

GROWTH AND EQUITY IN A SUB-REGIONAL ECONOMY: HAWAII, 1900-1976

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1. Introduction

This paper continues the analysis of Hawaii's economic growth initiated by Professor Harry Oshima during the early '60s at the University of Hawaii. He noted that "once we know the growth rate of Hawaii, we should be able to begin the study of the various factors which contributed to the growth of Hawaii. For example, the role of education, the role of capital formation, the role of technical progress, and others can be studied closely. These studies undoubtedly will uncover other factors pertinent to Hawaii's growth and will lead to other studies, as development economists are now discovering. The implications of the Hawaiian case for comparative analyses of the growth of nation may be far reaching" (Oshima and Ono, 1965, pp. XI-5).

Indeed, the socio-economic development of Hawaii involved a remarkable interplay of natural resource utilization, trade and physical and human capital formation molded under varied cultural and institutional forces related to the islands' racially mixed population base.

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During the last hundred years or so, Hawaii has evolved from a sparsely populated territory to an economy which ranked among the top ten states in the Nation in the mid-70s, as noted in Table 1.

Table 1 — Hawaii's Ranking on Selected Socio-Economic Indicators

	U.S.	Hawaii	Hawaii's Rank Among States
Per capita personal income (1977)	\$ 7,019	\$ 7,677	8th
Per capita money income (1977)	\$ 4,838	\$ 5,259	9th
Median family income (1975)	\$14,094	\$17,770	2nd
Percentage of people living below poverty level (1975)	11.4	7.9	44th
Long-term unemployment rate (1976)	6.8%	8.9%	12th
Life Expectancy (1969-1971)	70.85	73.6	1st
Death Rate (Rate per 1,000 population) (1975)	8.9	5.9	50th
Median School Years Completed (1976)	12.5	12.7	Top 2nd grouping
Percent High School Graduates (25 years +) (1976)	66.6	73.0	- do -
Inter-state Mobility (Percentage moving) (1965-1970)	11.5	18.5	5th

Source: U.S. Census Bureau, *Statistical Abstract*, various issues.

What was this "catching-up" process? How did it happen? What were the critical factors involved?

Although there are a number of economic histories on Hawaii, they are primarily descriptive. There is a need to identify and analyze the key social and economic changes (including sources of growth) that had taken place in Hawaii during the past seventy-five years or so using data obtained from the system of economic and social accounts. In this regard, historians in Hawaii are fortunate in having a comprehensive and valuable reference material available: Robert Schmitt's *Historical Statistics of Hawaii*. In addition, the gross state product estimates for 1901 and 1958-1960, formulated by Professor Oshima, provided the computational base analyzed herein. Without these historical data sources, this statistical investigation would not have been possible.

A further contribution here is that although there have been many country studies analyzing sources of long-term economic growth, to this writer's best knowledge, no such studies have been attempted for a sub-regional island economy like Hawaii, the only state in the Nation which has a continuing set of articulated income and expenditure accounts beginning with 1958.

2. Analytical Approach

The estimation methodology applied herein follows the Denison approach, (Denison, 1962, 1967, 1974, 1976).

His method uses the simple Cobb-Douglas aggregate production function concept. Thus, assuming short-term competitive conditions, changes in output value are equal to changes in factor supply weighted by the factor share of output value plus changes in a residual factor index.

A simple derivation follows:

$$(1) \quad \frac{dY}{Y} = \frac{dK}{Y} \cdot \frac{dY}{dK} + \frac{dL}{Y} \cdot \frac{dY}{dL} + \text{residual}$$

$$(2) \quad \frac{dY}{Y} = \frac{dK}{Y} \cdot \frac{dY}{dK} \cdot \frac{K}{K} + \frac{dL}{Y} \cdot \frac{dY}{dL} \cdot \frac{L}{L} + \text{residual}$$

$$(3) \quad \frac{dY}{Y} = \frac{dK}{K} \cdot \frac{dY}{dK} \cdot \frac{K}{Y} + \frac{dL}{L} \cdot \frac{dY}{dL} \cdot \frac{L}{Y} + \text{residual}$$

Also

$$(4) \quad \frac{dY}{Y} = \frac{dK}{K} \cdot \frac{dY/Y}{dK/K} + \frac{dL}{L} \cdot \frac{dY/Y}{dL/L} + \text{residual}$$

Since

$$\frac{dY}{dK} = MP_K = \text{Profit Rate}; \quad \frac{dY}{dL} = MP_L = \text{Wage Rate}$$

$$(5) \quad \frac{dY}{Y} = \frac{dK}{K} \cdot \frac{MP_K \cdot K}{Y} + \frac{dL}{L} \cdot \frac{MP_L \cdot L}{Y} + \text{residual}$$

$$\text{Overall Growth Rate} = \text{Growth of Capital Stock} \cdot \text{Capital Share} + \text{Growth of Labor} \cdot \text{Labor Share} + \text{Residual productivity index}$$

Calculations are made as follows:

Assume that the labor share of income is 73 percent. Then a one percent increase in labor quantity is associated with 0.73 percent increase in growth. Calculations show that a 1.3 percent increase in labor is related with 0.949 percent increase in growth. Assume that the long-term average annual growth was 3.8 percent. Dividing 0.949 percent by 3.8 percent provides the contribution of labor to the growth rate.

Assumptions used include the following:

Constant returns to scale with no interactions among variables; hence, each component is additive. Also, marginal products of factors are equal to factor returns which assume pure competitive conditions. Differential factor returns are wholly identified with the targeted sources. Also, no major economic structural changes are assumed for analytical periods. This is maintained by averaging short periods for analysis.

As in all quantitative studies, the estimation techniques applied here which reduce raw data into summary measures will be subject to some criticism.¹ However, in line with standard practice, detailed descriptions of the methods used to derive these results are available from the author so that future researchers can reproduce and further improve them.

1. For example, in the book review of Denison's *Sources* by Abramovitz (1962), he noted that:

"In spite of the author's careful and candid exposition, there is a certain air of reliability and precision about his estimates which the state of knowledge today simply does not support".

Also, in a book review of Denison's *Why Growth Rates Differ* by Dean (1968), she wrote:

"Denison's numbers raise some profoundly controversial issues. For these are not the kind of statistics that effectively prove or disprove anything at all, except the immense complexity of the task of defining or interpreting national growth rates. They raise more interesting questions than they answer and Denison is always explicit. Only the most naive reader could suppose that these numbers are intended to be taken at their face value".

These comments are also applicable to the preliminary statistical results included herein.

3. Historical Overview of Hawaii's Growth

Initially, the various stages of Hawaii's growth are presented to help identify sources of long-term growth.

Period I – *Agricultural Emergence (1866-1900)*

This period can be characterized primarily as the transformation period from an agricultural subsistence and trade economy to an agricultural industrial production economy. There were further developments in entrepôt trade such as expanded exports of forestry and agricultural products, e.g., sandalwood and services to whaling ships and related activities.

From 1866 to 1900, annual sugar exports increased from 8,000 tons to about 350,000 tons, respectively. Rice and coffee exports in 1873 amounted to 470 tons and 130 tons, respectively. By 1900, the foundation of agricultural industrialization was already established.

Period II – *Agricultural Expansion (1901-1935)*

According to Professor Oshima's estimates, the State product in 1901 was about \$38 million. Estimated population in 1900 was 155,500, of which 75 percent were living in rural places. Also, approximately 40 percent were native born. The balance was foreign-born, about 60 percent and 24 percent of whom were Japanese and Chinese, respectively. In 1900, approximately 75 percent of the 10 year-and-over population were gainfully working. About 63 percent were in agriculture, forestry and fishing. This would increase to 73 percent if the laborers in the "industry not specified" category were considered doing agricultural work. About 10 percent of the workforce were in manufacturing and mechanical industries, about 8 percent in transportation and communication, and about 7 percent in domestic and personal services. In 1909, the average annual payroll per worker in manufacturing amounted to \$370 per year. Dividing this by annual hours worked (62 hours per week x 52 weeks) resulted in a 12 cent-hourly rate. In 1910, 319 farms harvested 8,000 tons of pineapple valued at \$331,000, significantly less than the production of rice (503 farms reporting, 418,200 hundred weight harvested, sales valued at \$1.1 million) and sugarcane (1,028 farms reporting, 4.2 million tons harvested, sales of \$26.3 million). Also, in 1910, of the total outgoing shipment (\$46 million), about 93 percent (\$45 million) were sugar exports. The

emerging agricultural industrial expansion was based on sugar production.

Living conditions of the population also improved. The life expectancy at birth during 1919-1920 was 48 years, a substantial increase from the life expectancy of 32 years during 1883-1886.

During this period, the external sector (primarily agricultural exports) had the key economic role in expanding agricultural production. The high price of sugar (partially subsidized) on the Mainland yielded high profit rates which were then reinvested into capital equipment, research and development to improve productivity of sugar production and milling. According to Professor Oshima, "It seems clear that high profits as a source for financing the accumulation of capital in the sugar industry were the result of efficient management and low wages." (Oshima and Ono, 1965, pp. 1-7). On the factor supply side, he adds that "while the business sector was accumulating capital embodying new technology, families were raising a large number of children despite low wages" (Oshima and Ono, 1965, pp. 1-8). This is reflected in the median age of the population which dropped from 29.1 in 1910 to 23.8 in 1930. School attendance also increased. During this period, then, the expansion on the aggregate demand side (primarily moved by agricultural exports) was accompanied by "human capital" expansion on the factor supply side.

Period III – *Military Base Emergence (1935-1949)*

The two previous periods were primarily focused on agricultural development and export sales, primarily sugar, pineapple, rice and coffee. The visitor industry was only meeting "selective" tourism needs (as contrasted with "mass" tourism) supporting a relatively small number of recurring visitors in a few expensive Waikiki hotels during the winter months. Between 1922 and 1935, estimated visitor expenditures ranged around \$6-10 million, while the combined sales value of sugar and pineapple was about \$90-100 million. Beginning in the late twenties to mid-to-late thirties, however, the military base complex in Hawaii emerged. For example, the military population increased from about 18,000 (1929) to about 30,000 (1940), or about 67 percent increase. From 1935 to 1940, the military resident population rose by 35 percent, from about 22,000 to 30,000. Value of military expenditures increased from about \$35 million in 1935 to about \$45 million in 1940. For the 1939-40 period, personal income

was approximately \$230 million, while per capita income was about \$550.

Period IV – *War Time Expansion (1941-1945)*

This period was probably the most important in the current economic history of Hawaii which significantly sped up the transformation of the economy. Activities in this period were devoted exclusively toward meeting requirements of World War II. Defense employment increased from 6,925 in 1940 to 64,350 in 1945. Armed Forces ashore increased from 44,278 in 1941 to 100,328 in 1945.

The impact of military expenditures which shot up from about \$45 million in 1940 to about \$800 million plus in 1945 was reflected in increased personal income which rose from about \$250 million to about \$754 million between 1940 and 1945. Per capita income increased from about \$550 in 1939-40 to about \$1,328 in 1945. Hawaii's Gross State Product (GSP) rose from about \$309 million in 1940 to about \$1,225 million in 1945. The population almost doubled from 478,000 to about 815,000 while civilian employment increased from 155,000 to about 208,000. War-time activity during this period resulted in a significant backlog of consumer demand and accumulated savings which influenced business and government policies in the next phase (Period V) of Hawaiian economic growth.

Period V – *Postwar Adjustment (1946-1958)*

The GSP increased by 63 percent between 1946 and 1958 (from \$873 million in 1946 to \$1,425 million in 1958). Personal income and per capita personal income increased concomitantly by 64 percent and 51 percent, respectively. Personal income expanded from \$719 million to \$1,180 million while per capita personal income increased from \$1,312 to \$1,983. The changes during this period were as follows:

- a) Population increased from 545,439 to about 605,356 between 1946 and 1958 (+11 percent).
- b) The civilian labor force increased from 190,297 in 1946 to about 210,400 in 1958 (+11 percent).
- c) Membership in unions increased from an estimated 37,000 in 1946 to about 60,000 in 1958 (+62 percent).
- d) Consumer prices rose approximately by 42 percent (58.3 in 1946 to 82.8 in 1958, (1967=100)).

- e) Per capita personal income rose from \$1,312 in 1946 to \$1,981 in 1958 (+51 percent).
- f) Registered motor vehicles increased from 81,700 in 1946 to 202,434 in 1958 (+148 percent).
- g) The general excise tax base for contracting rose from \$47.0 million to \$174 million (+270 percent). In the same period, the construction cost index rose by about 52 percent.
- h) The number of telephones increased from 70,600 in 1946 to 176,750 in 1958 (+150 percent). Transpacific calls rose from 89,273 messages in 1946 to 326,669 messages in 1958. Hawaii originated calls rose from 50,471 in 1949 to 197,098 in 1958. Interisland telephone calls increased from 155,850 in 1947 to 375,000 in 1958.
- i) Increases in the retailing and service general excise tax bases were 60 percent and 122 percent, respectively, from 1946 to 1958. (Retailing, \$416.3 million to \$665.0 million; Services, \$61.1 million to \$135.7 million).
- j) Number of hotel units increased from 1,572 to 5,494 units (+249 percent). Hotel employment rose from 1,313 to 3,611 while its payroll increased from \$2.7 million to \$9.9 million.
- k) Government receipts expanded from \$42.4 million to \$119.7 million from 1946 to 1958 (+181 percent).
- l) The median years of school completed increased from 8.7 to 11.3 years. (+30 percent).
- m) The life expectancy of persons (at birth) rose from 69.5 years (1949-1951) to 71.6 (1959-1961) (+3 percent).

Although these indicators showed considerable overall improvements, there were still major economic transition problems, e.g., the prolonged shipping strike in 1958. More important, the gap in business activity caused by sharp reductions in military spending had to be balanced by additional income-employment generating industries. A major stopgap was the expansion in the construction industry. In the quest for new industries for Hawaii, the Industrial Research Advisory Council and the Economic Planning Coordination Authority worked together in identifying and planning for potential business growth areas, e.g., tourism development. The foundation laid in the postwar adjustment period prepared the statehood (1959) expansion phase that continued from 1959 through 1965.

Period VI – *Statehood Expansion (1959-1965)*

As planned, a significant economic transformation that occurred in this period was the influx of mass tourism in Hawaii which boosted the number of overnight visitors from 172,000 in 1958 to 687,000 in 1964. Between 1959-1964, the average intended stay of visitors declined from 21 days to about 14 days. Estimated visitor expenditures in this period rose from \$109 million to about \$225 million. Hotel units and hotel employment rose from 6,802 and 3,699, respectively, in 1959, to 14,227 and 6,308 in 1965. Hotel payroll rose from \$9.9 million to \$23.4 million.

Period VII – *Service Industrialization (1966-Current)*

This period reflects the shift from agricultural to service industrialization. Relative to agricultural and military support production, the visitor industry has become the primary export earner for Hawaii. The export share of visitor expenditures rose by 33 percent (from 30 percent to 40 percent in 1967 and 1971, respectively) while the combined share of agriculture and military support declined by 30 percent (from 25 to 20 percent).

The linkage between multi-unit construction (especially multi-unit residential buildings such as condominiums and apartment dwellings) and tourism also strengthened during this period, especially on Oahu. This tie-up between the visitor industry and construction activity also expanded in the outlying islands.

Period VIII – *International Development (1971-Current)*

This period is characterized by the expanding role of Hawaii as a base for international investment and technical assistance, especially for the Pacific basin countries. The linkage in construction and tourism, supported by non-Hawaiian financial flows (entrusted at 50-60 percent) further expanded, which also accelerated housing values upward. This trend continues to the present. The relative share of visitor expenditures to direct export earnings (covering four major industries) increased from 40 percent in 1971 to about 48 percent in 1976.

Summary

The growth of the Hawaiian economy begins with its highly favorable climate, key geographical location and bountiful resources.

The early industrial development of Hawaii starts with a "demand-creating supply" model related to the sugar industry. There was an assured market for sugar on the West Coast due to the "Gold Rush", the Civil War and the import tariff advantage. With relative low labor costs and a disciplined work force, sugar producers reinvested high profits into further production facilities, agricultural research and development. Cooperative arrangements among sugar producers in establishing a central experimental station to test better species and applying large scale (plantation) growing techniques eventually lowered production costs due to economies of scale and advance of knowledge. Labor unrest was limited. Human capital investments expanded in education, training and population increase. As productivity of agricultural industries increased, profits of local producers plus Mainland investment sources were channeled into industrial and mercantile activities, thus expanding the production base for additional profits and further investments. In the meantime, immigrant families were accumulating savings and investing in education, housing, land and in business activities. With a broadening base, income equity improved. Thus, the combination of application of advances of knowledge in better production techniques to obtain better yields, (for example, through better planting methods, selection of disease resistant strains, better irrigation systems, fertilizer applications and control of harmful insects), better managerial practices and diversification (economies of scale) together with inputs of a diligent, trained but relatively low paid labor force and reinvested capital resources created an economic environment highly suitable for significant improvements in Hawaii's agricultural and commercial development.

This agro-industrial base was further augmented by inputs from increased urbanization and expanding military-base procurements. During the post-war adjustment period, the "assured demand-creating supply" model transformed to a "supply-creating demand" model. The Hawaiian economy had a postwar excess production capacity during the late forties and early fifties before the statehood expansion. Intensive investigations were made to identify and plan for the development of exportable goods and services to fill the gap caused by military demobilization. Adequate investment outlets for accrued domestic capital funds built up during the war-expansion period had to be found. The labor movement also expanded and became more active in seeking better wages and working conditions.

during this postwar adjustment period. With growing labor force from returning veterans and lack of work opportunities, the unemployment rate rose, although this was somewhat softened by higher (government subsidized) college enrollment of veterans and out-migration of students and workers to the Mainland. Business and government agencies expanded the development of new industrial potentials for Hawaii, including tourism, manufacturing for import-substitution and exports, and diversified agricultural activities, e.g., clothing, giftwares, flowers, fruits and macadamia nuts. This transition period was a critical one in Hawaii's economic history. Demand creation and business investment development went hand-in-hand. For example, the linkages among technological developments in transportation, communication, hotel construction, expanding visitor industry demand and business expansion were analyzed and coordinated by the Hawaii Visitors Bureau. This in turn further increased business activities associated with the visitor industry and so on.

In summary, the economic development of Hawaii was based on a favorable investment climate, including both physical and human capital formation. In the early stage of Hawaii's specialized agricultural development, a primary demand-oriented model was applicable (where production followed export demand). Because of the small economic base, import-substitution industrial development was not feasible. In the later stages (especially after the postwar transition period), a primary supply-creating demand model appears to be applicable. During the past seventy years or so, factor productivity increased significantly due to a better trained labor force, some economies of scale and technological developments, resulting in more efficient transportation and communication facilities and equipment.

4. Analysis of Historical Findings

The next step is to relate these growth patterns with quantitative summary measures.

Growth Rate

The real growth rate of Hawaii's State Income between 1900 and 1976 (slightly dampened by declining sugar prices and the 1975 recession lag) averaged 3.8 percent per annum. State income grew by

6.9 percent in current dollars which was reduced by rising prices, expanding by about 2.9 percent per annum. The per capita income growth rate was 1.5 percent while the per worker income growth rate was 1.9 percent. While population expanded at a 2.3 percent annual rate, employment grew at 1.9 percent per annum.

For comparative purposes, the real U.S. Gross National Product (GNP) increased by 2.9 percent from 1909 to 1959. From 1909 to 1927, real GNP increased by 2.8 percent per annum (Denison, 1962, p. 21). From 1929 to 1969, real National Income increased by 3.3 percent (Denison, 1974, p.12). For Hawaii, the real State Income increased by 4.3 percent annually between 1930 and 1970. These figures indicate that Hawaiian output increased at a faster rate than that of the Mainland.

The average unweighted labor return (including self-employed) share of state income from 1900-76 was estimated to be 73 percent while the capital return share was assumed to be 27 percent (residual). For the Mainland, Denison noted a 71 percent labor share of national income, 22.8 percent for reproducible capital and a 5.8 percent land share from 1909-58 (Denison, 1974, p. 260). During the 1900-76 period, the labor share of Hawaii state income grew from about 64 percent to about 81 percent, primarily because of increasing supplementary wage payments received by employees, including the self-employed. The same trend is also evidenced by Denison's findings (Denison, 1962, table 4) for the United States. From 1909 to 1957, the share rate increased from 60 percent to about 83 percent. From 1958 to 1968, however, it was reduced from 83 percent to 80 percent (Denison, 1974, table J-1).

Contribution of Labor Input

Between 1900 and 1976, persons employed in Hawaii increased from 90,172 to 390,303, a fourfold increase (about 1.9 percent per annum). The population increased at a 2.3 percent annual rate. The de facto population almost doubled from 429,100 in 1940 to 952,306 in 1976, with an annual average increase of 3 percent per annum. Employment during this same period increased from 188,232 to 390,303 (about a 2.8 percent annual increase). Between 1900-1960, the employment level almost tripled (2.3 percent per annum increase).

For the United States, employment increased by 92 percent between 1909 and 1958 (Denison, 1962, p. 37). The average annual

growth rate was 1.3 percent in 49 years. In this same period, the population including Armed Forces overseas increased from 90,492 to 174,141, a 92 percent increase or an annual average rate of 1.3 percent. These data indicated that Hawaii's employment levels were growing faster than that on the Mainland.

The average annual number of hours worked per employed person in Hawaii declined by 40 percent from 3,182 to 1,920 hours per annum (a drop of 0.6 per annum from 1900 to 1976). In 1900, it was estimated that the average worker spent 61.2 hours per week working; but in 1976, the comparable rate was 40.0. The estimated number of weeks worked dropped from 52 to 49 weeks per annum. The total hours worked are over-estimated, however, since it is assumed that all workers are working full-time. Between 1910-60, the annual manhours worked in Hawaii dropped by 40 percent. For the United States, Denison estimated (from 1909 to 1958) that annual hours worked dropped by 25 percent from 2,704 in 1909 to 2,057 in 1958 (Denison, 1962, p. 37). Thus, rapid gains in employment benefits were accruing to Hawaii's workers.

The overall net gain in hours worked increased by 2.7-fold between 1900 and 1976 (average worker hour index multiplied by the employment index) which reflected a 1.3 percent annual rate of increase in labor input. Using the estimation procedure, the labor input growth rate (1.3 percent) was multiplied by the average labor share rate (73 percent) to obtain a labor (0.95 percent) contribution rate per annum toward the growth rate.

This meant that during the 1900-76 period, labor received an average share of 73 percent of state income. If labor costs remained fixed and with a gain of one percent of labor quantity input during this period, the state income should also increase by 0.73 percent, all other things remaining constant (including production methods and other activities).

This also assumes that any new supply of factor inputs was fully absorbed into underutilized capacity. Hence, the data presented here relate to contributions of factor inputs toward improvements in long-term productive capacity (Denison, 1962, pp. 31 and 32). Also, as noted by Abramovitz (1962) "the growth Denison seeks is growth in capacity to produce or, as he sometimes calls it, potential production".

Since a one percent labor quantity increase is related with a 0.73 percent increase in growth, then, a 1.3 percent labor quantity

increase is related to a 0.95 percent increase in growth. Dividing 0.95 percent (as derived above) by 3.8 percent gives the contribution of labor inputs (employment adjusted by hours) toward long-term Hawaiian productive capacity. This labor input contribution "explains" about 25 percent of the growth rate. This rate may be overestimated, however, since it was assumed that employment covered only full-time workers. These adjustments can be made later when more detailed data are available.

There are many growth policy implications related to this summary measure. Thus, working hours and employment data can be divided into various demographic, social and economic groups. As noted by Denison (Denison, 1962, Chapter 6) employment changes are related with changes in population, labor force participation rates, employment rates, etc. Working hour changes are related with potential to actual average working hours per week, average weeks worked per year, and the like. In turn, these relate to impact of work stoppages, nutrition and health status of the population, propensity for leisure, use of leisure time, family/household work patterns, lost labor due to crime, and other activities and so on. Also, each of these opportunity costs can be related to public and private programs to reduce lost labor and to find cost-effective ways to increase labor input. Simulation techniques can be applied to formulate different "what if" scenarios (under limiting assumptions) showing how different socio-economic activities can impact long-term Hawaiian productive capacity, e.g., what are the gains in retrieving lost labor from those unemployed or underemployed or in preventing institutional commitment through education and social rehabilitation.

Variations in Labor Input

If annual hours worked per person were kept constant from 1900-1976, the employment growth rate would show an increase of 1.9 percent per annum. Multiplying this rate by 73 percent gives 1.39 percent. Thus, during 1900-1976, the employment factor without accounting for lesser hours worked per worker would be accountable for about 37 percent of the 3.8 percent growth rate of long-term Hawaii State income capacity (instead of 25 percent rate found previously). Hence, the reduction in annual working hours per worker decreased labor input's contribution by about 32 percent.

Contribution of Education

Between 1900 and 1976, the median school year completed by the resident population increased from an estimated 3.6 years (related with school attendance) to 12.7 years. These data cover attainment of formal training only and do not cover additional human capital investments such as on-the-job training, special studies, and so on. The average rate of school year completed per person increased by 3.5 fold, about 1.6 percent gain per annum during the past 76 years. However, educational attainment gains must be related to economic value added. Thus, after making rough calculations, it was estimated that the real income gain associated with these school year changes was about fivefold (from \$1,207 in 1900 to \$6,399 in 1976). This resulted in an increase of about 2.2 percent per annum. Assuming that 50 percent of this gain was attributed to variables such as intellectual ability, home training, mass communication, and so on, approximately 50 percent of the 2.2 percent was allocated to gains from better household social environmental conditions. Denison (Denison, 1962, pp. 69-70) makes a 60 percent adjustment to reduce the school year differentials in economic contribution by education attainment.

Applying the estimation methodology, 1.1 percent (education input) is multiplied against 73 percent (labor share of income) to obtain 0.8 percent (the growth rate attributable to education). Dividing 0.8 percent by 3.8 percent produces 21 percent, the contribution of formal educational attainment toward the long-term Hawaii State income-generating capacity. Denison initially found that educational attainment contributed 20 percent towards improvement in the U.S. growth rate during the 1909-1957 period (Denison, 1962, pp. 73 and 148). For 1920-1957, it was calculated that education contributed 23 percent of the growth rate but in a later study (Denison, 1974, p. 346), the figures were revised downward to 13 percent due to reductions in the number of days attended per school year and changes in census estimates. (Denison, 1974, p. 346). Given the limitations of these summary measures, how can these data be used for human investment policymaking? Some of these issues are discussed by Denison (1962, Chapter 7). Unquestionably, adequate educational attainment of the population is a prime requisite for the expansion and improvement of Hawaii's long-term productive capacity. For each one percent school year completed, there appears to be a 1.4 percent gain in worker's

income. However, if education is to be cost-effective, it must be matched by available jobs (through effective demand creation and investment) to absorb the growing supply of school graduates. The mismatch between educational output and work opportunities needs to be reduced or eliminated through appropriate educational program planning and evaluation. Another useful investigation is to analyze the potential gains derived from the "permanent" labor commitment of Hawaii's labor because of social and economic barriers toward full labor mobility. The overall productivity level of Hawaii's working population may be higher than that on the Mainland because of many reasons, one of which may be the possible trade-off between the enjoyment of Hawaii's "amenities" for better compensation on the Mainland for the same type of work.

Contribution of Reproducible Capital

This component consists primarily of business structures and equipment, non-farm residential structures, inventories and net out-of-state returns. However, only producers' equipment and construction are covered herein.

Capital stock yields service returns over a period of time. Thus, the dwelling unit provides protection from the weather, comfort, prevention from illness, and other amenities which help in improving the productivity of workers. The contribution of capital stock is computed assuming that stock and flows are proportionate with each other. This portion of the estimates is probably among the most difficult and tentative.

The average annual real growth rate of construction activity was conservatively estimated at about 5 percent. The average (net) construction investment share to state income was computed at 6 percent for the period 1900-1976. Using the basic estimation formula, $(6.0) (5.0) = 0.30$ percent; $0.30 \text{ percent} / 3.8 \text{ percent} = 8$ percent. Therefore, 8-10 percent of the average Hawaiian productive capacity between 1900-1976 was attributed to construction activity. In the same manner, the contribution of producer's equipment input was computed as follows:

$$\begin{aligned} & (5 \text{ percent annual rate of increase}) (5 \text{ percent share} \\ & \text{of total output value} = 0.3 \text{ percent} \\ & 0.3 \text{ percent} / 3.8 \text{ percent} = 8 \text{ percent} \end{aligned}$$

Therefore, construction and equipment/machinery net input contri-

buted about 16 percent of Hawaiian economic growth between 1900-76. The relative contribution input of structures could be underestimated. Psacharopoulos computed a 35 percent contribution of capital investment covering the period 1950-60 (Psacharopoulos, 1969, p. 43) which may be appropriate for that period. These estimates need further investigation.

Denison shows contribution of private structure and equipment to growth of 15 percent for the period 1909 to 1957 (Denison, 1962, p. 148). For the early period 1909 to 1929, capital input's contribution was 24 percent. From 1926 to 1957, its contribution was 12 percent. His data include inventories and net foreign assets.

Putting the above together, estimates for Hawaii indicated that labor, education and capital inputs contributed 25, 21 and 16 percent, respectively, toward Hawaii's long-term productive capacity. The balance of 38 percent, discussed below, is associated with the contribution of "residual" productivity factors including advances in knowledge, work ethics, technological applications, economies of scale, industrial structure, management practices, and the like.

Contribution of "Residual" Productivity Factors

Because of their tentative nature, these estimates are considered exemplary, subject to future improvement by researchers. To estimate their contributions to long-term output, proxy indicators were used based on an eleven year period (1966-76). It was assumed that the trend found in these data applies over the analytical period. This, of course, is subject to further analyses. The proxy indicators were: (1) changes in professional employment, (2) changes in membership of professional societies, (3) number of companies engaged in research and development (R/D) and, (4) changes in the volume of Hawaiian originated transpacific calls made to the Mainland, assuming that communication expansion is correlated with technological developments.

Between 1966-76, professional employment, membership in professional societies and the number of R/D firms increased by 10.5 percent, 5.3 percent and 11.5 percent, respectively. Output elasticities were 16 percent, 32 percent and 15 percent, respectively. That is, a one percent change in real output is associated with a 0.16 percent change in professional employment, a 0.32 percent change in professional society membership and a 0.15 percent change in the number of R/D firms. The output elasticity of transpacific tele-

phonic calls was 0.24 percent. Averaging all four items together resulted in an output elasticity rate of about 0.22 percent. That is, there was a 22 percent contribution of "advance of knowledge" to output capacity.

For the contribution of specialization toward productive capacity, it was assumed that increases in the number of telephones, adjusted by reductions of telephone rates, were associated with specialization and economies of scale. Rough calculations showed a 10 percent contribution of this factor toward Hawaii's production capacity.

In summary, initial data on the contribution of production factors toward Hawaii's long-term economic growth were as follows:

Sources	Percent Contribution to Growth Rate
Labor Inputs	25
Capital Inputs (Construction and Equipment)	16
Education Inputs	21
"Residual"	
Advance of Knowledge	22
Specialization and Scale Economies	10
Others	6
	100%

Changes in Personal Income Size Distribution

A number of available data series indicated that the family income distribution pattern in Hawaii had become more equal over the past 75 years. However, these data are fragmented and sketchy. The long-term trend toward improved living conditions in Hawaii are noted in Table 2.

The above data indicate that the overall levels of living improved for certain types of families in Hawaii as reflected by the declining Engel coefficient (a key indicator of personal well-being assuming consistency of data) and the rising share of housing expenditures. Data also show the disparity in livelihood between the middle-income Caucasian families (mostly professional and managerial workers) and plantation workers in the 1930s. Based on the Engel coefficient, the living condition of middle-income Caucasian families was better than that of agricultural plantation workers. Data show that changes in income levels could be linked with occupational

Table 2 — Percent of Food and Housing Expenditures to Total Expenditures

Family Type	Percent of Food	Percent of Housing
"Representative" families — 1901	56.3	N.A.
Wage Earner's Families in Honolulu — 1910	50.4	18.1
Filipino Plantation Worker's Families — 1933-1934	45.5	12.6
Middle-Income Caucasian Families in Honolulu, 1937	24.3	31.3
Wage Earner's and Clerical Workers' Families in Honolulu — 1943	44.1	16.6
Office Workers' Families in Honolulu, 1951	29.8	27.5
Urban Families and Single Consumers on Oahu, 1961	25.9	25.6
Urban Families and Single Consumers on Oahu, 1972-73	20.0	33.5

Source: *Historical Statistics of Hawaii and the State of Hawaii 1980 Data Book.*

changes. Professional, technical and kindred workers and the Manager and Administrators' group made up 14 percent of the employed in 1940. However, in 1970, this rate was 23 percent. More important, the proportion of farm laborers and foremen among the employed was 28 percent in 1940. In 1970, this rate was reduced to 2 percent of the employed.

Using this indirect approach, the 62 percent proportion of workers ten years old and over in agriculture in 1900 can be related to the comparable 3 percent rate in 1975. Unquestionably, this shift from agricultural to non-agricultural pursuits over the past 75 years has resulted in improved levels of living of workers in Hawaii.

In the early 1900s, 25 percent of the total population (154,000) were Hawaiians and part-Hawaiians (of which, presumably, most would be in the lower income categories). Few of them received significant incomes from land holdings and other inheritances. The Caucasian group could be divided into two income-level sectors,

immigrants (1) working in the management of mercantile trade activities and the sugar plantations, and (2) working as plantation laborers. The Caucasian group comprised about 17 percent of the total population, of which a small group could be included in the higher income category. The balance of the population (approximately 26,000 Chinese, 61,000 Japanese and others) were mostly immigrant agricultural workers. Thus, this population profile of the early 1900s would indicate a rather skewed two income sector distribution, a relatively small upper income sector and a very large lower income sector. If these data could be converted into a summary income distribution measure, it would show a high rate of relative income inequality during this early 1900 period.

During the 75 years, income equity appears to have improved. For example, a good proxy measure of income equity is the percentage of housing units which are owner-occupied. In 1930, about 18 percent of housing units were owner-occupied. In 1976, the comparable rate was 45 percent. Another measure associated with long-term improvements in income distribution is the Engel Coefficient. It dropped from about 60 percent in the 1900s to about 20 percent in the mid-1970s. These reflect the broadening of the personal income base during the past seventy-five years.

There are recent family income size distribution data from the Census Bureau and other sources which could be used to compute summary income distribution measures. Thus, Professor Oshima's standard deviation of quintile share can be computed for 1949, 1959 and 1975 (Table 3) (Oshima and Ono, 1965, p. VIII-15).

Between the 26 year-period (1949-75), the standard deviation of quintile share declined by almost 25 percent. Within the same period real state income almost tripled, per worker income increased one and a half times and per capita income almost doubled. Key factors making for this equalizing trend are noted below. An important clue is the average number of earners per family, including working wives. Hawaii had a female labor force participation rate of 59.4 percent in 1976, the highest in the Nation (47.3 percent for the Mainland). Although per worker income is relatively lower compared with other states, Hawaii's family income is much higher because there are more earners per family. A simple model can be formulated to indicate this employment-income pattern in Hawaii.

As noted, changes in output (supply) can be related with changes in the quantity of factors of production and changes in the

Table 3 — Standard Deviation of Quintile Shares,
Hawaii, 1949, 1959, 1975

Quintile of Families		Income Shares (in percent)		
		1949	1959	1975
Lowest	20%	5.3	5.9	4.0
2nd	20%	11.0	11.6	11.0
3rd	20%	15.4	15.9	20.0
4th	20%	21.0	22.4	29.0
Highest	20%	47.3	44.2	36.0
Standard Deviation of Quintile Share (in percent)				
Hawaii		14.7	13.3	11.1
U.S.		13.9	13.3	12.4 (E)
Mississippi		17.0	16.3	15.2 (E)

E — Estimated

Sources: *Hawaii's Income and Expenditures*, 1958, 1959 and 1960 and *State of Hawaii's Data Book*, 1978.

productivity of these factors. Changes in the demand for these production factors, in turn, depend on the income elasticities of demand. In Hawaii, as the demand for agricultural products, services and construction activities expanded, employment demand was met by a relatively well-trained, disciplined work force, willing and able to work. This resulted in overall rising incomes and improved living conditions for most of the people in Hawaii. An accessible and quality-driven educational system produced a broadly trained work force which could easily move into expanding job opportunities as they became available. With the mechanization of household operations, the prevalence of the extended family system and the drive toward better living standards, wives entered into the work force as opportunities arose. With more earners per family, family incomes rose, allowing the purchase of more consumer durables, in turn improving household work efficiency and allowing household members to work. As Professor Oshima noted (Oshima, 1961), higher incomes, economies of scale and consumer asset formation, together with the underlying institutional forces, raised household saving rates. On factor demand in Hawaii, there was continuous

upgrading of the industrial and occupational employment structure. As noted, agricultural employment declined while output per worker significantly rose due to better technological application and managerial practices. For example, between 1950 and 1957, output and capital per person in the sugar plantations increased by 54 percent and 48 percent, respectively (Mollet, 1961).

Accompanying all of these dynamic changes were rapidly rising educational levels. The median school year completed by the population almost doubled from 6.9 in 1940 to 12.7 years in 1975.

If the standard deviation of quintile share is computed to reflect the income distribution pattern in the early 1900's, a guess would be that it would be about double in 1900 than that in 1975 (a standard deviation of about 24 percent in 1900 relative to an 11 percent rate in 1975). Between 1901 and 1973, the Engel Coefficient declined by about 64 percent. Using elasticities between the Engel Coefficient and the Standard Deviation of Quintile Share between the 12 year period, 1961-1973, it was estimated that a one percent drop in the Engel Coefficient was associated with a 0.74 percent decline in the Standard Deviation of the Quintile Share. Thus, assuming that this relationship is applicable between 1901-1951, an approximation was made that in 1901, the inequality rate fluctuated around a 24 percent level.

Summary of Findings

A. Contribution of Factor Input/Quality Changes

1. Between 1900 and 1976, state income (SI) increased from \$38 million (in current \$) to \$6,239 million. In the same period, the GSP deflator increased from 17.4 to 161.7 (1967=100). Deflating the SI by these deflators resulted in SI values of \$219.0 million and \$3,852.5 million (in 1967 \$) in 1900 and 1976, respectively. These SI values showed an 18-fold increase, averaging about a 3.8 percent annual increase over the 76 years. This 3.8 percent annual average growth rate is the capacity benchmark used for all future computations.
2. Between 1900 and 1976, the average labor share of SI was 73 percent. The estimated labor input (employment adjusted for hours) showed a 1.3 percent average annual increase. Thus, $(1.3\%) (0.735) = 0.95$ percent. Labor input then contributed

about 25 percent of the average annual growth rate over the 76 years ($0.95/3.8$).

3. Between 1900 and 1976, the median school years completed for persons were 3.6 years and 12.7 years, respectively. Average income of employed persons increased from \$1,621 to \$4,123 (in 1967 \$) between these two periods. The average annual growth rates were 1.7 percent and 2.2 percent respectively. Taking 2.2 percent and applying a 50 percent rate to isolate "pure" educational attainment contributions (excluding improvements in other factors such as training, ability, and so on) the contribution of education to the growth rate was 21 percent. Thus, $(1.1)(0.73) = 0.08$; $(0.08/3.8) = 21$ percent.
4. Between 1900 and 1976, then, the quantitative (24 percent) and "qualitative" (21 percent) contribution of labor amounted to 45 percent. Denison found for the U.S. (1962, 148) for 1909-57 that the comparable figures were about 34 percent for employment and hours ($0.97/2.89$), 20 percent for education ($0.58/2.89$) and about 3 percent for better labor utilization, sex age composition changes and so on.
5. Between 1900 and 1976, the average annual rates of equipment and construction inputs into the Hawaiian economy were 5.0 percent and 4.8 percent, respectively. After weighing each of these two rates by 6 percent (after depreciation), the contribution of net construction investment and producer durable equipment expenditures were about 0.3 percent each per annum. These rates (0.3 percent each) were then divided by 3.8 percent resulting in the following contribution to the average annual growth rate between 1900 and 1976:

Equipment = 8 percent

Construction = 8 percent

16 percent

Denison shows (1962, 148) that the contribution of capital inputs of structures and equipment to the growth rate during the period 1909-57, was about 15 percent ($0.44/2.89$). The net changes in impact of inventories and Hawaiian owned assets abroad on the long-term Hawaiian growth rate was

assumed to be relatively small. This needs to be analyzed, however.

6. Thus, between 1900 and 1976, labor input changes accounted for 46 percent while capital input changes accounted for 16 percent of the long-term (76 years) improvement in Hawaiian production capacity. This leaves a residual of 38 percent to be explained in factor productivity increases due to advances of knowledge, economies of scale, shift from agriculture to nonagricultural employment, better labor utilization, and other reasons.

B. "Residual" Productivity Factors

Applying output/factor elasticity rates, findings were as follows:

1. Of the residual (factor productivity), advance of knowledge and technological applications could have contributed 22 percent to Hawaii's economic growth.
2. Specialization could have contributed about 10 percent toward Hawaii's economic growth.
3. The residual including reallocation of resources (farm to nonfarm employment) and other variables was reduced to 6 percent for further analysis.

C. Changes in Income Distribution of Families

1. In 1975, the Standard Deviation of Quintile Share (SDQS) was 11 percent, a 25 percent decline from the 1949 measure of 14.7 percent.
2. Using Engel Coefficient elasticity rates, it was guessed that the SDQS could be conservatively about 24 percent during the early 1900 period. Thus, between 1900-1976, the SDQS was cut about half, from a 24 percent rate to a 11 percent rate.

5. Concluding Remarks

According to the "notional" estimates used herein to indicate what possibly could have contributed toward Hawaii's long-term growth capacity, one of the key contributors appears to have been technological applications. The critical role of technological applications in economic growth is widely accepted. In Hawaii, during the past 75 years, inventions, and improvements in sugar and pineapple production and processing have significantly improved productivity

within the sugar and pineapple industries. However, as evident by present trends, these early advantages are not permanent for Hawaii. Its primary resource for further development is still in its skilled manpower base. Further expansion of Hawaii's international linkage with the Pacific basin countries in technical and cooperative arrangements should result in greater and better opportunities for the people of Hawaii. In this regard, Hawaii's academic institutions play a key role for this further development.

As Professor Oshima notes, further analysis is required to study the relationship between economic growth, technological and institutional innovations. This interaction is seen in the development of agricultural industrialization in Hawaii. Thus, with assured market demand (expectations of future growth), early industrial leaders were willing to invest not only in physical capital and in research and development, but also in human capital. The commitment of investment requires expectations of adequate future gains. This has led to entrepreneur decisions to take technological risks, given the skilled manpower base. This relationship between Hawaiian economic growth, assured market demand for its goods and services, human investment, institutions and technological innovations and applications needs further investigation and Hawaii is an ideal location for this research.

Finally, as noted, this preliminary investigation is based on fragmented and rather inadequate data base. If this type of analysis is to be expanded and improved in order to project Hawaii's future economic growth patterns, the statistical foundation of these data needs to be further strengthened.

REFERENCES

- Abramovitz, M. (1962), "Economic Growth in the United State," *American Economic Review*, 762-782.
- Christensen, L. R. and Jorgensen, D. W. (1972), "Measuring the Performance of the U. S. Economy, 1929-1969," *Discussion Paper No. 265*, Harvard Institute of Economic Research.
- Crawford, D. (1933), *Paradox in Hawaii*, Stratford Co.
- Deane, P. (1968), "Book Review - Why Growth Rates Differ," *American Economic Review*, 980-982.
- Denison, E. (1962), *Sources of Economic Growth in the United States*, Supplementary Paper 13, Committee for Economic Development, New York.

- _____, (1967), *Why Growth Rates Differ*, Brookings Institution, Washington D. C.
- _____, (1974), *Accounting for United States Economic Growth, 1929-1969*, Brookings Institution, Washington D. C.
- _____, and Chung, E. (1976), *How Japan Economy Grew So Fast*, Brookings Institution, Washington D. C.
- Hawaii State Department of Planning and Economic Development (1976) *Hawaii's Income and Expenditures Accounts: 1958-76*, Volumes I and II, Honolulu, Hawaii.
- Hawaii State Department of Planning and Economic Development (1978), *The State of Hawaii Data Book*, Honolulu.
- Hawaii State Department of Planning and Economic Development (1980), *The State of Hawaii Data Book*, Honolulu.
- Hitch, T. (1962), "A Brief Political, Social and Economic History of Hawaii," First Hawaiian Bank, Honolulu.
- _____, (1971), "Lessons Taught by Recent Hawaiian History," First Hawaiian Bank, Honolulu.
- Kendrick, J. (1961), *Productivity Trends in the United States*, Princeton: Princeton University Press.
- Kuykendall, R. S. and Day, A. C., (1976), *Hawaii, A History from Polynesian Kingdom to American Statehood*, Englewood Cliffs, New Jersey: Prentice Hall, Inc.
- Mak, J. (1978), "A Concise Economic History of the Hawaiian Islands," Economic Department, University of Hawaii, Honolulu.
- Mollet, J. A. (1961), *Capital in Hawaiian Sugar: Its Formation and Relation to Labor and Output, 1870-1957*, Agricultural Bulletin 21, University of Hawaii, Honolulu.
- Morgan, T. (1948), *Hawaii, Century of Economic Change*, Cambridge: Harvard University Press.
- Oshima, H. T. (1961), "Consumer Asset Formation and the Future of Capitalism," *Economic Journal*.
- Oshima, H. T. and Ono, M. (1965), *Hawaii's Income and Expenditures, 1958, 1959 and 1960*, Volumes I, II and III, Economic Research Center, University of Hawaii, Honolulu.
- Psacharopolus, G. (1969), *The Anatomy of a Rate of Growth: The Case of Hawaii, 1950-1960*, Economic Research Center, University of Hawaii, Honolulu.
- Schmitt, R. C. (1977), *Historical Statistics of Hawaii*, Honolulu: University Press of Hawaii.
- United States Government Printing Office (1975), *Historical Statistics of the United States*, Washington D. C.
- United States Government Printing Office (1976), *Statistical Abstract*, Washington D. C.
- United States Government Printing Office (1977), "U.S. Economic Growth from 1976 to 1987: Prospects, Problems and Patterns," Volumes I thru XXII, *Joint Economic Print*, 95th Congress, 1st Session, Washington D. C.