Productivity Growth, Import Leakage and Employment Growth in Puerto Rico, 1967-87

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ABSTRACT Using Puerto Rican input-output data that cover the period 1967-87, we find that employment growth was led primarily by a rapid increase in final output- 5.1 % per year-although labor productivity growth was also substantial, at 3.7% per year. Import leakages also fell over this period, but had little impact on employment growth. Local absorption was more successful than exports in generating new jobs. Employment generated by local absorption grew by 35% and that from exports by 29%, even though exports increased almost four-fold, while local absorption only doubled. The difference reflects the greater labor intensity of industries that supply local absorption. There was also a notable shift in the occupational structure toward white-collar employment and away from blue-collar jobs. The primary reason for this was the shift in the composition of final demand toward industries that rely heavily on white-collar workers. A secondary reason was a bias in technological change, which favored white-collar over blue-collar workers.

KEYWORDS: Export-led growth, import substitution, productivity growth, decomposition analysis, Puerto Rico

1. Introduction

The nature of the remarkable record of economic achievement in Puerto Rico makes input-output (10) an even more indispensable tool that it is in other locations, for the design of rational plans for the island's future. The economic record of Puerto Rico is characterized by impressive success and crucial shortcomings. Perhaps its most notable accomplishment has been the growth in labor productivity which, in the period since World War II, has increased from the level of some of the world's most impoverished lands to an amount higher than that of any country in Latin America (see Baumol & Wolff, 1996). Even if that income

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level remains well below that of the US in an international comparison, on that criterion, Puerto Rico must be considered as one of the world's more prosperous areas. Direct observation supports the conclusion suggested by the data: while enormous problems remain, many of them critical, raising average per-capita income even further is not a matter of highest priority.

Instead, the highest priority is probably ascribable to what may be the greatest failure of the island's development programme, i.e. its inability to bring unemployment down to levels anywhere near those that would be considered normal in the US. Despite the general prosperity contributed by 'Operation Bootstrap' and its successors, and the tax incentives provided for the opening of manufacturing facilities on the island by Section 936 of the federal tax code, the unemployment rate was officially estimated at 16.4% in 1993. Not very long before, the figure was even higher (23.4% in 1983), and there are some who suggest that the figure today, corrected for disguised unemployment and other distorting influences, is well above 20%-a rate that prevailed in the US only during the Great Depression. This clearly means that the substantial rise that per-capita income underwent in Puerto Rico was most unevenly distributed. No doubt, a variety of social ills, such as a high crime rate, drug consumption and a number of others, are easily shown to be exacerbated by such unemployment rates, as is the migration to the US of a large body of Puerto Ricans with low incomes and records of low achievement in education and elsewhere.

The implication is that there may be general agreement that increased employment is an end sufficiently desirable in itself to be worth pursuing in the case of Puerto Rico, even if it entails some trade-off in economic efficiency and results in some sacrifice of further increases in per-capita income.

In this paper, we use 10 data to investigate the record of Puerto Rico's productivity and employment growth over the period 1967-87 (the latest date for which the pertinent data are available). In particular, we analyze the effects of productivity growth, import leakage, and the level and composition of final demand, especially exports, on overall employment growth and on the occupational composition of employment in Puerto Rico.

We also draw some policy conclusions on ways in which employment may be stimulated on the island. The use of 10 analysis for policy design is particularly appropriate here, because of the fulfilment of two conditions: (1) inputs (in this case, employment) as well as outputs directly enter society's objective function; (2) the economy in question is open, so that macro-economic policy is largely powerless to increase employment or to influence the use of other inputs. The only practical means to expand employment in Puerto Rico is to elicit increases in investment in labor-intensive activities, or a reallocation of the current capital stock in a similar direction. Even if markets were sufficiently perfect to permit full employment to be attained eventually through downward wage flexibility, the US minimum wage laws, which apply to Puerto Rico, would prevent it. In any event, the impediments to downward wage flexibility have been widely discussed in the literature.

However, to plan for such a programme, it is essential to determine which industries really are labor intensive, not only in the labor that they themselves employ, but also in the employment that their activities engender in the industries that serve them, and in the industries that serve those serving industries, and so on down the line. Of course, this is something that only 10 analysis permits the investigator to find out. Once such a calculation has been carried out, one can

begin to study what sort of incentive programme will be most effective in stimulating investment in industries that are truly labor intensive.

We find that, for this period at least, employment grew by 1.4% per year, i.e. somewhat greater than its post-World War II average of 1.1 % per year. Employment growth was led primarily by a rapid increase in final output, amounting to 5.1% per year, over the period 1967-87, although labor productivity growth was also substantial, at 3.7% per year. Import leakages also fell over this period, but the impact of this on employment growth was relatively modest. Local absorption was more successful than exports in generating new jobs. Over the period 1967-87, employment generated by local demand grew by 35% and that from exports by 29%, even though exports increased almost four-fold, while local absorption only doubled. The difference is primarily because local absorption absorbs relatively labor-intensive output compared with exports. Between 1967 and 1982, there was also a notable shift in the occupational structure towards white-collar employment and away from blue-collar jobs. The primary reason for the change was the shift in the composition of final demand toward output produced by industries which relied heavily on white-collar workers. A secondary reason was a bias in technological change which favored white-collar over blue-collar workers.

Exports consist almost exclusively of manufacturing products, which have been promoted by the Puerto Rican government through a variety of incentives, including tax relief (Section 936 of the federal tax code), the provision of infrastructure and other subsidies. The result has been the development of US branch plants in Puerto Rico which still heavily rely on the US for inputs and an output market. We argue that a change is called for in development strategy which places greater emphasis on attracting more labor-intensive industries and industries that can rely on inputs produced in Puerto Rico.

In Section 2, we present a brief historical overview of macro-economic trends in Puerto Rico over the period 1947-93. Section 3 develops our accounting framework and model. Results are presented in Section 4, and Section 5 provides some concluding remarks.

2. Post-World War II Macro-economic Trends [1]

Before beginning the 10 analysis, it is helpful to highlight the salient features of economic development in Puerto Rico since the end of World War II. There are five of note.

(1) The first is the rapid growth in per-capita income and, even more notably, aggregate labor productivity.
(2) The second is relatively low growth in employment over the period. (3) The third is high (official) rates of unemployment.
(4) The fourth is the heavy reliance on export-led growth-comparable with the 'Four tigers' of Asia.
(5) The fifth is a limited degree of import substitution, particularly in manufacturing (which we will discuss further in Section 4).

Figure 1 shows the growth in output (gross domestic product (GDP) in constant US dollars), employment and labor productivity, defined as the ratio of GDP in constant dollars to employment. The growth in output has been spectacular: a ten-fold increase between 1947 and 1993. Labor productivity has also shown remarkable growth, increasing by more than six times over the period-or 5.0%

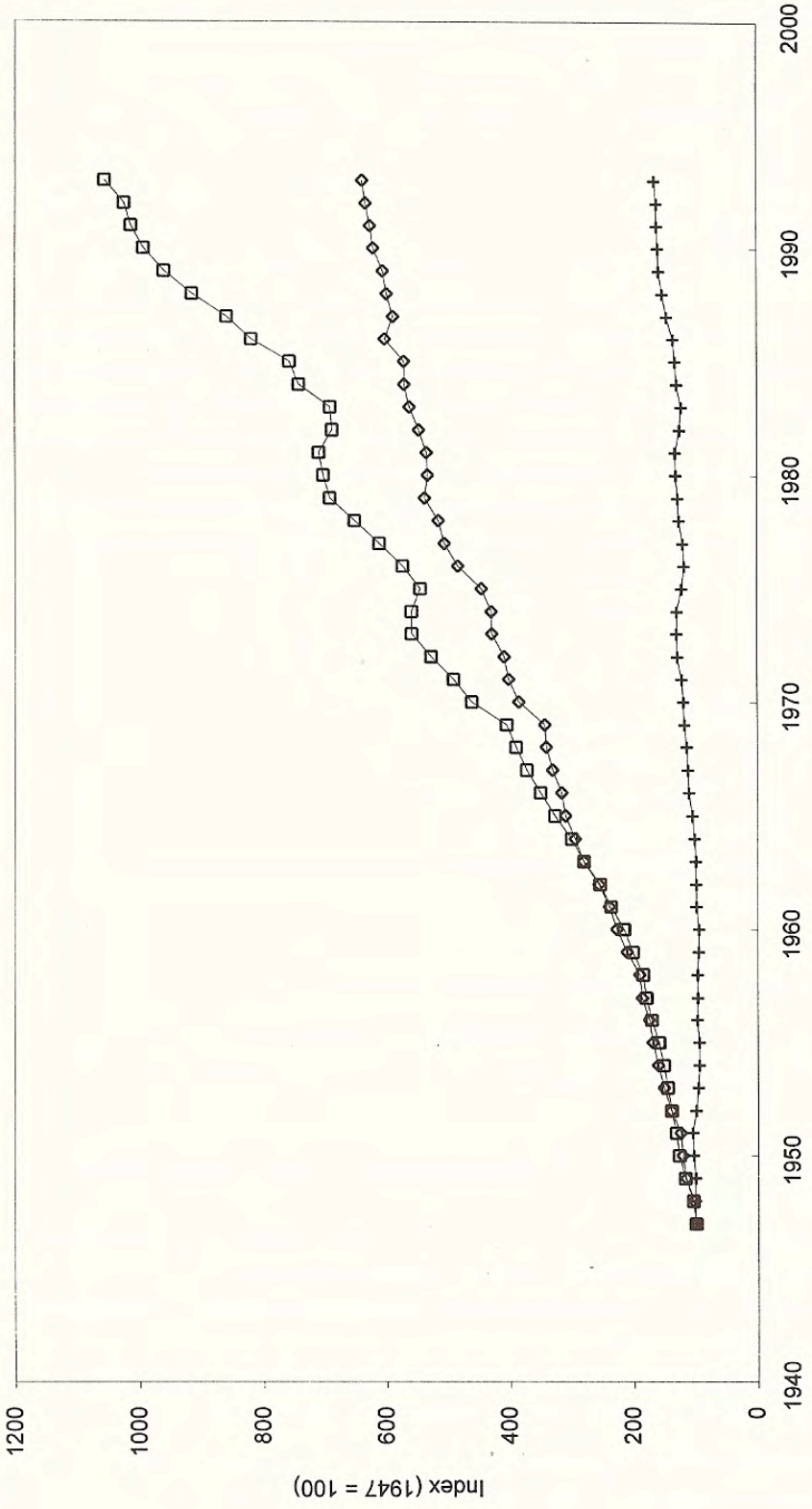

Figure 1. GDP (1954 dollars) (□), employment (+) and labor productivity (◇), with index, 1947 = 100.

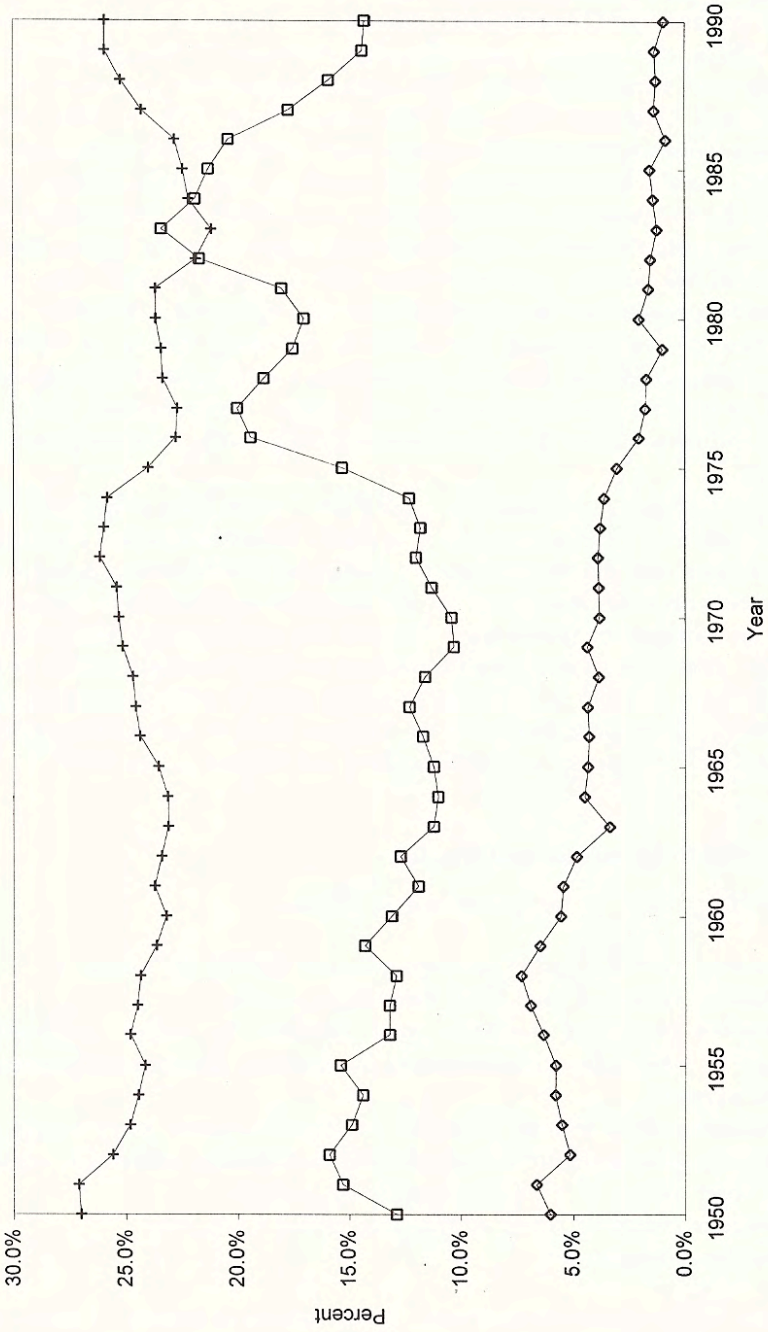

Figure 2. Unemployed rate (□), employment-to-population ratio (+) and annual productivity growth (5-year running average) (◇), 1950–90.

per year. However, employment has grown by only 65% or 1.1 % per year. Puerto Rico has made exceptional achievements in both output growth and productivity, but has not been very succesful in generating new employment.

Figure 2 shows trends in annual labor productivity growth (a 5-year running average), the (official) unemployment rate and the ratio of employment to population. The productivity growth trend has been downwards from 5-6% per year during the 1950s, to 3-4% per year during the 1960s and 1970s, and further down to 1-2% per year during the 1980s. The unemployment rate generally followed a downward trend between 1950 and 1970 (from about 15% to 10%) but then turned sharply upward, topping 20% in the early 1980s, before retreating to 16% in the early 1990s. It is interesting that there is very little relation between productivity growth and the unemployment rate. Whereas productivity growth almost continuously followed a downward trend since the early 1950s, the unemployment rate has moved cyclically over the post-war period. The ratio of employment to population-another indicator of employment behavior-has also moved cyclically, first declining from 27% in the early 1950s, to 23% in the mid-1960s, rising to 26% in the early 1970s, then falling again to 21 % in the early 1980s, before returning to 26% in the early 1990s. It seems clear that it is the structure of industry, rather than labor productivity growth, that has most affected employment.

The ratio of merchandise exports to GDP for Puerto Rico averaged 56% over the period 1960-90. This is the highest in Latin America and the Caribbean (at least for countries with the requisite data), except for the Bahamas (at 116%). This also compares with a figure of 35% for the Republic of Korea (i.e. South Korea) and 132% for Singapore (comparable figures are not available for Taiwan and Hong Kong). The ratio of exports plus imports to GDP averaged 121 % in Puerto Rico over the period 1950-90. The comparable ratio is 45% for the Republic of Korea, 309% for Singapore and 64% for Taiwan. Both in terms of openness and export dependency, Puerto Rico ranks among the highest in the world.[2]

3. Accounting Framework and Model

The formal IO model can be introduced as follows.

$\mathbf{X}$ = 53-order vector of gross domestic output (GDO) by sector
$\mathbf{Y}_T$ = 53-order vector of total final demand by sector
$\mathbf{Y}_D$ = 53-order vector of domestic final demand by sector (equivalent to $\mathbf{C}_D + \mathbf{I}_D + \mathbf{G}_D + \mathbf{E}_D$ (consumption, investment, government expenditures and exports)
$\mathbf{A}_T$ = 53-order matrix of total technical coefficients, where $a_{Tij} = x_{Tij}/x_j$
$\mathbf{A}_D$ = 53-order matrix of domestic technical coefficients, where $a_{Dij} = x_{Dij}/x_j$
$\mathbf{L}$ = 53-order vector of total employment by industry
$\mathbf{l}$ = 53-order vector of labor coefficients, where $l_j = L_j/x_j$
N = total employment

All variables, unless otherwise indicated, are in constant dollars. Then, we have

$$\mathbf{X} = \mathbf{A}_D \mathbf{X} + \mathbf{Y}_D \quad (1)$$

$$N = \mathbf{l}(\mathbf{I} - \mathbf{A}_D)^{-1} \mathbf{Y}_D \quad (2)$$

Define

$\mathbf{B}$ = 53-order matrix of domestic fulfilment of intermediate demand, where $b_{ij} = x_{Dij}/x_{Tij}$ (unity less the import leakage)

Then, we have

$$a_{Dij} = b_{ij} a_{Tij} \tag{3}$$

Define

$\mathbf{F}_T$ = 53×4 total final demand matrix (= $(\mathbf{C}_T, \mathbf{I}_T, \mathbf{G}_T, \mathbf{E}_T)$)
$\mathbf{F}_D$ = 53×4 domestic final demand matrix (= $(\mathbf{C}_D, \mathbf{I}_D, \mathbf{G}_D, \mathbf{E}_D)$)
$\mathbf{G}$ = 53×4 domestic fulfilment of final demand matrix, where $g_{ij} = f_{Dij}/f_{Tij}$ (unity less the import leakage)

For total final demand, we have

$\mathbf{G}^*$ = 53-order vector of domestic fulfilment of total final demand, where $g_i^* = y_{Di}/y_{Ti}$ (unity less the import leakage)
$\mathbf{M}$ = 10×53 manpower matrix, where m_{ij} shows employment of occupation i in industry j
$\mathbf{E}$ = 10×53 employment coefficient matrix, where $e_{ij} = m_{ij}/L_j$

Then, we have

$$\mathbf{D} = \mathbf{E}\hat{\mathbf{I}}(\mathbf{I} - \mathbf{A}_D)^{-1}\mathbf{Y}_D \tag{4}$$

where

$\mathbf{D}$ = 10-order vector that shows total employment by occupation

4. Results

We begin with statistics on employment multipliers by industry in 1987 (Table 1).[3] The first column in Table 1 shows the actual employment multipliers $\boldsymbol{\lambda}$, based on the domestic coefficient matrix, i.e.

$$\boldsymbol{\lambda} = \mathbf{l}(\mathbf{I} - \mathbf{A}_D)^{-1}$$

There is considerable variation among sectors, from a high of 348 employees per million dollars (1967 prices) of output in sugar cane to a low of 12 employees per million dollars in petroleum refining. Of the major sectors, manufacturing had by far the lowest employment multiplier, i.e. 37 per million dollars (based on domestic final demand weights). The employment multiplier for transportation, communications and utilities (i.e. 68) is almost double that of manufacturing, and those for agriculture, mining and construction (102) and services (99) are about triple the manufacturing value.

The second column in Table 1 shows what the employment multipliers would be if there were complete import substitution, i.e. no imported intermediate inputs. This is given by

$$\boldsymbol{\lambda}_T = \mathbf{l}(\mathbf{I} - \mathbf{A}_T)^{-1}$$

The third column shows the percentage difference between $\boldsymbol{\lambda}_T$ and $\boldsymbol{\lambda}$. A high value indicates the existence of considerable import leakage in the use of intermediate inputs. Here, too, there is considerable variation among sectors, from a high of 82% in petroleum refining (almost all intermediate inputs are imported) to a low of 3.9% for the commonwealth government (almost all inputs are produced

Table 1. Total (direct plus indirect) employment multipliers, 1987, and annual rate of change, 1967–87[a] (employees per million 1967 dollars of output)

Sector number and name		Employment multipliers			Annual rate of change, 1967–87 (%)		
		Domestic (λ)	Total (λ_T)	Per cent difference[b]	Domestic multiplier[c]	Total multiplier[d]	Per cent difference[e]
1	Sugar cane	348.1	387.1	10.1	0.51	0.33	−54.9
2	Other agriculture, forestry and fishing	128.5	151.1	15.0	5.36	5.06	−5.8
3	Mining	50.1	64.2	21.9	4.65	4.38	−6.1
4	Construction	94.5	124.3	24.0	2.08	1.88	−10.8
5	Meat and meat products	115.3	140.4	17.9	4.83	4.90	1.5
6	Milk and dairy products	92.4	128.3	28.0	5.16	4.40	−17.3
7	Canned and preserved fruits and vegetables	59.0	112.5	47.5	5.11	3.83	−33.5
8	Grain mill products	37.8	113.4	66.6	−0.97	5.26	[f]
9	Bakery products	78.8	114.4	31.2	1.65	2.83	41.6
10	Sugar mills, refineries, and confectionery	61.8	86.3	28.4	7.68	6.40	−20.1
11	Beer, malt and alcoholic beverages	19.1	27.2	29.6	5.05	4.55	−11.0
12	Bottled and canned soft drinks	41.1	65.3	37.0	3.76	3.08	−22.4
13	Miscellaneous food products	53.4	111.2	52.0	5.00	5.01	0.1
14	Tobacco products	33.1	44.2	25.1	6.22	8.74	28.9
15	Textile mill products and apparel	84.3	138.2	39.0	1.84	1.96	5.9
16	Furniture, lumber and wood products	92.2	150.8	38.9	1.59	0.96	−65.8
17	Paper and allied products	49.2	86.0	42.7	1.41	1.71	17.2
18	Printing and publishing	66.5	102.8	35.3	2.61	1.81	−44.5
19	Petrochemicals	26.9	50.5	46.7	3.95	3.91	−1.1
20	Drugs and pharmaceuticals	17.7	29.1	39.1	3.75	2.97	−26.3
21	Other chemical products	34.1	67.2	49.3	7.12	5.81	−22.6
22	Petroleum refining	12.2	66.6	81.7	4.97	3.70	−34.3
23	Other petroleum products	39.9	77.7	48.6	1.27	1.18	−8.0
24	Rubber and plastic products	42.7	70.7	39.6	6.12	4.95	−23.5
25	Leather and leather products	66.2	125.3	47.1	1.86	1.81	−2.8
26	Cement, stone, clay, glass and concrete products	54.2	83.5	35.1	3.26	2.42	−34.6

Table 1:—*continued*

Sector number and name	Employment multipliers			Annual rate of change, 1967–87 (%)		
	Domestic (λ)	Total (λ_T)	Per cent difference[b]	Domestic multiplier[c]	Total multiplier[d]	Per cent difference[e]
27 Primary metal products	52.4	62.1	15.6	0.53	2.27	76.5
28 Fabricated metal products	48.5	84.7	42.7	3.35	2.96	−12.9
29 Machinery, except electrical	32.3	62.6	48.4	5.13	2.90	−76.9
30 Electrical and electronic machinery	39.9	61.0	34.5	4.85	4.66	−4.2
31 Transportation equipment	50.2	77.0	34.8	3.53	3.18	−11.1
32 Professional and scientific instruments	34.8	56.0	37.9	8.43	7.29	−15.7
33 Miscellaneous manufactures	42.4	74.4	43.0	3.23	3.32	2.8
34 Transportation	82.6	93.8	11.9	2.56	2.52	−1.6
35 Communications	36.7	42.4	13.4	4.54	4.46	−1.9
36 Electricity and irrigation services	40.2	58.1	30.9	0.97	1.32	27.0
37 Water and sewerage services	115.3	126.1	8.6	3.12	3.18	2.0
38 Wholesale and retail trade	109.5	116.2	5.8	1.80	1.68	−7.1
39 Finances	28.5	32.4	12.2	5.71	5.78	1.2
40 Insurance	61.4	71.9	14.7	4.60	4.81	4.2
41 Real estate	31.3	39.7	21.3	−2.47	−2.49	0.8
42 Hotels	188.9	204.4	7.6	−1.52	−1.46	−4.6
43 Personal services	110.0	130.4	15.7	6.40	5.86	−9.3
44 Business services	72.5	81.3	10.9	4.74	4.63	−2.4
45 Repair services, car rental and parking	19.4	27.1	28.5	10.10	9.06	−11.5
46 Amusement and recreation	155.3	178.2	12.8	1.43	1.59	9.9
47 Medical and hospital services	187.0	199.5	6.3	2.29	2.25	−1.7
48 Other services	113.4	120.1	5.6	0.61	0.38	−58.3
49 Commonwealth government	116.1	121.0	4.1	1.59	2.05	22.3
50 Municipal government	226.2	235.2	3.9	1.20	1.46	17.7
51 Federal government	75.0	84.2	11.0	−0.87	0.10	[f]
Unweighted average	73.0	97.3	25.0	3.37	3.29	−2.5

Table 1:—*continued*

Sector number and name	Employment multipliers			Annual rate of change, 1967–87 (%)		
	Domestic (λ)	Total (λ_T)	Per cent difference[b]	Domestic multiplier[c]	Total multiplier[d]	Per cent difference[e]
Average weighted by domestic final demand						
Agriculture, mining and construction	101.7	130.0	21.8	2.37	2.19	−8.4
Manufacturing	37.3	62.1	40.0	5.89	5.69	−3.6
Transportation, communications and utilities	67.6	78.4	13.8	2.80	2.85	1.8
Services	99.0	106.2	6.8	1.87	1.97	4.9
All sectors	66.0	83.5	20.9	3.63	3.70	1.8
Average weighted by gross domestic output						
Agriculture, mining and construction	106.1	133.5	20.5	3.51	3.16	−11.0
Manufacturing	38.3	64.5	40.7	5.54	5.37	−3.2
Transportation, communications and utilities	58.3	69.0	15.5	3.29	3.25	−1.1
Services	88.6	95.9	7.6	2.28	2.32	1.7
All sectors	65.2	82.1	20.6	3.78	3.84	1.6

[a]From $\lambda = \mathbf{l}(\mathbf{I} - \mathbf{A}_D)^{-1}$ and $\lambda_T = \mathbf{l}(\mathbf{I} - \mathbf{A}_T)^{-1}$.
[b]Given by $(\lambda_T - \lambda)/\lambda_T$.
[c]Given by $1n(\lambda^{67}/\lambda^{87})/20$.
[d]Given by $1n(\lambda_T^{67}/\lambda_T^{87})/20$.
[e]Given by $[1n(\lambda_T^{67}/\lambda_T^{87})/20 - 1n(\lambda^{67}/\lambda^{87})/20]/1n(\lambda_T^{67}/\lambda_T^{87})/20$.
[f]Signs differ between the two terms.

locally). Of the major sectors, the degree of import leakage is greatest for manufacturing (a 40% difference, based on domestic final demand weights), followed by agriculture, mining and construction (21%), transportation, communications and utilities (16%), and services (8%). Thus, manufacturing is the sector with the lowest (domestic) employment multiplier and the highest degree of import leakage.

Column four in Table 1 shows the annual rate of change of the inverse of X between 1967 and 1987 (where we use the inverse to reduce the number of negative signs). Thus, a high positive value indicates a rapid reduction in the employment multiplier over time. Here, it is clear that manufacturing has had by far the most rapid reduction in its employment multiplier, at 5.9% per year on the basis of final demand weights (and 5.5% on the basis of gross output weights). This figure is more than 50% greater than the annual rate of reduction of the employment multiplier of transportation, communications and utilities (3.3%), more than double that for agriculture, mining and construction (2.4%), and more than three times as great as that for services (1.9%). For the economy as a whole, the employment multiplier declined by 3.6% per year on the basis of domestic final demand weights (and 3.8% per year on the basis of gross output weights).

The fifth column of Table 1 shows the same statistic for λ_T which indicates what the annual rate of change of the inverse employment multipliers would be if there were no imported intermediate inputs. This figure is also a measure of the annual rate of growth of the total (direct plus indirect) labor productivity by sector.4 Overall, labor productivity grew by 3.7% per year over the period 1967-87 (based on final demand weights). Manufacturing had the highest growth, at 5.7% per year, followed by transportation, communications and utilities (2.9%), agriculture, mining and construction (2.2%), and services (2.0%).

The difference between columns four and five is an indicator of whether or not the degree of intermediate import leakage has changed since 1967. A positive difference is indicative that, on net, import substitution has occurred; a negative difference indicates that import leakages have increased. For the economy as a whole, there was a modest degree of import substitution (1.8% difference on the basis of domestic final demand weights). Import substitution was relatively strong in the services sector (4.9% difference) and very modest in transportation, communications and utilities (1.8% difference). Manufacturing and (particularly) agriculture, mining and construction experienced increased intermediate import leakages between 1967 and 1987. Thus, the high rate of reduction of the domestic employment multiplier in manufacturing is primarily attributable to its high rate of total labor productivity growth, although increased intermediate import leakages also played a role.

4.1. Aggregate Employment

Table 2 shows the employment generated by each component of domestic final demand, derived from equation (2) for 1967, 1977 and 1987.5 In 1967, for example, 41 % of total employment was generated either directly or indirectly by personal consumption expenditures on domestically produced goods and services; 17% by investment; 15% by government spending; 24% by exports of goods and services; and 4% by visitor (tourist) spending in Puerto Rico (panel A). Between

Table 2. Employment generated by component of domestic final demand ($\mathbf{Y}_D$), 1967–87[a]

	Personal consumption expenditure	Investment	Government consumption	Exports		Total domestic final demand $\mathbf{Y}_D$
				Goods and services	Visitor expenditures	
(A) *Percentage composition of employment by component*						
1967	41.1	16.7	14.6	24.1	3.6	100.0
1977	46.3	10.0	22.7	17.2	3.8	100.0
1987	39.4	8.3	25.5	23.7	3.1	100.0
(B) *Average annual growth rate of employment by component (%)*						
1967–77	1.71	− 4.56	4.94	− 2.83	1.09	0.52
1977–87	0.75	0.44	3.48	5.53	0.49	2.34
1967–87	1.23	− 2.06	4.21	1.35	0.79	1.43
(C) *Employment generated per million dollars (1967 prices) of domestic final demand component*						
1967	141	141	153	118	153	137
1977	92	90	145	44	125	84
1987	75	85	125	36	99	66
Annual growth rate, 1967–87 (%)						
	− 3.13	− 2.51	− 1.02	− 5.95	− 2.17	− 3.63
Addendum: Average annual growth rate of domestic final output (1967 prices) by component (%)						
1967–77	6.01	− 0.03	5.53	7.07	3.08	5.44
1977–87	2.70	0.93	4.92	7.52	2.84	4.70
1967 87	4.36	0.45	5.23	7.29	2.96	5.07

[a]From equation (2), $N \quad \mathbf{I}(\mathbf{I} \quad \mathbf{A}_D)^{-1}(\mathbf{C}_D - \mathbf{I}_D - \mathbf{G}_D + \mathbf{E}_D)$.

1967 and 1977, the proportion of total employment generated by personal consumption increased from 41% to 46%, and then declined to 39% in 1987. The share generated by government expenditures increased dramatically over the years 1967 to 1987, rising from 15% to 26%. In contrast, the proportion attributable to domestic investment fell off very sharply, decreasing from 17% to only 8%. The share generated by direct exports also declined sharply, falling from 24% in 1967 to 17% in 1977, but then rebounded to 24% in 1987. The share attributable to tourism experienced a modest reduction between 1967 and 1987.

Panel B in Table 2 provides another way of looking at these changes, i.e. in terms of annual growth rates of employment. While overall employment grew by 1.4% per year between 1967 and 1987, the employment numbers generated by household consumption grew somewhat slower (1.2%), while employment from government expenditure rose much faster (4.2%). The total employment generated by investment actually declined over the period in absolute terms (by 34%). Employment generated by the export of goods and services increased at a pace slightly below average (1.35%), while tourist-generated employment rose by only 0.8% per year.

As is evident from equation (2), the change in the employment generated by final output arises from two sources: (1) changes in real output **(FD)** and (2) changes in the employment generated per real dollar of output, i.e. $\mathbf{[I(I - AD)^{-1}]}$. Panel C in Table 2 shows statistics on the second of these effects. Here, it should be recalled that, strictly speaking, the term $\mathbf{[I(I - AD)^{-1}]}$ is not an indicator of changes in total labor productivity, i.e. of the direct plus indirect labor required to

produce one unit of output. The term also reflects the degree of import leakage in intermediate demand, i.e. the difference between the matrix A and the matrix AD.

There are striking differences in the level and changes in the employment generated per dollar among final demand components. In 1967, 153 jobs were generated per million dollars of government spending, as well as per million dollars of tourist spending. Personal consumption and investment generated slightly lower levels of employment, with both generating 141 jobs. Exports of goods and services generated by far the fewest, i.e. 118 jobs (14% lower than the total final demand).

Between 1967 and 1987, employment generated per million (1967) dollars of personal consumption expenditures fell by 47% (3.1 % per year); employment generated by tourism and investment fell by slightly less, with levels of 35% and 40% respectively; while the number of jobs generated by a million dollars of government expenditure declined by only 18%, primarily reflecting the low productivity growth in this sector. In contrast, the number of jobs generated per million dollars of exports of goods and services fell by over 80%, or 6.0% per year. In 1987, jobs generated per dollar of direct exports amounted to less than half the number generated per dollar of personal consumption, investment and tourist spending.

The addendum to Table 2 shows the first effect, i.e. the growth in real domestic output by component. Over the years 1967-77, exports of goods and services had by far the fastest rate of growth, at 7.3% per year, compared with 5.2% per year for government consumption, 4.4% per year for personal consumption expenditures and only 0.5% per year for investment. Personal consumption grew very rapidly in the period 1967-77, at 6.0% per year, and then slowed down to 2.7% per year in the period 1977-87. Investment remained almost unchanged in real terms from 1967 to 1977, and then grew at 0.9% per year during 1977-87. The growth in government consumption was slightly higher between 1967 and 1977, at 5.5% per year, compared with 4.9% per year between 1977 and 1987. Export growth accelerated somewhat over the two periods, from 7.1 % to 7.5% per year.

4.2. Decomposition of Changes in Employment

We next analyze the sources of employment growth by taking the differential of equation (2), i.e.

$$\Delta \mathbf{N} = \mathbf{l}(\mathbf{I} - \mathbf{A}_D)^{-1} \Delta \mathbf{Y}_D + \Delta[\mathbf{l}\ (\mathrm{I} - \mathbf{A}_D)^{-1}]\mathbf{Y}_D \qquad (5)$$

where a delta (Δ) indicates the change in the matrix over the period. We use average period weights to provide an exact decomposition of ΔN. The change in domestic final demand can be further decomposed into the change in the total final demand matrix, holding constant the final demand import leakage ratios, and into the change in the final demand import leakage ratios, holding constant the total final demand matrix, i.e.

$$\Delta \mathbf{F}_D = \mathbf{G} \star \Delta \mathbf{F}_T + \Delta \mathbf{G} \star \mathbf{F}_T$$

where the asterisk (*) indicates term-by-term multiplication.

In a similar fashion, the change in the domestic interindustry coefficient matrix can be decomposed into the change in the total interindustry coefficient matrix, holding constant the interindustry import leakage ratios, and into the change in the

interindustry coefficient leakage ratios, holding constant the total interindustry coefficient matrix, i.e ..

$$\Delta \mathbf{A}_D = \mathbf{B}\star\Delta\mathbf{A}_T + \Delta\mathbf{B}\star\mathbf{A}_T$$

We can isolate three terms in this decomposition. The first term, which we will call the 'final demand effect', is the change in total employment generated by the change in the total final demand matrix ($\Delta\mathbf{F}_T$) over the period, with technology and the import leakage ratios held constant. The second term, i.e. the 'technical change effect', shows the change in total employment generated by the change in technology ($\Delta[\mathbf{I}(\mathbf{I} - \mathbf{A}_T)^{-1}]$) over the period, with the final demand vector and the import leakage ratios held constant. The third term is the 'import leakage effect', which shows the change in employment that results from the change in the import leakage ratios ($\Delta\mathbf{B}$, $\Delta\mathbf{G}$), with technology and final demand held constant. The decomposition can be applied to each component of final demand. We do this for all components of final demand, except inventory change, which we leave unchanged in the decomposition.

The first effect can, in turn, be decomposed into two further effects. First,

define $\phi_{ij} = F_{Tij}/\Sigma_i F_{Tij}$, where $\boldsymbol{\phi}$ is the coefficient matrix for final demand and shows the industrial composition of each component of final output. Also, let $\mathbf{H} = (\Sigma_i F_{Ti1}, \ldots, \Sigma_i F_{Ti4})$ be the four-order row vector that shows the total output of each component of final demand. Then, $\mathbf{Y}_T = \mathbf{H}\boldsymbol{\phi}$ and

$$\Delta\mathbf{Y}_T = \Delta\mathbf{H}\boldsymbol{\phi} + \mathbf{H}\Delta\boldsymbol{\phi} \qquad (6)$$

The first term on the right-hand side, which we call the 'levels effect', shows the change in the vector of total final demand that is attributable to changes in the level of output of each component of final demand, holding constant the industrial composition of each component of final demand. The second term, which we call the 'composition effect', shows the change in the vector of total final demand that is attributable to changes in the composition of each component of final demand, holding constant the total level of final output by component.6

Results are shown in Table 3. Between 1967 and 1977, total employment increased by 35 000 workers, or 5% of the initial employment level. If technology and import leakages had remained constant, as well as the composition of each component of final demand, and total final demand had increased from its 1967 level to its 1977 level, then total employment would have increased by 56%. However, the composition of the final output shifted towards industries with lower employment multipliers, reducing employment by 13%, so that the net effect of the change in the final demand vector YT was a 43% increase in employment. If final demand and import leakages had remained constant, then the change in technology would have reduced employment by 43%. There was also some substitution of domestically produced products for imports, which increased employment by 5%. The net result was a 5% increase in total employment.

Total final demand grew slightly slower in the period 1977-87, increasing employment by 46%, in contrast to a 56% rise in the previous period. The composition effect was also weaker, decreasing employment by only 6%, so that the total effect of the change in final output was a 40% increase in total employment. Technological change slowed down quite sharply in the period 1977-87, reducing employment by only 12%. Changes in import leakages were negligible during this period, so that the net effect was a 26% gain in total employment.

Table 3. Sources of total employment growth by period: decomposition into a final demand effect, technical change effect and import leakage effect, 1967–87[a] (per cent of initial employment)

	Actual change in employment ΔN	Change in total final demand $\Delta \mathbf{Y}_T^b$			Change in total coefficients ($\Delta \mathbf{A}_T$, $\Delta \mathbf{I}$)	Change in import leakages ($\Delta \mathbf{B}$, $\Delta \mathbf{G}$)
		Total effect	Levels effect	Composition effect		
(A) *Total final demand* ($\mathbf{Y}$)						
1967–77	5	43	56	−13	−43	5
1977–87	26	40	46	−6	−12	−1
1967–87	33	85	110	−25	−56	4
(B) *Local absorption* ($\mathbf{C} + \mathbf{I} + \mathbf{G}$)						
1967–77	15	48	53	−5	39	7
1977–87	16	33	35	−2	−14	3
1967–87	35	88	96	−8	−57	4
(C) *Exports, including tourism* ($\mathbf{E}$)						
1967–77	−22	37	66	−29	−57	−2
1977–87	53	53	89	−36	−6	5
1967–87	29	77	131	−54	−52	5

[a] From equation (5), $\Delta N = \mathbf{l}(\mathbf{I} - \mathbf{A}_D)^{-1} \Delta \mathbf{Y}_D + \Delta[\mathbf{l}(\mathbf{I} - \mathbf{A}_D)^{-1}] \mathbf{Y}_D$, where $\mathbf{A}_D = \mathbf{A}_T \star \mathbf{B}$, $\mathbf{F}_D = \mathbf{F}_T \star \mathbf{G}$, and the asterisk ($\star$) indicates term-by-term multiplication. The decomposition uses average period weights.

[b] From equation (6), $\Delta \mathbf{Y}_T = \Delta \mathbf{H}\phi - \mathbf{H}\Delta\phi$.

Over the entire period 1967-87, the growth in the level of total final demand added 110% to total employment, while the change in the composition of final demand reduced employment by 25% and technological change further reduced it by 56%. Reduced import leakage added 4% to total employment, of which the substitution of domestically produced intermediate inputs for imported inputs increased employment by 5%, while increased import leakage in final demand reduced employment by 1 %.

We can now understand the sources of the change in employment growth between 1967 and 1987. Employment grew much slower during 1967-77 than in 1977-87. During the first period, rapid technological change and the shift in the mix of final output towards less labor-intensive industries completely offset the growth in the level of final output in generating new employment. However, import substitution was relatively strong, so that employment did manage to grow over these years, although only by 5%. During the period 1977-87, final output continued to increase at almost the same rate as in the previous period, but the rate of technological change fell off sharply and the final output composition effect decreased by half. With the degree of import leakage remaining almost unchanged over the period 1977-87, employment grew substantially, i.e. by 26%.

Patterns differ markedly between local absorption (personal consumption, investment and government spending) and exports. Panel B of Table 3 analyzes the contribution of local absorption to employment. The growth in employment generated by local absorption was 15% in 1967-77-much higher than total employment growth-and this was led by a substantial (48%) gain in jobs from the growth in real local absorption. Import substitution also played an important role,

adding 7% to employment. Jobs generated by local absorption increased at almost the same rate during 1977-87, despite a slowing down of the growth in real local absorption. The main reason was that technological change reduced employment by only 14% in this period, in contrast to 39% during 1967-77. Import leakages also increased over the second period, causing a 3% reduction in employment. Shifts in the composition of local final output played a relatively minor role in explaining changes in employment.

The results for export-driven employment are quite different from those for local absorption. Jobs created by exports fell sharply in the first period, i.e. by 22%. Despite a very rapid growth in export demand (7.1 % per year), the jobs generated from export growth alone amounted to only 37%, i.e. less than that from the growth in local absorption. The main reason was that shifts in export composition greatly favoured industries with relatively low employment multipliers (in particular, out of refined sugar and rum, and towards petrochemicals, drugs and pharmaceuticals, and electrical and electronic equipment), causing a 29% decline in employment. Moreover, productivity growth in export industries was very high, causing a 57% loss in jobs. Together with a moderate increase in import leakages, this was responsible for a tremendous loss of export-generated jobs.

In contrast, during 1977-87, employment generated by exports increased by a remarkable 53%. This was led by a 53% gain in employment that resulted from the growth in export demand (despite the fact that export demand grew only slightly faster in the period 1977-87 than in the previous period). By itself, the growth in the level of final demand would have increased employment by 89%. However, as in the previous period, this was offset by a continuing shift in the composition of exports toward less labor-intensive industries (particularly towards drugs and pharmaceuticals, electrical and electronic equipment, and professional and scientific instruments), which lowered employment by 36% in the later period.

Moreover, while the pace of technological change slowed down for the economy as a whole, it was particularly slow in the export industries, causing a 6% reduction in employment. This was particularly the case for the three major export industries (based on average export shares over the period 1977-87): drugs and pharmaceuticals, whose domestic employment multipliers (A) increased over the period 1977-87 by 0.6% per year; electrical and electronic machinery, whose domestic employment multipliers remained constant; and textile mill products, whose domestic employment multipliers fell by 1.3% per year. There was also a substantial reduction in import leakages, adding another 5% to employment growth; together with the other two effects, this increased export-driven employment by 53% over the period 1977-87.

Interestingly, when we compare the records for local absorption and exports over the full period of 20 years, employment generated by local absorption increased more than that from export activity: 35% versus 29%. This difference results mainly from the greater final demand effect on employment: 88% from increasing local absorption compared with a 77% gain from export growth. The technical change effect was also slightly larger for the production of local absorption goods (57%) than export producers (52%). The leakage effect was quite similar for the two components: reduced import leakages added 4-5% to employment in the two cases.

Table 4. Percentage distribution of employment by major occupational group, 1967 and 1982

Occupational group	1967	1982	Annual growth rate of employment 1967–82 (%)
Executive, administrative and managerial occupations	8.3	8.7	1.24
Professional specialty occupations	9.3	11.8	2.46
Technicians and related support occupations	1.3	2.0	3.86
Administrative support occupations	12.0	15.2	2.43
Sales workers	7.8	10.7	2.97
Precision production, craft and repair occupations	12.8	10.4	−0.50
Operatives and fabricators	18.6	14.5	0.76
Laborers except farm	6.1	5.5	0.10
Farm and fishery workers	12.5	4.7	−5.62
Service occupations	11.3	16.5	3.37
Total	100.0	100.0	0.88

4.3. Employment by Occupational Group

We next turn to changes in employment by occupation. Table 4 details changes in the composition of employment by major occupational group. As was also true for the US, Puerto Rico saw a sizable increase in the proportion of white-collar employment and a corresponding decline in blue-collar jobs over the period 1967-82.7 Managerial jobs grew from 8.3% to 8.7% of total employment over this period; those employed in professional and speciality occupations grew from 9.3% to 11.8%; technical jobs and administrative support positions grew from 13.3% to 17.2%; and sales jobs grew from 7.8% to 10.7%.

Among the blue-collar occupations, a large relative loss-as well as an absolute decline-was experienced by craft jobs, falling from 12.8% to 10.4%; by operatives and fabricators, falling from 18.6% to 14.5%; and especially by farm workers, here falling from 12.5% to 4.7%. Non-farm laborers declined from 6.1% to 5.5% of total employment, although their number did rise slightly in absolute terms. The only blue-collar occupation that showed a relative increase was service jobs, which increased from 11.3% to 16.5% of total employment.

Table 5 shows employment by occupation as generated by the domestic final demand component in 1982 (see equation (4». There are several interesting results. First, 19% of the jobs generated by personal consumption expenditures were in sales, and this component alone accounted for 76% of the sales jobs in the economy and 65% of farm jobs in 1982. Almost 31% of the jobs generated by investment were craft and skilled positions (mainly attributable to construction). Over one-third of the jobs generated by government expenditures were managerial and professional positions, and another 47% were administrative support and service jobs. Government spending accounted for almost one-third of all managerial jobs, 57% of all professional jobs, and over one-third of administrative support and service jobs. Over half of all jobs generated by exports of goods and services were skilled craft and operative jobs, and this component alone accounted

Table 5. Employment by occupational group, as generated by component of domestic final demand ($\mathbf{Y}_D$), 1982[a]

	Personal consumption expenditure	Investment	Government consumption	Exports		Total domestic final demand $\mathbf{Y}_D$
				Goods and services	Visitor expenditures	
(A) *Percentage of total employment generated by final demand component*						
Managerial	8.6	6.0	11.0	7.2	8.1	8.7
Professional	9.0	3.4	26.7	3.4	5.1	11.8
Technicians	2.4	1.6	2.0	1.8	0.8	2.0
Administrative support	14.4	8.7	21.9	11.3	11.5	15.2
Sales	18.5	8.7	0.8	6.2	14.2	10.7
Craft, repair	8.9	30.9	4.4	14.5	7.8	10.4
Operatives	10.3	15.4	4.5	35.8	13.5	14.5
Non-farm labor	5.2	16.3	2.4	6.0	4.8	5.5
Farm workers	6.9	1.8	1.7	4.4	6.8	4.7
Service	15.9	7.3	24.6	9.4	27.4	16.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
(B) *Percentage of total employment of occupational group*						
Managerial	43.2	4.8	31.8	17.2	2.7	100.0
Professional	33.5	2.0	57.1	6.0	1.3	100.0
Technicians	51.0	5.4	24.4	17.8	1.2	100.0
Administrative support	41.9	4.0	36.5	15.4	2.2	100.0
Sales	76.3	5.7	2.0	12.1	3.9	100.0
Craft, repair	37.5	20.8	10.6	28.7	2.2	100.0
Operatives	31.4	7.5	7.8	51.1	2.7	100.0
Non-farm labor	42.4	21.0	11.2	22.9	2.6	100.0
Farm workers	64.7	2.7	9.1	19.4	4.2	100.0
Service	42.5	3.1	37.7	11.8	4.9	100.0
Total	44.1	7.0	25.2	20.7	2.9	100.0

[a]From equation (4), $\mathbf{D} = \mathbf{E}\hat{\mathbf{i}}(\mathbf{I} - \mathbf{A}_D)^{-1}\mathbf{Y}_D$.

for 51% of all operative jobs. Over one-quarter of the positions generated by tourist spending were service jobs.

Changes over time in the jobs generated by local absorption expenditure and exports also exhibit a sharp contrast, as shown in Table 6. Professional jobs generated by local absorption grew by 2.5% per year between 1967 and 1982, while professional jobs generated by exports increased by only 1.6% per year. Sales jobs generated by local absorption grew faster than those from exports (3.1% versus 2.2% per year), as did service jobs (3.7% versus 2.0% per year).

In contrast, technical jobs generated by exports rose faster than those generated by local absorption (5.4% versus 3.5% per year). Craft and skilled jobs that resulted from exports increased over time, rising 1.7% per year, but fell by 1.3%

Table 6. Employment by occupational group, as generated by local absorption and exports as a percentage of total employment generated by component, 1967 and 1982

	1967	1982	Annual growth rate of employment, 1967–82 (%)
(A) *Local absorption* (**C** + **I** + **G**)			
Managerial	9.2	9.1	1.15
Professional	11.8	14.3	2.53
Technicians	1.5	2.2	3.54
Administrative support	13.2	16.4	2.66
Sales	8.8	11.7	3.13
Craft, repair	13.8	9.4	−1.30
Operatives	11.9	8.9	−0.71
Non-farm labor	6.7	5.3	−0.29
Farm workers	10.6	4.7	−4.18
Service	12.4	18.0	3.69
Total	100.0	100.0	1.23
(B) *Exports, including tourism* (**E**)			
Managerial	5.6	7.3	1.59
Professional	2.8	3.6	1.57
Technicians	0.7	1.6	5.38
Administrative support	8.8	11.3	1.51
Sales	5.1	7.2	2.16
Craft, repair	10.3	13.7	1.69
Operatives	36.3	33.1	−0.79
Non-farm labor	4.6	5.9	1.44
Farm workers	17.3	4.7	−8.87
Service	8.3	11.6	2.02
Total	100.0	100.0	−0.16

per year as a result of local absorption. The same pattern is evident for non-farm laborers. Farm jobs derived from both local absorption and exports fell between 1967 and 1982, but the rate of decline was twice as great for export-driven jobs. Indeed, in 1967, 17% of the jobs created by exports were farm jobs but, by 1982, this proportion had fallen to 5%, reflecting the replacement of manufactured exports for exports of agricultural products (particularly sugar-cane products).

The technique used to decompose the change in total employment into final demand, technology and linkage effects can also be applied to changes in occupational employment. The results, shown in Table 7 for the period 1967-82, allow us to understand some of the reasons for the shift of employment out of blue-collar positions into white-collar posts. The change in total final demand has favored white-collar jobs. By itself, it would have more than doubled technical jobs, almost doubled managerial, professional, administrative support and service jobs, and increased sales jobs by 71 %. However, it would have raised the number of craft, operative, non-farm and farm labor jobs only in the range 35-61 %.

Changes in technology acted to reduce employment in all occupational groups. The largest effects were on managerial, operative, non-farm labor and, especially, farm laborer jobs, where technological change alone would have reduced employment by 63-108%. Interestingly, other large effects are not confined to blue-collar jobs. Large negative effects are found for professional, technical, and administrative support positions, as well as craft jobs. The effect is relatively small for sales and service jobs.

Table 7. Sources of total employment growth by occupational group, 1967–82: decomposition into a technical change effect, final demand effect and import leakage effects[a] (percentage of initial occupational employment)

	Actual change in employment ΔN	Change in total final demand $\Delta \mathbf{Y}_T$	Change in total coefficients ($\Delta \mathbf{A}_T$, $\Delta \mathbf{l}$, $\Delta \mathbf{E}$)	Change in import leakages ($\Delta \mathbf{B}$, $\Delta \mathbf{G}$)
Managerial	21	87	− 69	3
Professional	45	98	49	- 5
Technicians	78	124	− 47	1
Administrative support	44	92	− 48	1
Sales	56	71	20	5
Craft, repair	− 7	35	− 46	4
Operatives	− 11	59	- 76	6
Non-farm labor	1	61	- 63	4
Service	66	85	− 16	− 3
Farm workers	− 57	39	− 108	12
Total	14	78	− 68	4

[a]From equations (4) and (5), we have $\Delta \mathbf{D} = \hat{\mathbf{E}}\hat{\mathbf{l}}(\mathbf{I} - \mathbf{A}_D)^{-1} \Delta \mathbf{Y}_D + \Delta[\mathbf{E}\mathbf{l}(\mathbf{I} - \mathbf{A}_D)^{-1}]\mathbf{Y}_D$ where $\mathbf{A}_D = \mathbf{A}_T \star \mathbf{B}$, $\mathbf{F}_D = \mathbf{F}_T \star \mathbf{G}$ and an asterisk ($\star$) indicates term-by-term multiplication. The decomposition uses average period weights.

Import substitution for intermediate inputs and final output increased employment in all occupations except professionals and service workers. The effect was particularly strong for farm labor, where the substitution of locally produced agricultural products for imported products helped to raise employment by 12%. Other large effects are observed for operatives (6%), sales workers (5%), and craft workers and non-farm labor (4% for each group). In contrast, imports over the period substituted for local products that relied heavily on professional workers, reducing their employment by 5%; this also affected service workers, reducing their employment by 3%.

5. Concluding Remarks

Over the years 1967-87, employment grew by 1.4% per year-slightly greater than its historical average of 1.1% per year over the period 1947-93. Employment growth was led primarily by a rapid increase in final output which amounted to 5.1 % per year over the period 1967-87. Holding constant technology and import leakages, the overall output growth would have increased employment by 85% over the two decades. In addition, a modest reduction in import leakages (holding constant final demand and technology) would have increased jobs by another 4%. Labor productivity growth was also substantial over these years, amounting to 3.7% per year. Technological change (holding constant final demand and import leakages) would have reduced employment by 56%.

There are marked differences between the two decades 1967-77 and 1977-87. Employment growth was feeble during the earlier period, amounting to only 0.5% per year, despite a vigorous growth of output of 5.4% per year. However, overall

labor productivity grew rapidly, i.e. by 4.2% per year, and the technology effect almost exactly offset the employment growth induced by rising final demand. Import substitution occurred over the period 1967-77 and added 5% to job growth, accounting for the net gain in jobs over these years.

Between 1977 and 1987, employment increased by a substantial 2.3% per year, despite a modest slowing of output growth to 4.7% per year. The primary reason was a sharp slowing down of productivity growth, which averaged only 2.9% over these years. The import leakage effect was negligible over this period.

Between 1967 and 1982, there was also a notable shift in the occupational structure towards white-collar employment (managerial, professional, technical, clerical and sales) and away from blue-collar jobs (craft, operative, labor and service). White-collar jobs grew from 39% to 48% of total employment-or by 2.4% per year-over the period, and blue-collar jobs fell from 61 % to 52% of total employment, or by - 0.3% per year. The primary reason for the rapid growth in white-collar positions was the shift in the composition of final demand towards output produced by industries that relied heavily on white-collar workers, and away from those industries that were intensive in their use of blue-collar employees (88% increase for the predominantly white-collar industries compared with a 47% increase for the predominantly blue-collar industries). A secondary reason was a bias in technological change, which favored white-collar over blue-collar workers (a 46% reduction in white-collar employment compared with a 55% reduction in blue-collar employment). On the other hand, import leakage reductions slightly favored blue-collar over white-collar jobs (a 4% increase versus a 1% increase respectively)[8] .

Local absorption was more successful than export demand (including tourist spending) in generating new jobs. Over the period 1967-87, employment generated by local demand grew by 35% and that from exports by 29%, despite the fact that exports grew by a factor of 3.8, while local absorption increased by a factor of only 2.0. The difference is primarily because local absorption relied on goods and services produced by more labor-intensive sectors than did export-oriented industries. A secondary reason is that the composition of exports has continued to shift toward industries with relatively low employment multipliers, whereas the composition of local demand has remained relatively unchanged over time. By itself, the growth in the level of final demand would have increased employment by 96% for local absorption and 131% for exports. However, changes in the composition of final output reduced employment by 54% for exports and by only 8% for local consumption. The technology effect was slightly greater in absolute value for local absorption than for exports (- 57% versus - 52%), while the import leakage effects were similar for the two components.

Local absorption and exports played similar roles in accounting for the greater growth in white-collar jobs than in blue-collar jobs over time. Between 1967 and 1982, white-collar employment generated by local demand grew by 37%, while blue-collar jobs that emanated from local demand remained virtually unchanged. White-collar jobs that resulted from exports increased by 28% over the same period, while blue-collar jobs declined by 14%.

The fact that export demand failed to keep up with local absorption in generating employment growth over the period 1967-87 calls into question the wisdom of the particular industrialization course pursued in Puerto Rico. In earlier work (Weisskoff & Wolff, 1975, 1977), we called attention to the 'enclave-like' nature of Puerto Rico's export industries, which rely heavily on the US for inputs

and an output market, and which generate substantial import leakages. The earlier analysis was carried out for the Puerto Rican economy over the period 1948-63. We find here that the situation has not changed much since then. The export industries still operate basically as branch plants of their US owners, and have yet to be fully integrated into the local economy of Puerto Rico.

Much of the development of this type of economy can be attributed to a conscious development strategy embarked on by the Puerto Rican government. Through a variety of incentives, including tax relief (Section 936 of the federal tax code), the provision of infrastructure and other subsidies, the government has deliberately promoted manufacturing industries.9 Exports (including tourist spending) consist almost entirely of manufactured products (93% of total exports in 1987, up from 82% in 1967), and almost half of the manufactures produced in Puerto Rico (49% in 1987, which was down slightly from 51 % in 1967) are exported. Moreover, over half of the intermediate inputs used in manufactures are imported (54% in 1967 and 52% in 1987).

As a result, manufacturing industries in Puerto Rico have remained isolated from the rest of the local economy and have generated few jobs. They are characterized by high import leakages and low employment multipliers. This remains true despite a modest degree of import substitution of inputs in the production of export products between 1967 and 1987. Moreover, manufactured goods have undergone by far the most rapid growth in (total labor) productivity (5.7% per year over the period 1967-87). Although this is beneficial for overall growth in per-capita income and for the international competitiveness of Puerto Rican industries, it does not help very much in the creation of new jobs.

A change is called for in development strategy, to one which places greater emphasis on attracting more labor-intensive industries and industries that can rely on inputs produced in Puerto Rico. Which industries are the prime candidates? We see possibilities for the development of exportable services, such as finance, insurance and business services, as well as health services. As Ruiz and Castañer (1993) noted, the Caribbean basin, including Mexico, Central America, Colombia and Venezuela, now appears poised to undergo a rapid state of growth. Because of the high level of education of the Puerto Rican citizenry (see Baumol and Wolff (1996) for more details), it would make sense to promote the development of these high-end services for the Caribbean market. These services are all characterized by relatively high employment multipliers (see also Green (1996) for similar arguments).

Moreover, both tourism and agriculture have languished over the last several decades. Hotel services, agriculture and its associated manufactured food products all rely heavily on local inputs, and have high employment multipliers. Here, too, a reorientation of trade towards the surrounding Caribbean basin in the provision of these products might also reap rewards in terms of growth and employment.

Notes

1. See Baumol and Wolff (1996) for the sources and methods used for the data cited in this section.
2. Also, see Weisskoff (1985) for another, somewhat more critical treatment of Puerto Rico's post-World War II economic history.
3. A set of 51-order IO matrices for 1967, 1972, 1977, 1982 and 1987, as well as employment coefficient and sectoral price deflators, were obtained on either worksheets or computer tape from the Puerto Rico Planning Board (see Table 1 for sector names). Manpower matrices of31 industries by 10 major occupational groups are based on decennial Census data for Puerto Rico

for 1970 and 1980. The 1970 manpower matrix is aligned to the 1967 10 table, and the 1980 manpower matrix is aligned to the 1982 10 table.

4. Technically speaking, this is not exactly true, because a measure of total labor productivity would require some additional treatment of non-competitive imports. See Wolff (1985, 1994) for more details.

5. We concentrate our analysis on these three years, because both 1972 and 1982 were recession years.

6. As before, we use average period weights to provide an exact decomposition of ΔY_T. See also Oosterhaven et al. (1995) for a related application of this decomposition.

7. The occupational data are based on the 1970 and 1980 Census of Population, aligned to the IO tables of 1967 and 1982 respectively. Unfortunately, data from the 1990 Census are not yet available, to permit estimates that correspond to the 1987 10 table.

8. Using a similar type of IO-based decomposition analysis, Han (1995) reports similar results for the Japanese economy over the period 1975-85.

9. See Melendez and Blum (1996) and Ruiz and Melendez (1996) for further discussion of Section 936 of the federal tax code. Interestingly, estimates of the elasticity of investment by Section 936 corporations to a dollar change in federal tax credits is only of the order of 15-20 cents during the first year after the tax change, and about 25-30 cents over 5 years. As a result, it is safe to conclude that other factors, such as an educated workforce, played crucial roles in the industrialization of the Puerto Rican economy.

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