

LEARNING FROM TAIWAN'S EXPERIENCE IN INDUSTRIAL DEVELOPMENT

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Abstract

Taiwan's rapid economic growth and spectacular achievements is the result of the country's long-term economic planning that began in the 1950s. During the period, Taiwan was only a small-scale agricultural economy. In 1952, agriculture's share of gross domestic product (GDP) in Taiwan was 32.2 percent, while industry's share was 16.7 percent. However, in 1961, the agriculture's share fell to 25 percent, while the industrial sector's share rose to 23.7 percent. In 1962, industrial production contributed larger share of the GDP. Taiwan's industrial development can be divided into four phases: primary import substitution (1952-57), transition and export promotion (1958-72), secondary import substitution (1973-80) and promotion of strategic and high-tech industries (1981-present). In this paper, the significance of capital, labour productivity and R&D for industrial development is also estimated by using a regression method.

1. INTRODUCTION

Taiwan's success of industrial development has been widely discussed by international scholars for the lessons that can be learnt by other developing countries. In developing countries, industrialisation is an engine of economic growth. As for Taiwan, the main emphasis of industrial development is to achieve economic growth with equitable income distribution and high quality of living (Government Information Office in Taiwan 2010).

During the period of 1952 to 1980, Taiwan achieved an annual economic growth of 9.21 percent, which was the highest in the world. In 1962, agriculture lost its key position as the driving force behind Taiwan's economy, making way for the rapid development of industrial sector. With the exception of two energy crises, in 1973-1974 and 1979-1980, the country's industrial sector maintained an average annual growth rate of approximately 14 percent.

During the period from 1981 to 1999, there was economic recession around the world and within Taiwan itself, there were inevitable changes. Combined external and internal forces had brought a detrimental effect on Taiwan's economic development. The country's growth rate declined to 7.15 percent. Taiwan's economy began to shift its focus from industrial sector to service sector. Meanwhile, the agricultural sector grew by only 0.63 percent annually as its share of gross domestic product (GDP) continued to diminish.

Taiwan's economy is not self-sufficient. Limited natural resources and a high population density needed the development of foreign trade and the increase of foreign investment in the country. Since then, foreign trade and foreign investment become the driving forces behind Taiwan's industrial sector, which in turn fuels development in the service sector. From 1952 through 1980, the annual growth rate of commodity and labor exports had an average of 16.5 percent, while local demand grew by 10.97 percent per year. During the second stage of economic development, commodity and labor exports had an average of 10.05 percent per year, while local demand averaged 7.51 percent.

During the period of 2000 to 2009, economic growth of Taiwan further declined to 3.4 percent per year. Like other Asian countries, Taiwan's economic growth was affected by the 1997-1998 Asian financial crisis. However, the country was able to cope with the crisis effectively through its well-planned policies for macroeconomic, financial and real sectors (Yang 1998). In the period of 2000 to 2009, while the service sector contributed the biggest share in the country's GDP with an average of 66.8 percent, the industrial sector's share was 31 percent per year. The annual average share of agriculture in the GDP was 1.75 percent only.

In Taiwan, with the exception of the two periods of energy crises (1973-1974 and 1979-1980), its inflation rate was considered moderate. Between 1952 and 1980, the consumer price index (CPI) increased by an annual rate of 7.95 percent, whereas the wholesale price index (WPI) increased by an annual average of only 7.14 percent. If the period of energy crisis were excluded, the CPI increased by 5.39 percent annually, and the WPI increased by 4.3 percent per year. From 1981 to 2000, the inflation rate in Taiwan was even lower. During this period, the CPI averaged an annual increase of 2.87 percent, and the WPI averaged rose only 0.01 percent. During the period of 2001 to 2009, the CPI averaged 0.94 percent, and the WPI averaged 1.93 percent annually.

With the exception of 1950, Taiwan also has not had a serious unemployment problem. This is because of its strong level of exports. Large numbers of people have been provided jobs by labor-intensive export enterprises. Prior to 1970, the country's unemployment rate was above 3 percent. During the late 1980s, it dropped below 2 percent and a labor shortage emerged,

forcing Taiwan to employ foreign laborers. Such a low unemployment rate was considered a rare phenomenon rarely in the world. During the period of 2001 to 2009, the country's unemployment rate was 4.57 percent, which is termed the natural unemployment rate.

Taiwan accumulated its foreign exchange reserves when its exports continuously exceeded its imports (i.e., when there was a trade surplus) from 1981 to 1999. By 1995, its accumulated foreign exchange reserves reached US\$100 billion. In 2000, they had increased to US\$110 billion. Taiwan has been considered as one of the world's largest foreign exchange reserves holders. The country was second only to Japan for many years. In 2001, China moved up to second place, with large amounts of foreign exchange for a decade. Taiwan ranked third until October 2002, when its foreign exchange reserves achieved US\$150 billion. However unlike China, which accumulated foreign debts of over US\$160 billion, Taiwan had no foreign debt. In 2009, Taiwan accumulated foreign exchange reserves of US\$348 billion (ADB 2010).

The objectives of this paper are to describe and make an analysis on the industrial development in Taiwan. In this paper, section 2 describes four phases of industrial development in Taiwan and section 3 provides some literature review on selected variables related to industrial development. In section 4, an analysis on industrial development is done by using a regression method of ordinary least squares (OLS) and the findings are discussed. The last section concludes with some lessons learnt from Taiwan's experience in industrial development.

2. INDUSTRIAL DEVELOPMENT IN TAIWAN

The progress of industrial development in Taiwan is explored from the beginning of 1950s with its initial policy of promoting primary import substitution. Later, industrialisation in Taiwan has been increasingly significant after the country established export orientation policy in 1960s and 1970s. With this policy, the country has successfully helped its manufacturing sector expand international market through linking to the global value chain and through incentives that encourage investment and research and development (R&D) activities.

There are four phases of industrial development in Taiwan: Primary import substitution (1952-57), transition and export promotion (1958-72), secondary import substitution (1973-80), and promotion of strategic and high-tech industries (1981-present) (Tsai 1999).

2.1 Primary Import Substitution (1952-57)

During the first phase of industrial development, the land reform program carried out in 1949-1953 was able to accelerate agricultural growth with advancement of agricultural technology. The land reform program contributed to agricultural surplus and a sufficient market for industrial outputs. The individual farmers in the program became small modern economic agents.

Unlike most developing countries in the 1950s, Taiwan's policy of import substitution (IS) was mainly aimed at accumulating foreign exchange reserves. The government used measures of protective tariffs, quantitative import restriction, foreign exchange controls and multiple exchange rates to encourage locally produced goods, which were substitutes for imported goods such as textiles, cement and fertilisers. Meanwhile, deficit financing, selective credit allocation entry barriers, control of raw materials allocation were among the measures to protect domestic infant industries.

2.2 Transition and Export Promotion (1958-72)

During 1952-56, real gross national product (GNP) fell annually. The growth rate of industrial output dropped to 11 percent (Ranis 1979). Any foreign exchange was difficult to save. In 1958, Taiwan's trade deficit stood at approximately US\$70 million. The primary import substitution policy lost its momentum that led to reorientation of the development strategy. The three important measures established during the development period of transition and export promotion (1958-72) were the foreign exchange reform, the Nineteen-Point Economic and Fiscal Reform Programme (also called the 19-point programme) and the Statute for the Encouragement of Investment (SEI).

The foreign exchange reform was adopted at the end of 1957. The single exchange rate system replaced multiple exchange rates system to end the overvaluation of the Taiwanese currency, the New Taiwan dollar. In 1963, an exchange rate was set at NT\$40 per US dollar. The foreign exchange system was capable to expand Taiwan's exports.

The establishment of 19-point programme in 1960 aimed to increase levels of saving and investment, to reduce expenditure and to promote exports. This programme liberalised the various measures adopted in the past and restored market mechanisms through the establishment of permanent central banking system and capital market as well as the provision of preferential treatment to private sector companies.

The Statute for the Encouragement of Investment (SEI) was set up in 1960 to help domestic and foreign investors by ways of tax exemptions and deductions, facilitating the acquisition of plants sites and simplifying procedures for investment licensing. The SEI caused GNP to increase by 235 percent within seven years. Total foreign direct investment increased rapidly from US\$10.9 million in 1952-59 to US\$34.2 million in 1960-63. The SEI was considered the most important legislation tool to promote the industrial development in Taiwan. (Tsai 1999).

Other than the above three main measures, the liberalisation of foreign exchange allocation system, special export loan programme, import liberalisation and the establishment of export processing zones also helped promote exports of Taiwan.

2.3 Secondary Import Substitution (1973-80)

Economics and political shocks in the 1970s made existing policies less effective to achieve a sustained industrial development in Taiwan. In 1973, the Taiwanese government set up the Industrial Technology Research Institute (ITRI). The institute received government contracts to conduct research programmes, develop key technologies and transfer them to industries for products development activities. During the period of 1974-78, ten major projects were initiated and executed that included transportation, nuclear power plants, petrochemical plants, an integrated steel mill and a large size of shipyard. In the policy of secondary import substitution, the last three projects listed in the ten major projects were particularly involved in the establishment of a fully-fledged heavy and chemical industry (HCI). In 1979, the Institute for Information Industry (III) was established. These two institutes made cooperation in undertaking technology and manpower development, which became a foundation for the promotion of strategic and high tech industries in the next industrial phase.

2.4 Promotion of Strategic and High-tech Industries (1981-present)

In the 1980s, Taiwanese government did a major shift of the development strategy due to the 1979 oil shock, existing labour shortage and environmental problems as well as protectionist pressure from the United States (US). Several strategies were implemented (Tsai 1999).

First, in the Ten Year Economic Development Projection (1980-89), several strategic industries were selected based on the criteria: large linkage effects, large market potential, high rate of value-added, high technology intensity, low energy intensity and low level of pollution. The government provided subsidies for these industries through preferential medium- and long-term low interest loans.

Second, the existing Science and Technology Development Programme of Taiwan identified energy, materials, information and automation that led to the establishment of Hinshu Science-Based Industrial Park (HSBIP) in 1980. Various measures were used to promote the development and advancement of high-tech industries. In 1995, a second science park was approved.

Third, in the 1980s, there was an accelerated liberalisation through decontrolled foreign exchange and freed capital movement. Quantitative import controls were mostly eliminated and tariff protection was reduced at large size. There was also the replacement of the Statute for the Encouragement of Investment (SEI) by the Statute for Industrial upgrading (SIU) in 1991. In the SIU, there are functional incentives including accelerated depreciation and tax breaks for energy conservation and as a modernisation of industrial relations.

3. LITERATURE REVIEW

In this section, we review some papers on the three variables that explain industrial development of a country namely, capital, productivity and research and development (R&D). A comparison of Taiwan's industrial development with those in some countries is also discussed briefly.

In the writing of Surányi-Unger (1962), during the early stage of industrialisation in Southeast Europe, government subsidies is the most suitable means to accelerate industrial capital formation. Socialist industrialisation was brought into prominence by the development of government-financed investments. According to Bawa (1974), industrial sector requires a large size of capital in the urban areas, and agriculture in the rural areas is the dominant source of such capital. Increased industrial output in the long run will expand industrial capital base and then, will further increase industrial activities. His empirical analysis shows significant linkages between agricultural production and capital formation in public and private segments of industrial sector in a developing economy.

Sriyani (1991) employed two indexes of productivity namely, capital productivity and labour productivity to measure the productivity patterns of manufacturing sector in several districts in Sri Lanka. According to the author, the identification of productivity patterns is to find out some solutions that can improve industrial production in the country. Sriyani's regression analysis suggests that labour productivity is positively related to capital intensity and hence the levels of industrialisation in the districts. In the working paper of Chemingui & Isaksson (2008) on productivity change in Morocco, economic reforms in improving performance of productivity is necessary to strengthen private sector-led growth.

With regards to R&D, the growth of high-tech industries in Taiwan has been because of high performance of R&D activities (Liu 1998). For this category of industries, the country concentrates on personal computers and peripherals, semiconductors or integrated circuits, telecommunications, photoelectric products, precision machinery, and biotechnology. According to Breznitz (2005), the public research institution-based industrial technology policy of the country helps the growth of industry when the research institutions interact with the private information technology (IT) industry.

In a comparative study of industrial development in East Asia, Akkemik (2009) focuses on the four countries, Japan, Korea, Singapore and Taiwan, which have established macroeconomic stability, high saving rates, high rates of human and capital accumulation and active role of government in monitoring development. Although these countries had the same goal, there were great diversities among them with regards to the implementation of policies. Rapid economic development of Japan was emulated by the Newly Industrialising Economies (NIEs) of East Asia (Korea, Singapore and Taiwan) with a delay of two decades. These countries were able to achieve high growth rates with rapid industrialisation within three decades starting from the early 1960s.

4. THE ORDINARY LEAST SQUARES ESTIMATION

In this section, we explain the method used in the analysis of industrial development and discuss the results while taking account its theoretical aspects.

4.1 Methodology

Based on the availability of data, our analysis examines the influences of capital, labour productivity and R&D on industrial development in Taiwan whether the three variables influence the level of industrial development in the country or not.

We use time series data for dependent and independent variables involved in the analysis. A regression technique of ordinary least squares (OLS) is used to estimate each coefficient of independent variable. Sources of data are from Taiwan Statistical Data Book 2009 and Asian Development Bank reports of 2001 and 2010. All the variables data were deflated by GDP deflator in order to obtain their real values at the prices of a fixed base year, 2005=100.

The theoretical model of industrial development in Taiwan in this analysis is

$$IO = f(GDCF, LP, R\&D) \quad (1)$$

where

IO is the annual industrial output (in New Taiwan dollar) representing industrial development in Taiwan from the period of 1984-2008;

GDCF is the annual gross domestic capital formation (in New Taiwan dollar) representing the level of capital from the period of 1984-2008;

LP is the annual labour productivity (in New Taiwan dollar) from the period of 1983-2007; and

R&D is the annual R&D expenditure in Taiwan (in New Taiwan dollar) from the period of 1984-2008.

Theoretically, capital, labour productivity and R&D variables are expected to have positive relationship with the level of industrial development. Larger capital would increase the number of industrial firms and enlarge the size of industrial activities. Meanwhile, an increase in the level of labour productivity would reduce the cost of production by increasing the quantity of industrial output per unit of labour. Large size of R&D expenditure would increase R&D activities, which aim to increase quantity of quality and value-added products in economic sectors.

The OLS model of industrial development in Taiwan is based on population as follows:

$$IO_t = \beta_0 + \beta_1 GDCF_t + \beta_2 \ln LP_{t-1} + \beta_3 R\&D_t + \varepsilon_t \quad (2)$$

$t=1984, \dots, 2008$

where β_0 is the intercept; β_1 , β_2 and β_3 are the slope parameters or coefficients that estimate the industrial output with respect to each explanatory variable; ε is a random error term; and t refers to t -th time period, and \ln denotes the natural logarithm. In the econometric model, labour productivity is measured in growth form and lagged one period to prevent autocorrelation problem between the regressor and the regressand.

4.2 Discussing the Findings

The findings of the industrial development model are shown in Table 1. The estimated coefficients of all the independent variables are statistically significant to influence the level of industrial development, which is represented by the level of industrial output in Taiwan.

The variable of gross domestic capital formation (*GDCF*) has a positive relation with industrial output. The coefficient on the variable is statistically significant at the one per cent level with elasticity at means of 0.25. The result suggests that an increasing size of capital expands activities of industrial production in economic sectors. With regard to the labour productivity (*LP*), it also has a positive relation with industrial output and is statistically significant at the level of five percent with elasticity at means of 0.46. The result suggests that a higher level of labour productivity intensifies the operating firms to increase their industrial outputs for profit maximization motive. Meanwhile, the variable of R&D has elasticity at means of 0.11, which suggests that R&D activities promote industrial development in longer term.

Referring to the same table, the adjusted R-square value, 0.9680 indicates that nearly 97 per cent of the model explains the variation in the level of industrial output. In the overall test of one per cent level of significance, the calculated p-value of the F-statistic is close to zero, indicating the significance of the model of industrial development in Taiwan. In the findings, the positive signs of the three variable coefficients meet the theoretical expectations explained earlier in this section.

Table 1: Estimates of Industrial Output in Taiwan, 1984~2008

Variable	Estimated coefficient	Standard error	t-ratio	p-value	Elasticity at Means
Gross Domestic Capital Formation (<i>GDCF</i>)	0.35159 **	0.1229	2.862	0.0045	0.2463
Labour productivity (<i>LP</i>)	0.42178E+07*	0.1968E+07	2.143	0.022	0.4553
Research and Development (<i>R&D</i>)	1.6821**	0.6219	2.705	0.0065	0.1073

Note: Adjusted R-square = 0.9680

F-statistic (from mean) = 242.628 (p-value = 0.000)

** Significant at the level of 1 percent

* Significant at the level of 5 percent

The p-value is appropriate for one-sided hypothesis test for all independent variables.

Table 2 exhibits the increasing levels of gross domestic capital formation, labour productivity and R&D expenditure in the five-year average in the periods of 1984-1988, 1989-1993, 1994-1998, 1999-2003 and 2004-2008. The increase in the gross domestic capital formation was more than 200 percent within the periods of 1984-1988 and 1994-1998. The amount of labour productivity and R&D expenditure also increased from one period to another period. The amount of R&D expenditures increased more than triple from the period of 1984-1988 to the period 1989-1993. The three variables are found to be significant in promoting industrial activities in the country. In the period of 1984-1988, the level of industrial output was NT\$1,734 billion. It increased to NT\$2,652 billion in the period of 1994-1998 and further increased to NT\$3,356 billion in the period of 2004-2008.

Table 3 further compares R&D expenditures between Taiwan, Japan, United States, Germany, France and United Kingdom (UK). The percentage share of R&D expenditure in Taiwan's GDP is comparable to the developed countries. In 1999, Taiwan's R&D intensity was in the fifth position after Japan, US, Germany and France. However, in 2006, the country ranked third after Japan and the United States in the competition. The steady increase in R&D share from 2000 to 2006 indicates the seriousness of the country to upgrade its industrial development through R&D activities for economic growth.

Table 2: Indicators of the Industrial development in Taiwan, 1984~2009

Base: 2005=100

Year	Industrial Output (NT\$ billion)	Gross Domestic Capital Formation (NT\$ billion)	Labour Productivity (NT\$ thousand)	R&D Expenditure (NT\$ billion)
1984-1988	1,734	815.2	224	42.2
1989-1993	2,214	1,428	261.2	95.2
1994-1998	2,652	2,006	291.5	146.2
1999-2003	2,916	2,068	308.3	215.2
2004-2008	3,356	2,699.6	331.8	322.4

Sources: Calculated from the Taiwan Statistical Data Book, 2009 and Key Indicators for Asia and the Pacific, various issues.

Table 3: Comparing R&D Expenditures between Taiwan and Selected Developed Countries (as a percentage of GDP), 1999-2006

Unit: %

Year	Taiwan	Japan	US	Germany	France	UK
1999	1.98	3.02	2.66	2.40	2.16	1.86
2000	1.97	3.04	2.75	2.45	2.15	1.85
2001	2.08	3.12	2.76	2.46	2.20	1.82
2002	2.18	3.17	2.66	2.49	2.23	1.82
2003	2.31	3.20	2.66	2.52	2.17	1.78
2004	2.38	3.17	2.59	2.49	2.15	1.71
2005	2.45	3.32	2.62	2.48	2.10	1.76
2006	2.58	3.39	2.66	2.54	2.10	1.78

Source: Taiwan Statistical Data Book, June 2009.

5. CONCLUSION

Taiwan's industrial development has experienced difficulties and challenges during the four phases of industrial development. World energy crises, economic recession, combined with internal economic and political shocks became constraints to the country's industrial development. However, the seriousness of the Taiwanese political leaders in achieving the national goals of industrialisation had enabled the growth of industrial outputs in the country. Taiwan had also been able to meet the challenge of the Asian financial crisis happened in 1997-1998 with their effective strategies.

Governmental intervention has been extensive during the four phases of industrial development in Taiwan. As a result, the country has benefited from a mild inflation rate, low unemployment rate, and large foreign exchange reserves with almost no foreign debt. Taiwan's reform on exchange rate system also encourages industrial firms to increase their levels of exports to the world. During the last phase of industrial development, Taiwan's main concern is the adaptation of its economic policies and strategies to the changing international economic environment. The existing strategic and high tech industries are therefore focusing on producing more high technology and value-added products. It encourages the industrial firms in Taiwan to widen their businesses internationally.

In the analysis of Taiwan's industrial development, the time series data on industrial output were used for dependent variable. It covers the period from 1984 to 2008. The three independent variables in the model are gross domestic capital formation, labour productivity and R&D. The findings from the OLS estimation indicate that they have statistically significant influences on the achievement of industrial development in Taiwan. Their positive sign is consistent with the theoretical expectations for the economic model. Based on the findings, high performances of the three variables increase the performance of production of outputs in industries, which reflects a move to a higher stage of industrial development in Taiwan. These would surely not happen within short term.

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