retarded if not reversed. Chart 2 and Table 2.2 indicate a peak in the relative price of capital ($\omega_i = 1$) in 1963.

Since the issue of factor mix changes in response to relative factor prices becomes crucial later in this paper, it seems sensible at this stage to specify more carefully the behavior of ω_i from the mid 1950's to the present. Let us look first at capital costs. The footnote below indicates explicitly how $R_{i,t}$ is primarily determined by $r_{i,t}$ and $p^k_{i,t}$. Although we do know that r_t increased continually from 1955 to 1966, we have no information on the average interest rates

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(footnote 10 cont')

Kaldor (1957, 1962) and others have argued quite vigorously, of course, that the rate of interest is irrelevant in choosing factor mix. We prefer to adopt the traditional neo-classical approach where the annual cost of one unit of capital (R) can be written formally as

$$R = \frac{(P^k)\ (r)}{i - e^{-rl}},$$

and where

P^k = price of one unit of (fixed quality) capital goods,

r = interest rate

l = expected life of the investment.

Since l is unlikely to undergo great change, we can concentrate our attention on P^k and r {See W. Salter (1960), pp. 17-21}.

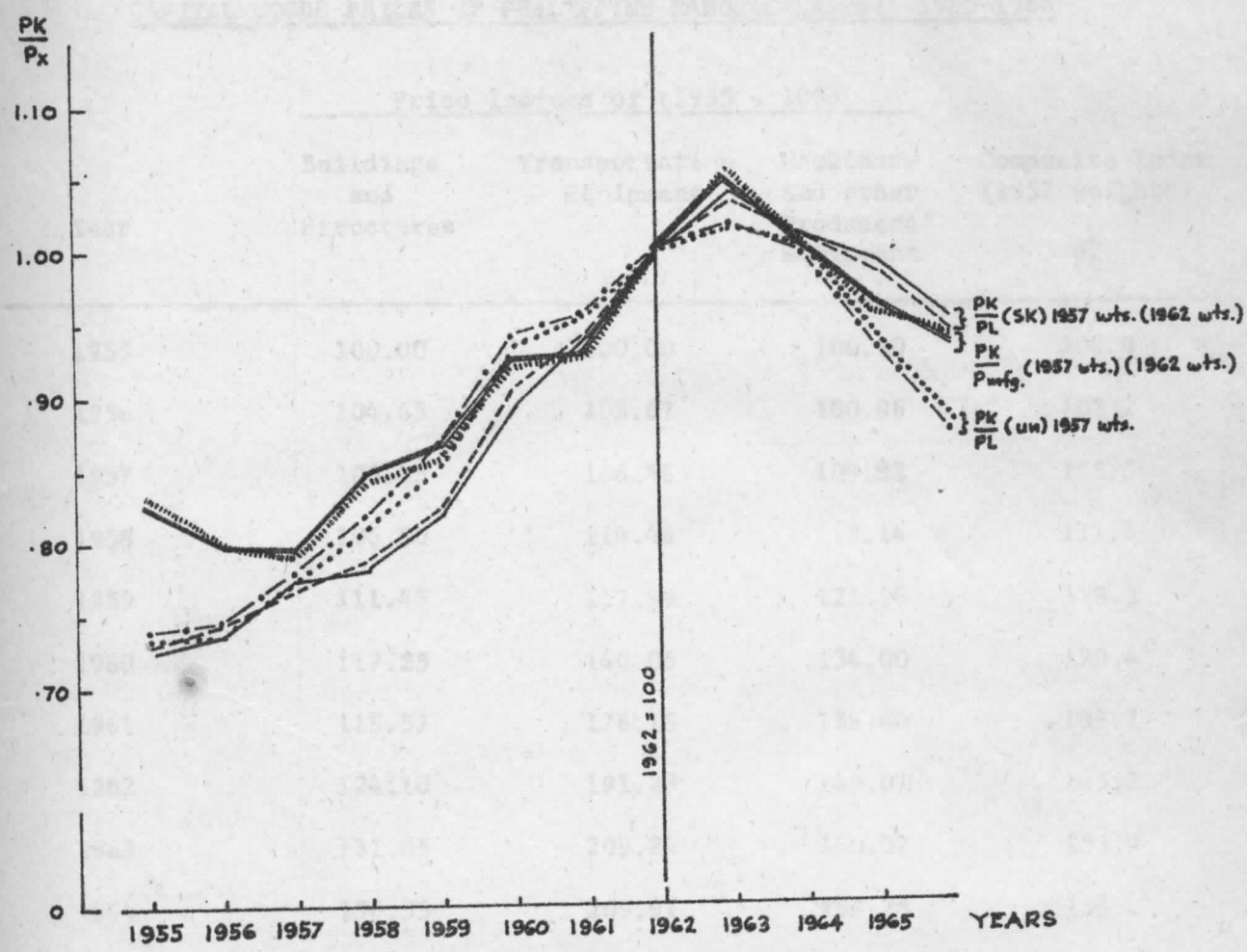

Chart 2. Relative Price of Capital
in Philippine Manufacturing, 1955 - 1966

Table 2.2

CAPITAL GOODS PRICES IN PHILIPPINE MANUFACTURING: 1955-1966

Year	Price Indices of (1955 = 100) Buildings and Structures	Transportation Equipment	Machinery and other Producers' Equipment	Composite Index (1957 weights) p_t^k
1955	100.00	100.00	100.00	100.0
1956	104.65	102.67	100.86	102.2
1957	106.45	106.56	104.82	105.5
1958	106.80	114.46	113.14	111.3
1959	111.45	117.99	121.98	118.3
1960	117.25	140.05	134.00	129.4
1961	116.57	176.16	138.40	135.2
1962	124.10	191.23	149.07	145.3
1963	131.35	209.24	160.27	155.9
1964	136.55	209.91	156.26	155.2
1965	139.15	212.60	154.63	155.3
1966	142.67	213.06	154.86	156.6

Source: Original data comes from the Central Bank Statistical Bulletin.

facing specific (ith) manufacturing sectors.[11] We instead concentrate our attention on the behavior of capital goods prices ($P^k_{i,t}$) since 1955. Table 2.2 presents the evidence for manufacturing as a whole. Although average prices of transportation equipment rose much more rapidly over the period as a whole, all three components -- building and structures, transportation equipment and machinery equipment, exhibit similar temporal behavior. The price of capital goods is fairly stable up to 1957, rises sharply to 1962-63, then stabilizes thereafter. These three stages are even more sharply delineated when P^k_t is deflated by P^c_t, the price of domestically produced manufactures: from 1955 to 1957 the relative price of capital goods declines; from 1957 to 1963 it rises at a brisk rate; since 1963 the "real" price of capital goods has revealed significant decline. The story is much the same when, in Table 2.3, we deflate capital goods prices by an index of the skilled or unskilled wage. It

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[11] One information on interest rates per firm is contained in a scatter of average interest rates on asset sizes of different firms in a recent cross-section study of investment in manufacturing firms. Although this information has no specific bearing on the model being pursued here, it may be of interest to note that the effective rates of interest for small firms grouped together were quite higher on the average than those charged against large firms, suggesting a diversity of interest rate charges facing different industries, depending on the average sizes of firms composing it. See R.W. Hooley & G.P. Sicat (1968).

Table 2.3

AN IMPERFECT MEASURE OF RELATIVE FACTOR PRICE MOVEMENTS IN PHILIPPINE MANUFACTURING: 1955-1966

Year	$\frac{p^k_t}{p^c_t}$	$\frac{W^s_t}{p^c_t}$	$\frac{W^{us}_t}{p^c_t}$	$\frac{p^k_t}{W^s_t}$	$\frac{p^k_t}{W^{us}_t}$
1955	100.0	100.0	100.0	100.0	100.0
1956	96.4	94.6	95.7	101.9	100.7
1957	95.4	90.5	90.8	105.5	105.1
1958	101.3	94.3	91.9	107.5	110.2
1959	103.2	91.9	88.8	112.4	116.2
1960	110.8	90.1	87.3	123.1	126.9
1961	111.9	86.7	86.4	129.0	129.5
1962	120.1	87.7	88.9	137.0	135.2
1963	126.7	88.8	92.2	142.6	137.5
1964	120.3	86.2	88.7	139.6	135.7
1965	115.2	84.8	90.9	135.8	126.8
1966	113.3	86.9	95.1	130.3	119.2

Source and Notes: Basic data is taken from the Central Bank Statistical Bulletin. P^c refers to the price of locally produced manufactures and all price indices use 1957 weights. It should be noted that the use of 1962 weights makes little or no difference in the secular movements of these factor and commodity prices.

W^{us} = index of unskilled labor average monthly earnings,

W^s = index of skilled labor average monthly earnings,

P^c = price of domestically produced manufactured goods.

appears that the relative price of capital has declined since 1962-63, reversing a trend which began at least as early as the mid 1950's. In fact, the index in 1966 lies below that of 1960 when we use W_t^{us} as the index of labor's price. As a final point, we should note that all industries, from 1957 to 1966, have been faced with similar relative factor price movements, certainly in direction if not also in degree. These capital goods prices are reported in the Appendix by 2-digit classification. However, great variety does appear when we consider the behavior of capital goods price deflated by the price of commodity output, or when we consider the price of capital goods compared to average wages of production workers (Table 2.4.3). Taking the latter measure, the most dramatic increases in the relative price of capital goods appears in beverages, tobacco, wood and cork, paper, non-metallic products and basic metals. The following industries underwent declines in relative capital goods prices: footwear, leather, rubber products, machinery, electrical machinery, and transport equipment.

This leads us to Johansen's final simplifying step. We assume that the relative increase in wages, ω_i, is the same in all industries. If we ignore for the moment our information on per unit capital costs by industry and instead concentrate on average wages, the assumption would appear to

Table 2.4.1

CAPITAL GOODS PRICE INDEX RELATIVE TO COMMODITY OUTPUT PRICE (p_t^k/p_t^c): 1957 = 100

Industry Code	57	58	59	60	61	62	63	64	65	66
20	100	1.04	1.20	1.23	1.14	1.28	1.23	1.10	1.10	1.00
21	100	1.05	1.10	1.26	1.17	1.39	1.32	1.23	1.23	1.21
22	100	1.05	1.12	1.20	1.23	1.35	1.44	1.46	1.42	1.42
23	100	1.10	1.14	1.14	1.16	1.25	1.33	1.23	1.17	1.14
24	100	1.08	1.15	1.07	1.06	1.00	1.01	.97	.92	.91
25	100	1.10	1.10	1.36	1.41	1.32	1.41	1.30	1.27	1.27
26	100	1.05	1.09	1.19	1.20	.96	1.20	1.16	1.16	1.09
27	100	1.03	1.01	1.15	1.10	1.21	1.39	1.30	1.30	1.26
28	100	1.06	1.14	1.16	.99	1.09	1.16	1.06	1.05	1.06
29	100	1.11	1.11	1.15	1.21	1.29	1.30	.82	.80	.60
30	100	1.09	1.11	1.03	.84	.90	.96	.94	.93	.85
31	100	1.03	1.08	1.19	1.12	1.10	1.14	1.10	1.09	1.11
32	100	1.07	1.13	1.03	1.15	1.18	1.23	1.20	1.17	1.15
33	100	1.01	1.09	1.14	1.28	1.34	1.35	1.29	1.22	1.20
34	100	.96	1.19	1.30	1.41	1.33	1.63	1.55	1.33	1.32
35	100	1.03	1.03	1.03	1.07	1.23	1.23	1.15	1.12	1.12
36	100	.97	.96	.94	.91	.95	.96	.97	.96	.99
37	100	.98	.95	.94	.90	.95	.99	.93	.92	.89
38	100	.98	.97	.89	.71	.75	.75	.74	.72	.73
39	100	1.01	1.01	1.04	1.11	1.14	1.16	1.13	1.16	1.14

Table 2.4.2

CAPITAL GOODS PRICE INDEX RELATIVE TO COMPUTED SURVEY AVERAGE WAGE OF PRODUCTION WORKERS (p^k/w_t): 1957=100

Industry Code	57	58	59	60	61	62	63	64	65	66
20	100	1.09	1.05	1.10	1.15	1.25	1.38	1.38	1.40	1.33
21	100	1.14	1.19	1.20	1.15	1.33	1.45	1.45	1.50	1.37
22	100	.90	.97	1.09	1.14	1.27	1.27	1.23	1.20	1.03
23	100	.89	.93	1.19	1.23	1.37	1.42	1.37	1.33	1.28
24	100	1.04	1.11	1.19	1.31	1.58	1.71	1.64	1.58	1.34
25	100	1.00	1.06	1.03	1.13	1.29	1.41	1.32	1.27	1.23
26	100	1.15	1.23	1.30	1.30	1.43	1.90	1.90	1.92	1.57
27	100	.87	.95	.96	.99	1.08	1.09	1.05	1.03	.93
28	100	1.09	1.02	1.40	1.47	1.51	1.74	1.68	1.64	1.69
29	100	1.00	1.13	1.25	1.24	1.36	1.74	1.98	2.31	2.39
30	100	1.07	1.10	1.12	1.36	1.82	1.86	1.73	1.65	1.52
31	100	1.02	1.06	1.19	1.28	1.51	1.59	1.47	1.39	1.33
32	100	n.a.	n.a.	n.a.	-	-	-	-	-	-
33	100	1.12	1.13	1.15	1.30	1.42	1.61	1.50	1.42	1.32
34	100	.95	.80	.79	.91	1.06	1.20	1.20	1.21	1.23
35	100	1.11	1.16	1.32	1.38	1.48	1.57	1.62	1.69	1.49
36	100	1.09	1.20	1.47	1.53	1.75	1.90	1.85	1.84	1.94
37	100	1.07	1.17	1.42	1.61	1.93	2.04	1.94	1.96	1.73
38	100	1.15	1.36	1.56	1.75	2.27	2.64	2.59	2.53	2.45
39	100	1.01	1.06	1.32	.83	2.23	2.52	2.26	2.06	1.91

Table 2.4.3

WAGES OF PRODUCTION WORKERS (P) COMPUTED FROM SURVEY (w_t)

Industry Code	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
20	1398	1418	1483	1491	1518	1546	1494	1481	1472	1561
21	2259	2088	2083	2360	2428	2496	2467	2438	2410	2654
22	1160	1337	1316	1282	1267	1252	1346	1380	1414	1656
23	1261	1489	1527	1360	1317	1275	1321	1349	1377	1431
24	930	963	939	954	870	787	777	811	845	1003
25	1332	1414	1419	1610	1513	1416	1465	1527	1590	1652
26	1492	1333	1314	1344	1358	1372	1109	1116	1124	1396
27	1462	1780	1742	1887	1867	1848	1980	2019	2058	2281
28	2448	2391	2739	2196	2093	1991	2086	2135	2185	2141
29	1109	1169	1107	1096	1133	1170	989	857	726	718
30	1665	1660	1739	1876	1583	1291	1361	1430	1500	1488
31	2117	2116	2221	2159	2054	1950	1986	2123	2261	2379
32	n.a.	n.a.	n.a.	n.a.	n.a.	4100	4184	5082	6106	6511
33	2202	1990	2056	2152	2167	2182	2079	2173	2267	2445
34	1812	1956	2436	2694	2520	2346	2240	2195	2151	2139
35	1810	1711	1737	1617	1637	1658	1669	1603	1538	1747
36	1819	1758	1673	1482	1475	1469	1450	1477	1504	1436
37	1602	1536	1490	1325	1227	1130	1196	1193	1191	1356
38	1971	1805	1629	1566	1369	1173	1084	1104	1124	1192
39	2052	2216	2134	1852	3113	1261	1197	1318	1439	1564

Note: 1961 interpolated from 1960-1962

1964 interpolated from 1963-1965

hold within Philippine manufacturing only when the manufacturing sector is disaggregated into six relatively homogeneous groups, as Table 2.5 shows. Within these six groups there is considerable homogeneity in experience with factor prices. This is not true between groups, however, as Table 2.5 shows.

Utilizing these assumptions, {2} can be simplified to read

$$\{3\} \qquad \frac{a_{i62}}{a_{i57}} = \left(\frac{A_{i62}}{A_{i57}}\right)^{\omega \beta_i}$$

or in log form

$$\{3a\} \qquad \log \left(\frac{a_{i62}}{a_{i57}}\right) = \beta_i (\log \omega) + \log \left(\frac{A_{i62}}{A_{i57}}\right).$$

The regression model used in this section is {3a}. We need only compute observations on the rate of growth of labor productivity over the five year period, $\left(\frac{a_{i62}}{a_{i57}}\right)$, and on the property income share in value added, β_i. In the regressions themselves, β_i is taken for 1957 and 1960. The end product of the regression tests is an estimate of the rate of technological change, $\frac{A_{i62}}{A_{i57}}$ and $\frac{A_{i65}}{A_{i60}}$, and an estimate of ω, a measure of the movement of the costs of labor relative to capital (by industry group). Thus, the Johansen model permits an indirect estimate of relative factor price movements which

Table 2.5

AVERAGE EARNINGS OF PRODUCTION WORKERS: PHILIPPINE MANUFACTURING, 1957, 1960, 1962 and 1965 (Current Pesos)

Industry		$W_{i,57}$	$W_{i,60}$	$W_{i,62}$	$W_{i,65}$	$\frac{W_{i,62}}{W_{i,57}}$	$\frac{W_{i,65}}{W_{i,60}}$	$\frac{W_{i,65}}{W_{i,62}}$
I								
20	Food	₱ 1398	1483	1670	1968	1.194	1.178	1.327
21	Beverages	2259	2361	2648	3138	1.172	1.185	1.329
22	Tobacco	1161	1293	1280	1455	1.102	1.137	1.125
II								
23	Textiles	1261	1464	1426	1701	1.131	1.193	1.162
24	Footwear	930	1089	1047	1318	1.126	1.259	1.216
29	Leather	1109	1175	1304	1360	1.176	1.043	1.157
III								
25	Wood and cork	1333	1483	1472	1898	1.104	1.289	1.279
26	Furniture	1492	1325	1501	1394	1.006	.929	1.056
IV								
30	Rubber	1665	2300	2031	2373	1.219	1.168	1.038
31	Chemicals	2117	2221	2448	3089	1.156	1.262	1.394
V								
34	Basic metals	1812	2425	2131	2316	1.176	1.087	.955
35	Metal products	1811	1854	1839	1961	1.015	1.066	1.056
36	Machinery	1820	1891	2183	2378	1.199	1.089	1.256
37	Electrical machinery	1603	1645	1619	1884	1.010	1.164	1.141
38	Transport equipment	1972	2174	2112	2231	1.071	1.056	1.027
VI								
27	Paper products	1463	2024	2075	2289	1.418	1.103	1.134
28	Printing	2450	2370	2517	3033	1.027	1.205	1.276
33	Non-metallic mineral	2203	2127	2285	2711	1.037	1.186	1.276
39	Miscellaneous	2053	2107	1508	1798	.734	1.192	.858
Group I		1441	1514	1659	1838	1.151	1.108	1.218
Group II		1045	1281	1340	1576	1.282	1.176	1.232
Group III		1316	1401	1377	1723	1.046	1.251	1.222
Group IV		1950	2254	2474	2910	1.269	1.176	1.292
Group V		2040	2090	2092	2045	1.025	.977	.977
Group VI		2185	2199	2329	2748	1.066	1.180	1.240
All Industry		1494	1655	1725	2033	1.154	1.178	1.221

Source: Basic data is taken from the Annual Survey of Manufactures, 1957, 1960, 1962, and 1965. The industry groups are described below. Industry (32), Petroleum, was not available.

can then be compared with observed changes in factor combinations in Philippine manufacturing over the period.

The regression model {3a} was estimated in two ways. First, we investigated an aggregate production function for manufacturing as a whole where the observations were 2-digit industries based on the Standard Industrial Classification. Second, we investigated a disaggregated production function for manufacturing. Due to the predictable non-homogeneity among industry groups and due also to the use to which the results of the disaggregated production functions are put later in the analysis, the second approach turns out to be much more meaningful and rewarding. The second approach, however, presents formidable data problems for it requires consistent 3-digit and 4-digit observations within industry groups. Since the Annual Survey changed its classifications over the period and since 4-digit industry groups appear and disappear over the period, we were able to get consistent pairs of observations containing each year (1957 and 1962; 1960 and 1965) in only a limited number of cases. These 3-digit and 4-digit industries are listed in Table 2.6 along with the larger industrial groupings under which they fall.[12]

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[12] We can summarize Table 2.6 in the following way:

Industry Group	2-digit Code	Number of observations at the 2-digit level or below
I	20, 21, 22	17
II	23, 24, 29	10

Table 2.6

INDUSTRY GROUPINGS FOR THE TESTS OF THE JOHANSEN MODEL ON PHILIPPINE MANUFACTURING DATA

Industry Group	ISIC	Description
Group I (N = 17)	201	Slaughtered, prepared and preserved meat
	2024	Milk processing
	203	Canned fruit and vegetables
	2051	Rice mill products
	2052	Corn mill products
	2056	Flour mill products
	2071	Sugar mill products
	208	Cocoa, chocolate and sugar
	2091	Vermicelli and noodles
	2093	Desiccated coconut
	2094	Vegetable lard and margarine
	2095	Coffee
	2096	Feeds for animals and fowls
	2097	Starch and by-products
	211	Distilled, rectified and blended liquors
	2141	Soft drinks and carbonated water products
	2211	Cigars and cigarettes
Group II (N = 10)	2314	Cotton, textile mill products
	2321	Hosiery knitting mill products
	2322), 2323)	Underwear and outwear
	2329	Other knitting mill products
	2331	Cordage, twine and net
	2411	Shoes, except rubber
	2412	Slippers, except rubber
	2431	Mens' and boys' garments
	2433	Womens' and childrens' garments
	29	Leather and leather products, except footwear and other wearing apparel
Group III (N = 6)	2511	Lumber (not worked)
	2512	Worked lumber
	2521) or 2522)	Veneer and plywood

Industry Group	ISIC	Description
	2611	Rattan furniture, except upholstered
	2621	Wood furniture, except upholstered
	2641	Metal furniture, except upholstered
Group IV (N = 10)	3011	Rubber shoes and slippers
	302	Tires, inner tubes and other rubber products
	3111)) & 3113)	Basic chemicals
	3117	Ethyl alcohol
	3121)) or 312)	Vegetable oils
	3191	Matches
	3192	Medical and pharmaceutical preparation
	3193	Perfumes, cosmetics and toilet prepration
	3194	Soap and other washing compounds
	3195)) or 3131)	Paints, varnishes
Group V (N = 11)	34	Basic metal products
	3511)) or 351)	Packer's cans, tin or aluminum
	3532	Architectural metal work
	3541	Stamped, enamelled, japanned and lacquered metal products
	355	Fabricated wire products
	357)) or 3591)	Metal shipping barrels
	362	Tractors and farm machinery
	364	Special industry machinery
	3731)) or 374)	Batteries
	3831	Motor vehicles, manufacfured and assembled
	3832)) or 3936)	Motor vehicles, engines, parts and bodies
Group VI (N = 11)	2712)) or 271)	Paper and board mill products

Industry Group	ISIC	Description
	272	Articles of pulp, paper and paper products
	28	Printed and published materials and allied products
	331	Structural clay products
	3321	Glass containers
	3322	Glass, mirrors and other glass products
	3341	Cement (hydraulic)
	3391	Structural concrete products
	3392	Lime
	3393)) or 3927)	Eyeglasses and spectacles
	3961	String instruments

The figures for labor productivity growth are given in Table 2.7. The overall impression is that the period 1957-62 was one of rapid improvement in average labor productivity whether measured by value added or gross output. Most of that growth occurs from 1957 to 1960 and 1962 to 1965 while stagnation prevailed in the middle (unstable) years of the period. Our purpose now is to isolate the sources of the growth in average labor productivity by applying the Johansen model to overlapping periods: 1957-1962 and 1960-1965.

2.1 Results Using the Johansen Model: 1957-1962. The tests were performed using the regression equation

$$\{3a\} \qquad \log\left(\frac{a_{i62}}{a_{i57}}\right) = \log\left(\frac{A_{i62}}{A_{i57}}\right) + \beta_{i57}\,(\log \omega),$$

but where the labor productivity data is deflated.[13]

(footnote 12 cont')

Industry Group	2-digit Code	Number of Observations at the 2-digit level or below
III	25, 26	6
IV	30, 31	10
V	34, 35, 36, 37, 38	11
VI	27, 28, 33, 39	11
Total		65

[13]The price deflators can be found in Appendix Tables A.1 and A.2. As far as we know, these are the first such deflators constructed at this disaggregated level for manufacturing. We hope other researchers will find them valuable.

Table 2.7

AVERAGE LABOR PRODUCTIVITY AND REAL WAGES IN PHILIPPINE MANUFACTURING: 1957-1965
(ALL IN CONSTANT 1957=100 PRICES)

ISIC Code	Value Added Per Production Worker				Gross Output Per Production Worker				Average Annual Earnings Per Worker			
	$(Q/L)_{1957}$	$(Q/L)_{1960}$	$(Q/L)_{1962}$	$(Q/L)_{1965}$	$(Q/L)_{1957}$	$(Q/L)_{1960}$	$(Q/L)_{1962}$	$(Q/L)_{1965}$	W_{1957}	W_{1960}	W_{1962}	W_{1965}
20	8,252	12,557	14,388	11,994	17,588	26,386	35,625	33,254	1,398	1,491	1,546	1,472
21	25,231	35,352	31,570	35,795	37,957	55,797	52,292	57,593	2,259	2,360	2,496	2,410
22	9,403	7,451	9,483	12,055	16,488	15,621	17,620	25,109	1,160	1,282	1,252	1,414
23	5,046	3,986	4,269	5,007	15,397	11,333	12,392	12,034	1,261	1,360	1,275	1,377
24	2,268	2,632	2,539	2,616	6,730	7,946	7,129	6,133	930	954	787	845
25	3,639	4,658	4,916	4,881	8,410	11,198	12,298	10,508	1,332	1,610	1,416	1,590
26	3,321	4,109	3,371	3,244	7,101	8,403	7,251	6,294	1,492	1,344	1,372	1,124
27	8,817	11,142	9,838	12,828	20,652	29,715	29,615	35,826	1,462	1,887	1,848	2,058
28	7,041	6,897	5,548	8,399	11,710	12,918	11,503	15,268	2,448	2,196	1,991	2,185
29	3,913	4,299	3,856	2,910	11,082	13,337	11,788	6,725	1,109	1,096	1,170	726
30	8,561	11,074	10,020	9,962	18,009	23,616	20,982	20,565	1,665	1,876	1,291	1,500
31	17,291	23,404	18,105	23,015	52,149	59,091	56,238	70,098	2,117	2,159	1,950	2,261
32	(NA)	(NA)	147,799	163,661	(NA)	(NA)	410,535	604,048	(NA)	(NA)	4,100	6,106
33	9,090	10,825	12,098	13,791	16,647	18,470	20,193	13,003	2,203	2,152	2,182	2,267
34	4,838	9,907	9,944	14,433	20,573	23,801	25,847	41,394	1,812	2,694	2,346	2,151
35	5,605	7,681	6,917	7,618	14,718	18,820	22,720	20,379	1,810	1,617	1,658	1,538
36	5,259	8,255	9,155	4,601	9,979	10,901	11,256	7,000	1,819	1,482	1,469	1,504
37	7,670	7,462	6,439	7,925	16,708	15,247	14,005	15,075	1,602	1,325	1,130	1,191
38	6,234	6,611	4,862	6,696	17,843	20,221	17,676	20,399	1,971	1,566	1,173	1,124
39	36,068	36,335	4,792	6,083	58,136	61,881	10,130	10,835	2,053	1,852	1,261	1,439
A11	7,687	9,591	9,571	10,011	16,624	20,797	23,529	24,001	1,494	1,571	1,490	1,554
I	10,629	13,883	13,428	12,869	19,910	26,923	32,133	32,620	1,441	1,533	1,469	1,464
II	3,594	3,425	3,968	4,903	10,393	9,876	11,642	11,505	1,045	1,195	1,222	1,362
III	3,839	4,672	4,693	4,922	9,350	11,363	11,795	10,547	1,316	1,122	1,255	1,344
IV	14,028	17,564	13,486	18,068	39,485	41,885	36,899	46,379	1,950	2,003	1,807	2,020
V	8,653	9,183	8,410	8,845	22,060	22,131	23,988	25,746	2,040	1,871	1,678	1,446
VI	8,142	9,287	9,001	13,557	15,140	18,601	19,800	22,052	2,185	2,098	2,030	2,196

Table 2.8 presents our first results. We might first note that in terms of traditional tests of significance industry groups III, IV, V and VI yield very poor results. This leaves us somewhat more uncomfortable than apparently it does Johansen:

> "It is seen that the points do not cluster around a line as we usually like them to do in regression analysis. However, this does not in itself give any reason to doubt the theory. It only means that there are large inter-industry variations in the rate of technological progress."[14]

Our sample sizes are too small given the variety within these industry groups, with the exception of the rather homogeneous groups I (food and beverages) and II (textiles, footwear and leather products). (Recall that these mixed results were anticipated in the preceding section.) The model performs very well, however, on an industry wide basis.

First, let us turn to the estimates of technical change. Table 2.8 illustrates the impressive rates of technical change recorded in the manufacturing sector over these five years. The highest gains appeared in industry groups I and II, the lowest in industry group IV (rubber and chemicals), while the remaining groups are close to the average for manufacturing.

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[14]Johansen, p. 779.

Table 2.8

THE JOHANSEN MODEL APPLIED TO PHILIPPINE MANUFACTURING: 1957-62

Industry Group	N	$\log\left(\frac{A_{i62}}{A_{i57}}\right)$	log (ω)	$\frac{A_{i62}}{A_{i57}}$	ω	R^2
I	17	1.4329	-2.0287 (.8769)	4.19	.110	.263
II	10	.7561	-1.4645 (.7770)	2.14	.231	.307
III	6	.3066	- .3800 (1.5709)	1.35	.684	.014
IV	10	-.3018	.2897 (1.8350)	.74	1.330	.005
V	11	.4218	- .7362 (.9178)	1.53	.479	.067
VI	11	.5142	- .7176 (.7480)	1.67	.488	.093
All (I-VI)	65	.5698	- .8910 (.3340)	1.77	.410	.100
III & IV	16	.3255	- .5626 (.6230)	1.38	.570	.055
V & VI	22	.4274	- .6562 (.5680)	1.53	.519	.062

These results are changed but little when we combine group III with IV and V with VI. The overall impression remains the same: a period of very rapid technological change for manufacturing as a whole.

These results might at first blush appear inconsistent with Williamson's analysis of overall Philippine experience since World War II.[15] These studies show overall rates of technical change declining dramatically from the mid 1950's. In fact, Williamson's study shows negative rates of technical change for the Philippine economy as a whole in every year between 1957 and 1962 except 1957-58 and 1958-59. These were the results of low and declining rates of total factor productivity improvement in other sectors, especially agriculture and of the increasing inability of the manufacturing sector to employ more resources at higher marginal productivity. The retardation of the growth in manufacturing may explain much of this economy-wide behavior.

We turn now to another issue which these results can effectively answer. Massell (1961) developed a model of technical change not so long ago which seems especially applicable

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[15] J.G. Williamson (1967), R.J. Lampman (1967), and Williamson (1968b).

to the Philippines. Massell disaggregates the production function so that a distinction can be "drawn between the reallocation of resources among industries and the improvement of efficiency within industries; both of these factors may contribute to a potential shift in the aggregate production function, although, strictly speaking, only the latter should be termed innovation in the usual sense."[16] In a study of American manufacturing from 1946 to 1957, Massell finds about one-third of measured technical change attributable to an inter-industry shift of resources in the direction of better utilization. A recent paper by Williamson (1967) applies a similar approach to the Philippine economy as a whole. Although that paper had much more limited goals, in that it examines only labor shifts between agriculture and industry, it found that the inter-industry shifts contributed negatively to Philippine "technical change" between 1956 and 1962. That is, labor resources were being employed increasingly in sectors of relatively low marginal productivity.

Williamson's work on the Philippines and Bruton's work on Latin American[17] argue that most of the secular variation in rates of overall productivity improvement can be explained

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[16] B.F. Massel (1961), p. 548.

[17] H. Bruton (1967). For a review see J.G. Williamson (1968c).