's Office of Agricultural Statistics by means of semi-annual surveys of farms in Puerto Rico. Approximately 1,500 farms are in the sample and the sample is stratified into four categories of small farms and four categories of large farms. In addition, the island is divided

into five regions. Each of the resulting forty sub-samples has its own expansion factor based on the sampling rate for the estimate of the production of each product in each sub-sample. The prices of the products are weighted averages based on the prices received and the quantities sold by each farm. The annual estimates of output and prices for each product are based on the estimates from the two surveys in each year. The aggregate index of physical production is then calculated using production in the base period (FY 1960-1963). The aggregate price index is computed in a similar fashion using base period value of production as weights for the aggregated product categories.

Employment of Agricultural Laborers (AGEMP) and the Wage Rate Variable (WAGE)

These two variables are estimated by the Puerto Rico Department of Labor's Bureau of Labor Statistics using a survey almost identical to the Current Population Survey of the U.S. Bureau of Labor Statistics. The employment variable is a simple average of the estimates from the twelve monthly surveys for the category of Employed Farm Laborers and Foremen. The wage rate variable is estimated by using an additional question in the surveys for January, April, July and October and gives the median weekly wages for the same category of labor. These median weekly wages were adjusted by this researcher for those April estimates which the Puerto Rico Bureau of Labor Statistics reported as being affected by the Holy Week observances. This adjustment involved averaging the difference between the January and April estimates in the years not affected and adding this average change to the January estimates of the affected years. The four quarterly estimates, if and as adjusted, were then averaged for the annual average. However, since the wage

rate subsidy held constant the wage rate paid by farm operators, the wage rate variable used in the estimation of the model remains constant at the 1969 value (\$18.88) through 1974.

Feed Prices (FEED) and Fertilizer Prices (FERT)

The only time series data on prices paid by farmers is the series for "Maximum Prices for Mixed Fertilizers," as published by the Puerto Rico Department of Agriculture in their publication entitled Ventas de Abonos. The weighted average (maximum) fertilizer prices were used in this research. A second input price variable was constructed by this researcher by using the data on imported feeds which the Puerto Rico Planning Board provides to the Office of Agricultural Statistics.⁶ From the data on tonnage and values for imported prepared dairy and poultry feeds, a weighted average price series was computed.

The Index of Production Equation

Methodological Considerations

In Chapter V, it was shown that for a given technology, a farm firm under competitive conditions selects that level of output that maximizes its profit equation. In particular, the selection of the optimum output level is dependent upon product price, such that the Marginal Revenue Product when the inputs are in least cost combination is equal to Product Price. Since the least cost combination of inputs is dependent upon

⁶Office of Agricultural Statistics, Net Income Section, File Number 1.70.

input prices, the production decision is dependent upon both product and input prices:

$$(6.1) \quad Y = f(\text{Product Price, Input Prices})$$

where Y is quantity produced.

A common approach to estimating this equation, given that the production function is both unknown and changing over time, is to estimate a supply function where output is a function of the ratios of input prices to product price (Klein, pp. 126-129):

$$(6.2) \quad Y_t = f \left[(P_{x1}/P_y)_t, (P_{x2}/P_y)_t, (P_{x3}/P_y)_t \right].$$

This equation was estimated with the data previously described but gave unsatisfactory results in that the signs of some of the price ratio variables were positive rather than negative. Positive signs would mean that the farm operator's demand curves for inputs would be upward sloping, thereby contradicting the logic of economic theory.

Another approach is suggested by the serial or sequential character of the decision making process which was described in the preceeding chapter. This approach is to use the concept of adaptive expectations which forms a part of the theory on distributed lags. Although this approach produced much more satisfactory results, there are both conceptual and statistical estimation problems associated with its use.

The Adaptive Expectations Model

The adaptive expectations model (Kmenta, pp. 474-476 and Griliches, pp. 16-49) posits that the value of the dependent variable in the current period is a function of the expected value of the independent variable for the current period:

$$(6.3) \quad Y_t = a + BX_t^* + e_t.$$

In the case under analysis, Y_t is the level of output which the farmer is to select based on his expectations about the prices which he will encounter in the upcoming period (X_t^*), with the decision being made just before period "t". Since X_t^* is not known, it is necessary to assume a relationship between X_t^* and some known values. The assumption under this model is that X_t^* is a weighted average of X in the previous period (X_{t-1}) and the value which X was expected to take in the previous period (X_{t-1}^*):

$$(6.4) \quad X_t^* = (1 - \lambda)X_{t-1} + \lambda X_{t-1}^*.$$

Since X_{t-1}^* may be expressed as a function of the values of X in period $t-2$, this relationship may be expanded by using all past values of X . This expanded form gives a geometrically decreasing weight to the values of the previous periods:

$$(6.5) \quad X_t^* = (1 - \lambda)X_{t-1} + (1 - \lambda)\lambda X_{t-2} + (1 - \lambda)\lambda^2 X_{t-3} + (1 - \lambda)\lambda^3 X_{t-4} \\ + \dots + (1 - \lambda)\lambda^{n-1} X_{t-n}.$$

Thus, equation 6.3 can be rewritten as a function of all previous values of X :

$$(6.6) \quad Y_t = a + (1 - \lambda)B(X_{t-1} + \lambda X_{t-2} + \lambda^2 X_{t-3} + \dots + \lambda^{n-1} X_{t-n}) + e_t.$$

Since there are too many regressors in this equation to permit statistical estimation, the Koyck transformation may be used. Lagging the equation once, multiplying through by λ , and subtracting this from the original equation and adding λY_{t-1} to both sides gives:

$$(6.7) \quad Y_t = a + (1 - \lambda)BX_{t-1} + \lambda Y_{t-1} + n_t,$$

where $n_t = e_t - \lambda e_{t-1}$.

Although this transformation permits statistical estimation by reducing the number of regressors, it creates a new problem of estimation in that the new error term is serially correlated, thereby causing the estimates of the coefficients to be inconsistent (Kmenta, p. 479). To overcome this problem, the Cochrane-Orcutt procedure may be used (Kmenta, p. 479). This is an iterative procedure which uses ordinary least squares (OLS) to estimate the original equation. The computed residuals are used to estimate the coefficient of serial correlation (ρ) and this estimate is then used to transform the original equation (6.7) to:

$$(6.8) \quad (Y_t - \hat{\rho}Y_{t-1}) = a(1 - \hat{\rho}) + B(X_t - \hat{\rho}X_{t-1}) + u_t.$$

These estimated coefficients are then used in the original equation (6.7) to obtain a new set of residuals with which a new ρ is calculated and subsequently is used in the transformed equation (6.8) again to obtain another set of estimated coefficients. This iterative procedure continues until the estimated coefficient of serial correlation ($\hat{\rho}$) converges, i.e., changes by a predetermined small amount. The estimated coefficients which result from the final round coincide with the maximum likelihood estimates (Kmenta, pp. 287-289).

Although the use of this procedure results in consistent estimates, the computation of the fitted values becomes complex since all previous error terms enter into the equation. In year t , the equation becomes:

$$(6.9) \quad \hat{Y}_t = \hat{a} + \hat{B}X_{t-1} + \hat{\lambda}Y_{t-1} + \hat{\rho}^t e_0 + \hat{\rho}^{t-1} e_1 + \dots + \hat{\rho} e_{t-1}.$$

Thus, when using the estimated equation with an assumed set of values for the independent variables in order to predict what the levels of production would have been for the "without subsidy" case, there are

no known values with which to compute the residuals which should be used in the subsequent years.

The conceptual problem of the adaptive expectations model is concerned with the imposition of a distributed lag scheme when it may actually be endogenous to the model. Mundlak provides simple examples of how the geometrically distributed lag scheme implies a geometric decline in output when the price of capital is increased by an amount greater than the increase in product price in the model: $Y = f(x, k)$ (Mundlak, pp. 51-60). Although Mundlak makes his point, he uses a two period analysis and a rise in the price of a firm's fixed assets so that output cannot be affected until the second period. For the purposes of this research, however, the behavior of the farm firm is assumed to be more directly related to changes in the prices of variable inputs, for which the geometrically distributed lag seems to be a reasonable approximation to what one would expect even if it does not reflect the real response exactly. Additionally, there is no available procedure for statistical estimation of the correct lag scheme, even if this research could avail itself of a more voluminous amount of data with which to use a more accurate method. Thus, the use of a potentially incorrect lag scheme may be seen as a less serious error than the use of a model which ignores completely the sequential character of the farm decision making process.

One additional conceptual problem, but one which appears to be less serious, is that the volume of available data do not permit the estimation of separate lag structure coefficients for each of the three variables in the equation. Thus, the lag coefficient combines the effects of all three variables and should not be utilized to compute long

run elasticities for the coefficients of the independent variables.

In summary, the adaptive expectations model, equation 6.3, relates actual production to the farmers' expectations, at planting time, of the year's product and input prices. In order to estimate the coefficients using observed rather than expected prices requires the transformation to equation 6.7. However, this results in a serially correlated error term, thereby requiring the use of the Cochrane-Orcutt procedure. The resulting coefficients coincide with the maximum likelihood estimates of equation 6.7, but the coefficient of serial correlation ($\hat{\rho}$) must be used in computing the fitted values with equation 6.9. Finally, the equation is estimated using three independent price variables instead of just one since many more data points would be required to estimate three separate lag coefficients. This implicitly assumes that the lag coefficients for the three price variables are the same--meaning that the farm operators use the same set of weights for each observed price from the prior years. Thus, the equation to be estimated is:

$$(6.10) \quad Y_t = a + B_1 X_{1t-1} + B_2 X_{2t-1} + B_3 X_{3t-1} + \lambda Y_{t-1} + \text{error}.$$

Statistical Estimation of the Production Index Equation

The results of the statistical estimation procedure are as follows:

$$(6.11) \quad \ln \text{AGPROD}_t = 1.53916 \\
\begin{array}{lll}
+ .0414235 \ln \text{AGPRCE}_{t-1} & (.0297) \\
- .247280 \ln \text{WAGE}_{t-1} & (.0341) \\
- .192987 \ln \text{FEED}_{t-1} & (.0506) \\
+ .357305 \ln \text{AGPROD}_{t-1} & (.0785)
\end{array}$$

$\hat{p} = -.401066$ (.2541), $R^2 = .9899$, $F = 197$,
 D.W. = not applicable, Number of Observations: 13 (1963-1975)
 Values in parentheses are standard errors.
 AGPROD = Index of Agricultural Production
 AGPRCE = Index of Agricultural Prices
 WAGE = Median Weekly Wages of Farm Laborers
 FEED = Weighted Average Imported Feed Prices

Therefore, the original adaptive expectations model (equation 6.3) becomes:

$$\begin{aligned}
 (6.12) \quad \ln \text{ Production Index}_t = & \\
 & 1.5396 \\
 & + .04142 \ln \text{ expected product price}_t \\
 & - .24728 \ln \text{ expected wage rate}_t \\
 & - .19299 \ln \text{ expected feed price}_t
 \end{aligned}$$

Figure 10 shows the observed values of the production index and the fitted values resulting from this equation.⁷

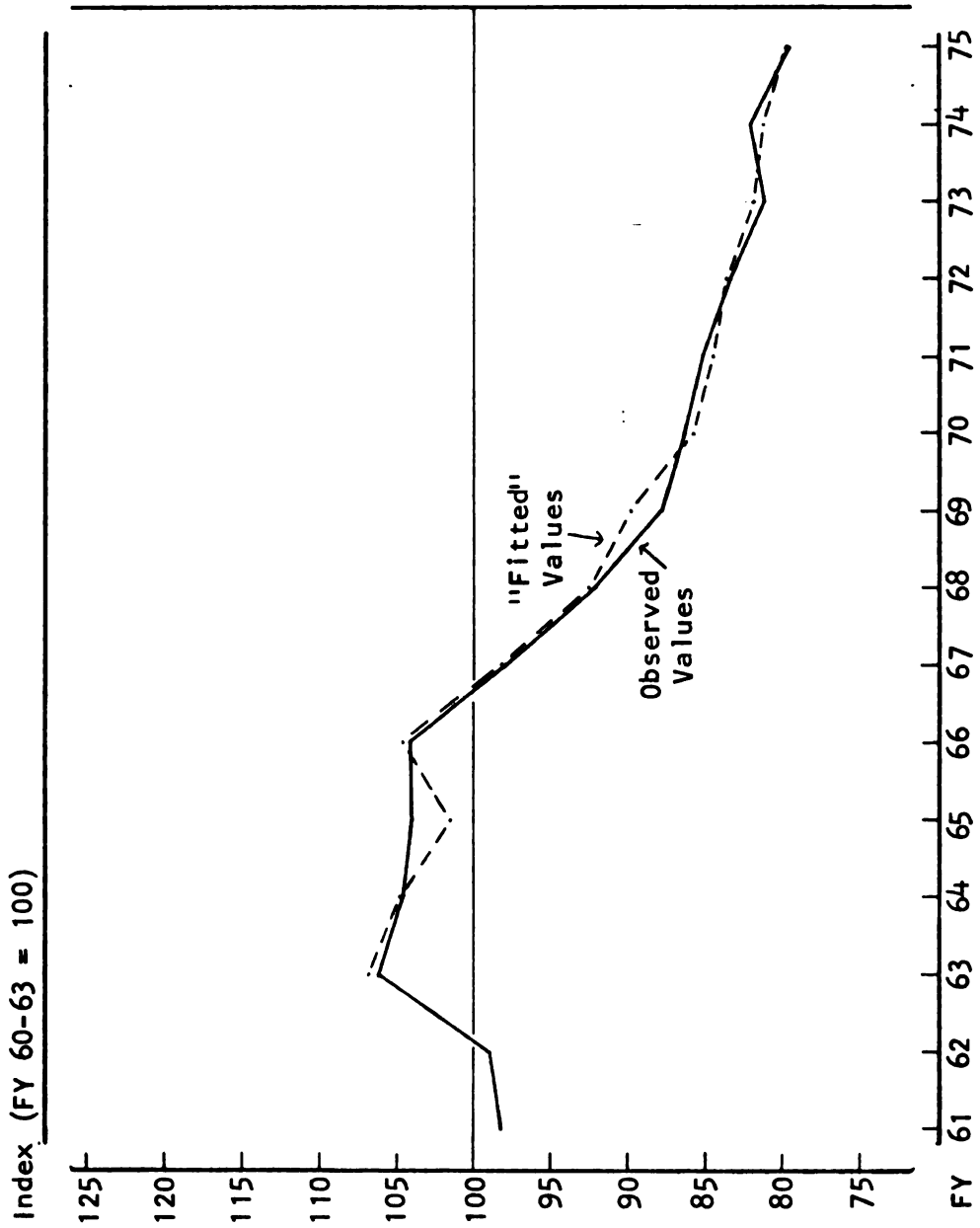
The Employment Equation

Methodological Considerations

The theoretical derivation of the farm manager's demand for labor function (equation 5.5) gives employment as a function of the product price, the wage rate, the prices of all other inputs and the quantities of all other inputs. This function tells how much labor will be employed at each possible wage rate when all other prices are held constant. For a given production function and a given set of input and product prices, the farm manager selects the level of output which will maximize his profits and thereby automatically selects his input use levels. While

⁷An observed value for 1975 is possible since the index for 1975 was available even though the other variables did not have 1975 values available and since this equation uses lagged values for the independent variables.

Figure 10. The Index of Physical Production of Agriculture in Puerto Rico, Observed Values (1961 to 1975) and Fitted Values (1963 to 1975).



these selections are simultaneous, they are all dependent upon the profit function (which embodies the production function) rather than being interdependent among themselves, as is the common case of supply and demand simultaneously and interdependently determining both price and quantity. This mutual dependence of the production and employment decisions on the profit function would suggest the formulation of an employment equation similar to the production index equation which was developed in the previous section.

The following adaptive expectations model for the employment of farm laborers in Puerto Rico was estimated:

$$(6.13) \quad E_t = a + B_1 X_1^*_{t-1} + B_2 X_2^*_{t-1} + B_3 X_3^*_{t-1} + e_t,$$

where E is employment, X_1 is the product prices index, X_2 is the wage rate variable and X_3 is the fertilizer price variable. Although this equation resulted in a very good fit ($R^2 = .9886$), the sign of the coefficient for fertilizer prices was positive--implying an upward sloping demand curve for fertilizer--and the coefficients for both the product prices index and the fertilizer price variable were not significantly different from zero.

The more common adaptive expectations model:

$$(6.14) \quad E_t = a + B_1 X_1^*_t + B_2 X_2^*_t + B_3 X_3^*_t + e_t,$$

which is predicated on the assumed relationship between the expected prices and the observed prices of:

$$(6.15) \quad X_t^* = (1 - \lambda)X_t + \lambda X_{t-1}^*,$$

was also estimated on the basis that the bulk of the labor is employed at harvest time when current prices are known with much greater accuracy.

This formulation, however, resulted in a lag coefficient greater than one (meaning that prices farther back in time receive greater weights in determining expected price in the current period) and the coefficient on the wage rate variable was extremely close to zero (implying that the wage rate has no effect on employment).

An alternative approach might be to simply use current or lagged prices as the explanatory variables, but this would ignore the sequential character of the production decisions and would permit an extreme value of one of the variables to yield an estimate of employment which would be completely out of line with the requirements of the level of production which is determined separately. A logical choice for a variable which will dampen the effects of an extreme price value is the level of production.

The simultaneous nature of the production and employment decisions suggests using the fitted or predicted values for the index of production which resulted from the index of production equation described in the previous section. This is, in effect, a two-stage least squares procedure. Thus, the equation:

$$(6.16) \quad E_t = f(X_{1_t}, X_{2_t}, X_{3_t}, Y_t)$$

was estimated, and although it gave a good fit ($R^2 = .9893$), it yielded a positive sign on the wage rate coefficient. This implies that farmers would employ larger amounts of labor as the price of labor increases, *ceteris paribus*.

In that the production and employment decisions are mutually dependent upon the profit function and are not interdependent (as the use of two-stage least squares would imply), the employment equation was

estimated using the observed values for the index of production instead of the fitted values. This equation:

$$(6.17) \quad E_t = f(X_{1t}, X_{2t}, X_{3t}, Y_t)$$

resulted in a good fit ($R^2 = .9599$), but the wage rate coefficient was not significantly different from zero and the Durbin Watson statistic indicated a moderate serial correlation in the disturbances, meaning that the estimators of the coefficients are not efficient and that the variances of the estimated coefficients are biased (Kmenta, p. 278).

Another alternative is to use the lagged index of production in place of the current index of production. This equation:

$$(6.18) \quad E_t = f(X_{1t}, X_{2t}, X_{3t}, Y_{t-1})$$

resulted in a slightly improved fit ($R^2 = .9732$), significant coefficients on all variables ($t \geq 2.0$) and less serial correlation in the disturbances (D.W. = 1.8). Although the logic of using current values of the index of production seems to be stronger, the improved statistical results of the lagged formulation may be due to a more direct reflection of the sequential nature of production decisions through the use of lagged values instead of current values.

In light of these logical and statistical considerations, the statistical estimates of both of these equations are presented in the next section and both are used in the next chapter to estimate the program's effects on employment, thereby providing alternative estimates.

Statistical Estimation of the Employment Equations

The results of the statistical estimation procedure are as follows:

(6.19) Employment Equation with Current Production

$$\begin{aligned}
 \ln \text{ AGEMP}_t &= 17.1965 \\
 &+ 2.30804 \ln \text{ AGPROD}_t \quad (.589) \\
 &+ 1.19110 \ln \text{ AGPRCE}_t \quad (.605) \\
 &- .49451 \ln \text{ WAGE}_t \quad (.379) \\
 &- 2.80598 \ln \text{ FERT}_t \quad (1.170) \\
 R^2 &= .9599, \quad F = 53.8, \quad \text{D.W.} = 1.5668, \quad n = 14
 \end{aligned}$$

(6.20) Employment Equation with Lagged Production

$$\begin{aligned}
 \ln \text{ AGEMP}_t &= 18.4859 \\
 &+ 2.14384 \ln \text{ AGPROD}_{t-1} \quad (.409) \\
 &+ 1.36951 \ln \text{ AGPRCE}_t \quad (.502) \\
 &- .89010 \ln \text{ WAGE}_t \quad (.251) \\
 &- 2.86476 \ln \text{ FERT}_t \quad (.954) \\
 R^2 &= .9732, \quad F = 81.6, \quad \text{D.W.} = 1.8402, \quad n = 14
 \end{aligned}$$

For both equations:

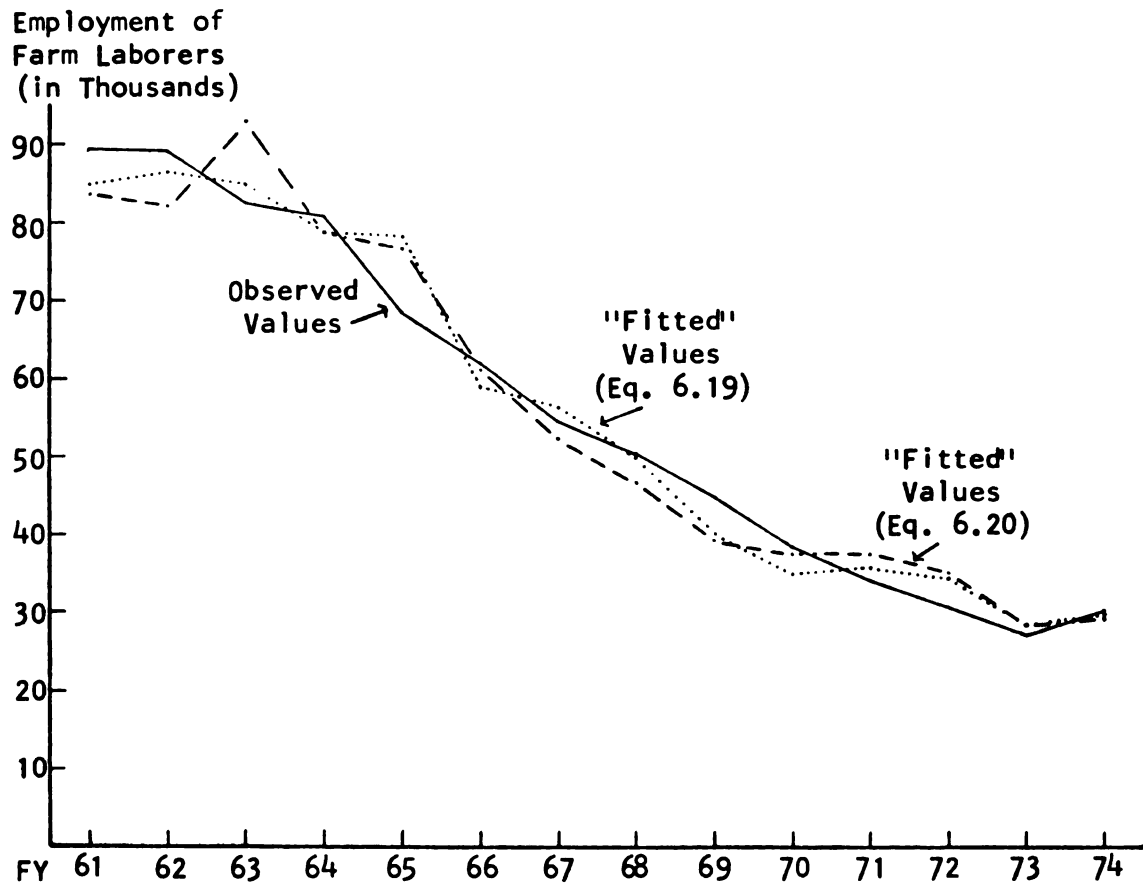
AGEMP = Employment of Farm Laborers and Foremen
 AGPROD = Index of Agricultural Production
 AGPRCE = Index of Agricultural Prices
 WAGE = Median Weekly Wages of Farm Laborers
 FERT = Weighted Average Maximum Fertilizer Prices

Figure 11 shows the observed values of employment and the fitted values for both of these equations.

Summary

The model developed in this research consists of one equation for the prediction of the index of physical production and one equation for the prediction of the level of employment of farm laborers. The production equation (6.11) makes use of the adaptive expectations model to incorporate the sequential character of farm decision making and includes as independent variables the prices of products, wages and feed, in addition to the lagged dependent variable. This equation was estimated

Figure 11. Employment of Farm Laborers and Foremen, 1961 to 1974, Observed Values and Fitted Values.



using the Cochrane-Orcutt procedure due to the introduction of serial correlation with the inclusion of the lagged dependent variable. The conceptual problem of the imposition of a specific lag structure was considered, but was disregarded since there was no alternative means of constructing the equation so as to reflect the sequential character of the production decision. The supply function formulation was estimated and rejected on the basis that some of the signs of the coefficients were contrary to theoretical expectations.

Two alternative employment equations are presented. Both include current period prices for products, wages and fertilizers as independent variables, but one includes the current production index (6.19), while the other includes the lagged production index (6.20). The production index is included as an explanatory variable in order to dampen any abrupt changes in the price variables and in recognition of the mutual dependence of the employment and production decisions on the profit function. Both variations of the adaptive expectations model (using lagged employment as a regressor) and a two-stage least squares formulation (using the fitted production index values from the production equation) were estimated and rejected since, in each case, some of the estimates of coefficients were contrary to theoretical expectations.

CHAPTER VII

APPLICATION OF THE MODEL: ESTIMATES OF THE PROGRAM'S EFFECTS ON AGRICULTURAL PRODUCTION AND EMPLOYMENT

Introduction

The type of evaluation design used in this research is a modification of the design which Hatry, et al., characterize as "Time Trend Projection of Pre-Program Data versus Actual Post-Program Data" (Hatry, Winnie and Fisk, pp. 45-47). Rather than using only the nine years of pre-program data in the estimation of the equations, it was possible to use all fourteen years of data since the effect of the program on the explanatory variables was only to hold the wage rate variable constant. Although the equations are not simple time-trend relationships, the use of the model requires that assumptions be made concerning how the wage rate variable would have resulted for the "without program" case. The assumption which is made, however, is a time-trend projection and specifies that the wage rate paid by farm operators would have continued to increase at 5.96% per year, which was the average annual growth rate for this variable from 1961 to 1969. Equally critical to the correct application of the model is the assumption made concerning the other price variables which enter into the equations. Here, it is assumed that the index of agricultural product prices and the feed and fertilizer variables would not have been affected by the implementation of the program. This assumption is based on the analysis presented in Chapter III which showed that the prices in the agricultural sector of Puerto

Rico (with the exception of labor) are primarily determined outside of Puerto Rico as a result of the island's dependence on imported food-stuffs and agricultural inputs and the relatively small share which the agricultural exports represent in the respective world markets. For these reasons, it is argued that these prices are not affected by changes in the level of production (in the case of product prices) or of input use (in the case of non-labor inputs).

The magnitude of the problem of farmers' falsely claiming larger subsidy payments, as reported in Chapter IV, pages 43 and 44, is completely unknown. Thus, the variables used in the model cannot be adjusted to reflect this problem. However, any such increase in subsidy payments would clearly make labor even cheaper relative to the prices of other inputs and would thereby increase the program's effects on production and employment.

A comparison of the observed and fitted values for the equations (Figures 10 and 11) shows that the equations do not capture the relationships of all of the factors which influence production and employment. Although they appear to capture most of the important relationships, either directly or indirectly, some errors remain in the equations. These errors may result from the omission of relevant variables or from errors in the measurement of the included variables (especially the feed and fertilizer variables). Although the production index equation tracks quite well after the first three years, it does not predict the one year increase in production in 1974. The employment equations show an even greater error, even in the more critical recent years, and should therefore have less reliance placed on their predictive abilities. The existence of errors in the model

requires the use of a simple two-step procedure in applying the model. This procedure is to compute the effect of the program by taking the difference between the fitted values of production or employment for the "with program" and the predicted values for the "without program" data and then subtracting this difference from the observed "with program" values to give the "without program" predicted values. This procedure ensures that the effect of the program will not also include the errors of the model.⁸

In addition to providing predictions about what production and employment would have been without the program, the effect on production may be translated into dollar values for comparison with the direct treasury costs of the program. This translation requires a two-step procedure. First, the difference in the production index for each year is multiplied by the value of production in the base period (average of 1960/61 to 1962/63) which was \$246.883 million. This intermediate result is the dollar value of the effect on production in real terms. This is then multiplied by the index of agricultural product prices to convert it to nominal or current dollars, in which terms the direct costs of the program are stated.

The evaluation of the program's effects is purposely limited to the five year period of 1970 to 1974. First, the equations were estimated with data for the period of 1961 to 1974 and projections beyond 1974 will not be within the range of the data. Secondly, some of the

⁸The difference between the observed "with program" values and the predicted "without program" values will include the model's errors. In the case of the employment equation in Figure 11, it is clear that the difference will be smaller in the period 1971-1973 than the equation's relationships would suggest.

data which were available for this research are of questionable accuracy. Thirdly, and of greatest importance, is the observation that the effects of the program are cumulative in nature and the model is incapable of predicting the significant structural changes which would be expected to occur in a longer period of time as the farm operators become able to alter their technological package through a change in their fixed asset structure.

A particular consequence of the use of the adaptive expectations model, which relates current production to all previous prices but not current prices, is that there is a one year delay in the effect of the program on production. However, since the employment equation does not use lagged price variables, the model results in an immediate effect on employment. The unacceptable results of the statistical estimation of the adaptive expectations formulation, which uses lagged price variables in the employment equation, suggest that it does not adequately reflect the realities of the farm operators' employment decisions. In particular, and as was noted in the previous chapter, a large part of the hired labor force is seasonal labor used primarily in harvesting sugar cane and coffee. These tasks occur at a time when current prices are either known or may be predicted with much greater accuracy than was possible at the time when the production decisions were made. Based on improved knowledge about price relationships, the farm operators may generally make limited changes in their harvesting technologies.

In the case of sugar cane, for example, there are six alternative methods for harvesting the cane. In addition, the cane field might or might not have been cultivated. The labor content of each of the resulting twelve methods is reflected in the subsidy program's payment rates

which are paid on the tonnage of cane milled, based on the labor content of each method (Table 13). These different methods affect the value of the crop through the raw sugar yield and milling costs, but they do not significantly affect the tonnage of cane, which is the measure which entered into the index of production.⁹

Table 13. Subsidy Payments per Ton of Cane, by Method of Harvest and Cultivation Status, 1972/1973 Crop.

Harvest Method Used						Payment/Ton	
Was Cane Field Burned?		Cutting Method		Collection Method		Was Field Cultivated?	
Yes	No	Hand	Machine	Hand	Machine	Yes	No
X			X		X	\$.45	\$.04
X		X			X	.43	.07
X		X		X		.57	.09
	X		X		X	.47	.11
	X	X			X	1.53	1.17
	X	X		X		2.20	1.52

Source: Compendio Estadístico, Oficina de Ingreso Garantizada a Trabajadores Agrícolas, Departamento de Agricultura, Julio, 1974, p. VII, (Mimeo).

In the case of coffee, an improved price will result from a more selective picking of the coffee beans. Since only the ripe beans are picked under the more selective method, a greater number of passes through the coffee trees is required, although less is picked on each pass. Whether or not the coffee pickers are paid on an hourly basis or a piece-rate basis (since piece-rates are computed according to a per hour productivity conversion), a relative cheapening of labor should

⁹A change to the use of raw sugar tonnage in the computation of the index was being considered by the Office of Agricultural Statistics of the Puerto Rico Department of Agriculture.

induce a greater utilization of labor. Although once again the quantity of coffee harvested is unlikely to change, thereby not affecting the production index variable, a slight rise in the average price of coffee may show up in the product price index when it is computed at a later date.

Thus, in spite of the natural expectation that the effects on production and employment should occur at the same time, the possibility of using alternative methods of cultivation and/or harvesting show how the impact of the program on employment could occur in the first year without a concurrent effect on production.

In an effort to test the sensitivity of the model to the wage rate variable, and thereby to determine how critical is the accuracy of the assumed wage rates in the "without program" case, the model was also used with alternative wage rate assumptions. These assumptions are that wage rates would have increased by either 5% or 7% per year. These results are presented in the lower portions of Table 14, 15 and 16. It may be noted that the annual average rate of increase in wage rates for non-farm laborers was 7.45% between 1961 and 1969 and 6.03% between 1969 and 1974. Since these wage rates reflect the rulings of the Minimum Wage Board, which would have set the minimum wage rates for farm laborers if the program had not been implemented, the assumed values appear to be reasonable.

The Results of the Application of the Model

Table 14 presents the results of the application of the production equation to predict the effects of the program on agricultural production. Columns 2 and 3 give the estimated index values for the "with

Table 14. Effects of the Wage Rate Subsidy Program on Agricultural Production in Puerto Rico, 1970 to 1974, Values in Real and Nominal Terms and Direct Program Costs.

Year	Observed Production Index with WRS (1)	Estimated Pro- duction Indices		Net Effect of WRS on Prod. Index (2-3)	Predicted Production Index without WRS (5)	Value of Increase in Production		Direct Cost of WRS Nominal \$ (8)
		with WRS (2)	without WRS (3)			Real \$ (6=4xBV) (7=6xPI)	Nominal \$ (7=6xPI)	
				(4)	(5)	----in thousands of dollars-----		

Assumption #1. 5.96% growth rate in wage rates paid by farm operators

1970	.864	.857	.857	0	.864	\$ 0	\$ 0	\$ 4,300
1971	.852	.845	.833	.012	.840	2,963	3,288	11,364
1972	.834	.835	.807	.028	.806	6,913	7,998	17,391
1973	.812	.819	.774	.045	.767	11,110	14,009	20,481
1974	.821	.812	.752	.060	.761	14,813	32,737	23,336

Assumption #2. 5.00% growth rate in wage rates paid by farm operators

1970	.864	.857	.857	0	.864	\$ 0	\$ 0	\$ 4,300
1971	.852	.845	.833	.012	.840	2,963	3,288	11,364
1972	.834	.835	.811	.024	.810	5,925	6,855	17,391
1973	.812	.819	.781	.038	.774	9,382	11,830	20,481
1974	.821	.812	.761	.051	.770	12,591	27,826	23,336

Assumption #3. 7.00% growth rate in wage rates paid by farm operators

1970	.864	.857	.857	0	.864	\$ 0	\$ 0	\$ 4,300
1971	.852	.845	.829	.016	.836	3,950	4,385	11,364
1972	.834	.835	.802	.033	.801	8,147	9,426	17,391
1973	.812	.819	.767	.052	.760	12,838	16,189	20,481
1974	.821	.812	.742	.070	.751	17,282	38,193	23,336

BV = Base value of Production Index (\$246,883,000)

PI = Price Index for Agricultural Products (AGRPE)

Table 15. Effects of the Wage Rate Subsidy Program on the Employment of Farm Laborers in Puerto Rico, 1970 to 1974, Equation 6.19 Using the Current Production Index.

Year	Observed Employment (1)	Estimated Production Index (Current) (2)	Estimated Employment		Net Effect of WRS on Employment (3-4)	Predicted Employment without WRS (1-5)
			with WRS (3)	without WRS (4)		

Assumption #1. 5.96% growth rate in wage rates paid by farm operators

1970	38,484	.864	37,528	36,465	1,063	37,421
1971	34,147	.840	37,637	34,396	3,241	30,906
1972	30,909	.806	35,246	29,894	5,352	25,557
1973	27,310	.767	28,403	22,207	6,196	21,114
1974	30,443	.761	29,225	21,257	7,968	22,475

Assumption #2. 5.00% growth rate in wage rates paid by farm operators

1970	38,484	.864	37,528	36,637	891	37,593
1971	34,147	.840	37,637	34,705	2,932	31,215
1972	30,909	.810	35,246	30,645	4,601	26,308
1973	27,310	.774	28,403	23,089	5,314	21,996
1974	30,443	.770	29,225	22,338	6,887	23,556

Assumption #3. 7.00% growth rate in wage rates paid by farm operators

1970	38,484	.864	37,528	36,295	1,233	37,251
1971	34,147	.836	37,637	33,691	3,946	30,201
1972	30,909	.801	35,246	20,043	6,203	24,706
1973	27,310	.760	28,403	21,325	7,078	20,232
1974	30,443	.751	29,225	20,127	9,908	20,127

Table 16. Effects of the Wage Rate Subsidy Program on the Employment of Farm Laborers in Puerto Rico, 1970 to 1974, Equation 6.20 Using the Lagged Production Index.

Year	Observed Employment (1)	Estimated Production Index (Lagged) (2)	Estimated Employment		Net Effect of WRS on Employment (3-4) (5)	Predicted Employment without WRS (1-5) (6)
			with WRS (3)	without WRS (4)		

Assumption #1. 5.96% growth rate in wage rates paid by farm operators

1970	38,484	.877	35,600	33,807	1,793	36,691
1971	34,147	.864	35,921	32,401	3,520	30,627
1972	30,909	.840	34,501	28,676	5,825	25,084
1973	27,310	.806	28,533	21,580	6,953	20,357
1974	30,443	.767	29,459	20,148	9,311	21,132

Assumption #2. 5.00% growth rate in wage rates paid by farm operators

1970	38,484	.877	35,600	34,095	1,505	36,979
1971	34,147	.864	35,921	32,927	2,994	31,153
1972	30,909	.840	34,501	29,376	5,125	25,784
1973	27,310	.810	28,533	22,528	6,005	21,305
1974	30,443	.774	29,459	21,392	8,067	22,376

Assumption #3. 7.00% growth rate in wage rates paid by farm operators

1970	38,484	.877	35,600	33,523	2,077	36,407
1971	34,147	.864	35,921	31,841	4,080	30,067
1972	30,909	.836	34,501	27,651	6,850	24,059
1973	27,310	.801	28,533	20,565	7,968	19,342
1974	30,443	.760	29,459	18,917	10,542	19,901

program" and "without program" cases.¹⁰ The difference between these values (Column 4) is the effect which the program had, as measured by the equation under the three alternative wage rate assumptions. This measured effect is then subtracted from the observed (historical) "with program" values (Column 1) to give the prediction of what the production index values would have been without the program. Column 6 shows the real dollar value of the effects on production, while Column 7 shows the nominal dollar values. The last column shows the direct program costs, also in nominal terms. Figure 12 illustrates the program's effects on production by plotting the observed "with program" indices (from Column 1) and the predicted "without program" indices (from Column 5).

Tables 15 and 16 present the results of the application of the two alternate employment equations to predict the effects of the program on employment. Column 1, in each table, gives the observed (historical) "with program" employment values. Column 2 lists the estimated production indices (from Column 5 of Table 14) that were used in the employment equations to estimate the with and without program employment levels (Columns 3 and 4, respectively), under the three alternative wage rate assumptions. The differences between these values (Column 5) is the effect of the program on employment, as measured by the alternative equations. These values are then subtracted from the observed values (Column 1) to give the predictions of what employment would have been without the program. Figure 13 illustrates the effects by plotting the observed employment (from Column 1, Tables 15 and 16) and the predicted

¹⁰Appendix D explains the procedure for computing these values with the production equation.

Figure 12. The Index of Physical Production in Puerto Rico, 1961 to 1974 and the Predicted "Without Program" Index, 1970 to 1974.

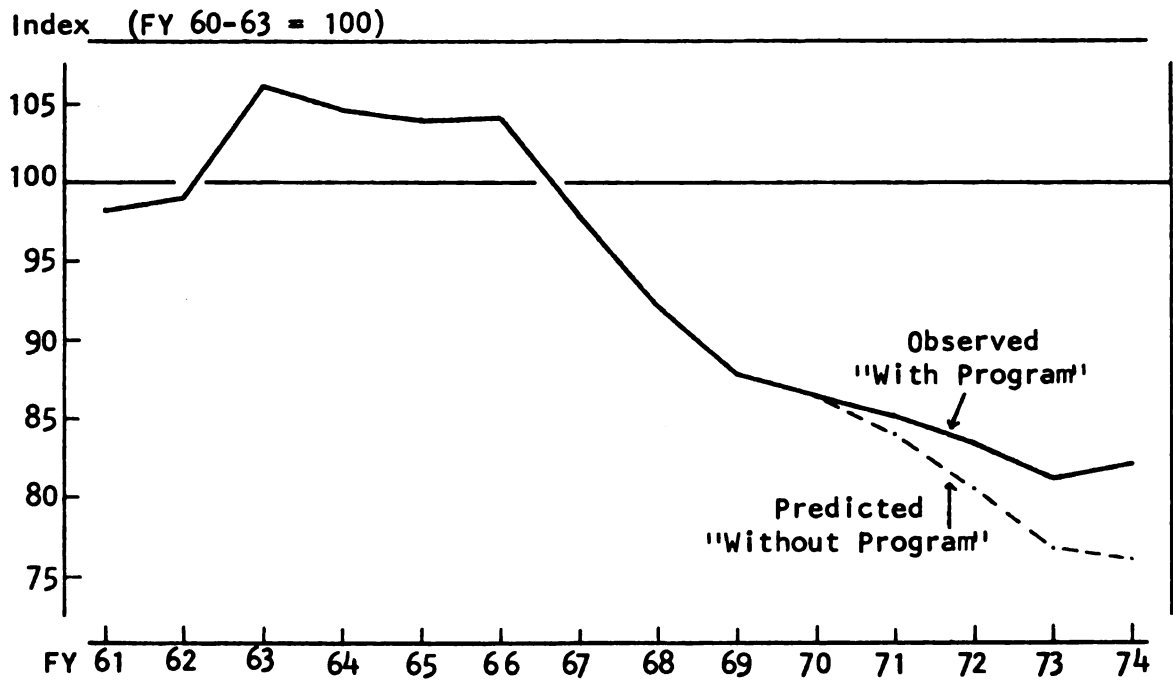
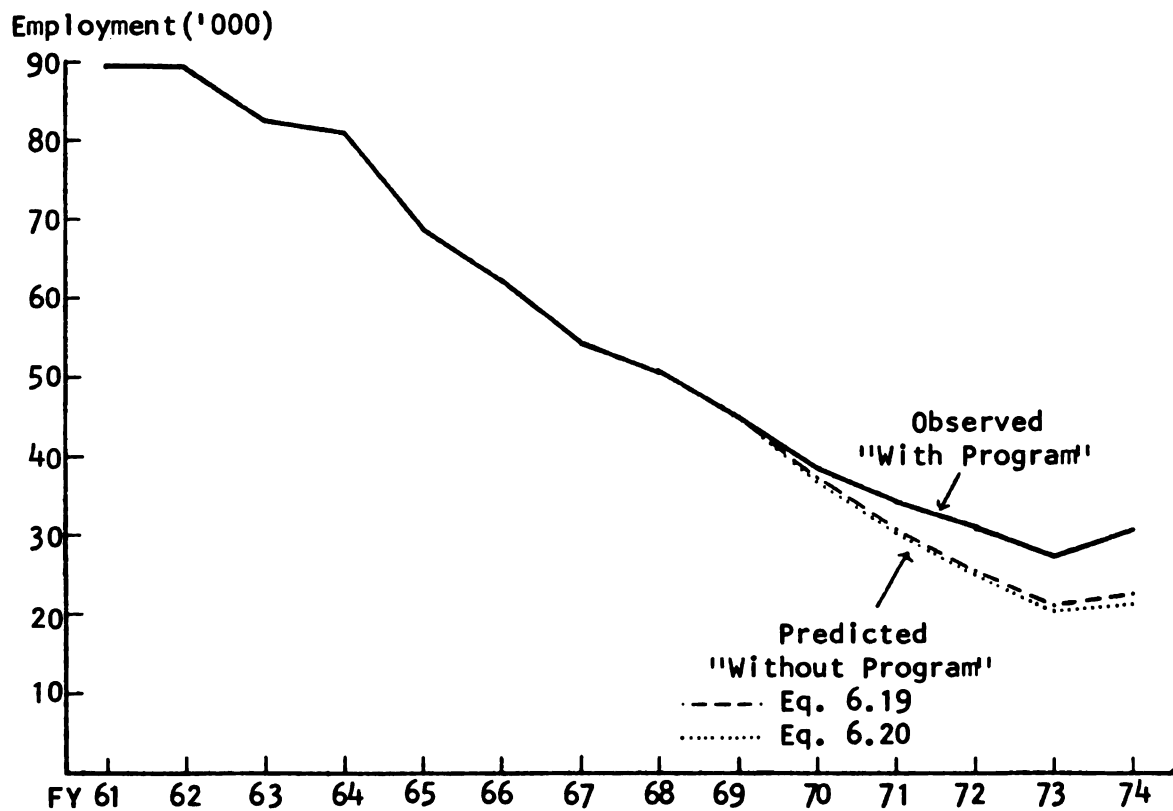


Figure 13. Employment of Farm Laborers in Puerto Rico, 1961 to 1974 and the Predicted "Without Program" Employment, 1970 to 1974.



employment levels under each of the alternative equations (Column 6, Tables 15 and 16).

The following chapter summarizes the analysis of this dissertation, presents the evaluation of the program and the conclusions which may be drawn from the analysis and suggests particular needs for further research.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Summary

Puerto Rico's rapid economic growth in recent decades has been accompanied by a significant change in the structure of the island's economy. As a result of its special relationship with the United States, and its own government's development programs, the manufacturing, government and trade sectors now dominate the economy. Although the agricultural sector continued to expand until the early 1960s, it then began a sharp decline in production such that by 1974 its physical production was only 82% of its 1960-1963 average. The decline of the agricultural sector can be attributed primarily to increases in wage rates that accompanied the industrialization process and the inability of the sector to adjust to these higher wage rates.

In 1940 Congress exempted Puerto Rico from the universal minimum wage rate of the Fair Labor Standards Act of 1938 and in its place Congress created a more flexible alternative system which established minima on an industry by industry basis. This system was a compromise which would avoid any unfair advantage for the Puerto Rican producers but also would not result in severe economic dislocations on the island had the universal minimum wage rate been imposed on Puerto Rico. In 1941 the insular government established a similar system, and in 1956 expanded its coverage to industries also covered by the federal minimum.

Vigorous action under both systems resulted in rapid increases in minimum wage rates. For the 1952 to 1962 period, Reynolds and Gregory have found that increases in wage rates for farm laborers were " . . . probably attributable in good measure to the island's minimum wage law . . ." (Reynolds and Gregory, p. 62). The available data for the period 1962 to 1969, when the subsidy program began, supports this finding and leads to the conclusion that, in the agricultural sector, minimum wage rates were above equilibrium wage rates, and therefore, the levels of employment in the sector were determined solely by the farm operators' demand for labor.

At least since the turn of the century, when the United States acquired Puerto Rico, the agricultural sector has been dominated by three export crops--sugar cane, coffee and tobacco. Its free trade status with the United States has permitted a reliance on the U.S. market for its foodstuffs, thereby removing any pressure on the agricultural economy to produce significant amounts of food for an ever increasing local population. The virtually complete dependence of the agricultural sector on the export crops, and in turn, the dependence of these crops on large amounts of low wage labor, made it extremely difficult for Puerto Rican agriculture to make the adjustments to the imposition of large increases in the minimum wage rates which have accompanied the rapid growth of the industrial sectors.

On the one hand, neither coffee nor tobacco lend themselves to the substitution of machines for labor, and the topography of the sugar cane areas and the organizational structure of the plantations and their labor unions have limited the mechanization of sugar cane. On the other hand, the Puerto Rican agricultural sector is a price-taker in virtually

all of its relevant markets. It has a small share of the market for its export crops, it consumes a small part of the U.S. foodstuffs market, and it also must import most of its non-labor inputs. About the only markets in which prices are determined on the island are for a few special tropical fruits and vegetables and for fresh milk and eggs.

A comparison of the rates of increases for product and factor prices since 1961 is consistent with the response in agricultural production. Between 1961 and 1963, when agricultural production reached its highest level, product prices rose faster than factor prices. Between 1963 and 1966, product prices decreased in absolute value while factor prices continued to increase, and production began a sharp decline. Between 1966 and 1969, product prices began increasing again and the rate of decline in production slowed. Table 5, page 27, also shows that the wage rate for agricultural labor experienced a much greater increase between 1963 and 1969 than did the prices of feed or fertilizer, which were the only other available factor price data.

The only subsector to experience an increase in production was the animal products subsector. Although the production of fresh milk and eggs does require the use of imported feeds, it does not require large amounts of hired labor and the product prices are determined to a greater extent in the local market since the perishable nature of these products makes them relatively freer from competition from imports.

The Wage Rate Subsidy Program for Agricultural Laborers in Puerto Rico was implemented for the express purpose of reviving the agricultural sector by retaining the sector's labor force through increasing the laborers' wage rate, but without raising the farm operators' hourly wage costs. The wage rate subsidy program operates by guaranteeing a

wage rate to the hired farm laborers. The farm operators are required to pay this wage rate and are reimbursed on a quarterly basis for the difference between the guaranteed rate and the minimum rate as established by the Minimum Wage Board. The guaranteed wage rates were established for various categories of farm enterprises and some are paid on a piece-rate basis rather than on an hourly basis.

A simple theoretical analysis, assuming competitive conditions, shows that in the short run the wage rate subsidy program, as implemented in Puerto Rico, would have no effect on either the farm operator's decisions on the level of production or on his demand for labor schedule. This result is due to the fact that the farm operator is faced with the same factor prices that he would have paid if the program had not been implemented.

In the intermediate run, however, the subsidy program maintained the cost of labor at the initial wage rate while the prices of the remaining factors of production continued to rise. The increases in wages received by laborers were completely absorbed by the program. This cheapening of labor relative to the other factors of production should lead to a more labor intensive technology (the substitution of labor for the other factors of production at any level of output). Each year, as the prices of the other factors continued to rise, the relative use of labor should have continued to increase as long as the program held the labor cost constant. Thus, both production and employment under the subsidy program should be greater than production and employment without the program. In absolute terms, however, both production and employment would continue to decline if the increases in marginal costs which result from the price increases in the other factors of production

(in spite of any substitution of labor) are not offset by increases in product prices.

In an effort to determine the effect of the wage rate subsidy program on production and employment in the agricultural sector, a two equation model was developed to estimate the net effect of the program on production and employment. The model consists of an Index of Production equation, which is recursive (based on the model of adaptive expectations), and two alternative Employment equations, one using current values of the production index and the other using lagged values of the production index as explanatory variables.

The Index of Production Equation

The specification of the Index of Production equation is based on two characteristics of the decision making process in agricultural production. First, the decision to commit resources to agricultural production must be based on the farm operator's expectations of future factor and product prices. This is a direct result of the amount of time required in the biological process of agricultural production. Secondly, the process of investment and/or disinvestment in the fixed assets of agricultural production places severe limits on the ability of a farm operator to make significant changes in his operation in the short run in response to changing price relationships. This is particularly true in the case of perennial crops such as sugar cane or coffee in which a large investment is required to plant a stand. Once planted, the stand becomes a fixed asset and will be cultivated and harvested as long as the value of the production less the variable costs

of cultivation and harvesting exceeds the stand's salvage value (possibly negative) or the opportunity cost of the land, whichever is greater.

The dependence on price expectations suggests the use of the "adaptive expectations" model which is estimated statistically by using the lagged values of the dependent variable (the production index) as an explanatory variable. The use of the lagged dependent variable as an explanatory variable also has the effect of placing limits on the year to year changes which may occur in the dependent variable in that its high degree of correlation with the dependent variable gives it a large influence in determining the value of the dependent variable relative to the yearly price variables, thereby dampening the effect of the yearly price variables. Thus, the equation performs well in predicting the values of the index of production, in spite of the conceptual problems which are discussed in Chapter VI. The serial correlation in the error terms, which is introduced by the lagged dependent variable, required the use of the Cochrane-Orcutt procedure to obtain consistent estimates of the regression coefficients. The results of the statistical estimation procedures may be found in equation 6.11 on page 67.

The Employment Equations

The mutual dependence of the production and employment decisions of the farm operator on the farm's profit function suggests the use of the adaptive expectations model for the employment equation also, again reflecting the sequential nature of farm decision making. Since neither of the two alternative adaptive expectations models gave results which were fully consistent with theoretical expectations, a variable which would retain the sequential nature of farm decision making was needed

to replace the lagged employment variable in the formulation of this equation. The production index variable was selected for this purpose. The simultaneous nature of the production and employment decisions suggests the use of the fitted or predicted production index--in effect, a two-stage least squares procedure. This formulation resulted in a positive sign on the wage rate coefficient--implying a greater demand for labor at higher wage rates--and was rejected for this reason.

Since the production and employment decisions are mutually dependent upon the profit function and are not interdependent (as the use of the two-stage least squares would imply), the employment equation was estimated using the observed values of the production index. This formulation gave a low significance on the wage rate coefficient and exhibited a moderate level of serial correlation in the disturbances. The use of the lagged production index variable yielded better statistical criteria, even though the logical considerations would favor the use of the current production index variable. In view of the slight conflict between the logical and the statistical considerations and in view of the small differences in the predicted values which result from the two equations (especially in the last years of the data), both equations are presented and used in the application of the model. The results of the statistical estimation procedures may be found in equations 6.19 and 6.20 on page 73.

Estimation of the Program's Effects

The type of evaluation design used in this research is a modification of the "time trend projection of pre-program data versus actual post-program data." Rather than using only the nine years of

pre-program data in the estimation of the model's parameters, it was possible to use all fourteen years of available data since the effect of the program on the explanatory variables was only to hold the wage rate variable constant. The other price variables are independent of the program due to their exogeneity to the agricultural sector. The application of the model requires only an assumption concerning how the wage rate variable would have increased if the program had not been implemented. Since the average annual increase in the wage rate variable in the nine years preceeding the program was 5.96%, it was assumed that this time trend projection would have continued. In order to test the sensitivity of the model to this assumption, the model was also applied with assumed annual wage rate increases of 5% and 7%, each about 1% above and below the rate of increase in the primary assumption.

In recognition of the errors which remain in the model's equations, the model is applied by finding the difference in the predicted values of production and employment in both the with and without program cases, rather than the differences between the observed with program and the predicted without program values. This procedure ensures that the effect of the program will not also include the errors of the model. These differences, then, are the net effects of the program on production and employment. To find what the absolute values of production and employment would have been without the program, one simply subtracts these differences from the observed values.

The estimated effects of the program on the production index and employment and the value of these measures which would have obtained in the absence of the program, under the primary assumption regarding

the wage rate variable and the first employment equation, are summarized in Table 17.

Table 17. Estimated Effects of the Program, Assumption #1 and Employment Equation 6.19.

Year	PRODUCTION INDEX			EMPLOYMENT		
	Observed Index With Program	Estimated Effect of Program	Predicted Index without Program	Observed Employment with Program	Estimated Effect of Program	Predicted Employment without Program
1970	.864	0	.864	38,484	1,063	37,421
1971	.852	.012	.840	34,147	3,241	30,906
1972	.834	.028	.806	30,909	5,352	25,557
1973	.812	.045	.767	27,310	6,196	21,114
1974	.821	.060	.761	30,443	7,968	22,475

Source: Tables 14 and 15.

The immediate, though small, impact on employment in the first year may be reasonable in spite of its conflict with the simple short run theory. This difference may be explained by noting that much of the labor used is seasonal harvest labor and if the prices of the other factors of production were rising noticeably during the first year, then a relative cheapening of labor would be noticed and the substitution of additional quantities of labor in the tasks of cultivation and harvesting would result, even without any change in the level of production in the first year.

The estimation of the program's effects are limited to the five year period of 1970 to 1974 since projections beyond 1974 are outside the range of the data with which the model was estimated and since the effects of the program are cumulative in nature due to the program's interaction with the structural changes in the agricultural sector.

In particular, the projection of without program employment would reach negative values in a short period of time.

An estimate of the cost that would have been required if the program were to have halted the decline in production by lowering the farm operators' wage costs can also be calculated with the model. For the purposes of this hypothetical case, it will be assumed that the increases in wage rates received by the laborers under the program are unchanged. A trial and error method was used to find the values of the WAGE variable (actual wage costs to the farm operators) that would result in a production index value of .864 for the years 1971 to 1974 (due to the one year lag in response, the 1970 index would not be affected). These values may then be used in the employment equation to find what levels of employment would have resulted with these wage costs. Both of these sets of values are listed in Table 18. These wage cost values can be translated into very rough estimates of total program costs by increasing the actual direct program costs by the percentage increase in the number of dollars of the laborers' median weekly wages subsidized under this case over the number of dollars of the laborers' median weekly wages that were subsidized under the actual program. The number of dollars of the laborers' median weekly wages that were subsidized under the program is simply the amount they received less the fixed wage costs to the farm operators (\$18.88). The increase in the number of dollars of the laborers' median weekly wages that would be subsidized in this hypothetical case is the fixed costs (\$18.88) less the wage costs estimated by the use of the production equation if the production index is to be fixed at .864. Table 18 also lists the actual direct program costs, the actual dollars of subsidized median weekly wages,

Table 18. Estimated Program Costs for the Hypothetical Case in which the Subsidy is Increased In Order to Stabilize the Production Index at the 1970 Level.

Year	Estimated Median Weekly Wage Costs to Farmers	Predicted Employment ('000)	Actual Program Costs (\$'000)	Actual \$ of Wages Subsidized	% Increase in Wages Subsidized	Estimated Program Costs (\$'000)
1970	\$ 17.25	38,929	\$ 4,300	\$ 6.07	26.9%	\$ 5,455
1971	16.95	39,134	11,364	7.35	26.3%	14,348
1972	15.90	35,865	17,391	10.15	29.4%	22,497
1973	15.90	39,213	20,481	13.42	22.2%	25,029

the percentage increase in the subsidized median weekly wages and the resulting total program costs for this higher level of subsidization. A more accurate estimate of what the program costs would be in this case would require detailed knowledge of the relationships among the program's parameters (the wage rates and hourly subsidy rates), the median weekly wage rate variable and the number of hours worked at each of the wage rates in the different subsectors.

Although a comprehensive evaluation of the benefits and costs of the program is beyond the scope of this research, several partial comparisons may be made with the information produced by the model. First, the value of the increased production may be compared with the direct treasury costs of the program. Secondly, the cost per man-year of increased employment can be calculated. These comparisons are displayed in Table 19. Taken individually, such simple comparisons implicitly assume that the benefits (either production or employment) are the only benefits and that the direct treasury costs are the only costs.

Table 19. Selected Program Evaluation Indicators.

Year	Nominal Value of Increased Production (\$'000)	Direct Program Treasury Costs (\$'000)	Cost Per Man-Year of Increased Employment (\$)
1970	0	4,300	4,045
1971	3,288	11,364	3,506
1972	7,998	17,364	3,249
1973	14,009	20,481	3,305
1974	32,737	23,336	2,929
Totals	58,032	76,872	--
Average	--	--	3,227

A comprehensive evaluation of the program's benefits and costs should consider the following types of effects.

A. Monetary Benefits and Costs

1. The increase in agricultural production.
2. The costs of the resources used in producing the additional agricultural output.
3. The net benefit of increased production in the other sectors that can be properly attributed to this program (the indirect effects).
4. The benefits of increased tax revenues resulting from the increased production (both direct and indirect).
5. The benefits of savings in other government programs such as urban public infrastructure, public security and welfare.
6. The benefits of the increased incomes to the farm operators and laborers.

B. Non-monetary Benefits

1. The increased employment of farm laborers.
2. The improved welfare of the families of the now employed farmers and laborers, including such things as their health, nutrition and education.
3. The potential reduction in urban social tensions if the individuals would have migrated to the urban areas in the absence of the program.

Conclusions

The analysis of this research shows that the wage rate subsidy program did have measurable effects on both agricultural production and employment in Puerto Rico. It accomplished these effects by holding the farm operators' hourly wage costs fixed at the 1969 minimum wage rate levels while the prices of the non-labor inputs continued to rise. Although both of these indicators continued to decline, the decline was less than that which would have occurred without the program if the wage costs had continued to increase.

The analysis of the way in which the program achieved its effects has an important implication for Puerto Rico's minimum wage policy. Rather than instituting the wage rate subsidy, the same effects on production and employment could have resulted from a policy whereby the Minimum Wage Board would not increase the minimum wage for agricultural laborers. Thus, the program could be seen simply as an income transfer program for agricultural laborers. The high probability that such an alternative policy measure would be politically unacceptable in Puerto Rico may be seen as evidence of a revealed preference for higher laborer incomes (in spite of higher unemployment rates) over the revitalization of the agricultural sector as it is today.

The objective of maximum labor force utilization (minimum unemployment) at higher laborer incomes and the revival of the agricultural sector in Puerto Rico appear to be incompatible, given the island's limited base of agricultural resources and its ability to import, at low prices, the foodstuffs required by its population. If these natural resources are to remain in production, rather than lie idle while food is imported, significant structural changes will be required in the agricultural sector. These changes will involve a shift out of the traditional, and labor intensive, export crops and into the production of products which can compete on the local market for their labor requirements. The most likely candidates will be fresh fruits and vegetables and animal products (principally milk and eggs) since these products are highly perishable. This perishability adds to the cost of transportation to the island and should therefore allow a competitive advantage to local production.

Areas for Future Research

A number of areas for future research that became apparent during the process of this research are as follows:

1. Extensive farm management research is needed to identify the products that would be best able to compete on the local market for their labor requirements.
2. A better understanding is needed of the apparent tendency for individuals to leave the labor force entirely after the seasonal jobs in agriculture are over and to re-enter the labor force when these seasonal jobs become available again. Who are these individuals and why don't they seek employment in the other sectors?
3. There is a need for the collection and dissemination of price data on the principal agricultural production inputs. The absence of this type of data would continue to severely limit effective analysis of the agricultural economy.
4. More effective means of reducing unemployment are also needed. The agricultural sector is now so small that further farm-to-city migration will be minimal. Additionally, the sector could not re-absorb very many of those that have already left. A particular area for study is the unemployment effects of the minimum wage policies. There appears to be a conflict between the objectives of increasing labor income and of maximum employment of labor.

APPENDICES

APPENDIX A

INCOME MAINTENANCE PROGRAMS AND THE WAGE RATE SUBSIDY

A Review of Income Transfer Programs

The general objective of the current United States public assistance programs is to provide assistance to those persons who are unable to earn an income sufficient to meet the needs of some reasonable minimum standard of living. Old age, physical or mental disability or illness, either permanent or temporary, and women with young children and no husband or an absent one are the principal categories of acceptable causes for the inability to earn an adequate income. Temporary unemployment also became an acceptable cause and the Unemployment Insurance program was implemented. Underlying these programs is the philosophy held by our society that people should obtain their income through gainful and productive employment unless, for reasons beyond their control, they were unable to do so. All of the programs have been implemented with rules and regulations which were intended to limit the abuse of the programs by people who were considered to be able to earn their livelihood or to depend on someone that had a moral obligation to provide for them. The rules and regulations for the programs have become more extensive and more specific as time goes by in order to provide even greater accuracy in deciding who will qualify and who will not.

These rules and regulations reflect a wide range of opinions as to how the poor should be assisted. Many of the rules are paternalistic toward the recipient and grow out of the desires of the donors, or

taxpayers, to impose their moral judgements about how a person should live as a condition on the provision of public assistance. The classical example is of the person who will give money to a destitute alcoholic only if he will use the money to buy himself or his family a good meal or some other "approved" use. Another expression of this paternalism is the reduction of the grant when the recipient receives income from other sources, either earned or unearned, and usually by an equal amount. Nevertheless, there exists a growing concern about the demonstrated effects of the paternalistic rules on the lives of the recipients. Welfare Rights Organizations have formed to protest the "invasion of privacy" which accompanies the information-gathering procedures used to enforce the rules. The reduction of the grant by an amount equal to the amount received by a recipient from other sources has been shown to be a severe disincentive for a recipient to reduce his dependence on public assistance. The recipient who does not have an opportunity for a challenging job or one that pays well will naturally ask himself: "Why work when I can get the money without working?" Since most states operate their own programs and set their own benefit levels, there is a wide variation in program availability and benefits between geo-political jurisdictions which may be causing interstate migration, thereby placing an even greater tax burden on the residents of states offering higher benefits.

This philosophy that people should obtain their income through employment is based on the belief that the American economic system is capable of providing the opportunity to be gainfully employed to all who seek employment. The basic law of supply and demand was believed to be valid for the labor market. Still following this belief, the War on Poverty of the 1960s placed a major emphasis on programs to expand the

opportunities for the poor by providing training and counseling services and by promoting the hiring of the disadvantaged. But the War on Poverty did not provide the results which were necessary to maintain the belief in the system and the belief began to wane, and many people now conclude that our economic system is not, or is no longer, capable of providing an adequate income to a significant segment of our population or even of providing employment to all who seek it. As evidence that our economic system is not capable of providing an adequate income for the employable, President Nixon's Commission on Income Maintenance Programs found that 70% of the non-aged heads of households of poor families worked for part of the year in 1966. Additionally, one-third of the poor live in families in which the family head works throughout the year. The Commission came to the conclusion that in many cases the possibility for improvement is not realistically within the power of the poor (President's Commission, pp. 2-3).

The awareness of the undesirable effects of the paternalistic characteristics of public assistance programs, the concern about the inequalities between the states, and the belief that our economic system is not capable of solving the problem of the employable poor have led to attempts to design a broad program, with a minimum of behavior-restricting rules, which could be made available on an equal basis to all of the poor, no matter where they live.

Two basic concepts have received attention as a means of improving the present system of public assistance. One is the Negative Income Tax (NIT), and the other is the Wage Rate Subsidy (WRS). The following sections present the basic formulations of the two programs. Subsequent sections present lessons from the Puerto Rican experience with a WRS,

a theoretical comparison of the effects of the two programs and a proposal of a plan which combines into one formula both of the NIT and the WRS concepts.

The Negative Income Tax

The NIT guarantees a minimum income to the recipient by providing a basic grant. For persons with some non-grant income, the basic grant (guaranteed income) is reduced by an amount proportionate to his non-grant income. An optional feature is to exclude or "disregard" certain amounts of an individual's non-grant income before applying the proportion by which the grant is reduced.

The general form of the NIT equation is:

$$Y = WH + (G - a(WH - D)) \quad \text{for: } (G - a(WH - D)) \geq 0, \text{ and } 0 \leq a \leq 1.$$

where: Y = net income	G = guaranteed income (the basic grant)
W = wage rate	a = proportion of income by which 'G'
H = hours worked	is reduced (the marginal tax rate
D = disregarded income	on earned income)

WH may represent both earned and unearned non-grant income.

This equation is often stated as:

$$\begin{aligned} Y &= G + (1 - a)WH & \text{for: } Y \leq G/a, \text{ and} \\ Y &= WH & \text{otherwise,} \end{aligned}$$

ignoring the disregarded income feature.

The Wage Rate Subsidy

The WRS, in its basic form, does not guarantee a specific level of income. It increases the recipient's hourly wage rate by providing a bonus, for each hour worked, computed on the basis of the recipient's actual wage rate. The general form of the WRS equation is:

$$Y = (W + b(B - W))H \quad \text{for: } b(B - W) \geq 0, \text{ and}$$

$$Y = WH \quad \text{otherwise,}$$

$$0 \leq b \leq 1,$$

where: Y = net income
 H = hours worked
 B = breakeven wage rate
 W = actual wage rate

b = the proportion of the difference between the breakeven wage rate and the actual wage rate to be provided as a subsidy (the marginal tax rate on wage rate increases)

This equation is often stated as:

$$Y = (g + (1 - b)W)H \quad \text{for: } W \leq g/b,$$

where 'g', the guaranteed wage rate, is equal to $(B \cdot b)$. This form of the equation shows the subsidy as the guaranteed wage rate less a portion of the individual's actual wage rate rather than as an addition to his actual wage rate.

Lessons from the Puerto Rican Experience

Although the Puerto Rican experience represents an extreme case of the general wage rate subsidy concept, several lessons for a broader application of the subsidy can be found.

First, the system of implementation should directly involve both the employer and the employee-recipient, so as to reduce the opportunity for fraudulent claims. In particular, both must be aware of and affected by the wage rates which are declared as the actual wage rate and the subsidy rate (or the rate eventually received by the recipient).

Although Puerto Rico used a 100% marginal tax rate and the minimum wage rate as the general bargained (actual) wage rate, an incentive for the employer to under-declare the actual wage rate exists also under a fractional tax rate system. As an example, assume that the employer agrees to pay the recipient \$3.75 per hour, including the subsidy.

Under the formula:

$$Y = (W + b(B - W))H$$

Where $B = \$5$ and $b = .5$, the values would be:

$$Y = (2.5 + .5(5 - 2.5))H = (2.5 + 1.25)H = \$3.75H.$$

However, the employer can declare an actual wage rate of, say, \$2.00 per hour so as to receive a subsidy reimbursement of \$1.50 instead of \$1.25. The recipient still receives his \$3.75 per hour and may not even care or know about what is happening.

On the other hand, the employer is also a necessary party to the implementation of the system in order to avoid widespread fraud by recipients if they were the sole source of information regarding wages earned and hours worked. One possible system of implementation that could work to reduce program abuse would be for the employers to pay by check, with the requirement of a check stub reporting hours worked and wage rate paid. The employee-recipient could then present his (endorsed) check and stub to the program office in exchange for a check which would include the subsidy payment. However, adequate disincentives would still be required to avoid the potential collusion between employer and employee whereby the reported wage rate is understated and the reported hours work correspondingly overstated. The employer, in this case, would pay the same amount in wages, but the recipient would be eligible for a larger subsidy payment. This system would also reduce the opportunity for claims on non-existent workers since the employer would not be reimbursed by the program.

Secondly, if the program is operated by means of reimbursements to the employers, a decision must be made as to whether or not the subsidy payments will be considered as wages which would be subject to the payment of Social Security and other wage related taxes.

Comparison of NIT and WRS Effects

The WRS is clearly of no benefit to those poor that have no hourly wage income, while the NIT would provide these people with a guaranteed level of income. The WRS will generally be preferred by people who work an intermediate number of hours, e.g., more than half-time, but receive low hourly wage rates, while people working fewer hours at higher wage rates will generally prefer the NIT. Clearly, there will be a large number of people who would qualify for benefits under either program.

The WRS and NIT have quite different incentive characteristics with respect to both working more hours and seeking increases in wage rates from employers. The NIT "taxes" increases in earned income whether this results from increasing hours or a higher wage rate. For a constant wage rate, the NIT taxes income from increasing hours by the marginal rate of 'a'. Similarly, for a constant number of hours worked, the increases in the wage rate are taxed at a marginal rate of 'a'. On the other hand, the WRS taxes only the increases in wage rates at the marginal rate of 'b' and not the increases in hours worked. In both cases, the incentive effects are relative to what the incentive would have been for the person not benefiting from the program--although the effects are quite real and readily visible since an individual will be very aware of his increase in hours or wage rates and the reduction in his benefits caused by the change in hours or wage rates. Unless the marginal tax rates are greater than one, the person will always receive a higher net income from working longer hours or negotiating a higher wage rate.

Due to the mathematical relationships among the programs' parameters, a reduction in the marginal tax rates will enlarge the coverage

of the programs--and thereby increase the cost of the programs. For the NIT, the breakeven non-grant income level (at which point the grant becomes zero) is: $Y_b = G/a$. ' Y_b ' clearly increases as ' a ' is reduced in order to improve the incentives to work. Although ' G ' can be reduced in order to maintain a lower ' Y_b ', lowering ' G ' also lowers the level of support provided. For the WRS, the effective guaranteed minimum wage rate is: $g = B \cdot b$ ($b \leq 1$). Thus, reducing ' b ' in order to increase the incentive to negotiate higher wage rates will either lower the guaranteed minimum wage rate (lowering costs and support) or require an increase in the breakeven wage rate ' B ' (raising costs and coverage).

Although recent theoretical comparisons of the NIT and WRS plans have not been able to show the superiority of one over the other, they have pointed out some of the advantages and disadvantages of each. Among those who have studied the plans are Barth and Greenberg, Garfinkel, Kesselman, Schlenker, and Zeckhauser. Their findings are limited by the static nature of the analyses and all of the articles point out that an empirical analysis is needed to show how the many sets of preferences among the recipients interact with each plan and to answer the dynamic questions of how the labor supply effects will interact with the demand for labor and how the plans will affect the human investment decisions of the recipients. Zeckhauser limited his analysis by using a "representative" recipient, while the others used multiple preference sets by comparing the plans for specific groups such as: the disabled, the low-wage-rate worker, those unable to find employment and those with backward-bending labor supply curves. Taken together, these analyses show that the WRS is superior to the NIT in terms of work incentive effects for those people who do not have backward-bending supply curves.

The problem of obtaining employment or additional hours through which the incentives may become effective will remain under both programs. Due to the varying effects of each plan on the different groups of people, a general conclusion is that both plans should be implemented. However, Rea (p. 26) found that when both a WRS and the Nixon Family Assistance Plan (an NIT plan) are available, the work incentives are improved but at a large budget cost, most of which goes to those with relatively high incomes. Schlenker recommends the addition of an income floor to the WRS (presumably if it is the only plan), but points out that a 100% tax rate would result for those persons who would be receiving a grant to raise their income up to the guaranteed level. This high tax rate results from the discontinuity between Schlenker's two equations:

$$\begin{aligned} Y &= W + b(B - W)H && \text{for } Y \geq G \text{ and } W \leq B, \text{ and} \\ Y &= G && \text{otherwise,} \end{aligned}$$

where 'G' remains a basic income guarantee grant. A similar discontinuity problem appears likely to arise for those individuals eligible under both an NIT and WRS and who must choose between them. If the process of changing from one plan to the other is difficult or time consuming, such administrative barriers may provide special disincentives to work or take advantage of training opportunities. Consider, for example, a head of household who is offered a full-time but low paying job and is now receiving benefits under the NIT due to a temporary disability or involuntary unemployment. If the changeover period from the NIT to the WRS is too long, he may find that the short run cash flow problems or high tax rate of the NIT prevent him from taking the opportunity.

Both the discontinuity between plans and the probable administrative barriers to changing plans lead to the idea of combining the WRS and NIT concepts into one single plan. A plan which overcomes these problems is outlined in the next section.

Outline of an Alternative Income Assistance Plan

The proposed plan would provide support for the employable poor only--those poor unable to work due to medical or other conditions would require support under a plan or plans which are geared to each individual's needs. The net income for a person under this plan would be:

$$Y = WH + b(B - W)H + (G - a(WH + b(B - W)H))$$

$$\begin{aligned} &\text{for } b(B - W)H \geq 0, \\ &0 \leq a \leq 1, \\ &0 \leq b \leq 1, \text{ and} \\ &(G - a(WH + b(B - W)H)) \geq 0, \end{aligned}$$

where W = actual wage rate

H = hours worked

B = breakeven wage rate

G = guaranteed income grant

b = the fraction of the gap between the breakeven wage rate (B) and the wage rate (W) to be subsidized

a = the fraction of earnings (including the WRS portion) by which the grant is reduced

To avoid continuing the income guarantee feature for someone working full-time at the breakeven wage rate, the following inequality must be observed when selecting the plan's parameters:

$$G \leq ahB$$

where ' h ' is the number of hours which constitute full-time work for the accounting period. If the breakeven wage rate is set relatively low and one wishes to continue the guaranteed income portion for people working full-time at a wage rate above the breakeven wage rate, ' G ' must be set larger than the quantity ' ahB '.

Since the guaranteed income portion of the equation is a function of the wage rate subsidy portion, the marginal tax rates on hours and wage rate increases are no longer single variable terms. The marginal tax rate on wage rate increases becomes:

$$MTR_w = a + b - ab \quad \text{for } W \leq B, \text{ and} \\ (G - a(WH + b(B - W)H)) > 0$$

while the marginal tax rate on hours worked becomes:

$$MTR_h = a + b - ab - \frac{(1 - a)bB}{W} \quad \text{for } W \leq B, \text{ and} \\ (G - a(WH + b(B - W)H)) > 0$$

Since the MTR_h is a negative function of the wage rate (W) this plan has the advantage of possessing a progressive tax rate on hours. Thus, a low wage rate individual will be taxed at a lower and possibly negative rate while a high wage rate individual will be taxed at a higher rate. The limiting case is the individual earning the breakeven wage rate ($W = B$), for whom the $MTR_h = a$. A series of examples using weekly income are given in Table A.1. If $G \leq ahB$, the guaranteed income portion will terminate before or at the point that the recipient works full-time at the breakeven wage rate. When the guaranteed income portion does become zero, the marginal tax rates become:

$$MTR_w = b \quad \text{for } W \leq B, \text{ and} \\ MTR_h = -b(B - W) \quad (G - a(WH + b(B - W)H)) = 0$$

If $G > ahB$, the wage rate subsidy portion will terminate before or at the point that the guaranteed income portion becomes zero and the marginal tax rates become:

$$MTR_w = a \quad \text{for } W > B, \text{ and} \\ MTR_h = aw \quad (G - a(WH)) > 0$$

Table A.1. Weekly Benefit Levels and Tax Rates for Selected Program Parameters.

B	a	b	G	Break-even Income	MTR_w	MTR_h			
						W=\$.5	W=\$1.	W=\$2.	W=\$B.
\$3	.4	.4	\$48	\$120	.64	-.80	-.08	.28	.40
3	.4	.5	48	120	.70	-1.10	-.20	.25	.40
3	.4	.6	48	120	.76	-1.40	-.32	.22	.40
3	.5	.4	60	120	.70	-.50	.10	.40	.50
3	.5	.5	60	120	.75	-.75	.00	.38	.50
3	.5	.6	60	120	.80	-1.00	-.10	.35	.50
3	.6	.4	72	120	.76	-.20	.28	.52	.60
3	.6	.5	72	120	.80	-.40	.20	.50	.60
2.5	.4	.4	40	100	.64	-.56	.04	.34	.40
2.5	.4	.5	40	100	.70	-.80	-.05	.33	.40
2.5	.4	.6	40	100	.76	-1.04	-.14	.31	.40
2.5	.5	.4	50	100	.70	-.30	.20	.45	.50
2.5	.5	.5	50	100	.75	-.50	.13	.44	.50
2.5	.5	.6	50	100	.80	-.70	.05	.43	.50
2.5	.6	.4	60	100	.76	-.04	.36	.56	.60
2.5	.6	.5	60	100	.80	-.20	.30	.55	.60
2.5	.6	.6	60	100	.84	-.36	.24	.54	.60
2	.4	.4	32	80	.64	-.32	.16	.40	0
2	.4	.5	32	80	.70	-.50	.10	.40	0
2	.4	.6	32	80	.76	-.68	.04	.40	0
2	.5	.4	40	80	.70	-.10	.30	.50	0
2	.5	.5	40	80	.75	-.25	.25	.50	0
2	.5	.6	40	80	.80	-.40	.20	.50	0
2	.6	.4	48	80	.76	.12	.44	.60	0
2	.6	.5	48	80	.80	.00	.40	.60	0
2	.6	.6	48	80	.84	-.12	.36	.60	0

B = breakeven wage rate

a = the fraction of earnings by which the grant is reduced

b = the fraction of the difference between B and W to be subsidized

G = the guaranteed income grant

W = actual wage rate

 MTR_w = marginal tax rate on wage rate increases MTR_h = marginal tax rate on increased hours

Summary of Plan's Advantages

The NIT and the WRS individually provide different coverages and have different disadvantages. When operated side-by-side, budget costs are high and the discontinuities of changing back and forth between plans present special disadvantages to the recipients. By combining both concepts into one plan, it becomes possible to: 1) cover a wide range of employable poor, 2) eliminate the discontinuities between the plans, and 3) permit a progressive marginal tax rate on hours according to the recipient's wage rate.

Guidelines for Implementation

The program may specify different sets of parameters for different categories such as family size, but adult dependents should be required to qualify independently of the family under either the disability plan or this plan. By operating the program on a weekly or bi-weekly basis, a steadier income flow may be provided for persons who can obtain only occasional employment and it may eliminate the need for separate unemployment compensation programs, if processing of claims can be accomplished in a short period of time.

Each individual would be required to make an initial application, at which time he or she would be classified according to the criteria for the selection of benefit parameters. Upon approval of the application, the recipient would be issued an identification card containing the appropriate personal and benefit parameter information. Each period in which an individual qualifies for benefits, he or she would present his or her identification card and paycheck, if any. The paycheck would be required to contain information on the number of hours

worked, the wage rate and Social Security and other taxes withheld. The local office would then issue a check for the net income (post-subsidy) in return for the endorsed paycheck.

To operate efficiently and reduce the opportunities for receiving multiple payments, a nation-wide computer system with on-line terminals in each office would be required. Each quarter, the program files can be compared with the Social Security tax records to check on unreported income. All income received under the program would be taxable and all recipients should be required to file a return, but the minimum taxable earnings limit should exempt most recipients.

A staff of case-workers would be needed to police compliance with the program rules, but this staff should perhaps be separate from those case-workers that investigate the original applications.

Various alternatives exist for altering the benefit parameters according to family size or other criteria. For example, if $G = ahB$ for a family of four, then 'G' could be lowered ($< ahB$) for smaller families and raised ($> ahB$) for larger families. Other alternatives would be to raise 'a' or lower 'b' as family size increases while holding $G = ahB$ constant. If age of the head of household is a criterion, one might wish to provide different breakeven wage rate levels (B) in recognition that persons of lesser experience generally receive lower wage rates.

APPENDIX B

Table A.2. Time Series Data Used in the Estimation of the Model

Fiscal Year	AGPROD	AGPRCE	FEED	FERT	AGEMP	WAGE
1960	.960					
1961	.983	.965	93.51	59.51	89,365	11.88
1962	.990	.995	94.79	60.98	89,177	11.95
1963	1.062	1.064	102.31	63.27	82,598	12.20
1964	1.046	1.009	92.86	62.62	80,929	14.93
1965	1.039	1.008	81.72	63.75	68,504	13.73
1966	1.041	.969	112.98	67.28	62,057	14.68
1967	.979	1.047	113.86	68.31	54,225	16.68
1968	.922	1.094	113.21	68.12	50,462	17.80
1969	.877	1.058	124.47	67.90	44,915	18.88
1970	.864	1.074	120.46	68.64	38,484	24.95
1971	.852	1.110	130.35	68.74	34,147	26.23
1972	.834	1.157	140.35	70.37	30,909	29.03
1973	.812	1.261	143.68	77.11	27,310	32.30
1974	.821	2.210	174.67	97.74	30,443	33.23
1975	.796					

See Chapter VI for a description of the data and sources.

Table A.3. Other Time Series Data: Farm Laborer Labor Force; Median Weekly Earnings, Laborers, Except Farm; and Agricultural Production Index, 1951 to 1959.

Fiscal Year	Farm Laborer Labor Force	Median Weekly Earnings, Laborers, Except Farm	Agricultural Production Index (AGPROD)	
			Fiscal Year	Index
1961	106,839	\$ 25.25	1951	.817
1962	110,363	25.82	1952	.951
1963	103,270	26.97	1953	.822
1964	96,876	31.88	1954	.903
1965	84,890	30.97	1955	.851
1966	76,711	35.00	1956	.907
1967	68,960	38.00	1957	.801
1968	64,831	42.62	1958	.885
1969	55,525	44.88	1959	.926
1970	48,727	51.03		
1971	44,333	53.38		
1972	39,251	55.95		
1973	34,298	61.45		
1974	37,396	60.15		

Source: Puerto Rico Department of Agriculture

Source: P.R. Bureau of Labor Statistics

APPENDIX C

SPANISH VERSION OF THE STATEMENT OF LEGISLATIVE INTENT IN LAW NUMBER 142 OF JUNE 29, 1969

EXPOSICION DE MOTIVOS

La agricultura ha sido y continúa siendo un renglón muy importante en la economía de nuestro país. Sin embargo, por diversas consideraciones, esta industria está pasando por momentos difíciles. El terreno en cultivo se ha venido reduciendo considerablemente; los costos de producción se han elevado a pesar de que los jornales agrícolas son relativamente bajos, los trabajadores escasean porque buscan trabajo en otras actividades más remunerativas.

A través de esta ley, se declara que es política pública del Gobierno del Estado Libre Asociado de Puerto Rico el garantizar a los trabajadores agrícolas un ingreso mayor al que ahora reciben, que los induzca a seguir trabajando en la agricultura a fin de aliviar la escasez de mano de obra que sufre esta industria, sin aumentar los costos de producción. Asimismo se pretende elevar el nivel de vida de dichos trabajadores para que disfruten de una vida más plena.

Es propósito de esta ley, pues, aumentar el ingreso del trabajador para así reducir su absentismo en las actividades agrícolas, aumentando de esa manera la producción agrícola mediante una más intensa labor de siembra, cultivo y recolección.

La situación económica de la empresa agrícola, sin embargo, no permite a los agricultores pagar al presente, salarios iguales o mayores al ingreso que se desea garantizar a estos trabajadores.

Por tales consideraciones y con el objeto de ayudar a la agricultura a recobrar su prosperidad y ponerse en condiciones de pagar salarios iguales o mayores a los ingresos garantizados por esta ley, se establece un suplemento al ingreso que actualmente reciben ciertos trabajadores agrícolas, a determinarse de acuerdo a lo dispuesto en esta ley, el cuál será sufragado por el Gobierno del Estado Libre Asociado de Puerto Rico, valiéndose del agricultor como intermediario para hacer llegar al trabajador dicho suplemento de ingreso a través del mecanismo establecido por esta ley.

APPENDIX D

COMPUTATION OF FITTED VALUES USING THE PRODUCTION EQUATION

The use of the Cochrane-Orcutt procedure to eliminate the effects of serial correlation of the error terms requires the use of the following procedures in computing the fitted values of the equation or in computing predictions with the equation.

$$\text{Let } F_t = a + B_1 \ln \text{AGPRCE}_{t-1} + B_2 \ln \text{WAGE}_{t-1} + B_3 \ln \text{FEED}_{t-1} \\ + B_4 \ln \text{AGPROD}_{t-1},$$

$$\text{and } g_t = \hat{p}^t e_0 + \hat{p}^{t-1} e_1 + \dots + \hat{p} e_{t-1},$$

$$\text{and } e_t = \ln Y_t - \ln \hat{Y}_t.$$

The fitted values ($\ln \hat{Y}_t$) must be calculated in order, beginning with 1962 ($t = 0$) since all previous error terms ($e_{t-1}, e_{t-2}, \dots, e_0$) must be used in calculating the fitted value for any particular year 't'.

$$\begin{array}{ll} \ln \hat{Y}_0 = F_0 & e_0 = \ln Y_0 - \ln \hat{Y}_0 \\ \ln \hat{Y}_1 = F_1 + g_1 & e_1 = \ln Y_1 - \ln \hat{Y}_1 \\ . & . \\ . & . \\ . & . \\ \ln \hat{Y}_t = F_t + g_t & e_t = \ln Y_t - \ln \hat{Y}_t \end{array}$$

When using the assumed values of the wage rate variable to estimate the without program values of the production index, the actual values of the error terms for years 1962 to 1970 are still used. However, since there are no observed without program index values (Y_t) for 1971 to 1974

with which to calculate the error terms (e_t), these error terms are assumed to be zero. The lagged production index variable, as predicted by the equation using the assumed wage rate values, beginning with the 1971 predicted index value, are the ones used as the lagged dependent variable. Table A.4 lists a few selected values as an aid in understanding the procedures used.

Table A.4. Selected Intermediate Computation Results in the Prediction of the Production Index for the Without Program Case.

Year	Y_t	t	Y_{t-1}	$WAGE_{t-1}$	F_t	g_t	$\hat{Y}_t$
1970	.864	8	.877	18.88	-.16292	+.00821	.8567
1971	.852	9	.864	20.01**	-.17568	-.00671	.8333
1972	.834	10	.8333*	21.20**	-.21677	+.00269	.8073
1973	.812	11	.8073*	22.46**	-.25492	-.00108	.7741
1974	.821	12	.7741*	23.80**	-.28518	+.00433	.7522

Note: Values in last five columns are rounded.

* Predicted Values ($\hat{Y}_t$) from last column, previous year).

** Assumed wage rate values.

BIBLIOGRAPHY

BIBLIOGRAPHY

Ballinger, Roy A., ed. "Economic Behavior in the United States Sugar Market," California Agricultural Experiment Station Bulletin Number 859, 1972.

Barth, Michael C. and David H. Greenberg, "Incentive Effects of Some Pure and Mixed Transfer Systems," Journal of Human Resources, 6 (Spring 1971), 149-170.

Commonwealth of Puerto Rico, Camara de Representantes, "Transcripción de los Testimonios Prestados ante la Comisión de Agricultura de la Camara de Representantes, en la Audiencia Pública celebrada en el Salón de Audiencia 3 del Anexo de este Cuerpo Colegislador, el 24 de Abril de 1969, sobre los P. de la C. 434 y 445: Garantizar a los Trabajadores en la Fase Agrícola," mimeo, 1969.

Commonwealth of Puerto Rico, Departamento de Agricultura, Oficina de Estadísticas Agrícolas y Estudios Económicos, "Anuario de Estadísticas Agrícolas," mimeo, various editions.

_____, "Ventas de Abonos en Puerto Rico, 1950/51-1973/74," mimeo, March 1975.

Commonwealth of Puerto Rico, Departamento de Agricultura, Oficina de Ingresos Garantizados a Trabajadores Agrícolas, "Compendio Estadístico," mimeo, October 1972.

_____, "Compendio Estadístico," mimeo, July 1974.

_____, "Informe Sobre los Ingresos Suplementarios a los Trabajadores Agrícolas Provistos por las Leyes Num. 142 de 1969 y Num. 20 de 1972," mimeo, August 1973.

Commonwealth of Puerto Rico, Junta de Planificación, "Informe Económico al Gobernador," mimeo, various editions.

Friedlander, Stanley L., Labor Migration and Economic Growth, Cambridge: The MIT Press, 1965.

Garfinkel, Irwin, "A Skeptical Note on 'The Optimality' of Wage Subsidy Programs," American Economic Review, 63 (June 1973), 447-453.

Griliches, Zvi, "Distributed Lags: A Survey," Econometrica, 35:1 (January 1967), 16-49.

Hatry, Harry P., Richard E. Winnie and Donald M. Fish, Practical Program Evaluation for State and Local Government Officials, Washington, D.C.: The Urban Institute, 1973.

- Henderson, James M. and Richard E. Quandt, Microeconomic Theory, New York: McGraw-Hill, 1971.
- Kesselman, Jonathan, "Labor Supply Effects of Income, Income-Work, and Wage Subsidies," Journal of Human Resources, 4 (Summer 1969), 1962.
- Klein, Lawrence R., An Introduction to Econometrics, Englewood Cliffs, New Jersey: Prentice-Hall, 1962.
- Kmenta, Jan, Elements of Econometrics, New York: Macmillan, 1971.
- Koenig, Nathan, A Comprehensive Agricultural Program for Puerto Rico, Washington, D.C.: U.S. Government Printing Office, 1953.
- Mundlak, Yair, "On the Microeconomic Theory of Distributed Lags," Review of Economics and Statistics, 48:1 (February 1966), 51-60.
- Pico, Rafael, The Geography of Puerto Rico, Chicago: Aldine Publishing Company, 1974.
- President's Commission on Income Maintenance Programs, Poverty Amid Plenty: The American Paradox, Washington, D.C.: U.S. Government Printing Office, 1969.
- Rea, Samuel Arthur, Jr., "The Supply of Labor and the Incentive Effects of Income Maintenance Programs," unpublished Ph.D. dissertation, Harvard University, 1970.
- Reynolds, Lloyd G. and Peter Gregory, Wages, Productivity, and Industrialization in Puerto Rico, Homewood, Illinois: Richard D. Irwin, Inc., 1965.
- Schlenker, Robert E., "Optimal Mechanisms for Income Transfer: Note," American Economic Review, 63 (June 1973), 454-457.
- United States Department of Labor, Employment Standards Administration, Wage and Hour Division, "Report, Findings of Fact, and Recommendations of Industry Committee No. 122 for the Agriculture Industry of Puerto Rico," mimeo, 1974.
- Zeckhauser, Richard J., "Optimal Mechanisms for Income Transfer," American Economic Review, 61 (June 1971), 324-334.

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