

BIBLIOGRAPHIC INPUT SHEET

| | |
|---------------------------|-----------------------------------|
| 1. SUBJECT CLASSIFICATION | A. PRIMARY Economics |
| | B. SECONDARY General Economics |

2. TITLE AND SUBTITLE
 Income redistribution and its effect on factor and import demand in Taiwan: a simulation approach

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| | | |
|--------------------------|----------------------------|----------------------|
| 4. DOCUMENT DATE 1975 | 5. NUMBER OF PAGES 34p. | 6. ARC NUMBER ARC |
|--------------------------|----------------------------|----------------------|

7. REFERENCE ORGANIZATION NAME AND ADDRESS
 Program of Development Studies, 121 Sewall Hall, William Marsh Rice University, Houston, Texas 77001

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)
 (In Program of Development Studies paper no.68)

9. ABSTRACT

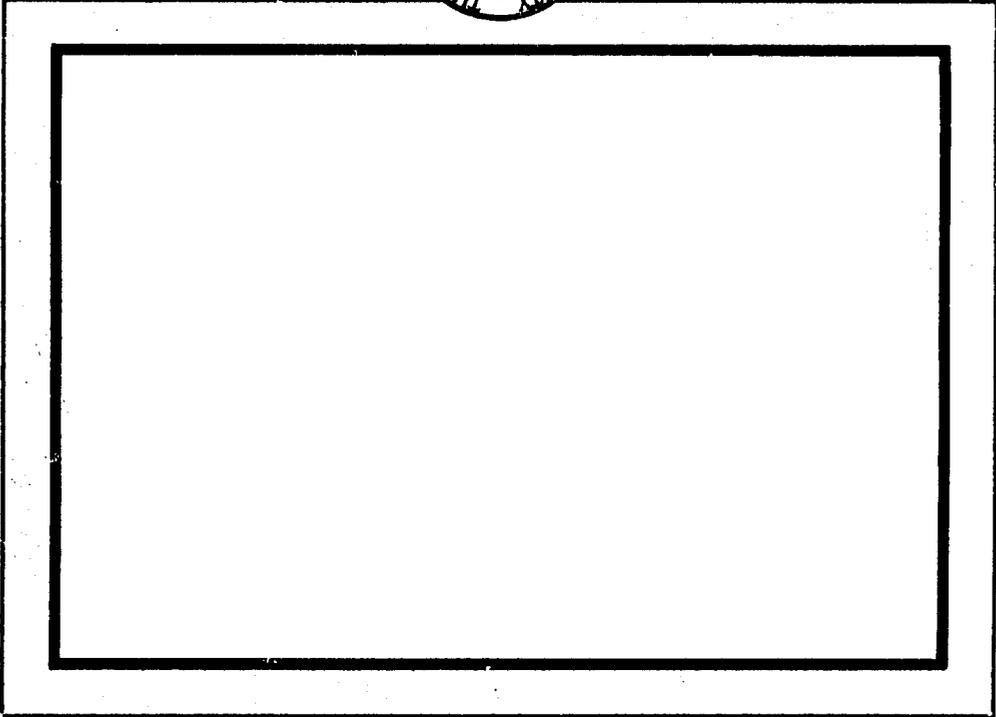
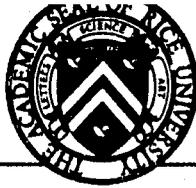
The methods and results of a simulation study of income redistribution and its effects on factor and import demand in Taiwan. The purpose of the paper is to (1) examine the empirical content of the factor-differentials hypothesis, and (2) evaluate the impact of income redistribution on factor demand and on imports. The analysis of consumption patterns of different income groups is based on data drawn from the Report on the Survey of Family Income and Expenditure in Taiwan: 1966. One major finding was that the capital content of the consumption mix by households in the lower half of the income scale is higher than that by households in the upper half. The pattern of the consumption mix in terms of capital/labor ratio is reversed if major service items and other miscellaneous items are excluded. Another major finding was that growth in employment and an equitable distribution of income are consistent goals. Thus the findings do not support the hypothesis that the consumption pattern of the rich has a higher capital content than that of the poor. The simulation results indicate the feasibility of integrating the redistribution element into the overall development planning by emphasizing the growth of labor-intensive industries, the small-scale sector, and other similar programs to benefit the poor. Growth and equity are not only consistent but also attainable without resorting to politically unpopular and unfeasible means.

| | |
|----------------------------------|-----------------------|
| 10. CONTROL NUMBER PN-AAB-620 | 11. PRICE OF DOCUMENT |
|----------------------------------|-----------------------|

| | |
|-----------------|--------------------------------------|
| 12. DESCRIPTORS | 13. PROJECT NUMBER |
| | 14. CONTRACT NUMBER GSD-3302 Res. |
| | 15. TYPE OF DOCUMENT |

RICE UNIVERSITY

Houston, Texas



Program of Development Studies

PROGRAM OF DEVELOPMENT STUDIES
121 Sewall Hall
WILLIAM MARSH RICE UNIVERSITY
Houston, Texas 77001

Paper No. 68

Income Redistribution and Its Effects on
Factor and Import Demand in Taiwan:
A Simulation Approach

by

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Fall, 1975

The author is Chairman of the Department of Economics at the University of Saint Thomas, Houston. This paper reports research conducted under AID contract AID/csd-3302 and AID/otr-C-1394 on "Distribution of Gains, Wealth and Income from Development."

Program Discussion Papers are preliminary materials circulated to stimulate discussion and critical comment. References in publications to Discussion Papers should be cleared with the authors to protect the tentative character of these papers.

Income Redistribution and Its Effects on
Factor and Import Demand in Taiwan;
A Simulation Approach

Abstract

In examining a possible trade-off between growth and equity, the paper reports on the results of (1) an empirical test of the hypothesis that a differential exists in the factor requirements of consumption patterns between the rich and the poor, and (2) the impact of income redistribution, through simulations, on factor and import demand. Findings of the study, using the 1966 household budget survey data of Taiwan, suggest that growth and equity are not only consistent but also attainable without resorting to politically unpopular and unfeasible means.

Income Redistribution and Its Effects on
Factor and Import Demand in Taiwan:
A Simulation Approach

1. Introduction

Growth and equity have long been regarded as two incompatible goals. However, the growing concern in recent years over the issue of an equitable distribution of income and gains from development has led a number of economists to critically re-examine the possible effects of income redistribution on the growth in employment and output. In view of the ever-widening gap of income disparity that characterizes most contemporary developing economies in the third world and the social frustrations and tensions created therefrom, the issue has a certain urgency.

Recent theoretical as well as empirical attempts challenging the long-standing growth-equity tradeoff assertion largely center around the examination of the effects of income redistribution on factor demand and on other growth agents.¹ In a closed economy a given distribution of income implies a given pattern of consumer demand, and this

¹See, for example, (1) Samuel Morley and Gordon W. Smith, "The Effect of Changes in the Distribution of Income on Labor, Foreign Investment and Growth in Brazil," Program of Development Studies, Discussion Paper No. 15, Rice University, 1971; (2) Felix Paukert, Jiri Skolka and Jef Maton, "Redistribution of Income Patterns of Consumption and Employment," working papers, International Labor Office, Geneva; (3) William R. Cline, Potential Effects of Income Redistribution on Economic Growth: Latin American Cases (New York: Praeger Publishers, 1972); and (4) Samuel A. Morley and Jeffrey G. Williamson, "Demand, Distribution, and Employment: The Case of Brazil," Economic Development and Cultural Change, Vol. 23, No. 1 (October, 1974), pp. 33-60.

pattern, in turn, shapes the demand for factors. Understandably, in studies attempting to analyze the growth impact of income redistribution on employment and output, attention is focused on the link between the characteristics of consumption patterns and factor requirements. Notable theoretical work in this regard is the factor-intensity hypothesis proposed by Dudley Seers and Land-Soligo.¹ They suggest that in a two-sector, two-commodity world the commodity bundle consumed by the rich is more capital-intensive than that consumed by the poor. Logically it follows that redistribution of income from the rich to the poor will in the short run increase employment given the constraint of capital. Hence, they argue that growth and equity are not necessarily competitive economic objectives.

The policy relevancy of the Land-Soligo model of income redistribution clearly hinges on the empirical verification of the hypothesis that the rich's consumption is indeed more capital-intensive than the poor's. Empirical findings known to date are inconclusive in supporting the factor-intensity hypothesis. Whereas work done by Soligo and others in Pakistan, Turkey, and Colombia confirms that consumption by the rich is more capital-intensive than that consumed by the poor, other researchers find, through simulations, that redistribution of income in favor of the poor generates little changes in the factor requirements, implying that the factor-intensity of consumption differs little between the rich and

¹Dudley Seers, Towards Full Employment: A Programme for Colombia (Geneva: International Labour Office, 1970); James W. Land and Ronald Soligo, "Income Distribution and Employment in Labor Redundant Economies," Philippine Economic Journal, Vol. XIII, No. 1 (1974), pp. 57-82.

the poor.¹

The purpose of the present paper is twofold: (1) to examine the empirical content of the factor-differentials hypothesis, and (2) to evaluate the impact of income redistribution, toward greater equality, on factor demand and on imports, in the context of the development experience in Taiwan. To an important extent, it is reasonable to argue that the differences in the empirical findings regarding the factor-intensity hypothesis are attributable to at least three broad elements: (1) the degree of aggregation of consumption and production data, (2) the possible variations in production techniques and factor proportions of a given consumer product because of the differences in factor prices and in the stage of development attained, and (3) conceptual and statistical difficulties in dealing with consumer durables and residential housing. It is believed that an empirical test of the factor intensity hypothesis and evaluation of income redistribution impact on factor and import demand on the basis of the Taiwanese data will shed some light on these issues described. Data that are required of such empirical attempts are quite satisfactory in Taiwan in terms of the degree of disaggregation and their reliability, especially compared with other developing countries.

In a recent study Dennis L. Chinn analyzes the effects of income

¹See Ronald Soligo, "Factor Intensity of Consumption Patterns, Income Distribution and Employment Growth in Pakistan," Program of Development Studies, Discussion Paper No. 46, Rice University, 1973; John G. Ballentine and Ronald Soligo, "Consumption, Earnings Patterns and Income Distribution," Program of Development Studies, Discussion Paper 67, Rice University, 1975 (mimeographed); Tuncay M. Sunman, "Short-run Effects of Income Distribution on some Macro-Economic Variables: The Case of Turkey," Program of Development Studies, Discussion Paper No. 46, Rice University, 1973; and F. Paukert, J. Skolka, and J. Maton, *op. cit.*

redistribution on foreign trade, savings, capital and labor requirements, and on other growth constraints in Korea and Taiwan.¹ While his study is broad in scope, the results of his analysis are unsatisfactory in that the whole agricultural and food-producing sector is virtually eliminated from his simulation experiments in income redistribution and factor demand analysis. What is covered in Chinn's simulations of factor demand and income redistribution is limited only to the food and farm products processing activities in the manufacturing sector. In an economy where more than 50 per cent of consumers' disposable income is spent on food and other agricultural products, the omission renders his simulation results highly questionable.

2. Description of the data

To test the factor-differential hypothesis and to empirically assess, through simulation, the redistribution impact on factor demand and on imports, three sets of statistical information are required:

- (1) surveys of consumer spending patterns by income and by occupation,
- (2) production data on agricultural and non-agricultural activities to identify the factor required in the production of consumer goods, and
- (3) input-output tables for the purpose of measuring interindustry dependency.

¹Dennis L. Chinn, "Potential Effects of Income Redistribution on Economic Growth Constraints: Evidence from Taiwan and South Korea," (unpublished Ph.D. dissertation, University of California, Berkeley, 1973).

We choose the year of 1966 as the basis of our empirical endeavor. This particular year is ideal in terms of data consistency. In 1966, an economy-wide survey of family income and expenditure and the third industrial and commerce census were conducted in Taiwan. In addition, a set of input-output tables for 1966 was also compiled and published by the government in Taiwan. Thus, possible discrepancies in data that pertain to different points in time with respect to consumption and production are avoided.

Our analysis of the characteristics of consumption patterns of different income groups is based on data drawn from the Report on the Survey of Family Income and Expenditure in Taiwan: 1966, published by the Bureau of Accounting and Statistics, Taiwan Provincial Government.¹ This 1966 report is the second of the biannual economy-wide surveys undertaken by the provincial government in Taiwan. In the 1966 survey, a sample of 3,000 households were surveyed and interviewed; the households were selected through a well-designed stratified sampling method. For the purpose of obtaining more detailed information that could not otherwise be collected through interviews and for the purpose of checking the reliability of data gathered from interviews, 400 households were chosen from the 3,000 sample households as the bookkeeping families to record daily information regarding income and expenditures during the entire survey year of 1966. Data collected from the bookkeeping households supplement the main survey data from the interviews of the sampled

¹Bureau of Accounting and Statistics, Taiwan Provincial Government, Report on the Survey of Family Income and Expenditure in Taiwan: 1966 (Taiwan: Taiwan Provincial Government, 1968).

households, conducted between January 5 and February 5, 1967.

This comprehensive report provides a detailed account of the consumption patterns by income and by occupation, and a detailed description of the characteristics of income distribution, by size, by administrative districts, by the size of the household, the age and occupation of the household head, and by the number of persons employed. The survey identifies 50 expenditure categories (see Table 1). Households are divided into 31 income classes with the lowest income class receiving an annual income under NT\$6,000 and the highest income class with an annual income over NT\$200,000. Despite its other virtues, the survey does not distinguish consumer demand of goods domestically produced from imports.

Statistical information on production other than agricultural products to measure the factor requirements of consumption goods is drawn from the General Report on the Third (1966) Industrial and Commerce Census of Taiwan, Republic of China, published in 1968.¹ The seven-volume report covers six sectoral surveys of mining, manufacturing, construction, electricity, gas, and water supply, commerce and other business. For the manufacturing sector the survey contains 112 industry classifications. The degree of disaggregation here is judged as being equivalent to the 3-digit industry groups defined in the U.S. Census of Manufacturing.

¹The Commission of Industrial and Commerce Census of Taiwan, General Report on the Third Industrial and Commercial Census of Taiwan, The Republic of China. (Taiwan: The Commission of I.C.C.T., June 1968).

TABLE 1: Consumption Items Identified in the Household Survey in Taiwan, 1966

- | | |
|---|---|
| 1. Rice | 6. Supplementary food |
| 2. Flour | 7. Condiments |
| 3. Sweet potatoes | 8. Food in restaurants |
| 4. Other cereals | 9. Food for family celebrations |
| 5. Milk | 10. Marriages, births, and funerals (food) |
| 11. Non-alcoholic | 16. Children's apparel |
| 12. Alcoholic | 17. Jewelry and ornaments |
| 13. Tobacco | 18. Actual rent |
| 14. Men's apparel | 19. Imputed rent |
| 15. Women's apparel | 20. Household repair and installation |
| 21. Water charges | 26. Gas |
| 22. Lighting | 27. Firewood |
| 23. Charcoal | 28. Refuse of agriculture |
| 24. Coal | 29. Other fuels |
| 25. Kerosene | 30. Furniture and furnishings |
| 31. Textile furnishings | 36. Personal care |
| 32. Appliances for kitchen and bath | 37. Barber and bath shop service |
| 33. Other household equipment | 38. Medical and health expenses |
| 34. Domestic servants | 39. Purchases of personal transport equipment |
| 35. Other household operation expenses | 40. Operation of personal transport equipment |
| 41. Purchased transportation | 46. Financial service |
| 42. Other transport and communications | 47. Education and research |
| 43. Recreation | 48. Marriage, birth, funeral expenses |
| 44. Books, newspapers, magazines and stationary | 49. Other miscellaneous items |
| 45. Other recreation and amusement items | 50. Interest |

Estimates of production factors required of agricultural and food products are made on the basis of statistics shown in the series of Cost Surveys of Farm Products in Taiwan, and Report of Farm Record-Keeping Families in Taiwan, both published by the Department of Agriculture and Forestry, Provincial Government of Taiwan.¹

The input-output tables for 1966 are those compiled by the Council for International Economic Cooperation and Development, Executive Yuan, Republic of China.² The 1966 series of input-output tables contains 15 sets of tables identifying interindustry transactions, input coefficients and interindustry interdependence, as well as interindustry domestic transactions, domestic input coefficients and domestic interindustry interdependence. The principal tables in the 1966 series register 76 industry entries and 5 final demand categories, and imports.

3. The methodology

Estimates of factor-intensity and import content

For the purpose of the present paper, as described in the previous section, our empirical analysis involves (1) the testing of the hypothesis that the consumption pattern of the higher income households is more capital-intensive than that of the lower income households, and (2)

¹Department of Agriculture and Forestry, Provincial Government of Taiwan. Cost Surveys of Farm Products in Taiwan. Taiwan: Provincial Government of Taiwan, various issues; Department of Agriculture and Forestry, Provincial Government of Taiwan, Report of Farm Record-Keeping Families in Taiwan, Taiwan: Provincial Government of Taiwan, various issues.

²Council for International Economic Cooperation and Development, Executive Yuan. Input-Output Tables, Taiwan, Republic of China, 1966. Taiwan: Council for International Economic Cooperation and Development.

simulation experiments to evaluate the impact on domestic factor and foreign import demand of income redistribution. For the present purpose described, we define the capital intensity as the ratio of total fixed assets in operation at the end of the 1966 census year to gross output during the census year; total fixed assets in operation, as defined in the 1966 census report, includes factory land, buildings, machinery and equipment, inventory, and cash assets. In the same vein, we define the labor-intensity as the ratio of the number of employees per NT\$1,000 output during the census year. Factor-intensity is defined as capital (per NT\$1,000) per employee.

As for factor intensities of food and other farm products, estimates are made on the assumption that competitive conditions in farm markets are met and the marginal principle operates. We assume, for lack of data on the allocation of labor time and agricultural capital among various products, that (1) labor time allocated among farm products is proportional to costs of labor, actual and imputed, of various farm products, and (2) depreciation of farm buildings, tools and equipment, assignable to various products, is indicative of the allocation of total farm capital among various products.

In the present study, the attempt to estimate factor proportions in agriculture is confined to the following nine farm product groups because of data limitations: rice, other common crops, sugar, other cash crops, horticultural products (including vegetables and fruits), hogs, other livestock products, forestry products and fishing products.

As reported in the previous section, the household income and expenditure surveys in Taiwan do not differentiate consumer spending on domestic goods from spending on goods imported. We estimate the impact on import demand of income redistribution through the comparison of input-output tables compiled on the basis of interindustry transactions (domestic and imports) and those tables defining only domestic transactions. Thus, the propensity to consume imported goods is assumed to be the same for all households regardless of income. Changes in import requirements are measured by the differences in import content of products explicitly listed in the input-output tables.

Table 2 shows the results of our estimates of factor intensity of the 76 products that were identified in the 1966 input-output tables of Taiwan.

Computation and simulation procedures

If we designate $C_{i,j}$ as the consumption of the j th product by households in the i th income class, k_j and l_j the capital and labor intensity of the j th product, respectively, total capital and labor required designated as K_i and L_i for the production of the commodity bundle consumed by the i th income class, by definition it can be measured as:

$$K_i = \sum_{j=1}^n C_{i,j} \cdot k_j \quad (1.1)$$

$$\text{and } L_i = \sum_{j=1}^n C_{i,j} \cdot l_j \quad \begin{array}{l} i = 1 \dots 31 \\ j = 1 \dots 76 \end{array} \quad (1.2)$$

TABLE 2: Capital/Output, Labor/Output Ratios and Import Content of 76 Major Products in Taiwan, 1966

| Input- Output Table Entry | Commodity | Capital/ Output† | Labor/ Output† | Import Content |
|------------------------------------|--|---------------------|-------------------|-------------------|
| 01 | Rice | 0.8919 | 0.0373 | 0.1068 |
| 02 | Other common crops | 0.0974 | 0.0396 | 0.0642 |
| 03 | Sugar cane | 0.6604 | 0.0425 | 0.0685 |
| 04 | Crops for processing | 1.8739 | 0.0568 | 0.0630 |
| 05 | Misc. horticultural crops | 0.9687 | 0.0300 | 0.0982 |
| 06 | Hogs | 0.4546 | 0.0148 | 0.2002 |
| 07 | Other livestock | 0.4546 | 0.0148 | -0.1183 |
| 08 | Forestry | 3.5722 | 0.0089 | 0.0495 |
| 09 | Fisheries | 0.5809 | 0.0386 | 0.2253 |
| 10 | Coal and products | 0.9158 | 0.0305 | 0.1410 |
| 11 | Metallic minerals | 1.3020 | 0.0112 | -0.1529 |
| 12 | Crude petroleum | 2.6040 | 0.0075 | 0.1899 |
| 13 | Natural gas | 2.6040 | 0.0075 | 0.1651 |
| 14 | Salt | 1.0546 | 0.0447 | 0.0262 |
| 15 | Non-metallic minerals | 1.0988 | 0.0408 | 0.0907 |
| 16 | Sugar | 2.3477 | 0.0090 | 0.1252 |
| 17 | Canned food | 0.9190 | 0.0110 | 0.3313 |
| 18 | Tobacco | 0.1916 | 0.0028 | 0.1455 |
| 19 | Alcoholic beverages | 0.2225 | 0.0033 | -0.0325 |
| 20 | Monsodium glutamate | 1.6809 | 0.0084 | 0.2109 |
| 21 | Wheat flour | 0.5579 | 0.0021 | 1.1502 |
| 22 | Edible vegetable oil | 0.5749 | 0.0026 | 0.9482 |
| 23 | Non-alcoholic beverages | 0.5636 | 0.0084 | 0.1685 |
| 24 | Tea | 0.6386 | 0.0091 | 0.0778 |
| 25 | Miscellaneous food | 0.2289 | 0.0031 | 0.1592 |
| 26 | Artificial fibre | 3.0790 | 0.0039 | 0.7292 |
| 27 | Artificial fabrics | 1.4002 | 0.0087 | 1.4100 |
| 28 | Cotton fabrics | 1.8584 | 0.0101 | 0.8814 |
| 29 | Woolen and worsted fabrics | 1.8276 | 0.0067 | 1.1074 |
| 30 | Misc. fabrics and apparel, accessories | 0.8526 | 0.0087 | 0.6017 |

TABLE 2--continued

| Input- Output Table Entry | Commodity | Capital/ Output† | Labor/ Output† | Import Content |
|------------------------------------|---------------------------------------|---------------------|-------------------|-------------------|
| 31 | Lumber | 1.2449 | 0.0062 | 0.1710 |
| 32 | Plywood | 0.7693 | 0.0065 | 0.6744 |
| 33 | Products of wood, bamboo, rattan | 0.6156 | 0.0233 | 0.1977 |
| 34 | Pulp, paper and paper products | 0.9662 | 0.0069 | 0.4333 |
| 35 | Printing and publishing | 0.7105 | 0.0040 | 0.2690 |
| 36 | Leather and products | 1.0350 | 0.0096 | 0.5487 |
| 37 | Rubber and products | 0.8222 | 0.0092 | 1.0494 |
| 38 | Chemical fertilizers | 1.9768 | 0.0032 | 0.2913 |
| 39 | Medicines | 1.0919 | 0.0106 | 0.6201 |
| 40 | Plastic and products | 1.1317 | 0.0070 | 0.9259 |
| 41 | Petroleum products | 1.2935 | 0.0024 | 0.5978 |
| 42 | Non-edible vegetable and animal oils | 0.5749 | 0.0026 | 0.0840 |
| 43 | Misc. industrial chemicals | 1.2342 | 0.0059 | 0.3115 |
| 44 | Misc. chemical manufactures | 0.9519 | 0.0056 | 0.9374 |
| 45 | Cement | 1.4940 | 0.0028 | 0.2789 |
| 46 | Cement products | 0.7192 | 0.0189 | 0.3876 |
| 47 | Glass and products | 1.9424 | 0.0105 | 0.1862 |
| 48 | Misc. non-metallic mineral products | 1.0721 | 0.0392 | 0.1901 |
| 49 | Steel and iron | 1.0976 | 0.0050 | 1.7098 |
| 50 | Steel and iron products | 0.5768 | 0.0095 | 1.5543 |
| 51 | Aluminum | 0.4700 | 0.0061 | 0.2997 |
| 52 | Aluminum products | 0.7545 | 0.0063 | 0.3281 |
| 53 | Misc. metallic products | 0.6559 | 0.0157 | 1.0952 |
| 54 | Machinery | 0.7289 | 0.0142 | 1.2382 |
| 55 | Household electrical appliances | 0.8820 | 0.0103 | 0.7379 |
| 56 | Communication equipment | 1.2107 | 0.0073 | 0.9760 |
| 57 | Other electrical apparatus and equip. | 0.9097 | 0.0096 | 0.8091 |
| 58 | Ship building | 1.3729 | 0.0180 | 0.6913 |
| 59 | Motor vehicles | 0.7802 | 0.0063 | 1.1068 |
| 60 | Other transport equipment | 0.3500 | 0.0101 | 0.9257 |
| 61 | Misc. manufactures | 0.9026 | 0.0203 | 0.5791 |
| 62 | Residential building | 0.5952 | 0.0409 | 0.3435 |
| 63 | Public construction works | 0.5952 | 0.0409 | 0.2315 |
| 64 | Other construction | 0.5952 | 0.0409 | 0.4817 |
| 65 | Electricity | 5.0950 | 0.0042 | 0.1515 |

TABLE 2--continued

| Input Output Table Entry | Commodity | Capital/ Output† | Labor/ Output† | Import Content |
|-----------------------------------|----------------------------|---------------------|-------------------|-------------------|
| 66 | Gas | 4.2261 | 0.0094 | 0.4713 |
| 67 | City water | 4.0781 | 0.0118 | 0.0750 |
| 68 | Water transportation | 2.1723 | 0.0035 | 0.0379 |
| 69 | Land transportation | 2.6928 | 0.0050 | 0.3678 |
| 70 | Air transportation | 1.2219 | 0.0058 | 0.2480 |
| 71 | Warehousing | 1.3027 | 0.0225 | 0.0488 |
| 72 | Communications | 1.9940 | 0.0156 | 0.0772 |
| 73 | Wholesale and retail trade | 0.3057 | 0.0137 | 0.0379 |
| 74 | Finance and insurance | 0.0388 | 0.0043 | 0.0747 |
| 75 | Miscellaneous services | 0.7110 | 0.0317 | 0.0396 |
| 76 | Undistributed | 0.3082 | 0.0243 | 0.4393 |

† Direct capital and labor inputs only.

- Sources:
- (1) Data used to estimate capital/output and labor/output ratios are drawn from Cost Surveys of Farm Products in Taiwan (Taiwan, Department of Agriculture and Forestry, Provincial Government of Taiwan, 1973); and from Report of Farm Record-Keeping Families in Taiwan (Taiwan, Department of Agriculture and Forestry), various issues.
 - (2) Data from non-agricultural activities are taken from General Report on the Third (1966) Industrial and Commerce Census of Taiwan, Republic of China (Taiwan, Commission of Industrial and Commerce Census of Taiwan, 1968).
 - (3) Import content of commodities is estimated from Input-Output Tables, Taiwan, Republic of China (Taiwan, Council for International Economic Cooperation and Development, Executive Yuan).

For the purpose of illustrating the matrix notations used in our simulations, we rewrite equation (1.1) in the convenient matrix form:

$$[C_{i,j}] \cdot \{k_j\} = \{K_i\} \quad (i = 1 \dots 31; \quad j = 1 \dots 76) \quad (1.3)$$

$$\text{or} \quad \begin{array}{c} \left| \begin{array}{cccc} C_{1,1} & C_{1,2} & \dots & C_{1,76} \\ C_{2,1} & C_{2,2} & \dots & C_{2,76} \\ \vdots & \vdots & & \vdots \\ C_{31,1} & C_{31,2} & \dots & C_{31,76} \end{array} \right| \cdot \begin{array}{c} \left| \begin{array}{c} k_1 \\ k_2 \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ k_{76} \end{array} \right| = \begin{array}{c} \left| \begin{array}{c} \Sigma C_{1j} \cdot k_j = K_1 \\ \Sigma C_{2j} \cdot k_j = K_2 \\ \vdots \\ \vdots \\ \vdots \\ \vdots \\ \Sigma C_{31j} \cdot k_j = K_{31} \end{array} \right| \end{array} \quad (1.3a)$$

Thus, in our notations, [] represents a matrix and { } represents a vector.

In computing the factor intensity of consumption by each income class, all consumption items reported in the household budget survey are matched and identified with the corresponding producing industries. To make computation feasible through matrix multiplication we expand the consumption matrix to have a 31 x 76 dimension, with the $C_{i,j}$ elements equal to zero for those producing industries that no consumer demand is identified.

In our simulation model the effects of income redistribution on factor and import demand are assumed to be confined to the changes in consumer spending responding to income changes. The relationship between changes in income and changes in consumption is defined by the following

form:

$$\Delta C'_{i,j} = \rho_{i,j} \cdot \Delta y'_i \quad (2.1)$$

$$\text{where } \rho_{i,j} = \frac{C'_{i+1,j} - C'_{i,j}}{\Delta y'_i} \cdot \frac{C'_i}{C'_{1,j}}$$

In the formulation, $\Delta y'_i$ stands for the change in income per household for households in the i th income class, $C'_{i,j}$, the consumption of the j th commodity per household for households in the i th income class, and C'_i , total consumption spending per household for the i th income class. $\rho_{i,j}$ may be described as the expenditure elasticity of the j th commodity for households in the i th income class; the expenditure elasticity in fact is nothing more than the conventional income elasticity weighted by the average propensity to consume, C_i/y_i , of the i th income class households. The weights are introduced here to simplify the additive problem. We should also note that our estimates of the responses in consumption to income changes are made on the basis of expenditure elasticity income class by income class, instead of using a single elasticity estimate for all income classes.

The overall changes in the consumption of all items by all income classes are derived, in the matrix notation, from the following:

$$[\rho_{i,j}]' \cdot \{\Delta Y'_i\} = \{\Delta C_j\} \quad (2.2)$$

where $[\rho_{i,j}]'$ is the transposed matrix $[\rho_{i,j}]$ of 31 x 76 dimension,¹

¹Expenditure elasticities for the 31st income class are assumed to be the same as the 30th income class.

$\Delta Y_i'$, a column vector of order 31, representing the changes in income for all households in the i th income class, and ΔC_j , a column vector of order 76, defining the changes in the consumption of the j th product.

Finally, total changes in production through interindustry interdependency as a result of changes in final demand is defined as:

$$[a_{i,j}] \cdot \{\Delta C_j\} = \{\Delta X_j\} \quad (2.3)$$

In equation (2.3), $[a_{i,j}]$ is the interindustry interdependence coefficients matrix of order 76 x 76, and $\{\Delta X_j\}$, the changes in the production of the j th industry, represented by a column vector of order 76.

Total increments in capital and labor input required of the changed demand structure can now be easily obtained from the following form:

$$\{k_j\} \cdot \{\Delta X_j\} = K \quad (2.4)$$

$$\{l_j\} \cdot \{\Delta X_j\} = L \quad (2.5)$$

Changes in import requirements, M , are measured by

$$M = \{m_q\} \cdot \{\Delta X_j\} \quad (2.6)$$

In the equation $\{m_q\}$ is a row vector of order 76, and $\{m_q\}$ is defined as:

$$m_j = \left\{ \sum_{i=1}^{76} a_{i,j} \right\} - \left\{ \sum_{i=1}^{76} a'_{i,j} \right\}$$

$\left\{ \sum_{i=1}^{76} a_{i,j} \right\}$ and $\left\{ \sum_{i=1}^{76} a'_{i,j} \right\}$, are row vectors of order 76. As explained

earlier, the elements in $\sum a_{i,j}$ and $\sum a'_{i,j}$, are interindustry interdependence coefficients and interindustry domestic interdependence coefficients.

To simulate the redistribution impact on factor and import demand, our experiments include a number of redistribution alternatives. The alternatives are designed to describe four types of redistribution plans: biased growth, income transfer, equal growth and the combination of income transfer and growth. Under each type of income redistribution scheme, various scopes of redistribution are assumed. The degree of equality of income distribution in Taiwan, measured in terms of the conventional Gini coefficient, is 0.3300 in 1966. Improvement in income equality that our income redistribution alternatives imply varies from Gini 0.3135 for Alternative 1 to Gini 0.2098 for Alternatives 8 and 16. For Alternatives 1 through 4, the biased growth scheme, as shown in Table 3, growth in national income is assumed to concentrate only in the lower income classes. For Alternative 5 through 8, income is redistributed from the upper income households to the lower income households; the size of income transferred equals to the size of income taxed. Distribution Alternatives 9 through 12 stipulate an equal growth pattern for all income classes. For the purpose of comparison, the growth rates of national income assumed here are the same as implied in the biased growth plan for each corresponding distribution alternative; that is, the growth rate defined by Alternative 9 corresponds to that implied by Alternative 1. Finally, Alternatives 13-16 are combinations of the income transfer and equal growth plans. Specifically, Alternative 13 is equivalent to the combination of Alternatives 5 and 9, and etc.

4. The Findings

On factor intensity of consumption

TABLE 3: Distribution Alternatives Assumed for Simulation†

| Income Class | Biased growth | | | | Income Transfer | | | |
|--------------|---------------|--------|--------|--------|-----------------|---------|---------|---------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | +20 | +30 | +40 | +50 | +20 | +30 | +40 | +50 |
| 2 | +20 | +30 | +40 | +50 | +20 | +30 | +40 | +50 |
| 3 | +20 | +25 | +40 | +45 | +20 | +25 | +40 | +45 |
| 4 | +20 | +25 | +40 | +45 | +20 | +25 | +40 | +45 |
| 5 | +10 | +20 | +30 | +40 | +10 | +20 | +30 | +40 |
| 6 | +10 | +20 | +30 | +40 | +10 | +20 | +30 | +40 |
| 7 | +10 | +15 | +30 | +30 | +10 | +15 | +30 | +30 |
| 8 | + 5 | +15 | +20 | +30 | + 5 | +15 | +20 | +30 |
| 9 | + 5 | +10 | +20 | +25 | + 5 | +10 | +20 | +25 |
| 10 | + 5 | +10 | +10 | +25 | + 5 | +10 | +10 | +25 |
| 11 | | + 5 | | +20 | | + 5 | | +20 |
| 12 | | + 5 | | +15 | | + 5 | | +15 |
| 13 | | + 4 | | +10 | | + 4 | | +10 |
| 14 | | + 3 | | + 5 | | + 3 | | + 5 |
| 15 | | + 2 | | | | + 2 | | |
| 16 | | + 1 | | | | + 1 | | |
| 17 | | | | | | | | |
| 18 | | | | | | -0.05b* | | -0.01d* |
| 19 | | | | | | -0.07b | | -0.04d |
| 20 | | | | | | -0.09b | | -0.07d |
| 21 | | | | | | -0.11b | | -0.10d |
| 22 | | | | | -0.05a* | -0.13b | -0.08c* | -0.13d |
| 23 | | | | | -0.07a | -0.15b | -0.11c | -0.16d |
| 24 | | | | | -0.09a | -0.17b | -0.14c | -0.19d |
| 25 | | | | | -0.11a | -0.19b | -0.17c | -0.22d |
| 26 | | | | | -0.13a | -0.21b | -0.20c | -0.25d |
| 27 | | | | | -0.15a | -0.23b | -0.23c | -0.28d |
| 28 | | | | | -0.17a | -0.25b | -0.26c | -0.31d |
| 29 | | | | | -0.19a | -0.27b | -0.29c | -0.34d |
| 30 | | | | | -0.21a | -0.29b | -0.32c | -0.37d |
| 31 | | | | | -0.23a | -0.31b | -0.35c | -0.40d |
| Growth Rate | 1.8% | 4.2% | 5.1% | 9.2% | 0 | 0 | 0 | 0 |
| Gini | 0.3135 | 0.2990 | 0.2850 | 0.2671 | 0.3025 | 0.2754 | 0.2519 | 0.2098 |

† Numbers shown in the table are percentage changes in income. For alternatives 9 through 12, income of each income class is assumed to grow at the rate of 1.8, 4.2, 5.2 and 9.2 per cent per year, respectively. For alternatives 13 through 16, the same growth rates in income, 1.8, 4.2, 5.2 and 9.2, respectively, is assumed for all income classes on the basis of the redistributed income stipulated in alternatives 5 through 8.

* a = 0.467, b = 0.535, c = 0.876, d = 1.082. These coefficients are introduced to bring the income transferred equal to that taxed.

Table 4 shows the results of our empirical analysis of the consumption pattern in terms of factor intensity by income class and by sector.

Two conclusions may be drawn from our empirical findings. First, our results clearly suggest that consumption by the low income households is more capital-intensive than consumption by the high income households. If we take the overall capital/labor ratio of 35.0 for all households as the point of reference, and the 16th income class as the mid-point of the income scale, we observe that 10 of 15 of the lower half income classes have capital/labor ratios higher than the average. In contrast, 8 of 15 of the upper income classes have lower capital/labor ratios than the overall average. Secondly, our results confirm that for households in the same income class consumption by the urban households tends to be more capital-intensive than consumption by the rural households. The factor differential in consumption between the urban and rural households appears to be more distinct for households in the lower half than for households in the upper half of the income scale.

Thus, our results contradict what is generally expected and assumed-- that the rich's consumption is more capital-oriented than the poor's. Moreover, in broad terms, our findings also suggest that the differentials in consumption in terms of factor requirements between income classes, in whatever directions, may be confined to the very rich and the very poor. In the context of the present study of Taiwan, sizeable and significant differences in factor intensity exist only between consumption by households with an annual income over NT\$200,000 and those with an annual income below NT\$14,000. For the majority middle-income classes, differences exist, but

TABLE 4: Factor Intensity of Consumption by Sectors and by Income Classes in Taiwan, 1966†

| Income Class | Sectors | | |
|----------------------|--|-----------------|-------------|
| | All Sectors (Unit: In thousands of NT\$ per worker) | Non-agriculture | Agriculture |
| 1 Under NT\$6,000 | 40.8 | 39.3 | 44.8 |
| 2 6,000 - 8,000 | 37.5 | 38.2 | 35.2 |
| 3 8,000 - 10,000 | 37.1 | 38.8 | 33.0 |
| 4 10,000 - 12,000 | 36.5 | 37.1 | 35.7 |
| 5 12,000 - 14,000 | 35.8 | 36.2 | 34.8 |
| 6 14,000 - 16,000 | 35.2 | 35.7 | 34.2 |
| 7 16,000 - 18,000 | 34.2 | 34.8 | 32.8 |
| 8 18,000 - 20,000 | 35.2 | 35.7 | 34.3 |
| 9 20,000 - 22,000 | 35.4 | 36.0 | 34.0 |
| 10 22,000 - 24,000 | 34.4 | 34.6 | 33.8 |
| 11 24,000 - 26,000 | 35.2 | 35.4 | 34.5 |
| 12 26,000 - 28,000 | 33.8 | 34.3 | 32.6 |
| 13 28,000 - 30,000 | 34.6 | 35.2 | 33.4 |
| 14 30,000 - 32,000 | 34.6 | 35.2 | 32.5 |
| 15 32,000 - 34,000 | 34.9 | 35.5 | 33.5 |
| 16 34,000 - 36,000 | 35.1 | 34.6 | 36.1 |
| 17 36,000 - 38,000 | 34.4 | 35.0 | 32.5 |
| 18 38,000 - 40,000 | 34.2 | 35.2 | 32.2 |
| 19 40,000 - 45,000 | 35.4 | 36.2 | 33.8 |
| 20 45,000 - 50,000 | 35.6 | 35.9 | 35.1 |
| 21 50,000 - 55,000 | 34.5 | 35.4 | 32.9 |
| 22 55,000 - 60,000 | 34.9 | 35.5 | 33.0 |
| 23 60,000 - 65,000 | 35.0 | 35.5 | 33.3 |
| 24 65,000 - 70,000 | 34.5 | 34.8 | 33.5 |
| 25 70,000 - 75,000 | 36.0 | 36.7 | 34.8 |
| 26 75,000 - 80,000 | 34.6 | 34.8 | 33.5 |
| 27 80,000 - 90,000 | 34.7 | 35.3 | 33.6 |
| 28 90,000 - 100,000 | 34.4 | 34.5 | 33.8 |
| 29 100,000 - 150,000 | 36.6 | 37.3 | 35.1 |
| 30 150,000 - 200,000 | 38.3 | 37.9 | 40.3 |
| 31 Over NT\$200,000 | 35.4 | 35.4 | - |
| For All Classes | 35.0 | 35.5 | 33.8 |

†Measured in terms of capital/labor ratios.

not as distinctly. This particular point is worth emphasizing.

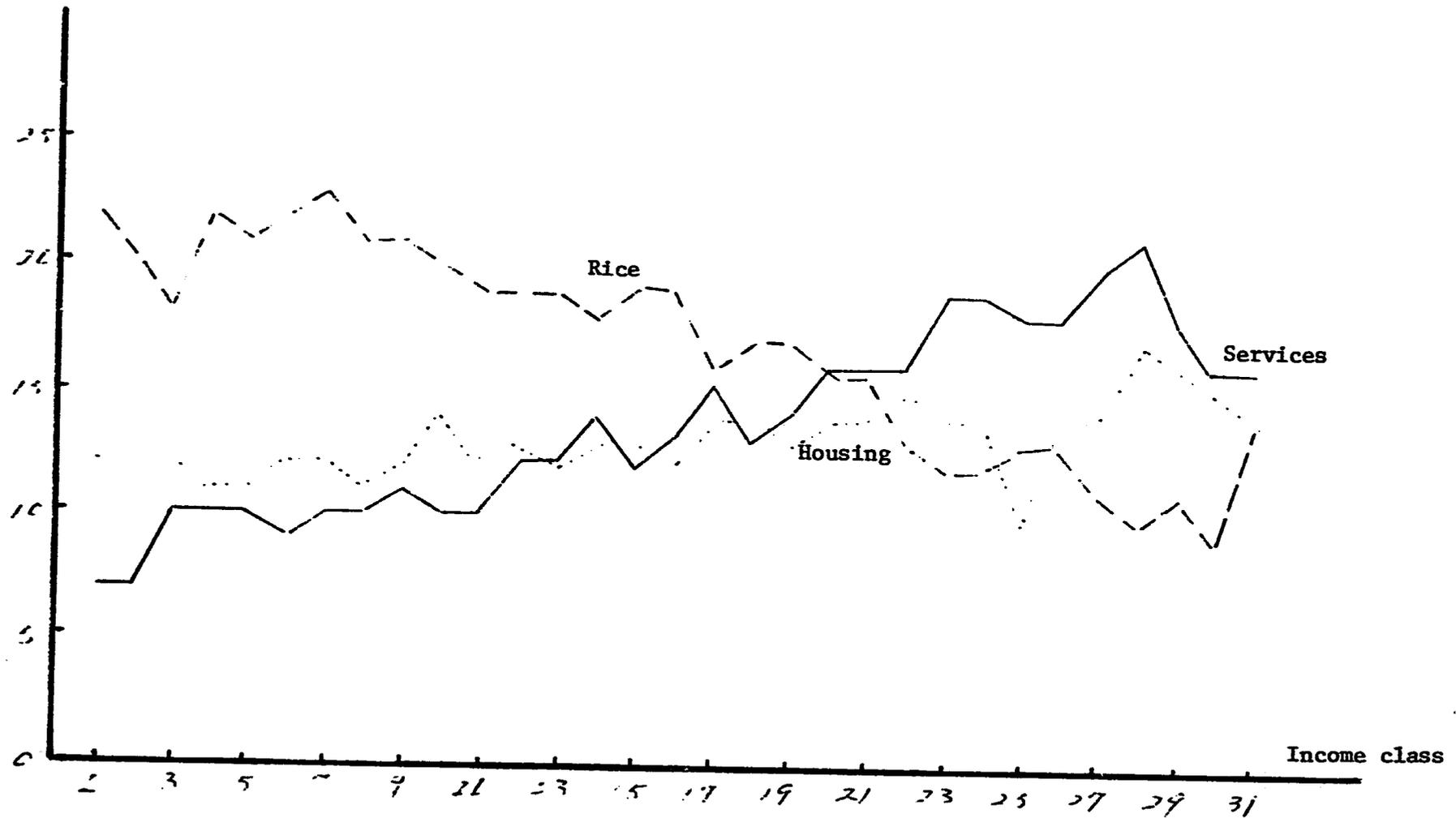
Unavoidably, the assumptions and definitions that we make in deriving our capital and labor intensity estimates involve some conceptual and methodological issues. As we previously argued, the differences in the empirical findings regarding the factor-intensity hypothesis may be attributable to at least three broad categories of elements. In so far as the question of the degree of disaggregation is concerned, data in Taiwan is more disaggregated than in most cases where similar empirical testing has been attempted. We note with special emphasis that for agricultural products we were able to identify nine product groups, each with a capital/labor ratio estimate. In most other similar attempts, the agricultural sector is represented by a single capital/labor ratio. However, we encounter the same difficulties in disaggregating the consumption items described in the household budget surveys as "miscellaneous items." And the fact that several service categories that are identified in the household budget survey have to be aggregated to match with input-output table industry classifications may also have bearings on our empirical results.

According to the 1966 household income and expenditure survey, consumer spending on rice, the staple food, on housing and on services dominate household budgets for all income groups in Taiwan (See Chart 1). The proportion of household income spent on rice, and other food products, declines as income increases. For low income households, consumption of rice counts for as high as 20 per cent of total household spending, compared with 10 per cent for high income households.

Contrary to this spending pattern on food, spending on services and on housing rises with income. The rise in spending on services as income

% In Total Expenditures

Chart 1: Relative Importance of Three Major Consumption Items



is more distinctive and notable than the rise in spending on housing. While spending on services accounts for 7 to 10 per cent of the total budget for the low income households, it is over 16 per cent for high income households. As for spending on housing, it varies from 12 per cent for the low income families to 16 per cent for the high income families.

It is therefore quite conceivable that the three dominating consumption items are decisive in determining the results of empirical testing. According to our estimates, capital/labor ratios for agricultural products vary from 15.6 for sugar cane to 33.0 for vegetables and fruits. In contrast, capital/labor ratios for services are much lower; they range between 7.2 and 7.5 for most service items we identified.

To test the extent to which our empirical results are determined by each of the three broad spending categories, we ran two additional tests with one involving the measurement of factor intensity of consumption for each income class without the service items and the other experimenting with different capital/labor ratios for housing. Results of the two experiments are summarily reported in Table 5.

The results of our testing without the service items are rather interesting. They now show the opposite pattern to what we reported earlier. That is, without the service items in our calculations, our results now support the hypothesis that the rich's consumption is more capital-intensive than the poor's. This reversal in empirical findings definitely underscores the sensitivity of our empirical results. We shall return to this point later.

TABLE 5: Factor Intensity of Consumption by Income Classes:
Results of Alternative Experiments

| Income Class | Factor Intensity (In thousands of NT\$ per worker) | |
|--------------|--|-----------------|
| | Experiment I† | Experiment II†† |
| 1 | 42.8 | 44.0 |
| 2 | 39.3 | 40.8 |
| 3 | 39.5 | 40.4 |
| 4 | 38.9 | 39.4 |
| 5 | 38.2 | 38.7 |
| 27 | 40.4 | 38.7 |
| 28 | 40.0 | 38.8 |
| 29 | 42.1 | 40.9 |
| 30 | 43.7 | 42.6 |
| 31 | 39.5 | 39.1 |

†Calculations made here left out two consumption categories: miscellaneous services and undistributed items, which consist of basically other services too.

††In this experiment housing is considered as a service; the capital/labor ratio for housing service is assumed to be 30:1.

Our other experiment has to do with the issue whether housing should be treated as a service item or as an ordinary consumer good.

The results we previously reported are based on the assumption that housing is an ordinary consumer good. Thus, the capital/labor ratio in the construction of residential houses is adopted. On the contrary, if housing is treated as a housing service, a different capital/labor ratio should be used. In the absence of reliable data, we assume that housing as a service item has a capital/labor ratio of 30.0:1, as compared with the capital/labor

ratio of 14.5:1 we previously adopted.

Surprisingly, the results of our experiment have remained the same as we previously observed. That is, even if consumer housing is treated as a service item, our empirical results will suggest that consumption by the poor is more capital-intensive than the rich.

On redistribution impact

The results of our simulation of the impact of income redistribution on capital and labor requirements and on import demand are presented in Table 6. As we described earlier, redistribution programs for simulations involve four different types of income redistribution schemes, namely biased growth, equal growth, pure transfer and transfer with growth. For each type of redistribution, four redistribution plans of different scopes are assumed. Thus, all together, our simulations of the redistribution impact on factor and import demand contain the results of 16 hypothetical redistribution schemes.

In terms of capital and labor required to meet the consumption demand that the redistributions imply, our simulation results indicate that redistribution of income through a biased growth path has the greatest impact, followed by equal growth, transfer with growth and pure transfer. The results are especially interesting if biased and equal growth patterns are compared. If capital is assumed to be abundant, redistribution through biased path is undoubtedly preferred; under the plan, the growth rate in employment is higher. However, even if capital is assumed to be a growth constraint, our simulation results do not suggest that the biased growth path is an inferior choice. Under the equal growth plan, capital requirement

TABLE 6: Redistribution Impact

| Distribution Alternative | On Capital (In millions of NT\$) | On Employment (In thousands of persons) | On Imports (In millions of NT\$) |
|--------------------------|--|---|--|
| 1 | 1,743.6 | 39.6 | 486.0 |
| 2 | 4,029.5 | 90.8 | 1,145.1 |
| 3 | 5,076.1 | 114.9 | 1,429.1 |
| 4 | 8,791.1 | 119.4 | 2,518.3 |
| 5 | 272.8 | 9.0 | 60.5 |
| 6 | 619.9 | 18.0 | 114.0 |
| 7 | 848.2 | 24.0 | 205.4 |
| 8 | 1,265.9 | 38.3 | 267.5 |
| 9 | 1,500.6 | 32.8 | 452.7 |
| 10 | 3,527.6 | 77.0 | 1,064.3 |
| 11 | 4,324.6 | 94.4 | 1,304.7 |
| 12 | 7,770.1 | 169.7 | 2,344.3 |
| 13 | 311.4 | 9.4 | 90.1 |
| 14 | 764.4 | 22.9 | 153.2 |
| 15 | 875.6 | 26.3 | 269.7 |
| 16 | 1,391.2 | 45.2 | 390.0 |

is 14 per cent less than what is required under the biased growth plan. But growth in employment is also less by the same extent. Thus, under the same capital constraint, as defined in the equal growth plan, employment growth is comparable under either plan. Therefore, our simulation results indicate that there is no tradeoff between growth and equity. The choice of biased growth path toward a better distribution of income is still preferred.

As for the other two redistribution plans, their employment impact is much too limited. Also, under the transfer and transfer with growth plans, capital requirement per worker appears to be higher. Thus, these

two choices are inferior ones if capital is assumed to be scarce.

The redistribution impact on import demand reveals the same pattern as on factor demand. Redistribution through biased growth path will not generate any special pressure on balance of payments, as compared with what growth in income on the basis of the existing distribution implies. On the other hand, redistribution through transfer and taxation reduces import demand. This latter result implies that input-content of consumption is lower for the poor than for the rich.

5. Summary and Concluding Remarks

In this paper attempts have been made to test the factor intensity of consumption hypothesis and to measure through simulations the impact of income redistribution on factor and import demand in the context of the experience in Taiwan. One major finding of our empirical work is that the capital content of the consumption mix by households in the lower half of the income scale is higher than that by households in the upper half. Interesting enough, the pattern of the consumption mix in terms of capital/labor ratio is reversed if major service items and other miscellaneous items are excluded. The question whether housing should be treated as a consumer durable or as any other ordinary consumer good for the purpose of identifying its factor contents is unimportant so far as our empirical results are concerned. The result suggesting the high capital content in the consumption mix by the lower income households remains unvaried no matter how the capital/labor ratio for housing is defined.

Another finding of major significance is that despite the finding that the poor's consumption has a higher capital/labor ratio, growth in

employment and an equitable distribution of income are consistent goals. In addition, our simulation results indicate the equal desirability of achieving more equitable distribution of income through a biased growth approach in favor of lower income households as compared with the alternative of achieving the same objective through explicit transfer and taxation programs. Whereas the latter is no more efficient, in the economic sense, politically it is less acceptable and plausible in most developing nations.

Thus, it goes without saying the empirical findings reported here do not support the hypothesis that the consumption pattern of the rich has a higher capital content than what the poor consumes. Because of the complexity of the conceptual and methodological issue involved, we caution that the findings here should not be interpreted as empirical evidence rejecting the high capital-intensity hypothesis. Nevertheless, our empirical results do raise several critical questions regarding the broad issue of demand structure, income redistribution and employment growth. These questions may indicate the major limitations of the applicability of the factor-intensity hypothesis in achieving a more socially acceptable pattern of the distribution of income.

The first question our empirical results raise has to do with the reversal of the capital-content when the major service items are left out in the computation of factor intensity. Recall that the two major service categories identified in the input-output table, which account for 7 to 16 per cent between the poor and the rich households, are represented by a single capital-labor ratio. If empirical data were available to disaggregate the two categories sufficiently so that all major service items were identified with more accurate capital/labor ratio, conceivably our empirical results would be qualified again, in an unknown direction. Thus, the question of

disaggregation here is serious and decisive enough to determine the outcome of empirical testing.

In our view, however, the reversal in factor intensity that we uncovered signifies issues other than the one regarding disaggregation. As the case of Taiwan clearly demonstrates, the general household budget is dominated by three broad expenditure categories: spending on food, services and housing. Insofar as the differential in factor contents between the low and high income households is concerned, housing appears to be neutral in the sense that the direction of factor-intensity remains unchanged regardless of how housing is measured. Logically the direction of the contents of factor is likely to be determined by the factor contents in the service sector relative to the factor proportions in the agricultural sector.

Given factor proportions in the two sectors, the factor content of the overall consumption mix changes as the relative share of the two consumption categories shift in the consumer's budget. That is, the differentials in factor-intensity because of income differentials, may change over time within a country as well as between countries characterized by the stage of development attained. To be more explicit, the hypothesis that the rich's consumption mix is more capital-intensive than the poor's can be applied, if it is valid at all, equally between the rich and the poor countries. Considering the possible effects of development on the factor-intensity of the consumption mix, it is not surprising at all to find the variations in empirical findings regarding the direction of factor differentials.

Furthermore, the status of development may influence the factor

proportions in still another manner. Techniques and factor proportions in agriculture and in the service sector undoubtedly reflect the stage of development attained. Hence, to what extent our empirical findings are influenced by the state of technological advancement in Taiwan's agriculture is an interesting question.

Our simulation results suggest that growth and equity are consistent goals despite the fact that the poor's consumption mix is more capital intensive than the rich's. Our interpretation of this seemingly contradictory result is that the differential in factor intensity of consumption is confined to the very rich and the very poor. For the mass majority of households the differences in the consumption pattern in terms of factor content are minimal. But their influence on the overall factor content of consumption may be far greater because of the sheer relative size in terms of number of households. Thus, we suspect that the validity, as well as the applicability, of the high capital-intensity hypothesis may also depend on the degree of skewness in the distribution of income. Thus, our results seem to indicate that the factor intensity hypothesis is not a pre-condition to maintain consistency between growth and equity. In the realistic multi-class world, compatibility between growth and equity does not require the total consistency in the factor content of consumption throughout income classes.

Finally, the results of our empirical analysis of the Taiwanese experience suggest a policy alternative to achieve a more equitable distribution of income. In the context of our findings, improvement in the distribution of income through biased growth strategy appears to be at least equally efficient in terms of its employment effects as compared with outright transfer and taxation approach. In our view, each and every development strategy

or program has its distribution implications. The pattern of the unequal distribution of income and the gains of development reflected the biases in the development strategies and programs adopted in the past. To promote equity as an acceptable social goal on a broader base, our simulation results indicate the feasibility of integrating the redistribution element into the overall development planning by emphasizing the growth of labor-intensive industries, the small-scale sector and other similar programs to benefit the poor and the neglected. Thus, on the basis of our finding, we may draw the conclusion that growth and equity are not only consistent but also attainable without resorting to politically unpopular and unfeasible means.

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