

Regional Variation of Industrial Development in Taiwan: An Overview

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Abstract

Taiwan is a small island with different topography that undoubtedly helps in shaping human settlements and production activities ever since the Han Chinese people migrated to open up the island. Motive power machines were introduced into Taiwan during the Japanese colonial period and symbolized the beginning of industrial development on the island. However, it was only in the late 1970s that the share of heavy industry overrode that of light industry. The speed and the structural change of industrial development in Taiwan have already been well documented and studied. This paper only attempts to investigate into regional variations of industrial development with a focus on manufacturing industry.

摘 要

臺灣是一個具有多樣地形條件的島嶼，自從漢人渡海來臺拓墾以後，這些地形條件無疑的對聚落及生產活動之型態有所影響。動力機器在日本殖民統治時期引進臺灣，象徵近代工業之起始。然而，直到 1970 年代末期，臺灣重工業的比重才真正超過輕工業，確定了工業結構的轉型。有關臺灣工業發展的史料相當豐富，既有之研究成果亦多。本文之目的僅在於以製造業為焦點，來探討臺灣工業發展在區域間之差異。

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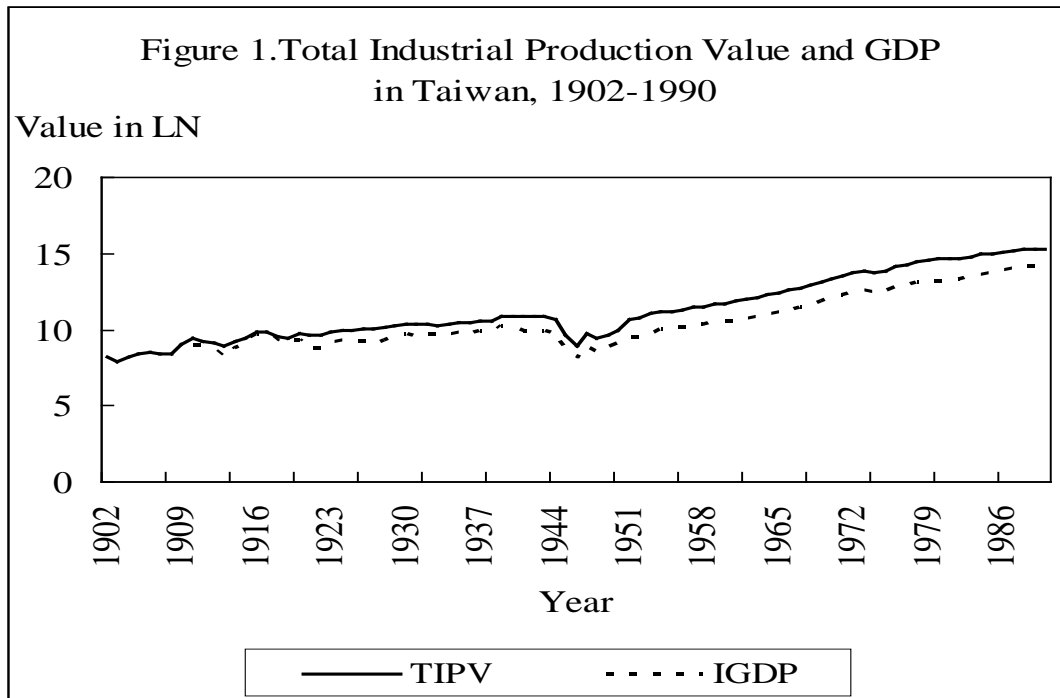
Introduction

This paper aims at giving an overview of Taiwan's industrial development with a focus on regional variation of the manufacturing industry. By 1860 the rice and sugar processing industries were two major components of Taiwan's manufacturing. This state of industrial structure changed slightly up until 1895 when Taiwan was ceded to Japan as a result of China's defeat in the first Sino-Japanese War. Modern industry was introduced into Taiwan in the Japanese colonial period (1895-1945). The industrial structure, however, did not change very much throughout the colonial period despite that the colonial government began to emphasize the heavy industry's development in 1933. After recovering from World War II, the share of heavy industry eventually exceeded that of light industry in 1978, indicating a transformation of the industrial structure in Taiwan. In this paper I will first present a general view with time series data to show the changing structure of the manufacturing industry before and after World War II. I will then discuss regional variations of manufacturing industries since the 1950s by using census data.

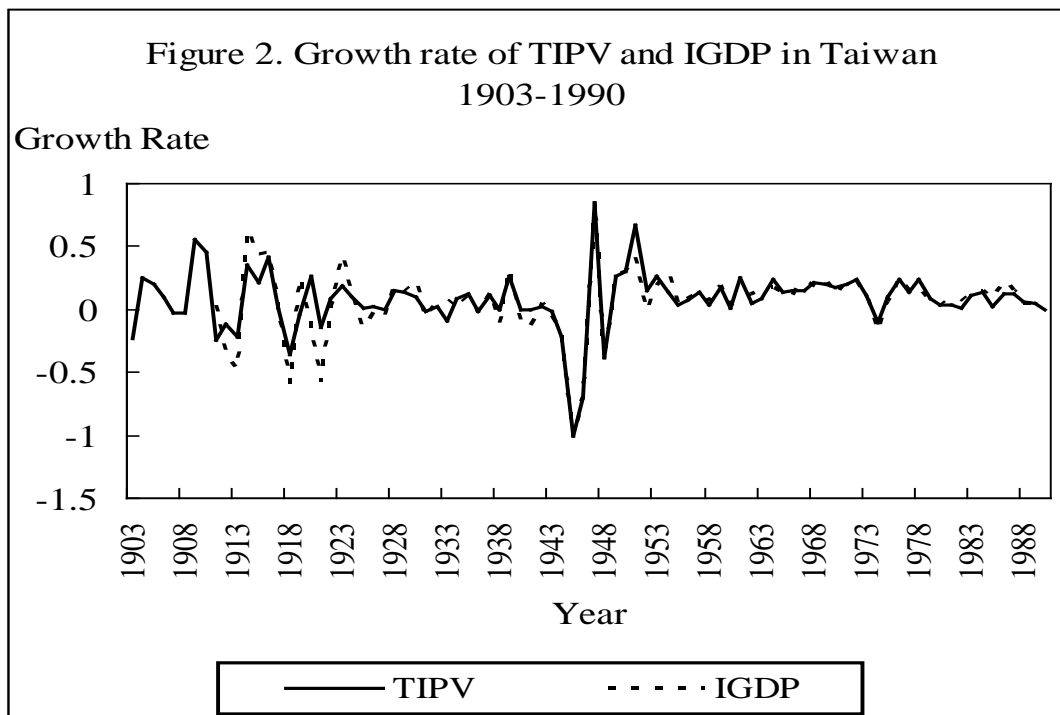
1. A Brief Overview

Scholars have done many studies on Taiwan's industrial development with focuses on different aspects and periods. Among them, Yeh Shu-jen, a professor of economic history at National Taiwan University, has done a succinct yet comprehensive study on Taiwan's industrial development in a historical perspective.¹ It is convenient to summary her findings here to provide a background. Yeh Shu-jen took manufacturing industry as a representative because it had the largest share in the industrial sector and its structure was closely related to Taiwan's income distribution. With the time series data provided by Yeh, the total industrial production value (TIPV) and industrial gross domestic products (IGDP) during 1902-1990 were calculated in natural log and depicted in Figure 1; their growth rates are illustrated in Figure 2. The annual growth rate of TIPV was 6.73 per cent during 1902-1942 and 12.71 per cent during 1953-1990. Except during the First and Second World War periods, both TIPV and IGDP grew faster and the growth rates appear to be more stable after the 1950s than before.

¹ Yeh Shu-cheng 葉淑貞, "Ts'ung li-shih chiao-tu p'o-hsi Taiwan chan-hou kung-yeh fa-chan te t'e-cheng 從歷史角度剖析臺灣戰後工業發展的特徵 (An analysis on features of Taiwan's post-war industrial development from a historical perspective)", in *Chung-kuo hsien-tai-shih chuan-t'i-yen-chiu pao-kao* 中國現代史專題研究報告第 17 輯 (Topics on history of contemporary China, Vol. 17), ed. by The Historical Material Center of the Republic of China (Taipei: The Historical Material Center, 1995), 508-610.



Source: Yeh Shu-jen, "Ts'ung li-shih chiao-tu p'o-hsi Taiwan chan-hou kung-yeh fa-chan te t'e-cheng 從歷史角度剖析臺灣戰後工業發展的特徵", pp. 590-595.

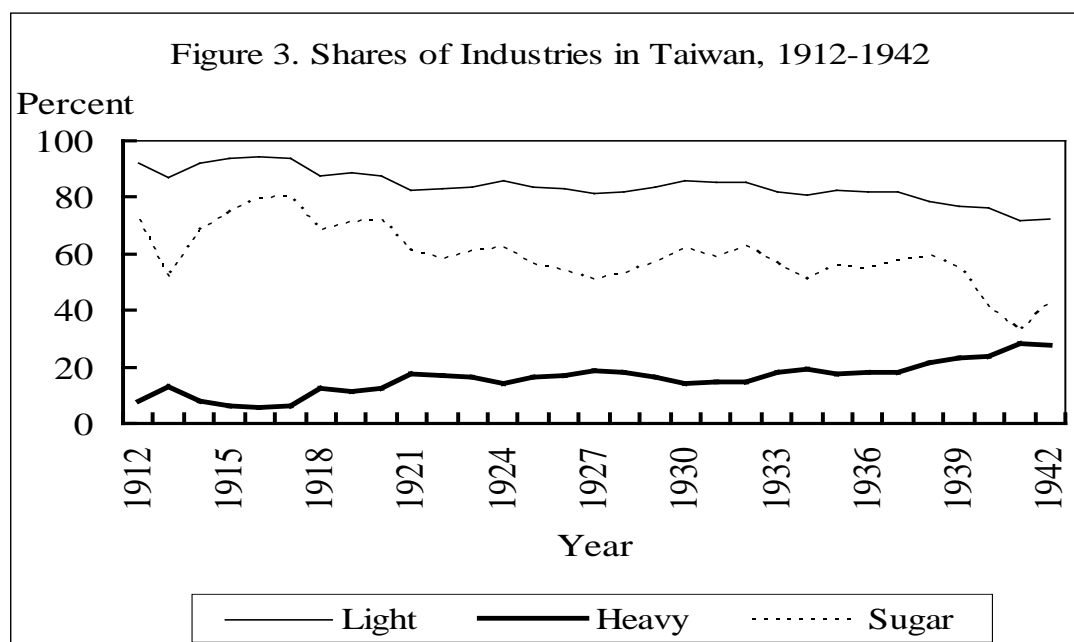


Source: See Figure 1.

During the Japanese colonial period, motive power machines were gradually introduced into Taiwanese factories. Available statistics showed that the number of these factories increased from 642 in 1915 to 6,150 in 1936, an increase of nearly 10 times. These factories used 17,078 horsepower in 1918 and 234,574 horsepower in

1940, an increase of more than 13 times. The production value of the industrial sector grew 6.73 percent annually during 1902-1942, although fluctuated quite drastically in short terms by 1924. The production value of the industrial sector in 1939 was 633 million-yen, while that of agricultural sector was only 522 million-yen. This indicated that the economic structure for the first time changed towards favoring the industrial sector in the late 1930s.

As for the structure of the industrial sector per se, light industry shared 92 percent in 1912 and until 1942 it still counted for 72 percent. Furthermore, among light industries, the share of food and beverages manufacturing was as high as 81 percent until 1942; and sugar manufacturing was the leading one throughout the colonial period (see Figure 3). Due to a demand for Taiwanese sugar in Japan and the colonial government's promotion, sugar production increased rapidly and enormously. In terms of average annual production quantity, it was 50 million-catty in 1902-1905 and 830 million-catty in 1931-1935. The share of sugar production value in 1939 still counted for more than 50 percent of Taiwan's total industrial production value.

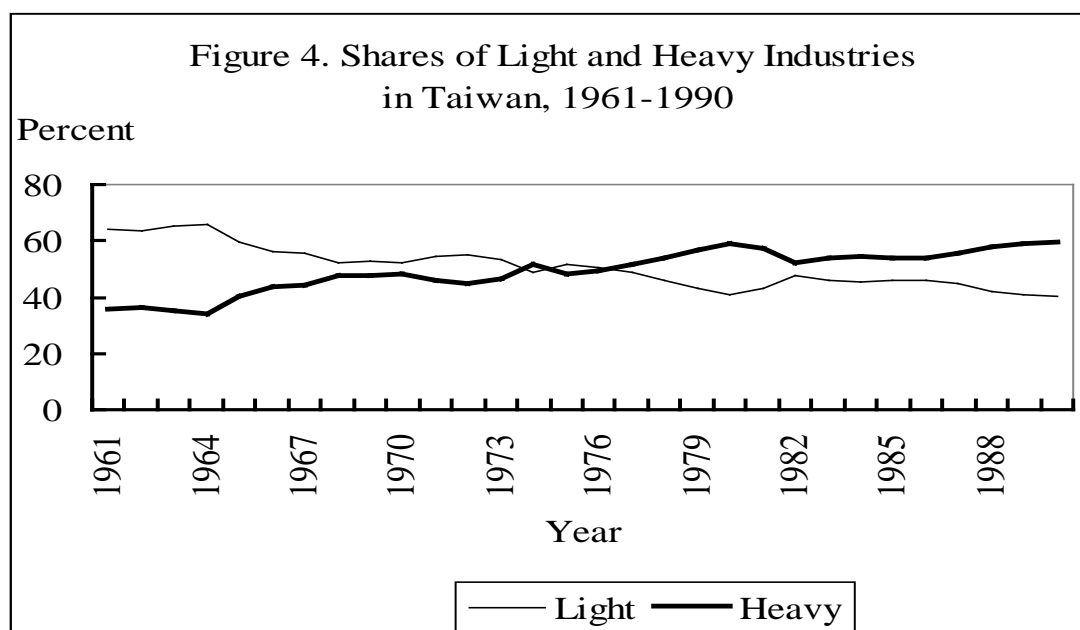


Source: See Figure 1.

After Taiwan's restoration in 1945 and after a short period of political turmoil and hyperinflation in 1946-1949, production activities gradually resumed. Calculated in 1986 prices, the total industrial production value in 1953 was NT\$63,721 million which surpassed the highest amount ever reached in the colonial period, NT\$52,850 million in 1942. It was in 1953 that the government began to undertake the first four-year economic planning project, which was consequently succeeded by later projects.

From 1953 onward, the government's industrial policy could be traced in three phases: (1) the import-substitution phase from 1953 to 1960, (2) the export-expansion phase from 1961 to 1972, and (3) the phase of industrial structure adjustment from 1973 and onwards. The third phase could be sub-divided with 1978 as a landmark; the first sub-phase emphasized a general development of chemical and heavy industries while the second one pursued development of strategic industries.

In the 1950s the government encouraged labor-intensive industries to substitute for imports. During 1961-1972, with the Regulation for Promoting Investment announced in 1960, the industries promoted by the government were mainly for exports. The third phase began with ten major construction projects initiated in 1973 and further reinforced with an announcement in 1979 to undertake a ten-year planning project from 1980 to 1989. Figure 4 shows the shares of light and heavy industries in 1961-1990. Although the gap between shares of light and heavy industries had been narrowing down by the end of the Japanese colonial period, it was closing up by the late 1960s. After a lingering period due to the oil crisis in 1974-1976, the two industry groups finally switched their positions after 1978. This demonstrates that the industrial structure underwent more substantial change since then.



Source: See Figure 1.

Both before and after World War II, the government industrial policies emphatically influenced the course of Taiwan's industrial development. However, there were also negative impacts of these policies. Under the Japanese colonial rule, the predominance of sugar manufacturing encouraged by the government prevented other light industries, which could have beneficially utilized local raw materials, from

being developed. Since the 1950s, negative impacts of the government industrial policies could be reviewed from two aspects. First, too much government interference sometime caused distortions in resource allocation; and second, too little attention was paid to some areas and thus could not satisfy the need of industrial development. The first aspect was well argued in regard to high tariffs, regulation and protection in trade as well as net benefits of the regulation for promoting investments. As for the second aspect, criticisms were focused mostly on insufficient government investments in construction of infrastructure, technological innovation research, pollution prevention and environmental protection.

2. Regional Variations of Industrial Development

With an overview with aggregate data as shown above, this section will present the regional variation of Taiwan's industrial development with census data. Taiwan's first census on industry and commerce was taken for the year 1954 and the second one for the year 1961. Since then, a census of industry and commerce was taken every five years and thus there are already nine censuses of this genre by the end of the twentieth century. Because the scope of coverage was slightly different in 1954 and 1961, the data of these two censuses are not fully utilized in this paper. The census data have an advantage in providing details that can be reorganized according to the need of a specific study. Statistics available in these census reports are arranged mostly by detailed items of industries and some have breakdowns by counties and cities. For a study of regional variation, it is necessary to reorganize these data by region. Before doing that, let us first get a general view of the composition of Taiwan's industrial sector.

2.1 The Composition of the Industrial Sector

The census data show that Taiwan's industrial sector consists of four main industries: (1) mining and quarrying, (2) manufacturing, (3) electricity, gas and water supply, and (4) construction. The number and share of establishment units of these industries during 1954-1996 are listed in Table 1.

Thus we see that the manufacturing industry has the lion's share; the percentage of this industry accounted for 92 percent in 1954 and remained around 85-89 percent until 1991; however, it declined to 76 percent by 1996. It is notable that the number of establishment units in construction increased remarkably between 1991 and 1996; there was an increase of nearly 92 percent, compared to only 9 percent in manufacturing. Moreover, in terms of value added, which indicates the efficiency of industrial management, there was an increase of 2.5 percent between 1991 and 1996

for construction, compared to a decrease of 1.2 percent for manufacturing.² Apparently, the structure of the industrial sector per se was changing in recent years and the construction industry requires further study. However, this paper will limit the discussion only to the manufacturing industry with regional variation.

Table 1: Number and Share of Establishment Units in Taiwan's Industrial Sector

(1) Number								
Item \ Year	1954	1961	1971	1976	1981	1986	1991	1996
Mining and Quarrying	426	1094	518	1,149	1,028	943	1,012	1,019
Manufacturing	40,713	52,152	44,144	72,237	139,297	118,755	145,976	158,609
Electricity, Gas and Water	194	230	217	213	1,981	715	726	745
Construction	2,683	4,315	5,883	8,676	12,554	14,464	25,095	48,294
Total	44,016	57,791	50,762	82,275	154,860	134,877	172,809	208,667
(2) Share								
Item \ Year	1954	1961	1971	1976	1981	1986	1991	1996
Mining and Quarrying	0.97	1.89	1.02	1.40	0.66	0.70	0.59	0.49
Manufacturing	92.49	90.24	86.96	87.80	89.95	88.05	84.47	76.01
Electricity, Gas and Water	0.44	0.40	0.43	0.26	1.28	0.53	0.42	0.36
Construction	6.10	7.47	11.59	10.55	8.11	10.72	14.52	23.14
Total	100	100	100	100	100	100	100	100

Source: The 1954 Census, 2-4.

The 1961 Census, Vol. I: Statistical tables, 72-80.

The 1971 Census, Vol. I: 23.

The 1976 Census, Vol. I: 44.

The 1981 Census, Vol. I: Statistical tables, 108-115.

The 1986 Census, Vol. I: Statistical tables, 226-227.

The 1991 Census, Vol. I: Statistical tables, 328.

The 1996 Census, Vol. I: Statistical tables, 318.

2.2 Classification by Regions

In order to reorganize the data by region, this paper adopts the four-region divisions set by the Executive Yuan in 1979 with groupings of cities and counties as follows:³

The North region: Taipei City, Keelung City, Taipei County, Ilan County, Taoyuan County and Hsinchu County (with Hsinchu City upgraded to a provincial

² The 1996 Census, Vol. 1: 29-31.

³ Liu Ts'ui-jung 劉翠溶, "Pa-shih-nien-lai Taiwan te tu-shih fa-chan 八十年來臺灣的都市發展 (Urban development in Taiwan in the past eighty years)", in *Proceedings of Conference on Eighty Years History of the Republic of China, 1912-1991* ed. by the Conference Symposium Editorial Committee (Taipei: Modern China Publisher, 1991), Vol. 4: 530-572.

city in 1982).

The Central region: Taichung City, Miaoli County, Taichung County, Changhua County, Nantou County, and Yunlin County.

The South region: includes Kaoshiung City, Tainan City, Chiayi County (with Chiayi City upgraded to a provincial city in 1982), Tainan County, Kaohsiung County, Pingtung County, and Penghu County.

The East region: Taitung County and Hualien County.

The cities and counties included in the four regions have a total land area of around 36,000 square kilometers. Because Taiwan is an island with mountainous terrain, it is better to make an adjustment of the land area figure by deducting the mountainous areas which are not all suitable for building manufacturing factories. With available land areas of the mountain rural townships, it is possible to subtract at least these mountain areas to get an adjusted land area for each region and the result is listed in Table 2.

Table 2: The Land Area in Taiwan

(1) Total Area (km ²)				
Region \ Year	1956	1971	1981	1996
North	7,343.9364	7,346.9538	7,347.2754	7,347.2303
Central	10,494.0929	10,498.8846	10,506.8788	10,506.8788
South	9,979.3592	9,991.7791	10,002.0827	10,002.0827
East	8,143.8240	8,143.8240	8,143.8240	8,143.8240
Total	35,961.2125	35,981.4415	36,000.0609	36,000.0158
(2) Land Area with mountain rural townships excluded (km ²)				
Region \ Year	1956	1971	1981	1996
North	4,518.5246	4,521.5420	4,521.8636	4,521.8185
Central	6,112.3110	6,117.1027	6,125.0969	6,158.5969
South	6,692.4077	6,704.8276	6,715.1312	6,715.1312
East	2,618.7289	2,789.9822	2,789.9822	2,790.7477
Total	19,941.9722	20,133.4545	20,152.0739	20,186.2943
(3) Share of (2) in (1) (%)				
Region \ Year	1956	1971	1981	1996
North	22.66	22.46	22.44	22.40
Central	30.65	30.38	30.39	30.51
South	33.56	33.30	33.32	33.27
East	13.13	13.86	13.84	13.82
Total	55.45	55.96	55.98	56.07

Source: For 1956, 1971 and 1981, see Liu Ts'ui-jung, "Pa-shih-nien-lai Taiwan te tu-shih fa-chan 八十年來臺灣的都市發展", p. 533. For 1996, see *The Population Statistics of Taiwan and Fukien Area, The Republic of China, 1996*, pp. 250-253.

The adjusted land area shown in Table 2 reveals that with the exclusion of mountain rural townships, only 56 percent of Taiwan's land area are left for consideration. As shown in Table 3, the land area used by Taiwan's manufacturing industries increased from 58.66 km² in 1966 to 242.61 km² in 1996, an increase of four-fold in 30 years. In 1996, all manufacturing establishment units used 1.2 percent of the land area, excluding mountain rural townships, and most of these were distributed along the western part of Taiwan from north to south. In terms of density, there were 15 manufacturing establishment units per square kilometer in the North region in 1996; this number was almost double of the average. Compared with the number in 1966, the density had increased seven-fold in the North; while on the average, the increase was 5.5 times.

Table 3: Land Area Used by Manufacturing Establishments and the Density

(1) Land Area Used by Manufacturing Establishments (km ²)							
Region	1966	1971	1976	1981	1986	1991	1996
North	38.1737	44.2369	65.3592	72.9623	69.9591	76.9559	84.9443
Central	8.3606	24.7656	35.6575	44.5912	41.4499	54.3357	56.6198
South	11.5459	36.8850	59.7376	73.0357	65.8516	87.0200	95.2465
East	0.5772	3.1724	4.6985	6.3038	5.1662	6.8108	5.7997
Total	58.6574	109.0599	165.4527	196.8929	182.4268	225.1224	242.6103
(2) Percentage of Land Area Used by Manufacturing Establishments							
Region	1966	1971	1976	1981	1986	1991	1996
North	0.84	0.98	1.45	1.61	1.55	1.70	1.88
Central	0.14	0.40	0.58	0.73	0.68	0.89	0.92
South	0.17	0.55	0.89	1.09	0.98	1.30	1.42
East	0.02	0.11	0.17	0.23	0.19	0.24	0.21
Total	0.29	0.54	0.82	0.98	0.91	1.12	1.20
(3) Density of Manufacturing Establishments in Taiwan (number per km ²)							
Region	1966	1971	1976	1981	1986	1991	1996
North	2.18	3.46	5.99	8.07	11.04	13.81	15.27
Central	1.55	2.39	4.16	5.62	6.80	4.53	9.09
South	1.28	1.88	2.77	3.31	3.84	4.53	4.81
East	0.34	0.45	0.42	0.51	0.49	0.48	0.45
Total	1.44	2.19	3.59	4.69	5.89	7.24	7.86

Source: The 1966 Census, Vol. 3: 19-20;
The 1971 Census, Vol. 3: 34-61;
The 1976 Census, Vol. 3: 740-741;
The 1981 Census, Vol. 3: 294-297;
The 1986 Census, Vol. 3: 392-393;
The 1991 Census, Vol. 3: 382-383;
The 1996 Census, Vol. 3: 318-319.

In addition to land area used by manufacturing establishments in four regions, comparisons can also be made with the number of people engaged and annual earnings paid. Table 4 lists the data in two parts: Part (1) shows the percentage of personnel employed in manufacturing and part (2) that of annual earnings paid. It is clear that the North region had a share of around 50 percent in these two aspects throughout the entire study period. This further demonstrates the concentration of manufacturing in northern Taiwan.

Table 4: Regional Variation of Manufacturing in Taiwan, 1966-1996

(1) Percentage of Personnel							
Region \ Year	1966	1971	1976	1981	1986	1991	1996
North	47.40	49.45	47.51	47.40	47.00	47.22	49.98
Central	24.66	23.21	26.01	26.64	27.80	27.80	26.42
South	26.35	26.12	25.65	25.20	24.54	24.32	23.09
East	1.59	1.23	0.84	0.76	0.66	0.67	0.51
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Number of Personnel							
1,000 persons	583.9	1,186.3	1,893.0	2,178.2	2,729.5	2,622.9	2,474.6
(2) Percentage of Annual earnings paid							
Region \ Year	1966	1971	1976	1981	1986	1991	1996
North	50.36	52.24	49.81	49.16	47.75	49.65	51.74
Central	18.89	19.71	23.36	24.68	26.64	24.24	23.26
South	29.06	26.73	25.97	25.39	24.98	25.42	24.43
East	1.69	1.31	0.86	0.77	0.63	0.69	0.57
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Amount of Annual earnings paid							
NT\$ 1 million	7,387	23,532	88,595	229,763	404,945	670,165	918,039

*The annual production value for 1986 was based on enterprise units instead of establishment units as the data for the latter are not available, see The 1986 Census, Vol. 3: 15.

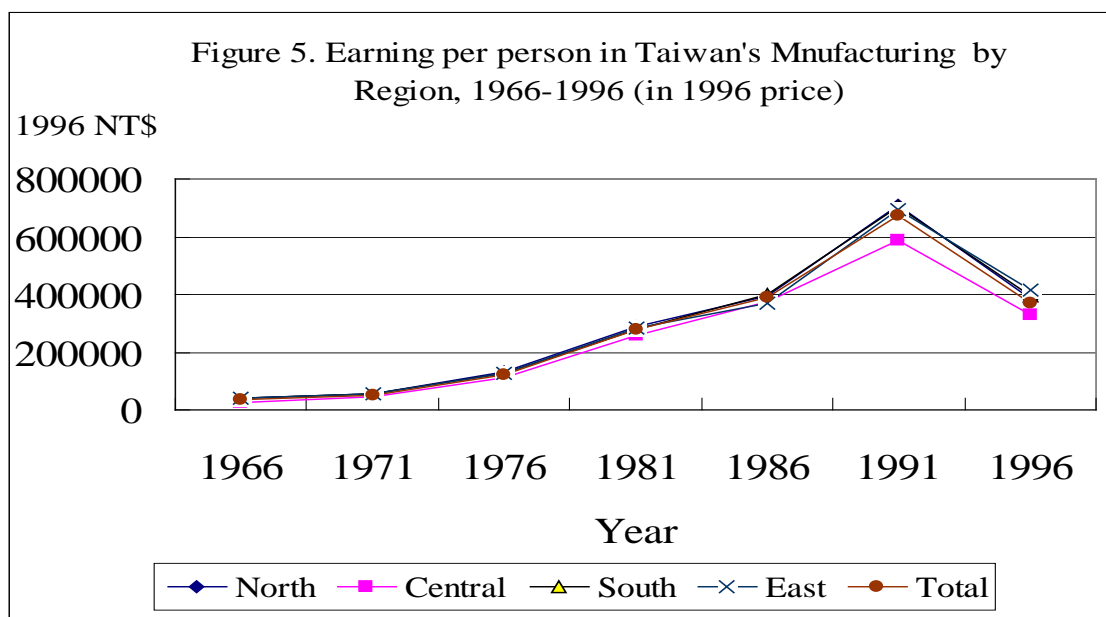
Sources: See Table 3.

Comparison can be further made with per capita earnings. The data are listed in Table 5 in two parts: (1) in terms of current price and (2) in terms of 1996 prices and the growth rate calculated with the total. Figure 5 shows the earnings per person in 1996 prices. It is clear that earnings per person in the Central region fell below the average throughout the entire period and ranked at the bottom except in 1986. This may imply that the Central region had more small-sized, labor-intensive manufacturing than other regions. It is notable that earnings per person in the North and South regions were above the average throughout, but neither region occupied the top rank throughout. It is remarkable that earnings per person in the East region jumped to become the highest in 1996. If we look into the original data, we can see

that this leap came from Hualien County, which had on the average, earnings of NT\$ 421,378 per person in that year.⁴ Why was this so?

Table 5: Per capita annual earnings of manufacturing, 1966-1996

(1) Current price (NT\$)							
Region \ Year	1966	1971	1976	1981	1986	1991	1996
North	13,440	20,956	49,064	109,417	150,733	268,663	384,011
Central	9,693	16,850	42,036	97,701	142,150	222,832	326,636
South	13,950	20,303	47,395	106,274	151,051	267,061	392,535
East	13,454	21,218	48,244	106,733	140,333	263,752	414,651
Total	12,651	19,836	46,801	105,483	148,356	255,502	370,979
(2) 1996 price (NT\$)							
Region \ Year	1966	1971	1976	1981	1986	1991	1996
North	38,323	55,234	129,320	288,396	397,294	708,127	384,011
Central	27,640	44,411	110,796	257,515	374,671	587,328	326,636
South	39,777	53,513	124,922	280,110	398,132	703,905	392,535
East	38,362	55,925	127,160	281,322	369,881	695,182	414,651
Total	36,072	52,281	123,356	278,027	391,029	673,438	370,979
Growth rate		0.37	0.86	0.81	0.34	0.54	-0.60



Source: See Table 3; for price index, see *The 1999 Statistical Almanac*, p. 360.

With statistics from the census of 1991 and 1996, we see that five industries in Hualien increased in the number of establishment units.⁵ These industries were

⁴ The 1996 Census, Vol. 3: 318.

⁵ The 1991 Census, Vol. 3: 414-437; The 1996 Census, Vol. 3: 350-375.

petroleum and coal products (from 7 to 11), plastic products (from 6 to 8), basic metal products (from 11 to 14), fabricated metal products (from 172 to 206), and machinery and equipment (from 43 to 49). Although data of earnings in each industry is not available with breakdowns by county level, earnings per person in petroleum and coal products was NT\$ 892,317 and in basic metal products was NT\$ 440,583, both were much higher than the average.⁶ Thus, we may guess that the jump in the earnings per person in Hualien came mainly from the increase in petroleum and basic metal manufacturing.

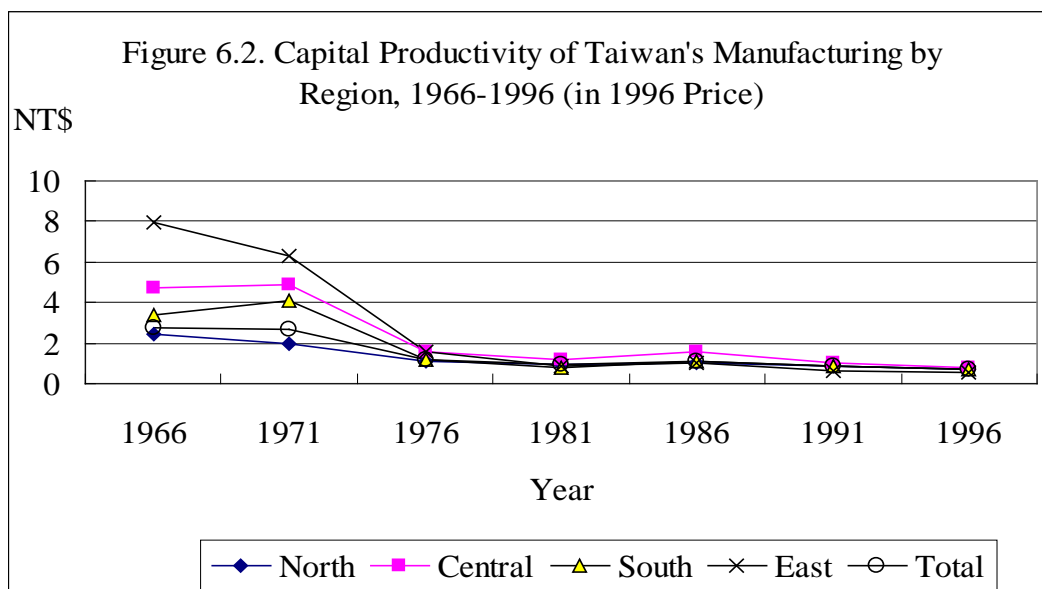
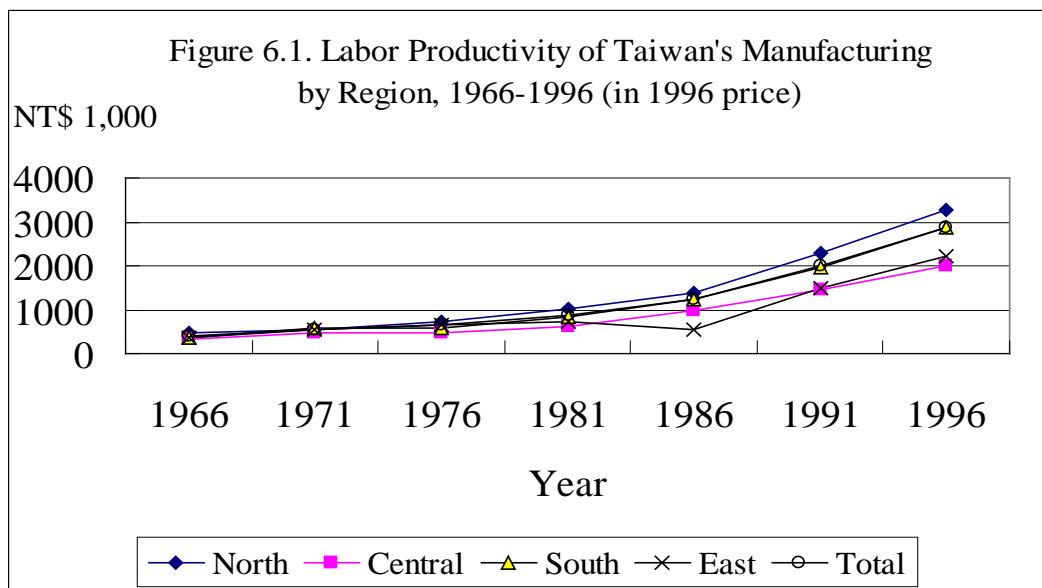
As for the growth rate of earnings per person in terms of 1996 prices, it grew in general until 1991 and the rate was faster in 1976 and 1981, but there was a 60 percent decline between 1991 and 1996. The regional difference in growth rate was rather negligible.

A comparison of labor productivity and capital productivity can also be made with the available data based on enterprise units, instead of establishment units. Labor productivity is calculated as annual production value per person (total production value divided by total number of personnel). Capital productivity is calculated as the average production value produced per NT dollar value of assets operating at the end of the year (total production value divided by total value of assets). The data are adjusted with the whole sale price index by taking 1996 as a base year. The results are listed in Table 6 and depicted in Figures 6.1 and 6.2.

Table 6: Labor and Capital Productivity of Manufacturing in Taiwan, 1966-1996

(1) Labor Productivity (in 1996 price, NT\$ 1,000)							
Region \ Year	1966	1971	1976	1981	1986	1991	1996
North	459	562	738	1,017	1,368	2,279	3,269
Central	318	469	476	620	968	1,446	2,015
South	369	575	595	835	1,239	1,959	2,887
East	349	545	649	722	556	1,501	2,205
Total	411	544	643	880	1,234	1,991	2,871
(2) Capital Productivity (in 1996 price, NT\$)							
Region \ Year	1966	1971	1976	1981	1986	1991	1996
North	2.41	1.97	1.09	0.94	1.05	0.85	0.69
Central	4.73	4.90	1.58	1.21	1.54	1.02	0.82
South	3.38	4.10	1.15	0.81	1.12	0.88	0.73
East	7.97	6.31	1.59	0.83	1.04	0.64	0.59
Total	2.77	2.71	1.17	0.94	1.14	0.88	0.72

⁶ The 1996 Census, vol. 3, p. 332, p. 334.



Source: The 1966 Census, Statistical Tables, Vol. 3: 19-20;
 The 1971 Census, Vol. 3: 34-41, 224; The 1976 Census, Vol. 3: 16-17;
 The 1981 Census, Vol. 3: 12-13, 56; The 1986 Census, Vol. 3: 14-15;
 The 1991 Census, Vol. 3: 14-15; The 1996 Census, Vol. 3: 14-15.
 For price index, see The 1999 Statistical Almanac, 360.

The North region had the highest labor productivity, except in 1971 when the South was higher than the North by a small margin. The Central region had the lowest labor productivity, as was the case of earnings per capita. On the whole, labor productivity increased almost 600 percent between 1966 and 1996.

As for capital productivity, the East region ranked at the top in 1966 and 1971 and was about the same with the Central region in 1976, but since then the East fell to the bottom until 1996. The Central region took the lead in capital productivity from 1981 to 1996. The North region ranked at the bottom from 1966 to 1976 and next to

the bottom from 1986 to 1996, while in 1981 it ranked the second, next only to the Central region. On the average, capital productivity decreased 74 percent, with the East decreasing more drastically by 93 percent.

The increasing labor productivity may imply an improvement in the living standard of manufacturing employees. However, the declining capital productivity may not be so desirable for investors. A summary quoted at current price reveals that comparing 1996 with 1991, only four among the 22 categories of manufacturing had an increase in capital productivity. These four categories were wood and bamboo products (4.48%), wearing apparel (2.88%), machinery (2.41%), and printing processing (1.64%). The decreases in capital productivity were mostly more than 10 percent, and the most serious cases were found in petroleum and coal (-30.12%), food and beverages (-29.49%), transport equipment (-16.50), non-metallic mineral (-15.87%), plastic (-15.38%), chemical matter (-15.15%), precision instruments (-14.78%) and electric and electronic machinery (-12.77%). Nevertheless, the profit rate remained around 7 percent for manufacturing as a whole.⁷

2.3 Regrouping of Manufacturing Industries

Individual industries may be grouped into broader categories in order to analyze the manufacturing sector further. There are different ways of regrouping. For instance, one study regrouped the 22 manufacturing industries classified by the 1996 census into four types: the urban technical-intensive type, the urban labor-intensive type, the local resources-relying type, and the basic materials-providing type.⁸ The advantage of this re-grouping highlights characteristics of urban vs. rural as well as labor vs. technical intensive. However, the industries grouped under the local resources-relying type are not so appropriate as raw materials for textile mills, such as cotton and wool, are not locally produced.

To make it easy, this paper simply adopts a classification according to the nature of manufacturing into four types in the following way:⁹

Type I: Industries directly related to livelihood. This type includes (1) food processing, (2) beverages and tobacco, (3) textile, (4) wearing apparel and accessories, (5) wood and bamboo products, (6) furniture and fixtures, (7)

⁷ The 1996 Census, Vol. 3: 1-22.

⁸ Lin Chien-yuan 林建元, 《*Taiwan-sheng kung-yeh fa-chan ts'e-lueh chi kung-yeh-chu she-chih chu-wei fen-pu chih yen-chiu* 台灣省工業發展策略及工業區設置區位分佈之研究 (A study on the policy of industrial development and location distribution of the industrial zones in Taiwan province)》 (Nantou: Taiwan Provincial Government, 1999), 24-25.

⁹ The 1986 Census, Vol. 3: 16.

non-metallic mineral products, and (8) miscellaneous items.

Type II: Metal and machinery industries. This type includes (9) basic metal, (10) fabricated metal products, (11) machinery and equipment and (12) transport equipment.

Type III: Chemical industries. This type includes (13) leather and fur products, (14) pulp and paper products, (15) printing processing, (16) chemical matter, (17) chemical products, (18) petroleum and coal products, (19) rubber products, and (20) plastic products.

Type IV: Electric and electronic industries. This type includes (21) electrical and electronic machinery, and (22) precision instruments.

With this classification, the data are reorganized and summarized in Table 7 and further cross-classified into two parts: (1) the shares of four types calculated by region (Table 7.1 and Figure 7.1) and (2) the shares of four regions calculated by type (Table 7.2 and Figure 7.2). On the whole, Table 7 shows that the number of manufacturing establishment units increased from 28,771 in 1966 to 158,609 in 1996; there was an increase of 5.5 folds in 30 years. Apparently, these manufacturing establishment units were not evenly distributed by region and by type.

Table 7: Distribution of Taiwan's Manufacturing Establishment Units, 1966-1996

Total: by Region					
Year	North	Central	South	East	Total N
1966	34.30	32.91	29.66	3.13	28,771
1976	37.48	35.22	25.42	1.88	72,237
1981	38.62	36.37	23.50	1.50	94,542
1986	42.04	35.07	21.73	1.16	118,755
1991	42.80	35.44	20.85	0.91	145,976
1996	43.52	35.31	20.37	0.79	158,609
Total: by Type					
Year	Type I	Type II	Type III	Type IV	Total N
1966	65.86	17.72	14.22	2.20	28,771
1976	44.20	31.20	19.98	4.62	72,237
1981	37.59	35.64	20.67	6.11	94,542
1986	33.17	36.18	22.55	8.10	118,755
1991	28.25	39.27	22.60	9.89	145,976
1996	23.80	43.88	21.88	10.44	158,609

Source: The 1966 Census, Vol. 3:159-168;
 The 1976 Census, Vol. 3.1: 742-757;
 The 1981 Census, Vol. 3: 456-457;
 The 1986 census, Vol. 3:466-489;
 The 1991 Census, Vol. 3: 414-437;
 The 1996 Census, Vol. 3: 350-373.

These cross tabulations help to discern some facts. Table 7.1 shows that in 1966, Type I industries predominated in every region: 58 percent in the North, 70 percent in the Central, 68 percent in the South, and 92 percent in the East. However, the share of Type I declined steadily through time in every region. On the whole, it declined from 66 percent in 1966 to 44 percent in 1976 and further down to 24 percent by 1996. It is also notable that in the East region, Type I remained predominant with a share of 55 percent in 1996.

Type II ranked next to Type I in 1966 in every region. However, the share of Type II increased to become the largest from 1981 in the Central region and from 1986 in the North and the South regions. On the average, the share of Type II increased from 17.7 percent in 1966 to 43.9 percent in 1996, an increase of nearly 2.5-fold.

In every region, the share of Type III was also increasing, but not as rapidly as Type II. Except that in the East region where the share of Type III was only 3.8 percent in 1966 and 9.3 in 1996, the shares in other regions were mostly around 20 percent from 1976 to 1996. On the whole, the share of Type III increased from 14.2 percent in 1966 to 21.9 percent in 1996, an increase of 1.5-fold.

In every region the share of Type IV was the smallest. The North was the only region where the share of Type IV was above 10 percent since 1981. On the whole, the share of Type IV was only 2.2 percent in 1966 and 10.4 percent in 1996, an increase of 5-fold.

Table 7 also shows that the North region apparently had the largest share of manufacturing establishment units and its share increased from 34 percent in 1966 to 44 percent in 1996. The leading position of the North region was particularly remarkable in Type IV, as the share of the North region in this type was around 65 percent throughout (Table 7.2d and Figure 7.2d). The Central region competed with the North in leading Type II; the difference in their shares accounted merely 1.4 percentage points (39.9% and 38.5%) in 1996. (Table 7.2b and Figure 7.2b)

Moreover, the North, the Central, and the South regions each shared about one-third of Type I in 1966, but the share of the South region reduced to 22 percent in 1996. Thus, in 1996, the North region took the lead in Type I with a difference of 3 percentage points higher than the Central (39.7% and 36.7%). The East region's shares in the four types of manufacturing were all very small, only about 2 percent in Type I and below 1 percent in the other types. On the whole, the shares of the North and the Central regions were increasing while those of the South and the East regions were decreasing. (Table 7.2a and Figure 7.2a)

As mentioned above, there was an increase in the number of establishment units in five industries in Hualien County in 1996, however, the total number of manufacturing establishment units in the East region declined from 1,326 to 1,260

between 1991 and 1996 (Table 7.1d) This indicates that the policy proposed recently to move industries to the East coast has not been successfully carried out so far. Perhaps from the viewpoint of environmental conservation, it is better not to develop industry too fast there.

Table 7.1: Classified by Region

7.1a The North Region

Year	Type I	Type II	Type III	Type IV	Total N
1966	58.18	19.48	18.30	4.04	9,868
1976	39.81	31.00	21.40	7.78	27,078
1981	35.07	32.33	22.19	10.41	36,512
1986	31.33	32.42	23.58	12.67	49,924
1991	25.91	35.39	23.50	15.20	62,485
1996	21.69	38.81	23.40	16.10	69,032

7.1b The Central Region

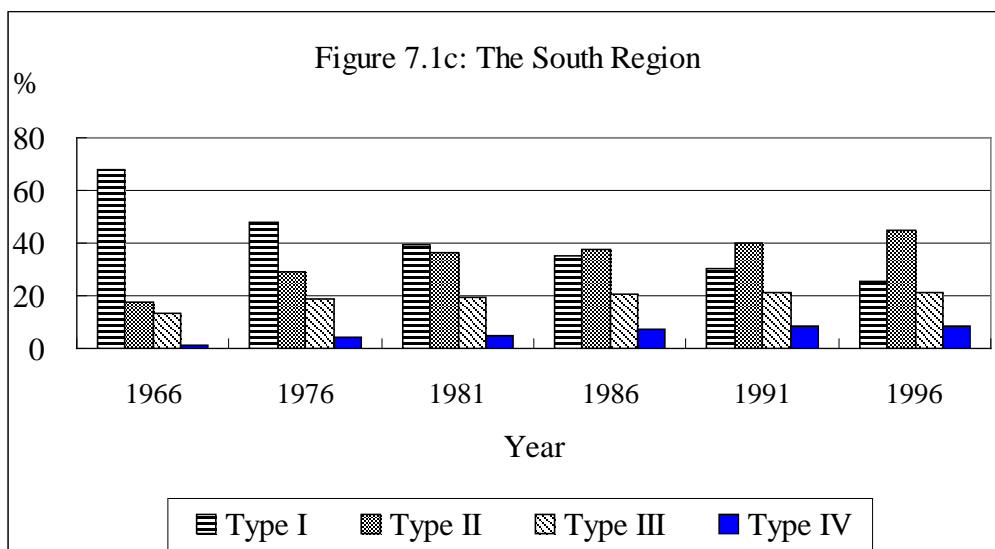
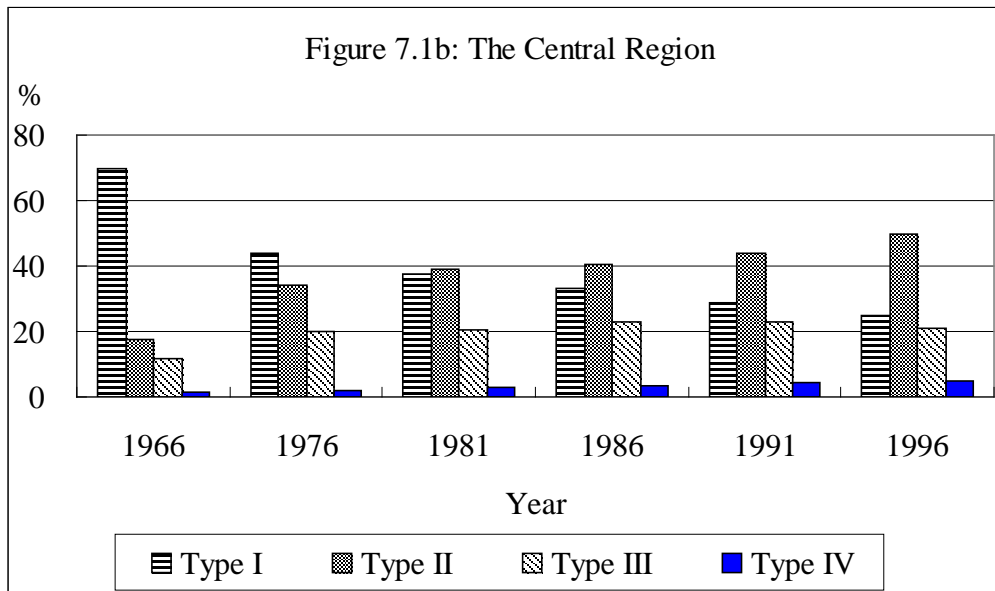
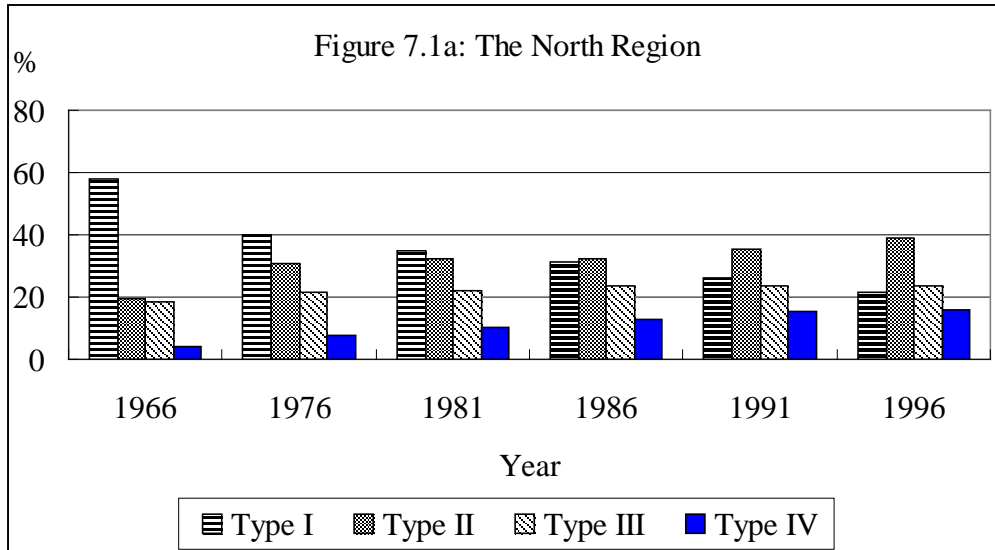
Year	Type I	Type II	Type III	Type IV	Total N
1966	69.80	17.38	11.58	1.24	9,468
1976	43.76	34.13	20.21	1.90	25,440
1981	37.76	39.17	20.39	2.69	34,389
1986	33.09	40.28	23.16	3.47	41,651
1991	28.98	43.84	22.75	4.44	51,727
1996	24.75	49.64	20.84	4.77	56,003

7.1c The South Region

Year	Type I	Type II	Type III	Type IV	Total N
1966	67.65	17.47	13.53	1.35	8,534
1976	47.99	29.21	18.74	4.06	18,361
1981	39.10	36.62	19.58	4.69	22,220
1986	35.02	37.43	20.42	7.12	25,805
1991	30.39	39.95	21.06	8.61	30,438
1996	25.46	45.09	20.93	8.52	32,314

7.1d The East Region

Year	Type I	Type II	Type III	Type IV	Total N
1966	91.68	4.44	3.77	0.11	901
1976	88.06	7.07	3.98	0.29	1,358
1981	74.52	19.77	5.28	0.42	1,421
1986	67.85	24.80	6.55	0.80	1,375
1991	61.46	27.98	9.20	1.36	1,326
1996	54.60	35.08	9.29	1.03	1,260



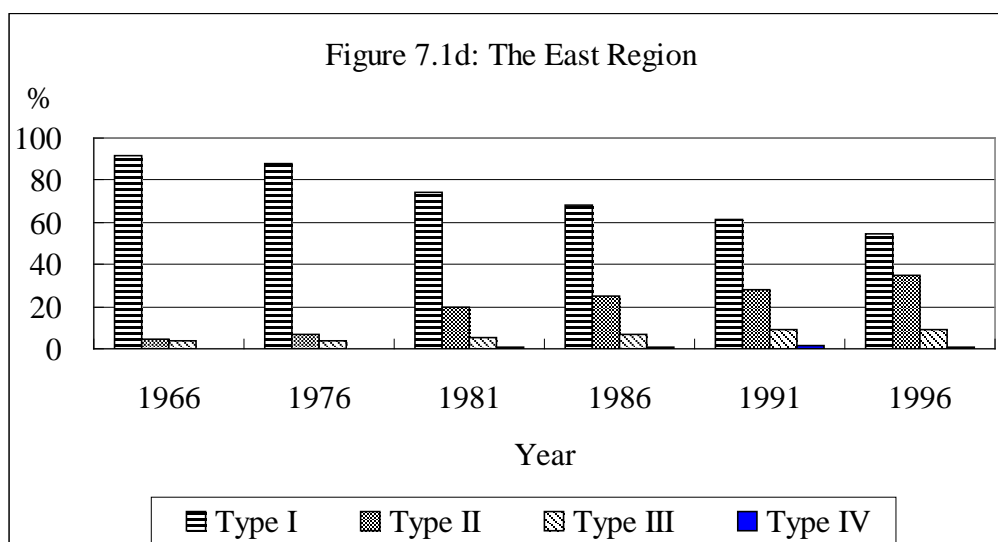


Table 7.2: Classified by Type

7.2a Type I: livelihood Industries

Year	North	Central	South	East	Total N
1966	30.30	34.88	30.47	4.36	19,849
1976	33.77	34.87	27.60	3.77	31,929
1981	36.03	36.54	24.45	2.98	35,538
1986	39.70	34.99	22.94	2.37	39,393
1991	39.25	36.34	22.43	1.98	41,240
1996	39.67	36.71	21.80	1.82	37,746

7.2b Type II: Metal and Machinery Industries

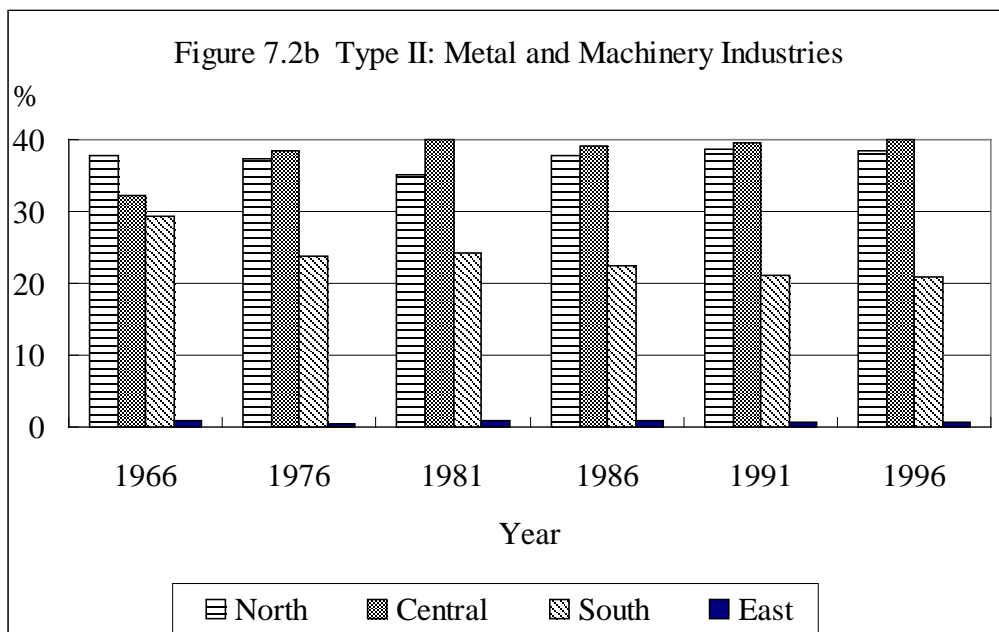
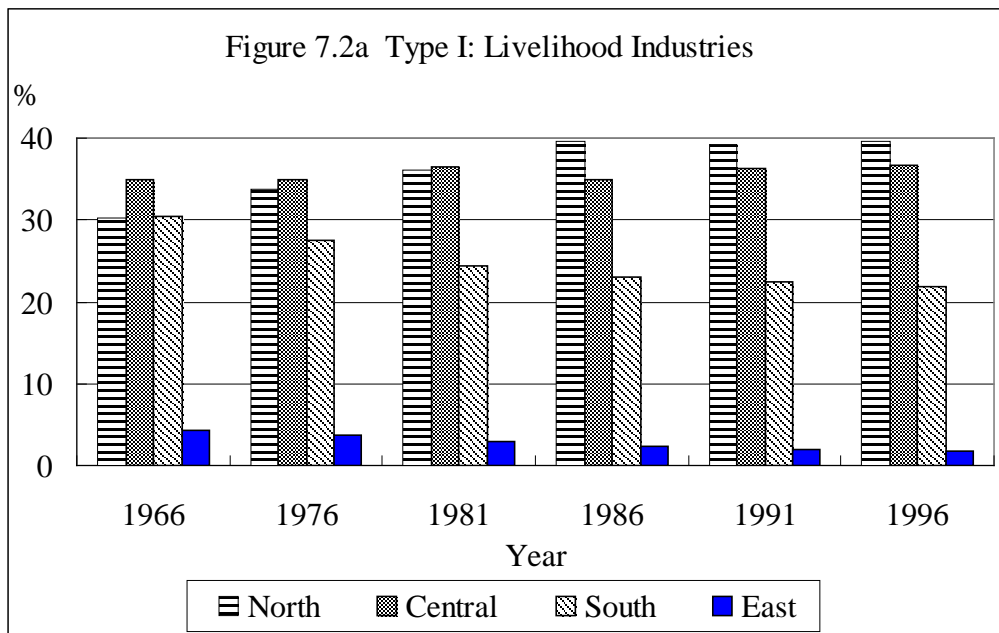
Year	North	Central	South	East	Total N
1966	37.69	32.28	29.24	0.78	5,099
1976	37.25	38.52	23.80	0.43	22,537
1981	35.04	39.98	24.15	0.83	33,691
1986	37.67	39.05	22.48	0.79	42,967
1991	38.58	39.56	21.21	0.65	57,321
1996	38.49	39.94	20.93	0.64	69,604

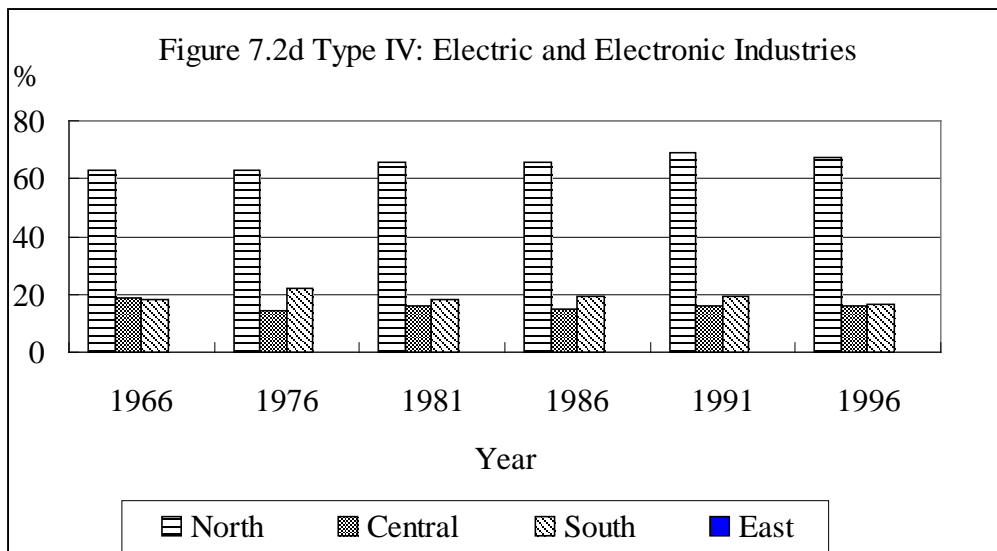
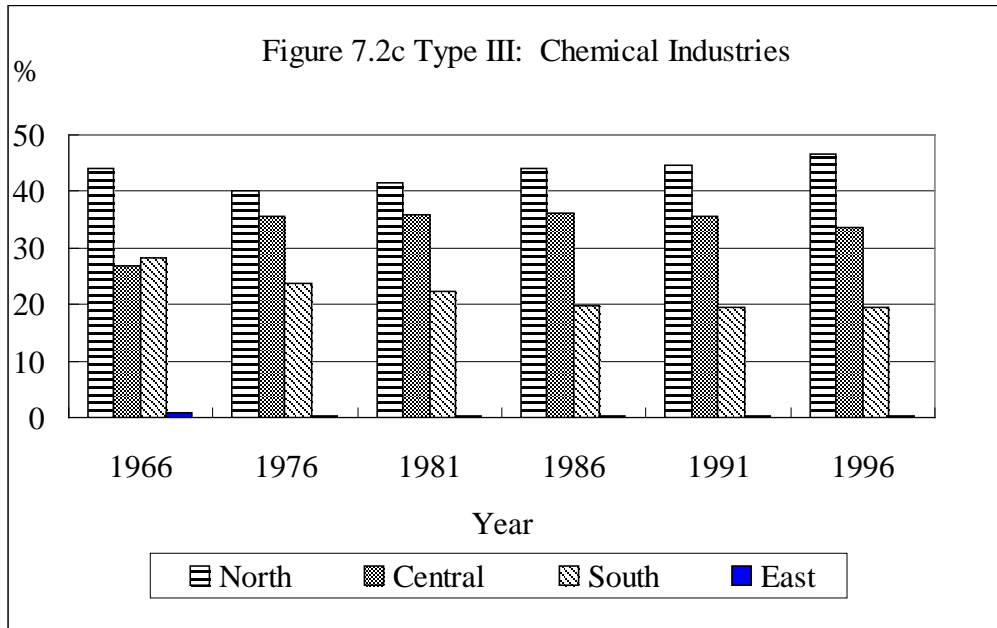
7.2c Type III: Chemical Industries

Year	North	Central	South	East	Total N
1966	44.15	26.79	28.23	0.83	4,091
1976	40.16	35.63	23.84	0.37	14,431
1981	41.47	35.88	22.27	0.38	19,540
1986	43.97	36.02	19.68	0.34	26,778
1991	44.53	35.67	19.43	0.37	32,984
1996	46.55	33.63	19.49	0.34	34,701

7.2d Type IV: Electric and Electronic Industries

Year	North	Central	South	East	Total N
1966	63.13	18.51	18.20	0.16	632
1976	63.08	14.46	22.34	0.12	3,340
1981	65.82	16.01	18.07	0.10	5,773
1986	65.77	15.02	19.10	0.11	9,617
1991	68.80	15.92	19.16	0.12	14,431
1996	67.14	16.15	16.63	0.08	16,558





3. Regional Variation in the Development of Industrial Zones

Regional variations can also be seen in the development of industrial zones. The industrial zones were established to provide industrial land for investors and to use the land efficiently. In Taiwan, there are four categories of industrial zones. The first category is established in the urban planning areas according to the Urban Planning Act. The second category is established at the non-urban, fourth-grade land classified for construction use according to the Regulation of Non-urban Land Use. The third category is established according to the Regulation for Promoting Investment issued in 1960 and furthermore according to the Regulation for Upgrading the Industry issued in 1991; this category is also known as a designated (*pien-ting* 編

定) industrial zone. These three categories of industrial zones are distributed all over cities and counties. The fourth category is established particularly for processing industry especially for export near Kaohsiung and Taichung harbors.¹⁰

Taiwan's first designated industrial zone was developed at Liutu 六堵 in Keelung City. It took five years from 1960 to 1965 to complete the development of this industrial zone. By 1997, there were 95 designated industrial zones that had been developed with 13,421 hectares of land in Taiwan. In 1998, seven of the 95 designated industrial zones were dissolved and re-registered under the category of urban industrial zone. Table 8 shows land areas used for the first three categories of industrial zones in 1998.

Table 8 shows that the total land area of industrial zones is 52,348 hectares, of which the North region shares 35 percent, the Central region 33 percent, the South region 29.5 percent, and the East region 2.5 percent. The urban industrial zones have 23,323 hectares and share 44.6 percent of the total area; the non-urban industrial zones have 17,602 hectares and share 33.6 percent; and the designated industrial zones have 11,422 hectares and share 21.8 percent. Furthermore, of the urban industrial zones, the North region shares 36 percent, the Central region 26 percent, the South region 35 percent and the East region 3 percent. Of the industrial zones located at non-urban, fourth-grade construction land, 46 percent are in the Central region, 37 percent in the North region, 15 percent in the South region and 2 percent in the East region. Of the designated industrial zones, 40 percent are in the South region, 31 percent in the North region, 26 percent in the Central region and 2 percent in the East region.

Looking into the details of individual cities and counties, we see that the urban industrial zones are mostly located in five counties in the order of magnitude as follows: Taichung (13.3 %), Taoyuan (12.1 %), Taipei (11.8 %), Tainan (10.4 %) and Kaohsiung (10.2 %). The non-urban industrial zones are mostly located in three counties: Changhua (24.1 %), Taoyuan (19.7 %), and Yunlin (10.7 %). The designated industrial zones are mostly located in Taoyuan County (19.4 %), Kaoshiung City (10.3 %) and Kaohsiung County (9.2 %). In short, industrial zones are concentrated in the North region in Taipei and Taoyuan Counties, in the Central region in Taichung and Changhua Counties and in the South region in Kaohsiung City and Kaohsiung County.

¹⁰ Ch'en Sheng-ch'ang 陳慎昌, "Kung-yeh-ch'u te k'ai-fa yu kung-yeh fa-chan 工業區的開發與工業發展 (The development of industrial zones and the industrial development)", *T'u-ti kai-ke 土地改革* (Land Reform Monthly), 23.5-6 (1973): 28-31. *Kung-yeh-ch'u k'ai-fa kuan-li nien-pao, pa-shih-pa nien-tu 工業區開發管理年報, 八十八年度* (The annual report of the industrial zone's management, 1999), Ch. 5.

Table 8: Land Area of Industrial Zones (area in hectare)

Region, City and County	Total Land Area of Industrial Zones		Urban Industrial Zones		Designated Industrial Zones		Non-urban 4th Grade Construction Land	
	Area	%	Area	%	Area	%	Area	%
North Region	18,325.58	35.00	8,300.57	35.59	3,578.00	31.32	6,447.01	36.62
Taipei City	514.53	0.98	514.53	2.21	-	-	-	-
Keelung City	670.99	1.28	625.42	2.68	30	0.26	15.57	0.09
Taipei County	3,897.29	7.44	2,761.11	11.84	486	4.25	650.18	3.69
Ilan County	2,134.99	4.08	613.97	2.63	236	2.07	1,285.02	7.30
Taoyuan County	8,503.59	16.24	2,822.00	12.1	2,221.00	19.44	3,460.59	19.66
Hsinchu County	1,987.57	3.80	429.18	1.84	593	5.19	965.39	5.48
Hsinchu City	616.62	1.18	534.36	2.29	12	0.11	70.26	0.40
Central Region	17,295.46	33.05	6,095.54	26.14	3,019.00	26.46	8,177.92	46.46
Taichung City	1,375.34	2.63	794.34	3.41	581	5.09	-	-
Miaoli County	2,421.65	4.63	685.04	2.94	749	6.56	987.61	5.61
Taichung County	4,232.81	8.09	3,112.34	13.34	452	3.96	668.47	3.80
Changhua County	5,458.81	10.43	683.63	2.93	523	4.60	4,249.18	24.14
Nantou County	1,172.86	2.24	349.34	1.50	435	3.81	388.52	2.21
Yunlin County	2,633.99	5.03	470.85	2.02	279	2.44	1,884.14	10.70
South Region	15,434.52	29.48	8,155.22	34.97	4,601.00	40.26	2,678.30	15.22
Kaohsiung City	2,055.07	3.93	878.07	3.76	1,177.00	10.3	-	-
Chiayi County	1,616.07	3.09	545.21	2.34	615	5.38	455.86	2.59
Chiayi City	232.39	0.44	232.39	1.00	-	-	-	-
Tainan County	4,271.97	8.16	2,420.44	10.38	928	8.12	923.53	5.25
Tainan City	1,400.96	2.68	1,202.96	5.16	198	1.73	-	-
Kaoshiung County	4,017.69	7.67	2,370.26	10.16	1,052.00	9.21	595.43	3.38
Pingtung County	1,840.37	3.52	505.89	2.17	631	5.52	703.48	4.00
East Region	1,292.66	2.46	771.51	3.31	222	1.94	299.15	1.70
Taitung County	201.33	0.38	148.48	0.64	22	0.19	30.85	0.18
Hualien County	1,091.33	2.08	623.03	2.67	200	1.75	268.3	1.52
Total	52,348.22	100	23,322.84	100	11,422	100	17,602.38	100

Source: 1. The data of urban industrial zones from the Ministry of Interior.

2. The data of designated industrial zones from the Ministry of Economic Affairs.

3. The data of the fourth-grade construction land from investigation of 1997.

The Industrial Development Bureau (IDB) of the Ministry of Economic Affairs has carried out an investigation over 79 designated industrial zones and thus some details are now available. In terms of the number of factories, the top five industrial zones are Wuku 五股 (1,153) in the North, Taichung 台中 (846) in the Central, Tafa 大發 (549) and Anping 安平 (531) in the South, and Nankang 南崗 (463) in the Central. These five industrial zones are all characterized as a synthetic zone.

The distribution of major industries at designated industrial zones is also available to some extent. Table 9 lists available statistics in 1999 and Table 10

summarizes the shares of the top five industries in each region.

Table 9: Regional Shares of Firms located at the Designated Industrial Zones
in Taiwan in 1998

Industry \ Region	North		Central		South		East		Total	
	N	%	N	%	N	%	N	%	N	%
Food	167	4.55	212	5.64	208	6.39	6	2.20	593	5.41
Tobacco	0	0.00	9	0.24	1	0.03	0	0.00	10	0.09
Textile	313	8.53	168	4.47	90	2.76	0	0.00	571	5.21
Apparel	73	1.99	23	0.61	50	1.54	3	1.10	149	1.36
Leather	23	0.63	40	1.06	25	0.77	0	0.00	88	0.80
Wood & Bamboo	37	1.01	89	2.37	45	1.38	3	1.10	174	1.59
Furniture	59	1.61	90	2.40	69	2.12	0	0.00	218	1.99
Pulp	98	2.67	112	2.98	67	2.06	0	0.00	277	2.53
Printing	51	1.39	33	0.88	65	2.00	1	0.37	150	1.37
Chemical Matter	101	2.75	147	3.91	152	4.67	0	0.00	400	3.65
Chemical Product	203	5.53	195	5.19	141	4.33	1	0.37	540	4.93
Petroleum & Coal	8	0.22	5	0.13	5	0.15	1	0.37	19	0.17
Rubber	41	1.12	66	1.76	27	0.83	2	0.73	136	1.24
Plastic	256	6.98	311	8.28	277	8.51	0	0.00	844	7.71
Non-metallic	86	2.34	124	3.30	114	3.50	136	49.82	460	4.20
Basic Metal	157	4.28	185	4.93	470	14.44	12	4.40	824	7.52
Fabricated Metal	417	11.37	481	12.81	364	11.18	25	9.16	1287	11.75
Machinery	399	10.88	479	12.75	260	7.99	22	8.06	1160	10.59
Electronic	764	20.83	468	12.46	281	8.63	7	2.56	1520	13.88
Transport equipment	172	4.69	221	5.88	313	9.62	41	15.02	747	6.82
Precision Instrument	54	1.47	71	1.89	49	1.51	0	0.00	174	1.59
Miscellaneous	162	4.42	185	4.93	167	5.13	13	4.76	527	4.81
Non-manufacturing	27	0.74	42	1.12	15	0.46	0	0.00	84	0.77
Total	3,668	100	3,756	100	3,255	100	273	100	10,952	100

Source: *The Annual Report of Development and Management of Industrial Zones, 1999.*

Table 10: The Shares of the Top Five Industries

Rank	Total	North	Central	South	East
1	EL 13.88	EL 20.83	FM 12.81	BM 14.44	NM 49.82
2	FM 11.75	FM 11.37	MA 12.75	FM 11.18	TR 15.02
3	MA 10.59	MA 10.88	EL 12.46	TR 9.62	FM 9.16
4	PL 7.71	TX 8.53	PL 8.28	EL 8.63	MA 8.06
5	BM 7.52	PL 6.98	TR 5.88	PL 8.51	--
Sub-Total	51.45	58.59	52.18	52.38	82.06

Indications: EL: electronic, FM: fabricated metal, MA: machinery, PL: plastic, BM: basic metal, TX: textile, TR: transport equipment.

Source: Table 9.

On the whole, the top five industries are electronic, fabricated metal, machinery, plastic, and basic metal and they together share 51.45 percent of the total 10,952 factories. Among the top five industries, electronic, fabricated metal, machinery and plastic industries commonly appear in the North, Central and South regions. However, the North has textile ranked fourth, the Central has transport equipment ranked fifth, and the South has transport equipment ranked third.

Regional concentration and variation can also be seen. In the North region, textile manufacturing accounts for 55 percent of the total 571 factories, while electronic manufacturing is 50 percent of the total 1,520 factories. It seems that the Central region does not predominate in any branch of manufacturing. However, its machinery manufacturing accounts for 41 percent of the total 1,160 factories, its fabricated metal manufacturing shares 37 percent of the total 1,287, and its plastic manufacturing makes up 37 percent of the total 844 factories. In the South region, basic metal manufacturing accounts for 57 percent of the total 824 factories and the transport equipment manufacturing shares 42 percent of the total 747 factories. Finally, it is notable that in the East region, nearly half (49.82%) of the 273 factories engage in non-metallic mineral products based on local natural resources, such as marble and granite quarries. In short, concentration and polarization phenomena appear in textile, electronic, and non-metallic manufacturing industries due to development policy, location, and special resources.

Concluding remarks

This paper has presented numerical facts related to regional variation of Taiwan's industrial development and these make up only a preliminary study of the topic. Briefly speaking, the situation in 1996 showed that the North region had 43.5 percent of Taiwan's manufacturing establishment units, the Central region had 35.3 percent, the South region had 20.4 percent, and the East region had 0.8 percent. Moreover, the tendency is that the shares of the North and the Central regions are increasing, while those of the South and the East are decreasing. Details related to types of manufacturing industries and the industrial zones also reveal regional variation and concentration. It is hard to say, however, that the picture now we have for regional variation in Taiwan's industrial development is entirely an outcome of rational planning. Further studies are required to investigate into crucial factors and process of changes leading to this result.

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