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THE CONSTRAINT OF MINIMUM WAGE LEGISLATION ON THE LONG-RUN CHOICE OF TECHNOLOGY IN THE CANNED PINEAPPLE INDUSTRY

By

Armando Armas Jr.*

Introduction

The growing economic literature on "appropriate" technology is in the fashion of theorizing that complex factors, particularly non-economic factors, constrain the choice of "appropriate" technology in LDCs (e.g. Stewart 1974, Picket, et al 1974, and Westphal 1974). Without substantial empirical tests, multidisciplinary-oriented eocnomists condemn the "naive" microeconomic models on choice of technique that emphasize factor prices. Economics, however, has to be concerned with prices much more than with non-economic factors such as engineering aestheticism or cultural inhibitions. It seems ironical, therefore, that some economists were already looking at non-economic factors to explain the use of "inappropriate" technology, while they had neglected or excluded the importance of factor prices such as wages. The present essay seeks to amend this neglect by empirically testing the traditional microeconomic models on the choice of technology through an investigation of some economic effects of minimum wage legislation (MWL) in the Philippine canned pineapple industry.

Section I inquires into the availability of MLI (more labor intensive compared to the Philippines') plant designs that are usually considered in the long-run choice of technology. Section II establishes the competiveness of the MLI canneries *vis-a-vis* capital intensive ones. Section III analyzes the importance of wage costs on the competitiveness of MLI canneries. Finally, the last section

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empirically tests the hypothesis that MWL has constrained the long-run choice of MLI technology.

Availability of MLI Plant Designs

Upon inquiring about the availability of MLI pineapple processing machines from selected canning machinery firms in the US and Taiwan, most respondent firms sent catalogues on machines of varying labor requirements which could be installed in the pineapple cannery. Because of the interdependence of production operations, however, machines of random specifications, such as speed rates, floor spaces, or technological vintage, become less relevant compared to machines in sets or modules in the choice of plant designs. In this regard, a request was made for technically consistent plant designs from leading manufacturers of pineapple processing machines.

The context of the plant designs is limited to modular operations of canning solid pineapple products: (1) peeling and coring, (2) trimming, (3) packing, (4) can sealing, (5) processing, (6) labelling, and (7) casing. Thus, the plant designs necessarily exclude other operations, particularly "peripheral" operations such as those in the juice plant and bran department, empty can handling, washing, can-making, and stevedoring. Operations included are more specialized compared to those excluded even within the canned fruit industry. Although the excluded operations are important, the concept of the plant design, nevertheless, is limited as such because the plant design proposals on a pineapple cannery consist only of the above-mentioned integral operations [this context of the plant design is almost similar to those presented in other studies on pineapple canning technology, see, for instance, Souza 1972, Haendler and Py 1971].

Furthermore, for a more consistent comparison, the proposed plant designs were modified as one-line systems of pineapple preparation. These one-line plant design systems will process pineapples with outside diameters ranging from 4 11/16" to 5 3/16". Pineapples of these diameters were estimated to account for 70-95% of the fruits entering most canneries [Farmer 1962]. Feasible pineapple products of the designed plants are: (1) whole slices, (2) half slices, (3) broken slices, (4) tidbits, (5) chunks, (6) diced, and (7) crushed pineapples. These products are to be canned in Nos. 2 and 2 1/2 cans which are widely used, particularly by Hawaiian firms [Farmer 1962].

Based on the response of the leading pineapple processing machinery firms, it was ascertained that MLI plant designs are readily available for the consideration of business clients. Only six plant designs with data on machinery specifications, and four plant designs with limited data on labor requirements and capacities were secured (directly or via business clients). The plant designs, nevertheless, are feasible alternatives because they are seriously considered as such by business clients, are based mainly on actual plants, and represent some of the stereotyped proposals of well-established firms, namely, Honolulu Iron Works Company (Honiron), Food Machinery Corporation (FMC), American Can Company (ACC), Shin-I Machinery Works Co. Ltd. (Shin-I), and Shin Hwa Nan Metals Co., Ltd. (Shin-H).

Table 1 summarizes the relevant features of the six plant designs with data on machinery specifications. From the viewpoint of labor intensity, plant design I is the least labor-intensive as most of its operations require the least number of workers per fruit. It has high-speed and automated machines even in the relatively more labor-intensive operations such as trimming and packing. Plant design I represents some plant designs adopted in labor-scarce countries like Hawaii and Australia.

Plant designs II and III are similar to Dolefil and Philpack plants, respectively, since most of the technical specifications of their machines reasonably approximate those of these two firms. Plant designs II and III are more labor-intensive than plant design I as most of their machines have slower speeds and most of their operations, especially in trimming and packing, involve more workers per fruit. Moreover, plant design III is more labor-intensive than plant design II as it has machines of slower speeds, that operate semi-automatically with more workers per fruit.

On the other hand, plant designs IV, V, and VI represent more, the pineapple canneries in LDCs. Plant design IV could represent some of the pineapple canneries in the Ivory Coast and West Indies, whereas plant designs V and VI represent Taiwanese and Malaysian pineapple canneries, respectively. These plant designs are more labor-intensive than plant designs I-III because most of the former's machines have slower speeds and most of their operations, particularly in trimming and packing, require more workers per fruit. Finally, plant design VI is the most labor-intensive as it requires the largest number of workers per fruit. Most of its machines have the slowest speeds and some operations such as casing involve manpower inputs only.

TABLE 1

Summary Features Of Six Proposed Plant Designs
(As Modified)

	No. of Units	Prices as of 1972 (US$)	Labor Require-ments	Capacity[1] Per Minute	Horse-power
Plant Design I					
Equipment (Manufacturer):					
Ginaca, blower, chutes (Honiron)	1	52,356	1-1	120 fpm	8
Two-Diameter Preparation Table (Honiron)	1	19,536	4-10		16
Single Knife Slicer[1] (Honiron)	1	9,150	none	1800 spm	1
Corer-can Loader (Honiron)	3	37,200	4-6	120 cpm	1.5
Resizer-Corer[1] (Honiron)	1	14,370	2-4	320 spm	1.5
Segment Cutters (Honiron)	2	6,400	none	60 spc	1
Rotary Disc Accumulator (Manzini)	1	791	1-1		none
Vacuum Syruper (Manzini)	1	20,785	1-2	200 cpm	3.5
Automatic Seamer (Manzini)	1	24,445	1-2	350 cpm	3.5
Cooker-Cooler-Dryer (Manzini)	1	49,133	2-2	180 cpm	5
Labeller (Standard-Knapp)	1	7,280	1-1	290 bpm	1
Case Filler (Chisholm-Ryder)	1	3,070	1-1	10 bpm	.5
Case Sealer (Ellict)	1	11,500	1-1	10 bpm	1.5
		$257,016	19-31	120 fpm	43-47

Continuation of Table 1

	No. of Units	Prices as of 1972 (US$)	Labor Requirements	Capacity[1] Per Minute	Horsepower
Plant Design II					
Equipment (Manufacturer):					
Ginaca, blower, chutes (FMC)	1	35,000[2]	1-1	75 fpm	8
Pineapple Trimming Table (FMC)	1	3,500	5-8		3
Automatic Pineapple Slicer (FMC)	1	3,875	1-1	1,200 spm	.5
Tidbit Cutter (Urschel)	1	9,135	1-1	50 lbspm	.5
Dicer (Urschel)	1	11,175	1-1	50 lbspm	.5
Resizer (FMC)	1	4,000[2]	1-1	220 spm	.5
Pineapple Packing Table (FMC)	1	3,500	7-10		3
Transfer Disc (Standard Metal Products)	1	550	1-2		none
Vacuum Syruper (American Can Company)	1	19,000[2]	1-1	120 cpm	3
Automatic Seamer (American Can Company)	1	16,000[2]	1-1	120 cpm	3
Cooker-Cooler-Dryer (FMC)	1	30,000[2]	2-2	100 cpm	4
Labeller (FMC-Kyler)	1	4,613	1-1	100 bpm	.5
Case Filler (FMC-Kyler)	2		2-2	5 bpm	.5
Case Sealer (FMC-Kyler)	1	1,000	1-1	5 bpm	1
		$141,348	26-33	75 cpm	28

Continuation of Table 1

	No. of Units	Prices as of 1972 (US$)	Labor Requirements	Capacity[1] Per Minute	Horsepower
Plant Design III					
Equipment (Manufacturer):					
Ginaca, chutes, etc. (FMC)	1	15,000	1-1	60 fpm	3
Pineapple Trimming Table (FMC)	1	3,500	7-12		3
Semiautomatic Pineapple Slicer (FMC)	1	3,000	1-1	90 spc	1
Semiautomatic Tidbit Cutter (FMC)	1	3,000	1-1	40 lbspm	.5
Semiautomatic Dicer (FMC)	1	4,000	1-1	40 lbspm	.5
Semiautomatic Resizer (FMC)	1	2,500	1-1	180 spm	1
Pineapple Packing Table (FMC)	1	3,500	6-11		3
Stainless Steel Tank Accumulator (FMC)	1	300	1-2		none
Exhaust Box with Instrument (FMC)	1	7,000	1-1	85 cpm	3
Automatic Seamer (Angelus)	1	10,000	1-1	85 cpm	3
Retorts (FMC)	1	2,710	1-2	80 cpm	5
Adjustable Labeller (FMC-Kyler)	1	1,000	1-1	85 cpm	.5
Case Filler (FMC-Kyler)	1	1,000	1-1	4 bpm	.5
Manual Case Sealer (Dixie Co.)	1	45	1-1	n.a.	none
		$56,555	25-37	60 fpm	24

Continuation of Table 1

	No. of Units	Prices as of 1972 (US$)	Labor Requirements	Capacity[1] Per Minute	Horse powe
Plant Design IV					
Equipment (Manufacturer):					
Semi-automatic Hand Operated Pineapple Sizer and Corer (FMC-Elliot)	3	13,660	3-6	46 fpm	n.a.
Pineapple Trimming Table (FMC)	1	3,500	6-10		3
Model 100 Automatic Pineapple Slicer (FMC)	1	3,875	1-1	over 46 fpm	n.a.
Semi-automatic Dicer (FMC)	1	2,000	1-1		n.a.
Pineapple Packing Table (FMC)	1	2,000	5-10		n.a.
No. 60-6 Valve Syruper (FMC)	1	1,470	1-1	over 46 cpm	1
Stainless Steel 150 Gallon 2-Tank Units	2	940	1-1	over 46 cpm	n.a.
3 B Exhaust Box with Instruments	1	5,000	1-1	over 46 cpm	2
Double Seamer Can Closing Machine (Angelus)	1	6,000	1-1	over 46 cpm	3
Open Process Kettles with Instruments (FMC-Kyler)	3	5,130	3-3	over 46 cpm	n.a.
Heavy Duty Retort Crates (FMC-Kyler)	18	1,000	2-3	over 46 cpm	n.a.
Model B Adjustable Labeller (FMC-Kyler)	1	4,613	1-1	over 46 cpm	2
Model P Caser (FMC-Kyler)	2		2-2	over 5 bmp	2
		$49,188	28-41	46 fpm	13

Continuation of Table 1

	No. of Units	Prices as of 1972 (US$)	Labor Requirements	Capacity[1] Per Minute	Horsepower
Plant Design V					
Equipment (Manufacturer):					
Automatic Corer and Sizer for Pineapple (Shin-I)	1	8,000	1-1	26-32 fpm	1
Trimming Table (Shin-I)	1	2,397	6-8		2
Pineapple Slice Machines (Shin-I)	1	955	1-2	60 fpm	.5
Tidbit Cutter "hand-operated" (Shin-I)	1	408	1-1	n.a.	none
Dicer "hand-operated" (Shin-I)	1	408	1-1	n.a.	none
Resizer "hand-operated" (Shin-I)	1	408	1-1	n.a.	none
Packing Table (Shin-I)	1	3,389	5-9		3
Manual Hand Marker (Shin-I)	2	90	2-2	n.a.	none
Gear-type Exhaust Box (Shin-I)	1	3,309	1-1	40-60 cpm	1
Semiautomatic Seamer (Shin-I)	2	2,104	2-2	40-60 cpm	1
Horizontal Retort (Shin-I)	2	1,714	1-2	570 cans	4
Semiautomatic Labeling Machine (Shin-I)	1	100	1-1		n.a.
Case Filler	0		1-1		n.a.
Manual Case Sealer (Shin-I)	2	100	1-1		none
		$23,382	25-33	32 fpm	12.5

Continuation of Table 1

	No. of Units	Prices as of 1972 (US$)	Labor Requirements	Capacity[1] Per Minute	Horse powe
Plant Design VI					
Equipment (Manufacturer):					
Semi-Automatic Corer and Sizer for Pineapple (Sin Hwa)	1	2,000	1-2	20 fpm	n.a.
Trimming Table (Sin Hwa)	1	400[2]	5-6	over 20 fpm	n.a.
Packing Table (Sin Hwa)	1	400[2]	5-7	over 20 fpm	n.a.
Piece Machine (Sin Hwa)	1	408	1-2	20 fpm	n.a.
Manual Hand Machine (Sin (Hwa)	1	45	1-2	n.a.	none
Gear-type Exhaust Box (Sin Hwa)	1	3,309	1-1	70 cpm	2
Semi-Automatic Seamer (Sin Hwa)	1	1,052	1-2	30 cpm	1
Horizontal Retort (Sin Hwa)	2	1,714	1-2	over 30 cpm	n.a.
Semi-Automatic Labeling Machine (Sin Hwa)	1	100	1-1	over 30 cpm	1
Case Filler	0		1-1		
Case Sealer	0		1-1		
		$9,428	19-27	20 fpm	4

Continuation of Table 1

Legend:

fpm = fruits per minute
spm = slices per minute
cpm = cans per minute
spc = slices per cycle
bpm = boxes per minute
lbspm = pounds per minute

[1] The capacities of other machines are not less than the over-all rated capacities of the plants as indicated by that of the Ginaca.

[2] Approximated by the representatives of the manufacturers or seller.

Source: Honolulu Iron Works Company, American Can Company, Shin-I Machinery Works Co. Ltd., and Sin Hwa Nan Metal Co. Ltd.

Though Table 1 presents six plant designs of different capacities, Table 2, however, compares four plant designs that are grouped into two pairs of equal rated capacity. But unlike the first six, the four plant designs do not include data on machinery specifications. Each pair of plant designs of equal rated capacities illustrates the differences in labor requirements between a modernized and a conventional plant. Although only ten plant designs were obtained, most respondent firms, however, indicated their capabilities to propose (with study fees) numerous MLI plant designs of equal capacities, even of Dolefil and Philpack capacities, to prospective business clients.

In addition to the feasibility of machinery substitution within each operation, the plant designs could be combined (with or without duplication) to derive plant designs of intermediate labor intensities. With duplication, the number would increase tremendously so as to "smooth" out factor proportions. The labor intensities of the intermediate plant designs are, however, necessarily confined to those of the proposed plant designs.

Finally, pineapple canneries are designed within the framework of food canneries. Machines of various speeds and technological vintage used in ancillary operations would increase the number of integrated MLI plant designs. The United States Agency for International Development (USAID), for instance, proposed three small and unspecialized canneries of different labor requirements per canned fruit output [see USAID 1972]. Since the labor requirements of the

USAID proposed integrated plants pertain to the processing of various fruits, it becomes inaapropriate to compare them to those of the specialized pineapple cannery proposals. To be sure, the integrated proposed MLI plant designs have already invalidated the technological fixity assumption in the long-run.

Competitiveness of MLI Pineapple Canneries

This section discusses the competitiveness of MLI pineapple canneries by an intercountry comparison of labor intensities and efficiency of actual firms in the production and/or export of canned pineapples. It is limited to the firms in Malaysia, Taiwan, Hawaii, and the Philippines due to the inavailability of information on firms in other countries. At any rate, the selected countries have produced more than 80 per cent of the known world canned pineapple output.

Because of the insufficiency of microdata on capital and labor, firms are classified according to labor intensities using the speeds of the Ginacas[1] or peeling and coring machines installed in their canneries as the main criterion.[2] Although this classification is arbitrary, it reasonably reflects, nonetheless, the level of mechanization in most departments of the canneries, since the speeds and labor coefficients of the Ginacas most likely determine those of other machines. The firms are, therefore, classified as follows: (1) capital-intensive (CI): those with a majority of Ginacas which could process more than 75 fruits per minute, each operated by only one worker; (2) labor-intensive (LI): those with a majority of Ginacas which could process about 50-75 fruits per minute, each operated by one worker and; (3) more labor-intensive (MLI): those with a majority of Ginacas which could process less than 50 fruits per minute, each operated by one or more workers.

Table 3 classifies the Hawaiian, Taiwanese, Malaysian, and

[1] Ginaca is an indigenous machine that removes pineapple skins, cores the fruit, and trims the ends. The machine is called "Ginaca" after its inventor.

[2] The classical study of Boon 1964 classifies techniques according to labor intensity solely based on the speeds of machines. Similarly, Haendler and Py 1971, Tkatchenko 1941, classify pineapple processing techniques according to the types of the Ginacas. In contrast, Farmer 1966 distinguishes a conventional from a modern pineapple processing method with the trimming operation as the main basis. On the importance of the Ginaca to the processing of pineapple, see, among others, Ugas 1971 and Lopez 1969.

TABLE 2

Comparison Of Labor Requirements In The Processing Of Pineapple In Two Plant Designs Of Equal Capacity

	Number of Required Persons
I. Capacity up to 75 pineapples per minute	
A. Conventional Plant Design	
Operation	
Trimming	14-20
Packing	12-18
Salvage	2-4
Supervision	1-2
Total	29-44
B. Modernized Plant Design with the "Two-Diameter" System	
Operation	
Trimming	2-3
Strip scraps	1-1
Separate clean and spotted slices	1-2
Sort fancy and choice slices (1st can loader)	2-3
Operator and can loader	1-2
Select spotted slices for resizing	1-2
Inspect resized slices	1-2
Setup rejected slices for "pick eye"	1-2
"Pick eye" column of slices	1-1
Final inspection of broken and crushed mat from "pick eye"	1-1
Final check line rejects	1-1
Supervision	1-1
Total	14-21

Continuation of Table 2

	Number of Required Persons
II. Capacity up to 80 pineapples per minute	
A. Conventional Plant Design	
Operation	
Feed Ginaca	1-1
Trimming	12-20
Packing	12-16
Salvage	2-4
Total	27-41
B. Modernized Plant Design with the "Two-Diameter" System	
Operation	
Feed Ginaca	1-1
Trimming	1-3
Slicing	none
Strip scraps	1-1
Sort and clean spotted slices	1-2
Grade clean slices	2-4
Select and prepare resized slices	1-2
Sort and prepare resized slices	2-4
Salvage operations	2-4
Total	11-21

Source: Honiron *Two-Diameter Pineapple Preparation System* (Honolulu: Honolulu Iron Works Company, 1966).

Philippine firms according to their labor intensities using the abovementioned criterion. Dolefil and Philpack have labor intensities that are in-between those of the Hawaiian firms which are more capital-intensive, and those of the Malaysian and Taiwanese firms which are more labor-intensive. The ranking of the firms seems realistic as they were also classified as such in other technical studies that may have used different criteria of labor intensity[3] [e.g., Abraham 1971, Py 1965].

Table 3 also documents the survival of MLI firms such as the Taiwanese and Malaysian firms. MLI firms even outsurvived some capital-intensive firms in Hawaii. Many Malaysian and Taiwanese firms have been existing since the pre-World War years or early 1950s. On the other hand, seven of the Hawaiian firms and one Philippine firm have ceased operations.

Although various factors may have accounted for the competitiveness of the firms, it could be argued that competitiveness is greatly due to the production techniques of firms, because the canned pineapple industry has been a technology-based industry[4] [Haendler and Py 1971, Abraham 1971, Mark and Naya 1962]. Consequently, the competitiveness of firms as established solely by survival,

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[3] For instance, most Taiwanese firms even installed non-Ginaca, manually operated peeling and coring equipment because they process a smaller amount of pineapple compared to Philpack and Dolefil. Likewise, substantially large employment in the peeling and coring operations in Malaysia indicates that Malaysian firms are more labor intensive compared to Dolefil and Philpack because the latter firms employ only a machine operator, i.e. feeder, for every Ginaca installed.

[4] Fresh pineapple harvest is a necessary, but not sufficient condition, for the production of canned pineapple. Plausibly, the comparative advantages of the leading canned pineapple countries are potentially established by their fresh pineapple harvests. The expedient omission of natural resources from popular foreign trade models makes these trade models less effective in the explanation of the comparative advantage of some countries in given instances [see, particularly, Vanek 1963]. Recently, however, Hufbauer 1966, and others like in Vernon 1970, put technology as more significant to the comparative advantage of some industries. In regard to canned pineapple, the climatic or resource advantage of tropical regions could be diminished with increased trading in fresh pineapple within some tropical-temperate boundaries. Some firms are reportedly engaged in the canning of pineapple in their plants located in non-tropical areas, e.g., Canadian Canners Ltd., Fourniers Inc., Limpact Bros., Inc. [Edward E. Judge & Son 1972]. In fact, about 200 thousand tons were annually produced in continental U.S. from 1951-66 [Pineapple Growers Association of Hawaii (PGAH) 1973_a].

TABLE 3

Firms Engaged In The Production And Export Of Canned Pineapple In Hawaii, Taiwan, Malaysia, And The Philippines

	Classified According to Technology	Year Established	Year Closed
HAWAII			
Del Monte Corporation	CI	1917	surviving
Dole Company	CI	1901	1975[1]
Haserot Pineapple Company, Ltd.	CI	1962	1973
Hawaiian Fruit Packers	CI	1932	1973
Libby, McNeil & Libby	CI	1909	1970
Maui Land and Pineapple Company	CI	1962	surviving
Maui Pineapple Company	CI	1932	1962
Baldwin Parkers, Ltd.	CI	1912	1962
Hawaiian Canneries	CI	1913	1962
Kauai Pineapple Company	CI	1906	1964
TAIWAN			
Chung Hsing Canned Factory Co., Ltd.	MLI	1962	surviving[2]
Chung Nam Canned Food Manufacturing	MLI	1966	surviving
Hwa Chen Canned Food Industrial Corp.	MLI	1957	surviving[2]
Kuan U Yuan Canned Food Factory, Ltd.	MLI	1950	surviving
Pollo Food Canning Factory Co., Ltd.	MLI	1956	surviving
Sentai Canning Factory Corp.	MLI	1937	surviving
Shang-Ho Packing Corp.	MLI	1962	surviving
T.K. Canned Foods Corp.	MLI	1958	surviving
Ta San Fa Food Industrial Corp.	MLI	1967	surviving
Tai Change Industrial Corp., Ltd.	MLI	1959	surviving
Tai Hong Canned Food Factory, Ltd.	MLI	1945	surviving[2]
Tai San Fa Food Industrial Corp.	MLI	1947	surviving
Tai Shin Canned Food Factory Co., Ltd.	MLI	1961	surviving
Taitung Food Products and Supply Corp.	MLI	1968	surviving
Taiwan Canneries Consolidated Corp.	MLI	1954	surviving
Taiwan Kagone Co., Ltd.	MLI	1965	surviving
Taiwan Pineapple Corp.	MLI	1955	surviving
Taiyu Products Corp.	MLI	1953	surviving[2]
Ter Lih Canning Factory Co., Ltd.	MLI	1959	surviving

Continuation of Table 3

	Classified According to Technology	Year Established	Year Closed
TAIWAN			
Tong Hsing Food Industrial Corp.	MLI	1956	surviving[1]
International Quick Frozen Corp.	MLI	1967	surviving
Lu Ho Shing Canned Food	MLI	1960	surviving[1]
Taiwan Maling Canned Goods Factory Co., Ltd.	MLI	1949	surviving
MALAYSIA			
Lee Pineapple Co. Sdu. Bhd.	MLI	1931	surviving
The Malayan Pineapple Co. Sdu. Bhd.	MLI	1930[3]	surviving
Pineapple Cannery of Malaya Sdu. Bhd.	MLI	1964	surviving
United Malayan Pineapple Growers and Canners	MLI	1933	surviving
PHILIPPINES			
Philippine Packing Corporation	LI	1926	surviving
Dole Philippines, Inc.	LI	1963	surviving
Midwest Manufacturing Corp.	LI	1965	1973

[1] As reported in *Hawaii '72 Annual Economic Review* (Honolulu: Bank of Hawaii, 1972).

[2] Passed the Taiwan Government Factory Inspection for Export Standard.

[3] Unofficial based on interviews.

Legend:

CI = capital-intensive with a majority of Ginacas that could process more than 75 fruits per minute.

MLI = more labor-intensive with a majority of Ginacas that could process less than 50 fruits per minute.

LI = labor-intensive with a majority of Ginacas that could process about 50-75 fruits per minute.

Source: *1973 Pineapple Fact Book/Hawaii* (Honolulu: The Pineapple Growers Association, 1973); *Taiwan Buyer's Guide 1968-69* (Taipei: China Productivity and Trade Center, 1968); China Credit Information Service Ltd. (Taiwan); Philippine Embassy (Malaysia); Register of Companies (Malaysia); and Various Interviewees.

especially in exports, correspondingly establishes the competitiveness of the production techniques used by the firms. The main rationale for this criterion is that it becomes acceptable to establish the competitiveness of firms by the efficiency of their production function.[5]

The use of MLI production techniques by surviving Taiwanese and Malaysian firms establishes *prima facie* evidence on the competitiveness of MLI technology. This evidence is strengthened further by the persistent use of MLI production techniques by Taiwanese and Malaysian firms even if capital-intensive techniques have been available. In contrast, one of the most important reasons for the closing of Midwest Manufacturing Corporation seems to be its heavily capital-intensive plant within the context of the Philippine environment.[6] Moreover, despite the prevalent installation of labor-saving devices, some well-established, capital-intensive firms such as those in Hawaii (also Australia and Mexico) planned to shut-down. Despite the adoption, for instance, of one of the latest capital-intensive techniques in the Haserot Pineapple Company in 1965, it still dropped out of business in 1973. Hawaii's share in the world canned pineapple output significantly declined, but those of Malaysia and Taiwan increased (Table 4). Finally, despite protective tariffs or quotas on processed pineapple imports already imposed in some countries, canned pineapple exports of Taiwan and Malaysia have increased (Table 5), particularly in the leading, high-income, importing countries[7] (Table 6).

[5] Stigler 1952 seems to assert that the production function of firms is regarded by some economists as the indicator of total efficiency or competitiveness of firms. On the theoretical disputes on efficiency, see, for instance, Hall and Winsten 1959, Friedman 1962; and for a discussion of the measurement of efficiency, refer to Lau and Ytopoulous 1971.

[6] Based on interviews with former officers of the Midwest Manufacturing Corporation, it was learned that the cannery of that firm was established under the supervision of an expatriate American officer, formerly of Philpack, who prescribed the machines installed therein. The fact that Midwest's cannery became too capital-intensive could be evidenced by its underutilization. The cannery was normally operated only during the summer months as the pineapple supply from independent farms used to be extremely low for commercial operations.

[7] Mr. William Sun, former Taiwanese Ambassador to the Philippines, said that Taiwanese canned pineapple products are banned as commercial imports in the Philippines. On the other hand, Paul and Mote 1970, McGeehan 1968 seem to imply that the test of economic efficiency is export perfoance (or perhaps unprotected import substitution).

Although various factors accounted for the declining competitiveness of Hawaii, it is well documented, however, that the trend was, by and large, caused by Hawaii's increasing wage disadvantages which unlike the early post-World War period [see, e.g. Abraham 1971, International Processed Fruit 1970, Mark and Naya 1962], had not been counterbalanced by its technological advancement. The lack of time series data precluded the analysis of comparative movements in unit labor costs in the production of canned pineapple in the countries under study. Table 7, nevertheless, indicates that Hawaii has substantially higher unit labor costs compared to Taiwan, Malaysia, and the Philippines in spite of her higher scale of production and greater capital-intensity. It could be inferred, then, that Hawaii's high labor costs, among other factors, largely caused the declining Hawaiian competitiveness[8] [on this see Newsweek 1974].

On the other hand, almost all of the other significant advantages considered to have accounted for Hawaii's competitiveness, *viz.*, preference for quality products, supply of fresh pineapple, cannery-plantation integration, and multinational investments, have not adversely affected the comparative advantage of Hawaii. The increasing per capita income of leading pineapple importing countries, for instance, should have tremendously favored Hawaiian canned pineapple exports [Abraham 1971, Cushing 1963]. Furthermore, in spite of land rents, Hawaiian firms planned to export relatively more fresh than canned pineapple [Philipp and Baker 1974, PGAH 1973$_b$, Bank of Hawaii 1972] which would make the firms definitely more land-intensive than labor-intensive in terms of value-added shares. Moreover, Hawaiian canneries have become more inte-

[8]The Hawaii State Department of Agriculture (HSDA) reports that the Number One problem being faced by Hawaiian pineapple nowadays is "high production costs compared to foreign produced pineapple" which is due to the fact that "labor costs account for about one half of total production costs." [HSDA 1972, p. 3]. PGAH 1973$_b$ criticizes the findings of the State Report particularly on labor costs. PGAH 1973$_b$, however, complains that "Productivity-Output per man hour has not kept up with increases in average hourly earnings" [PGAH 1973$_b$, p. 19]. Lastly, although PGAH 1973$_b$ reiterates that the Hawaiian special tax of 2 1/2 per cent on pineapple canning in Hawaii since 1960 has most strongly handicapped Hawaii's competitiveness (see sample of advertisements reprinted in PGAH 1973$_b$, pp. 8, 11, 20, 25); it states, however, that the current annual special taxes amount to only $703,000, but the two Minimum Wage Bills currently before the Hawaiian State Legislature "would raise the seasonal wage bill alone in 1974 by $2,783,351." [PGAH 1973$_b$, p. 27].

TABLE 4

Production Of Canned Pineapple In Hawaii, Taiwan, Malaysia, And The Philippines (In thousand standard cases)

Year	Hawaii	Taiwan	Malaysia[1]	Philippines[2]	World Production
1970	12,028	4,554	3,374	4,899	35,648
1969	11,596	4,919	3,322	5,350	34,682
1968	12,116	4,059	3,124	5,423	31,866
1967	11,994	3,808	3,079	2,768	30,389
1966	13,168	4,342	2,842	2,214	30,365
1965	12,594	4,306	3,241	2,170	30,071
1964	11,520	3,804	2,620	1,685	27,187
1963	12,731	2,343	2,512	1,587	25,836
1962	13,177	2,720	2,355	1,940	25,599
1961	13,130	2,897	2,197	2,126	26,597
1960	13,240	2,227	1,919	2,195	25,345
1959	12,585	1,731	1,889	2,165	24,097
1958	12,863	1,744	2,015	1,044	23,243
1957	12,220	1,143	1,805	1,053	21,535
1956	13,211	1,132	1,753	1,146	21,676
1955	13,726	1,024	1,220	1,773	21,555
1954	11,977	999	1,184	1,666	19,562
1953	12,227	415	851	3,655	17,818
1952	12,508	490	692	3,797	16,887
1951	10,953	388	830	2,616	16,058
1950	11,314	204	734	3,204	15,782

[1] Includes output in Singapore.

[2] Exports only (converted from metric tons to standard cases using 2204.622 lbs. = 1 metric ton and a standard case = 45 lbs.).

Source: *1973 Pineapple Fact Book/Hawaii* (Honolulu: The Pineapple Growers Association of Hawaii, 1973); *Statistical Bulletin* (Manila: Central Bank of the Philippines, 1971).

TABLE 5

Canned Pineapple Exports Of Hawaii, Malaysia, Taiwan, And The Philippines (In thousand metric tons)

	Hawaii*	Malaysia	Taiwan	Philippines
1970	31.1	62.3	80.9	100.0
1969	28.0	69.8	82.5	109.2
1968	27.7	67.0	77.3	110.7
1967	30.7	62.9	79.7	56.5
1966	41.3	58.9	77.9	45.2
1965	45.5	53.9	76.4	44.3
1964	49.8	43.7	59.4	34.4
1963	38.6	39.5	47.9	32.4
1962	51.2	36.6	46.9	39.6
1961	30.5	33.8	53.0	43.4
1960	32.6	33.0	37.5	44.8
1959	39.5	38.6	36.0	44.2
1958	43.9	41.5	27.4	21.3
1957	44.5	37.7	15.8	21.5
1956	45.7	30.4	19.5	23.4
1955	27.3	27.8	16.8	36.2
1954	33.0	21.6	12.1	34.0
1953	21.9	17.4	8.0	74.6

*Converted from lbs. to metric tons (2,205 lbs = 1 ton).

Source: Various issues of the following: *United States Exports, Commodity by Country; General Merchandise, Merchandise for Consumption* (US Bureau of Census); *West Malaysia Trade Statistics* (West Malaysian Department of Statistics); *Industry of Free China* (Taiwan); and the *Statistical Bulletin* (Central Bank of the Philippines).

TABLE 6

Canned Pineapple Imports Of The Leading Canned Pineapple Importing Countries* From Hawaii, Taiwan, Malaysia And The Philippines During Specified Marketing Years (In thousand cases)

Marketing Year	Hawaii (US)	Taiwan	Malaysia	Philippines	Total Imports
1973/72	1,348	2,940	2,462	3,763	18,617
1972/71	1,200	3,844	2,432	3,733	19,936
1971/70	1,348	3,638	2,652	3,699	19,697
1970/69	1,147	3,595	2,835	2,878	18,493
1969/68	1,130	3,490	2,728	2,384	17,500
1968/67	1,452	3,747	2,957	2,124	17,051
1967/66	1,692	3,442	2,616	1,343	15,628
1966/65	2,120	2,902	2,402	1,247	14,171
1965/64	1,940	2,613	2,286	1,420	13,415
1964/63	1,956	2,289	2,213	1,378	13,360
1963/62	2,320	2,171	1,915	1,434	12,362
1962/61	1,953	2,348	2,129	1,527	12,924
1961/60	1,353	1,841	1,698	1,426	11,589

*Canada, United States, Belgium-Lux, Denmark, Finland, France, West Germany, Netherlands, Sweden, United Kingdom New Zealand, and Japan

Source: Various issues of: *The Almanac of the Canning, Freezing, Preserving Industries* (Maryland: Edward E. Judge & Son).

TABLE 7

Estimated Annual Unit Cannery Labor Costs In The Production Of Canned Pineapple In Hawaii, Malaysia, Taiwan, And The Philippines (Converted to US dollars per standard or actual case)[1]

	per standard case[2]			per actual case	
	Hawaii	Malaysia	Taiwan	Philippines[4]	Hawaii
1971	2.86	n.a.	.34[3]	n.a.	1.93
1970	2.87	.62	n.a.	.23	1.99
1969	2.95	.64	n.a.	.31	1.97
1968	2.62	.65	n.a.	.34	1.83
1967	2.72	.66	n.a.	.31	1.82
1966	2.37	.66	n.a.	.25	1.70
1965	1.74	.67	n.a.	.22	1.74
1964	2.46	n.a.	.41	.30	1.67

[1] Based on the selling exchange rate.

[2] Equivalent to 45 lbs.

[3] Pertains to Taiwan Pineapple Corporation.

[4] Pertains to Philpack.

Source of Raw Data:

1973 Pineapple Fact Book/Hawaii (Honolulu: The Pineapple Growers Association of Hawaii, 1973); West Malaysia Department of Statistics (Malaysia); Council for International Economic Corporation and Development Executive Yuan (Taiwan); China Credit Information Service, Ltd. (Taiwan); Central Bank of the Philippines; Social Security System.

grated with plantation operations as the Hawaiian firms have acquired the lands of independent growers whereas the Taiwanese and Malaysian canneries are still substantially dependent on the harvest of independent growers [Abraham 1971]. Finally, the multinationals which operate the biggest Hawaiian pineapple canneries, *viz.*, Castle and Cooke Inc. and Del Monte Corporation, have started expanding their investments to some LDCs such as Kenya, Cameron, Thailand, mainly because of low wages in those areas.[9]

MWL as a Constraint in the Choice of MLI Plant Designs of Philippine Pineapple Canneries

As the availability of MLI plant designs disproved *ex ante* technological fixity, the competitiveness of MLI canneries argued against the *ex post* fixity assumption in the long-run choice of technology. Furthermore, the differences in the labor intensities of the canneries of Dolefil and Philpack compared to those of the canneries of the Dole Company and Del Monte Corporation respectively invalidated the hypothesis that production processes of US multinationals are standard across countries [Hal Mason 1973, Yeoman 1968]. Dolefil and Philpack, however, did not adopt MLI plant designs for their canneries as installed, for instance, in the Taiwanese or Malaysian canneries. It is, therefore, the main objective of this section to ascertain the influence of various factors in constraining the establishment of MLI canneries in the Philippines. The importance of wages, particularly the legal minimum as a determinant of labor intensities is evaluated in accordance with a "testable" MWL hypothesis.

Stated in a testable proposition, it is hypothesized that the higher the wage rate in a country compared to that of another country, *ceteris paribus*, the lower the labor intensity of the firms in the former as compared to the latter country. In terms of a general MWL hypothesis, it is as if the country with the lowest average wage rates represents the "no-MWL" situation, while the countries with higher average wages represent various MWL situations. Finally, in accordance with a corollary hypothesis on the constraint of the Philippine MWL on the choice of MLI technology as used in Taiwan and Malaysia, one would expect to find that Philippine manufacturing wages, particularly in the canned pineapple industry, are higher compared to those in Taiwan and Malaysia.

[9] Extracted from the letter of J.D. Winter of the Tropical Fruit Institute, dated February 1972.

To test this MWL hypothesis, the average wage rates in the manufacturing industries and the minimum wage rates in the canned pineapple industry in the Philippines were respectively compared with those in Hawaii, Malaysia, and Taiwan, particularly during the early 1950s and mid-1960s when Philpack and Dolefil, respectively, established their canneries.

Manufacturing wage rates were obtained from the various issues of an official publication in each country, except Malaysia which has no available data. The wage rates of unskilled workers in the industrial sector of Manila and Suburbs published in the *Statistical Bulletin* (Central Bank of the Philippines) represented the average Philippine manufacturing wage rates. Likewise, the wage rates of factory workers in Taiwan published in the *Industry of Free China* (Taipei: K.T. Li) represented the average Taiwanese manufacturing wage rates. Lastly, the manufacturing wage rates in Hawaii published in the *Employment and Earnings* (Washington D.C.: U.S. Bureau of Labor Statistics) represented the average Hawaiian manufacturing wage rates.

As for the canned pineapple industry in these countries, various estimates of the wage rates were used as proxies for the minimum wage rates. The average wage rates of the group of lowest paid workers in the Malaysian canned pineapple industry as estimated from various issues of the *Annual Report of the Ministry of Labour* (Kuala Lumpur: Ministry of Labour) were used as proxies for the minimum wage rates in the Malaysian firms. Similarly, the average wage rates of adult female workers in the Taiwanese canned food industry as derived from various issues of the *Report of Taiwan Labour Statistics* (Taiwan: Department of Reconstruction) were used as proxies for the minimum wage rates in the Taiwanese firms.[10] In contrast, the industrial legal minimum wage rates in the Philippines were also the minimum wage rates in the industrial sectors of the canned pineapple firms. Lastly, the minimum wage rates of regular cannery workers as interpolated from the *1973 Pineapple Fact*

[10] Perhaps, wage rates in the Taiwanese canned pineapple industry were not made available because most firms in the industry produce greater volume of other canned food, such that their workers are not strictly employed in the production of canned pineapple. However, wage rates in the specialized canning pineapple firms, as represented by those in the Taiwan Pineapple Corporation, were not necessarily higher than those in the whole canned food industry (based on the report of the China Credit Information Service Limited, and on the wage data furnished by the Taiwan Pineapple Corporation).

Book/Hawaii (Honolulu: Pineapple Growers Association of Hawaii) were used as proxies for the minimum wage rates in the Hawaiian pineapple canning firms.

As in other intercountry studies on wages [Minhas 1963, Arrow *et al.* 1961, and William and Eaton 1959], the domestic wage rates were converted to US dollars per hour, using the official selling exchange rates published in *International Financial Statistics* (Washington D.C.: International Monetary Fund). Unlike in the other studies, however, the use of the official selling exchange rates in this study would not significantly affect the relative wage positions of the countries under comparison because the firms in the canned pineapple industry are export oriented. Obviously, if the product wage rates (i.e. wage rates deflated by the prices of the products) are used instead, the Philippines would be in higher wage levels vis-a-vis Malaysia or Taiwan since its export prices were lower than those of Malaysia or Taiwan (Table 8). In effect, the use of the money wage rates is biased against the MWL hypothesis because the Philippine wage rates would appear lower than those of Malaysia and Taiwan. Lastly, though the Philippine peso has been occasionally overvalued, there is no definite indication, however, that its official selling exchange rates have been persistently more overvalued than those of the Taiwanese and Malaysian dollars [see Castro 1974 on the Philippine, Hsing 1971 on Taiwanese, and Power 1969 on Malaysian currency].

Table 9 shows that Hawaii's manufacturing wage rates were significantly higher than those of the Philippines or Taiwan, but those of the Philippines were significantly higher than those of Taiwan. In particular, the minimum wage rates in the Hawaiian canned pineapple industry were significantly higher than those of the Philippines, and even much more than the average wage rates in the Taiwanese or Malaysian canned pineapple industry. Also, the minimum wage rates in the Philippine canned pineapple firms were significantly higher than the average wage rates of the lowest paid workers in Taiwanese or Malaysian canned pineapple firms.

It is therefore likely that the labor intensities of the canned pineapple firms in these countries (Table 3) were influenced by the intercountry wage differentials (Table 9), particularly in the canned pineapple industry. Hawaii, the highest wage economy, for instance, has the least labor-intensive pineapple canneries, whereas Malaysia and Taiwan, the lowest wage economies, have the most

TABLE 8

Unit Values Of Aggregate Exports Of The Philippines, Taiwan, And Malaysia (Converted to U.S. dollars per ton)*

	Philippines	Taiwan	Malaysia
1971	196	225	240
1970	214	239	226
1969	158	226	226
1968	170	222	235
1967	179	219	227
1966	197	228	243
1965	197	224	246
1964	225	215	247
1963	224	218	243
1962	288	211	250
1961	242	195	254
1960	165	188	254
1959	181	201	n.a.
1958	206	164	n.a.
1957	212	236	n.a.
1956	234	281	n.a.
1955	164	191	n.a.
1954	138	297	n.a.
1953	148	n.a.	n.a.
1952	146	n.a.	n.a.
1951	152	n.a.	n.a.
1950	145	n.a.	n.a.

*Based on the official selling exchange rate.

Source of Raw Data:

Various worksheets on Philippine exports from the Department of Economic Research, Central Bank of the Philippines; Various issues of *Industry of Free China* (Taiwan); Various issues of *West Malaysia Trade Statistics* (Kuala Lumpur: West Malaysian Department of Statistics).

labor intensive ones. It could be concluded also that the MWL has constrained the choice of MLI technology for the cannery of Philpack or Dolefil because the industrial minimum wage rate in the Philippines was significantly higher than the average wage rates of the pineapple cannery workers in Malaysia or Taiwan. Obviously, this MWL constraint on the long-run choice of MLI technology has decreased the labor requirements of canning pineapple in the Philippines compared to those in Taiwan and Malaysia.

Lastly, it is definite that high Hawaiian wages forced the Hawaiian firms to discard their former labor-intensive technology, which is presently used in the Philippines. In other words, the more the Philippine legal industrial minimum wage approaches the Hawaiian level, *ceteris paribus*, the more the canneries of Philpack and Dolefil would approach the capital intensities of the Hawaiian firms.[11] This latter conclusion seems reasonable because Philpack and Dolefil are mere subsidiaries of Hawaiian multinationals which prefer capital-intensive operations under *ceteris paribus* conditions. The available evidence on wage differentials, therefore, underscores the importance of MWL as a constraint on the long-run choice of MLI technology.

Concluding Remarks

This paper excludes other numerous factors, cited both in the literature on "appropriate" technology and by interviewed experts in the industry, as explanations for the non-adoption of MLI technology in the Philippine canned pineapple industry. Hypotheses on the choice of "appropriate" technology that take "too many" explanatory variables may lead to nonverifiable propositions, *viz*, hypotheses incapable of being refuted. Although the results of this study are not capable of generalization for the whole problem of inappropriate technology choice, it has presented price distortion as the first candidate that could explain the phenomenon of "inappropriate" technological choice in the LDCs. Unlike the current fuss to suggest the consideration of noneconomic variables, a plea should be made to economists to first study the implications of prices before they shift their attention to the variables of other disciplines. This is not

[11] It could be argued that the wage rate need not reach the levels of Hawaii, since the shut-down point might be reached first. This is because Hawaii already has a comparative advantage in regard to marketing; and the operations in the Philippines should bring out higher returns as investments outside the U.S. are considered more risky.

TABLE 9

Average Wage Rates In The Manufacturing Sectors And The Canned Pineapple Industry In Hawaii, Philippines, Taiwan, And Malaysia (In U.S. dollars per hour)[1]

	Hawaii		Philippines		Malaysia	Taiwan	
	Manufac-turing	Canned Pine-apple	Manufac-turing	Canned Pine-apple	Canned Pine-apple	Manufac-turing	Canned Pine-apple
1971	3.36	2.49	.186	.156	n.a.	.231	.093[2]
1970	3.17	2.32	.174	.156	n.a.	.198	n.a.
1969	3.02	2.16	.256	.190	n.a.	.187	.177
1968	2.81	2.05	.245	.191	n.a.	.178	.165
1967	2.56	1.93	.220	.191	.130	.158	.165
1966	2.44	1.84	.212	.192	.136	.139	.138
1965	2.28	1.75	.197	.192	.089	.131	.126
1964	2.14	1.67	.184	.128	.091	.120	.138
1963	2.04	1.63	.182	.128	.082	.121	.102[3]
1962	1.93	1.59	.172	.128	.090	.117	.096[3]
1961	n.a.	1.56	.302	.230	.106	.106	.090[3]
1960	n.a.	1.53	.288	.225	.115	.091	.070[3]
1959	n.a.	1.43	.282	.220	n.a.	.079	.057[3]
1958	n.a.	1.36	.315	.248	.091	.078	.057[3]
1957	n.a.	1.30	.313	.248	.075	.099	.076[3]
1956	n.a.	1.27	.326	.248	n.a.	.095	.075[3]
1955	n.a.	1.24	.321	.248	n.a.	.091	.072[3]
1954	n.a.	1.20	.312	.248	n.a.	.128	.092[3]
1953	n.a.	1.20	.316	.248	n.a.	.121	.088[3]
1952	n.a.	1.16	.307	.248	n.a.	n.a.	.085[3]
1951	n.a.	1.16	.287	.248	n.a.	n.a.	n.a.

[1] Based on the official selling exchange rate.

[2] Average wage rate of adult female cannery workers in the Taiwan Pineapple Corporation (1971 and 1973).

[3] Estimate based on the average wage ratio of the all adult and female adult workers during 1964-69.

Source of Raw Data:

1973 Pineapple Fact Book Hawaii (Honolulu: Pineapple Growers' Association of Hawaii, 1973); Various issues of the following: *Employment and Earnings* (U.S.: Bureau of Labor Statistics); *Statistical Bulletin* (Central Bank of the Philippines); Republic Acts 602, 4180, and 6129; *Annual Report of the Ministry of Labour* (Malaysia); *Industry of Free China* (Taipei: K.T. Li); *Report of Taiwan Labour Statistics* (Taiwan Department of Reconstruction); China Credit Information Service Ltd. (Taiwan); and Taiwan Pineapple Corporation.

to propose that economists should maintain their conceits, but merely to imply that they should not be as humble as a dentist.

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