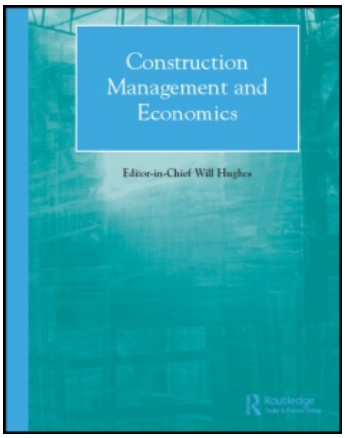

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Taiwanese construction sector in a growing 'maturity' economy, 1964-1999

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Taiwanese construction sector in a growing 'maturity' economy, 1964–1999

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Using 12 input-output tables compiled in Taiwan between 1964 and 1999, the role of the construction sector in the development of the Taiwanese economy is examined and analysed in relationship to other economic sectors. Analytical results reveal a two-stage inverted U-shaped relationship between the share of construction in GNP versus GNP per capita. The 'pull effect' of the Taiwanese construction sector is approximately equal to that of the Japanese construction sector over time, demonstrating that construction is more closely linked to the wider economy in Taiwan than elsewhere, like Italy, the UK and the USA. The 'push effect' increases significantly over time, indicating that the M&R (maintenance and repair) construction expenditures are growing in Taiwan. Finally, the direct and total construction input from manufacturing initially increased from 1969 and then declined after 1981, while the input from the service sector has been steadily growing. These findings confirm the increasing 'maturity' of the Taiwanese economy, a trend that mirrors the economic development of other AICs like Italy, Japan, the UK and the USA.

Keywords: Input-output analysis, pull effect, push effect, Taiwanese construction sector

Introduction

Taiwan is a typical case of rapid economic development, having developed her economic status from less developed country (LDC) to newly industrialized country (NIC) and now advanced industrial country (AIC).[1] With a total area of around 36 000 square kilometres and the third highest population density in the world, Taiwan had a population of over 22.4 million residents at the end of April, 2002. Given the rapid economic growth during the past five decades, Taiwan's average annual economic growth rate from 1952 to 2000 was 8.3%, and GNP growth increased from US$196 to US$14 216 per capita during the same period. Simultaneously, Taiwan has also experienced rapid urbanization, with the proportion of the population living in urban areas growing from 25% in 1951 to 75% in 2000.

The construction sector is commonly regarded as a leading sector in an economy. Given the above mentioned pattern of social and economic development, it is important to understand the relationship of the Taiwanese construction sector with other economic sectors, and the kind of role it has played in Taiwan's past economic development. This study briefly analyses the role of the construction sector in the Taiwanese economy using the 12 input-output tables compiled to date. To the best of our knowledge, no input-output studies of the Taiwanese construction sector itself have been published, and nor has any previous study investigated all twelve of the tables published to date.

Previous studies of the construction sector in some AICs were analysed by Ranko Bon and his colleagues, revealing many similarities between the USA, UK, Italy, Japan, and even Turkey (Bon and Pietroforte, 1990; Bon, 1991; Pietroforte and Bon, 1995; Bon and Yashiro, 1996; Bon *et al.*, 1999). Significantly, the results of the Taiwanese input-output analysis also revealed many similarities with the above mentioned AICs, especially with Japan. Essentially, this study follows the structure of the study published by Bon and Yashiro (1996) to achieve a consistent comparison with previous studies.

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This paper first briefly describes the input-output analysis for the construction sector, and then introduces the Taiwanese input-output tables. Data analysis and discussion are then presented, and finally conclusions are offered.

Input-output analysis for construction sector

Over six decades have passed since Wassily W. Leontief developed input-output tables to analyse the economic interdependence of industries. Input-output analysis breaks the economy into sectors (or industries) and the flow of goods and services among sectors (or industries registered) to indicate systematically the relations among them. These relations are called input-output relations because they tell us the inputs required by a sector to produce its output (Yan, 1968). An input-output table contains the basic information on which an input-output analysis is based. The rows of an input-output table describe the distribution of a producer's output throughout the economy, while the columns describe the composition of inputs required by a particular industry to produce its output (Miller and Blair, 1985).

Input-output analysis has been widely applied in four partially overlapping fields of construction sector analysis, namely: (1) construction employment creation and material requirements; (2) construction linkages and construction as the leading economic sector; (3) construction productivity; and (4) changes in the impact profile of the construction sector, or construction technology (Bon, 1991). Recently, the use of input-output data for embodied energy or environmental impact analysis of the construction sector or construction activities has also become a new research field due to global climate change and sustainable construction development (Irurah and Holm, 1999, Treloar *et al.*, 2001, and Hendrickson and Horvath, 2000).

Based on input-output analysis, Ranko Bon and his colleagues have developed two sets of papers to discuss the relationship between construction sector development and economic maturity. The one set of papers utilized a series of indicators derived from input-output tables to analyse the construction sector's maturity in various countries (Bon, 1988, 1991; Bon and Pietroforte, 1990, 1993; Pietroforte and Bon, 1995, 1999; Bon and Yashiro, 1996; Bon *et al.*, 1999; Pietroforte *et al.*, 2000). In these studies, the input and output profiles of the construction sector offer a sui generis representation of construction technology (for details see Bon, 1991). The changes in the profiles of input-output tables in different years indicate the development of construction technology over time.

The other one set of papers are dedicated to the empirical comparative analysis of the demand- and supply-side input-output models. These papers show that the construction sector's maturity signals the maturity of an entire economy through the relative forecasting performance of demand- and supply-side input-output models (for details see Bon, 2000, 2001).

In this paper, we are not attempted to discuss the above-mentioned second approach of input-output analysis for construction and maturity due to the limited space. We utilized a series of input-output indicator to analyse the role of Taiwanese construction sector in the growing maturity economy.

Taiwanese input-output tables

This study uses 12 Taiwanese input-output tables complied from 1964–1999. The 1999 input-output table became available in December 2001 (Directorate-General of Budget, Accounting and Statistics, DGBAS, 2001). The DGBAS prepares a comprehensive benchmark table along with the industrial, commercial and service industry census once every five years (specifically in years whose last digit is one or six). Furthermore, a non-census year table, based on data obtained from industrial and commercial enterprise management and industrial production cost surveys, is prepared in years whose last digit is four or nine. All of these input-output tables are given in current values.

As an economy develops, economic activity becomes increasingly complex. The number of sectors differs among the 12 Taiwanese input-output benchmark tables, with a diversification from 29, to 39, and finally 45 sectors from 1964–1999. However, regardless of the number of sectors over time, the construction sector consistently remained one of the sectors included in the tables, and was separated from the others by 1994. After 1996, the construction sector was further subdivided into two sectors, namely the building construction sector and the public and other construction sector. These two sectors were aggregated into a single construction sector to facilitate comparisons over time in this study. Appendix 1 presents the aggregation scheme of these benchmark input-output tables used during 1964–1999.

Data analysis and discussion

This study analyses 12 indicators used in previous studies and compares them with the input-output analysis results of the construction sector in some advanced industrial countries. These 12 indicators include share of construction in GNP, share of construction in NI, share of manufacturing in GNP, share of services in GNP, backward linkage indicators, output multipliers, forward linkage indicators, input multipliers, direct construction

inputs from manufacturing, total construction inputs from manufacturing, direct construction inputs from services, and total construction inputs from services. These indicators are defined as in previous studies conducted in some other countries, such as the UK, the USA, Japan, Italy and Turkey to permit consistent calculations (for further details regarding the definitions and equations of these 12 indicators, see Bon, 1988).

The figures displaying these 12 indicators were derived from 12 Taiwanese input-output benchmark tables compiled between 1964–1999, as presented in Table 1. The 12 data series are also presented in pairs in six figures to allow readers to make comparisons with previous studies on other countries (Figure 1 and Figures 3–7).

The following presents the results of data analysis and discusses them in terms of the share of construction in GNP and NI, the share of manufacturing and services in GNP, the 'pull effect' of the Taiwanese construction sector, the 'push effect' of the Taiwanese construction sector, and the direct and total construction inputs from manufacturing and services.

Share of construction in GNP and NI

Analysing the share of construction in GNP and NI will help people reveal the role of the construction sector in the Taiwanese economy. Figure 1 shows the share of the Taiwanese construction sector of both GNP and NI, and reveals a two-stage inverted U-shaped relationship in both cases (for further details regarding the inverted U-shaped relationship between the share of construction in GNP versus GNP per capita, see Bon, 1992). During the first stage of development, the share of GNP of the Taiwanese construction sector increased from 0.07 to 0.095 between 1964–1976, then declined to a low of 0.063 in 1986. During this period, the per capita GNP increased from US$203 in 1964 to US$3993 in 1986, representing the first stage of the inverted U-shaped relationship between 1964 and 1986. This development pattern between the share of construction of GNP versus per capita GNP over time appears again between 1986 and 1999. In the second stage, the share of GNP of the Taiwanese construction sector increased from 0.063 to 0.086 between 1986 and 1994, then declined to a low of 0.065 in 1999. During this period, per capita GNP increased from US$3993 in 1986 to US$13 235 in 1999. The peak of the second stage was in 1994, and was lower than the peak of first stage in 1976. As in previous studies of AICs, the share of NI of the Taiwanese construction sector is around half of its share of GNP.

Comparing the share of GNP and NI of Taiwanese construction sector with previous studies on other countries, the share of the Taiwanese construction sector of GNP

Table 1 Data series from Taiwanese input-output tables, 1964–1999

	1964	1966	1969	1971	1976	1981	1986	1989	1991	1994	1996	1999
Share of construction in GNP	0.071	0.072	0.08	0.076	0.094	0.087	0.062	0.074	0.076	0.084	0.077	0.065
Share of construction in NI	0.031	0.035	0.044	0.038	0.058	0.051	0.038	0.044	0.043	0.048	0.046	0.038
Share of manufacturing in GNP	0.503	0.501	0.496	0.540	0.548	0.536	0.541	0.498	0.469	0.444	0.450	0.453
Share of services in GNP	0.307	0.278	0.308	0.251	0.249	0.272	0.300	0.330	0.356	0.371	0.374	0.390
Construction backward linkage indicators	0.675	0.637	0.607	0.665	0.621	0.647	0.639	0.638	0.664	0.665	0.655	0.658
Construction output multipliers	2.504	2.365	2.256	2.463	2.578	2.747	2.624	2.558	2.664	2.612	2.543	2.555
Construction forward linkage indicators	0.106	0.082	0.078	0.083	0.063	0.081	0.179	0.124	0.147	0.144	0.156	0.154
Construction input multipliers	1.185	1.144	1.146	1.158	1.118	1.146	1.282	1.204	1.257	1.236	1.255	1.251
Direct construction inputs from manufacturing	0.457	0.467	0.437	0.504	0.452	0.493	0.474	0.479	0.483	0.472	0.446	0.432
Total construction inputs from manufacturing	0.916	0.869	0.807	1.013	1.050	1.120	1.090	1.040	1.080	1.030	0.940	0.930
Direct construction inputs from services	0.144	0.066	0.076	0.072	0.083	0.081	0.092	0.092	0.118	0.130	0.145	0.159
Total construction inputs from services	0.261	0.181	0.170	0.171	0.202	0.239	0.251	0.253	0.326	0.356	0.369	0.386

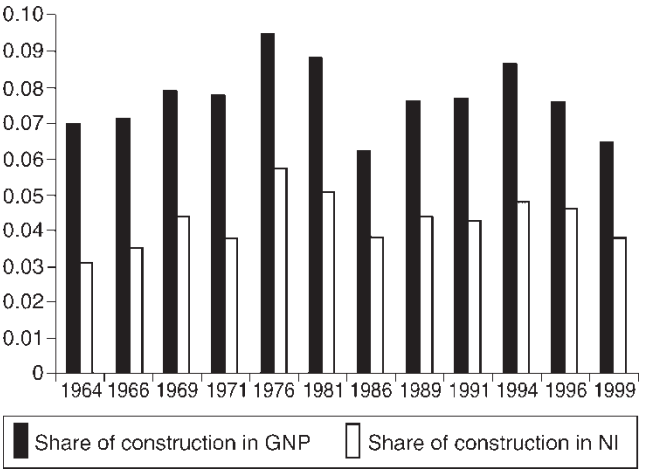

Figure 1 Construction sector's share in GNP and NI

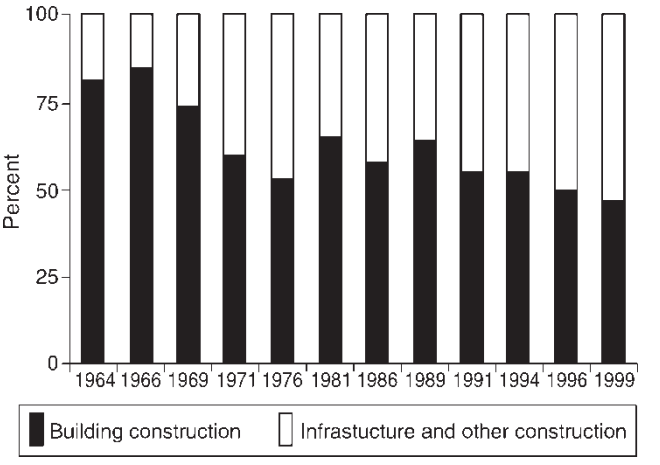

Figure 2 Output composition of the Taiwanese construction sector

and NI is much lower than that in the USA, the UK, Japan, Italy, Finland, Ireland, and even Turkey (Bon, 1991; Pietroforte and Bon, 1995; Bon and Yashiro, 1996; Bon *et al.*, 1999). Previous studies have found that the share of the construction sector of GNP in the USA, the UK and Finland tends to stabilize at between 10% and 12%, while in Taiwan it is between 6% and 8%. The Taiwanese construction sector has thus been relatively insignificant compared to other advanced industrial countries, and was even less important than in a newly industrialized country such as Turkey.

Taiwan is unique in the imbalance between building and infrastructure construction (the later namely public and other construction), the two mainstays of construction activity. Figure 2 shows the output composition of the Taiwanese construction sector, and indicates that building construction significantly exceeds infrastructure construction, a trend that is especially evident before 1994.

During the past four decades in Taiwan, the development of construction sector was affected by two main factors. The one is the population growth, and the other is the government policy related to infrastructure development.

The population of the Taiwan area increased by more than 14 million people from 1951–2000. The construction sector mainly produced buildings to fulfil the urgent need for residential, industrial, and commercial facilities during this period. Especially, in the late 1980s and early 1990s, due to booming house prices and the government proposal of floor area ratio (FAR) control, building construction grew rapidly. Because of overbuilding, the Taiwan area now contains more than 1.2 million unoccupied housing units, according to the population and housing census by DGBAS in 2000, and the building construction output fell to under 50% of total construction output in the late 1990s.

On the other hand, due to the oil crisis and global economic recession in the 1970s, the Taiwanese government launched 'Ten Major Construction Projects' to stimulate the economy and improve the island's infrastructure. The government continuously launched and completed further major infrastructure projects in order to stimulate economic growth, improve infrastructure, and enhance production facilities during 1980s and 1990s. Even thus, the infrastructure construction output was still lower than building construction output before the early 1990s.

According to the *World Competitiveness Yearbook* published by the IMD in Switzerland, Taiwan's infrastructure is consistently rated as being well behind that of other AICs. The past unbalanced development, with oversupply of residential buildings and under-investment in infrastructure has seriously affected the competitiveness and productivity of the Taiwanese economy. Aschauer (1989) has demonstrated that public infrastructure investment would contribute significantly to private production and economic development. Therefore, it is necessary to increase infrastructure investment to ensure further social and economic development in Taiwan in the future.

Share of manufacturing and services in GNP

Comparing the share of construction of GNP with the share of manufacturing and services of GNP over time will help in understanding the changes in the industrial structure of an economy. Figure 3 shows the GNP shares of manufacturing and services in Taiwan. The GNP share of manufacturing grew along with that of construction before 1981, and when the GNP share of construction entered the second stage of the inverted U-shaped pattern

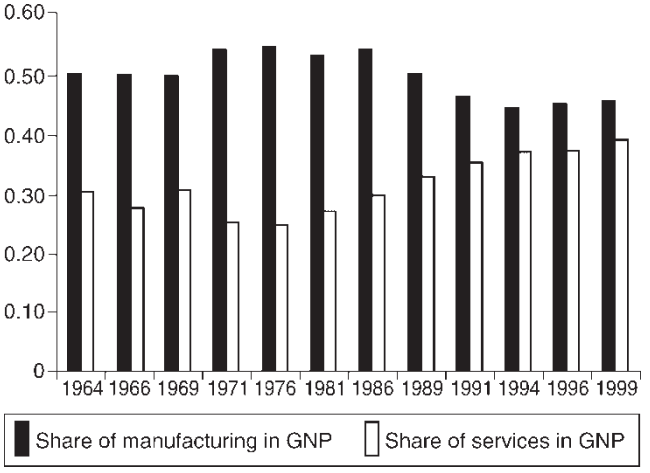

Figure 3 Shares of manufacturing and services in GNP

and begun to grow after 1986, the GNP share of manufacturing begun to decrease, finally stabilizing after 1994.

Meanwhile, the GNP share of the service industry began increasing in 1976, and has been growing ever since. The decreasing share of manufacturing of GNP, and the increasing share services since 1976, indicate that a new engine of economic development is emerging. Evidence of this 'changing of the guards' in the Taiwanese economy is more obvious than in the Turkish economy, and the trend in Taiwan is similar to that in Japan. In the Turkish economy, the GNP share of manufacturing decreased between 1973 and 1979, increased between 1979 and 1985, and decreased again after 1985. Meanwhile, the GNP share of services has increased after decreasing abruptly in 1985. Moreover, in the Japanese economy, the GNP share of manufacturing decreased after 1960, and the GNP share of services increased after 1960. The data series from Japanese (1960–1990) and Turkish (1973–1990) input-output tables are also presented in Table 2 (Bon and Yashiro, 1996; Bon *et al.*, 1999).

'Pull effect' of the Taiwanese construction sector

Figure 4 shows the backward linkage indicators and output multipliers of the Taiwanese construction sector, both of which are associated with the 'pull effect' of the construction sector. The backward linkage indicators are also termed the direct backward linkages, which measure the proportion of the direct inputs of a sector that come from other sectors of the national economy rather than from primary inputs (such as land, labour, capital and so

Table 2 Data series from Japanese (1960–1990) and Turkish (1973–1990) input-output tables

	Japanese							Turkish			
	1960	1965	1970	1975	1980	1985	1990	1973	1979	1985	1990
Share of construction in GNP	0.176	0.179	0.196	0.203	0.204	0.154	0.185	0.0847	0.1002	0.0873	0.1249
Share of construction in NI	0.061	0.073	0.080	0.095	0.093	0.072	0.092	0.0454	0.0378	0.0418	0.0551
Share of manufacturing in GNP	0.442	0.404	0.383	0.322	0.306	0.325	0.281	0.2579	0.2313	0.2820	0.2578
Share of services in GNP	0.331	0.373	0.355	0.454	0.425	0.504	0.501	0.1980	0.2010	0.1443	0.1701
Construction backward linkage indicators	0.680	0.620	0.620	0.560	0.570	0.573	0.539	0.4770	0.6307	0.5321	0.5637
Construction output multipliers	2.700	2.350	2.420	2.360	2.420	2.327	2.153	1.7932	2.0708	1.9215	1.9366
Construction forward linkage indicators	0.090	0.080	0.080	0.070	0.070	0.095	0.077	0.0242	0.0205	0.0215	0.0105
Construction input multipliers	1.190	1.170	1.160	1.150	1.160	1.180	1.151	1.0339	1.0297	1.0319	1.0159
Direct construction inputs from manufacturing	0.520	0.422	0.448	0.363	0.376	0.359	0.307	0.3682	0.3836	0.3965	0.3877
Total construction inputs from manufacturing	1.120	0.860	0.950	0.790	0.850	0.770	0.623	0.5298	0.6246	0.5924	0.5822
Direct construction inputs from services	0.064	0.082	0.093	0.101	0.114	0.115	0.149	0.0252	0.0099	0.0079	0.0278
Total construction inputs from services	0.150	0.170	0.200	0.230	0.250	0.270	0.322	0.0504	0.0410	0.0328	0.0613

Sources: Bon and Yashiro (1996); Bon *et al.*, (1999).

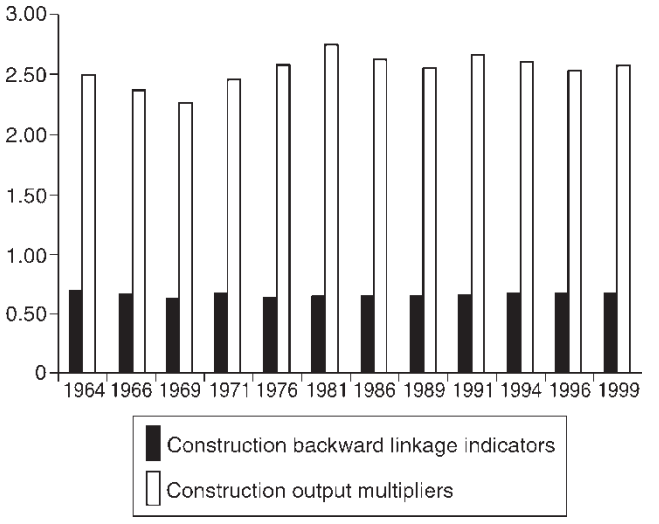

Figure 4 Construction backward linkage indicators and output multipliers

on). The backward linkage indicators of Taiwanese construction sector are stable over time, and all exceed 0.6.

The output multipliers are also termed the direct and indirect backward linkage indicators, or total backward linkage indicators. Because they measure the total effect of a monetary unit change in the value of final demand for the goods and services of the construction sector on the output of all sectors. The output multipliers fluctuate more than the direct backward linkage indicators over time in Taiwan, ranging from a low of 2.256 in 1969 to a high of 2.747 in 1981.

Backward linkage indicators are generally used as a measure of the degree of the industrialization of the construction production process. Because they show the extent to which building materials and components are manufactured off site (Bon, 1990, 1991; Pietroforte and Bon, 1995). Previous analysis of the construction sector in the USA, Japan, the UK, Italy, Finland and Ireland has found that the direct backward indicators in the USA, the UK and Japan all exceed 0.5 (Bon, 1991). This phenomenon indicates the level of industrial development of these countries. The direct and total backward indicators of the Taiwanese construction sector reveal much closer links between the construction and other sectors in Taiwan than in other AICs.

What causes the variation of 'pull effect' of construction sector in a given country's economy? Polenske and Sivitanides (1990) analysed the differences in backward linkages among countries and over time may be attributable to variations in three factors: product mix, relative prices, and technologies. For example, the 'pull effect' sometimes increase over time, as in the case of Ireland, while at other times it remains relatively constant in the USA or decrease in Japan. In addition, the 'pull effect' of Taiwanese construction sector show relatively constant and a little fluctuation over time with high values, which are roughly equal that in Japan, and exceeds that in Turkey. Because of the strong 'pull effect', it is little wonder that the Taiwanese government used to launch large-scale public work projects to stimulate the economy development.

To some extent, even the strong 'pull effect' can reflect the closer links between construction sector and other sectors. It is needed to conduct additional comparative analysis to find out the causes of variation come from in the 'pull effect' of construction sector among different countries and over time.

'Push effect' of the Taiwanese construction sector

Figure 5 shows the forward linkage indicators and input multipliers of the Taiwanese construction sector, both of which are associated with the 'push effect' of the construction sector. The forward linkage indicators are also termed the direct forward linkage indicators, which measure the proportion of the direct output of a sector that goes to other sectors of the national economy, rather than to the final consumer. The input multipliers are also termed the direct and indirect forward linkage indicators, or the total forward linkage indicators. Because they measure the effect of a monetary unit change in the value of primary input available to the construction sector on the input of all industries.

The strength of the Maintenance and Repair (M&R) construction expenditures can be analysed by measuring the two indicators mentioned above. In Taiwanese

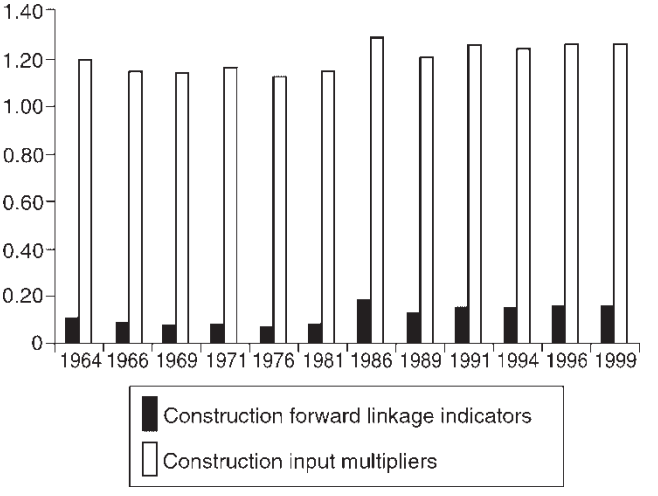

Figure 5 Construction forward linkage indicators and input multipliers

input-output tables, new and M&R construction are not separated. The construction row contains only maintenance and repair flows to others, whereas the new construction goods and services go to final demand. Therefore, the values of the construction row element represent only the maintenance and repair expenditures made by each sector. This is because the interindustry portion of an input-output table just contains current-account transactions, all sales of plant and equipment appear only as a lump-sum sale by the sector producing the capital to investors (Polenske, 1990; Bon, 1991).

The direct and total forward linkage indicators in Taiwan show an increasing trend over the years, from a value of 0.106 in 1964 to 0.154 in 1999, and 1.185 in 1964 to 1.251 in 1999, respectively. It reflects the progressive ageing of building stock and infrastructure system in Taiwan. Therefore, the Figure 5 suggests that the amount of M&R construction expenditures grows with economic maturity. The growing trend of 'push effect' in the Taiwanese construction sector is more apparent than that in Japan, and is significantly higher than in Turkey. In the future, the Taiwanese construction sector needs to put more emphasis on the development of techniques and materials in the M&R construction field.

The low values of both direct and total forward linkage indicators reflect the fact that the construction sector provides intermediate goods and services through its M&R construction expenditures. About 70–75% of these M&R expenditures go to the real estate services sector in Taiwan. It also should be noted that the M&R construction expenditures tend to be underestimated in national income accounts because much of this work is done by owners of constructed facilities on so-called force account (Bon, 1990).

Direct and total construction inputs from manufacturing and services

Figure 6 shows the direct and total construction inputs from manufacturing, both of which initially increase, and then decline after 1981. The proportion of the total direct inputs of the construction sector coming from manufacturing has fallen by between 40% and 50% over time, indicating the connection between construction and manufacturing is still closer up to now. The Taiwanese situation thus differs from other AICs, where direct construction input from manufacturing is declining over time (Bon, 1991). From 1971 to 1994, the total construction inputs from manufacturing consistently exceeded 1, representing the change is greater in manufacturing output resulting from a monetary unit change in the value of final demand for goods and services in the construction sector. In Japan, with the exception of

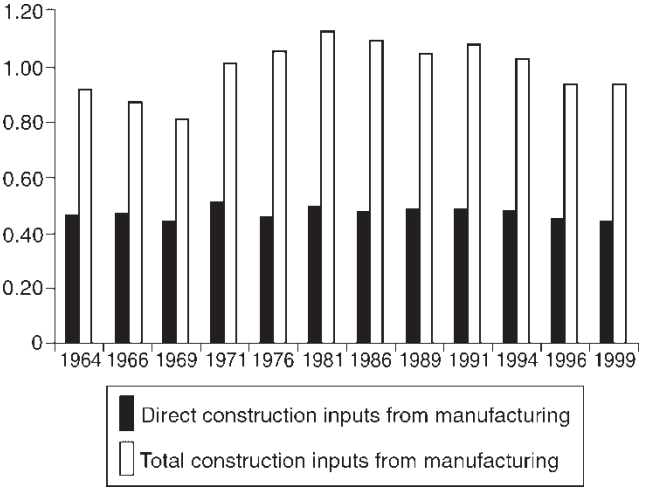

Figure 6 Direct and total construction inputs from manufacturing

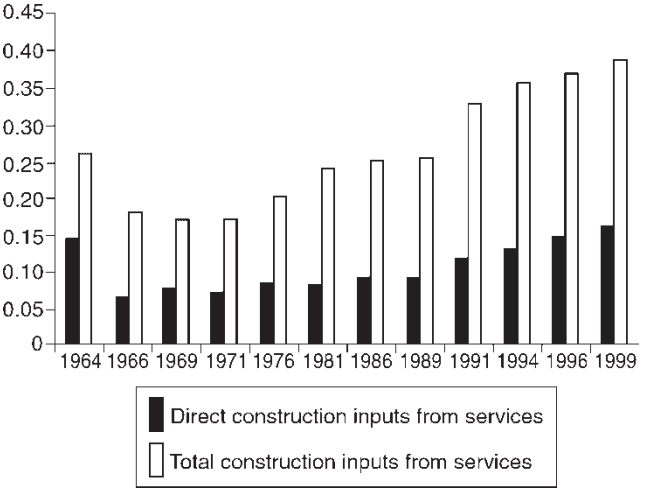

Figure 7 Direct and total construction inputs from services

1960, total construction inputs from manufacturing have never exceeded 1 (Bon and Yashiro, 1996), and even in the USA, the UK, Italy and Turkey, the total construction inputs from manufacturing are all below 1 (Bon, 1991; Pietroforte and Bon, 1995; Bon *et al.*, 1999). This evidence reconfirms the close relationship between the construction and manufacturing sectors in the Taiwanese economy.

Figure 7 shows the direct and total construction inputs from services, both of which are growing over time, similar to the Japanese case. Service sector inputs come mainly from the commodities trading sector (including wholesale, retail and international trade) and the business service sector (including legal and accounting, consulting, data processing and information, advertising, renting

and leasing, and miscellaneous business services). As the economy becomes increasingly 'mature', the direct and total construction inputs from services will also grow. Nevertheless, the manufacturing sector remains the main partner of the construction sector.

Conclusion

This study uses 12 indicators to analyse the role of the construction sector in the Taiwanese economy, and confirms the general trend of growing 'maturity' displayed by many other advanced industrial countries.

As the economy becomes increasingly 'mature', the comparison between the share of the Taiwanese construction sector of GNP and per capita GNP shows a two-stage inverted U-shaped relationship. The share of the manufacturing sector of GNP is declining, whereas the share of GNP of the service sector is growing since 1976. Like the Japanese construction sector, the Taiwanese construction sector also has a strong 'pull effect', which is why the Taiwanese government has launched large-scale public construction projects to stimulate economic development during the past few decades. The getting stronger trend of the 'push effect' shows that the M&R construction expenditures are growing in Taiwan. All of the evidence shows that the Taiwanese construction sector is following the same development path as the construction sector in other advanced industrial countries. Particularly, the two-stage inverted U-shape relationship of the construction sector's share in GNP versus per capita GNP is also expected to be found in other AICs, although further observations are required to prove this.

From the viewpoint of the share of construction in GNP and NI, the Taiwanese construction sector made less significant contribution to economic development than in other AICs. However, the 'pull effect' of the Taiwanese construction sector is stronger than in other AICs, which is relevant to the structure of construction related industries (product mix) and the relative price and quantity of construction materials and techniques in an economy. It would be useful to make further comparisons of the 'pull effect' between various countries, since this could offer useful policy guidelines to help government and industry adjust the structure of construction related industries, and also adjust the development of construction materials and technique.

The most important application of input-output tables is to utilize input-output analysis to understand the socio-economic and environmental impacts of large-scale infrastructure projects or construction industry, especially on the economic growth of a country. Linking input-output tables with energy or environmental data for embodied energy or environmental impact analysis of construction sector or activities has also become a new research field due to global climate change. The information contained in an input-output table and relevant environmental data can be used to establish an integrated socio-economic and environmental CGE (Computable General Equilibrium) model, which is an extension of input-output analysis. In addition, this CGE model could be based on a social accounting matrix (SAM), which is a matrix of interactions in the spirit of the production relationships of input-output, with a much greater emphasis on institution accounts. Applying this CGE model to evaluate the sectoral socio-economic and environmental impact of a particular large-scale infrastructure project or construction industry in an economy-wide context would be a useful future research direction.

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Note

1. Taiwan is classified as one of the high-income economies, just like Japan, the USA, the UK and Italy, according to the classification of economies by World Bank. High-income nations are commonly termed ‘developed’ or ‘industrialized’.

Appendix 1. Aggregation scheme used between 1964 and 1999

29 sectors (1964–1976)	39 sectors (1981–1994)	45 sectors (1996–1999)
1. Agricultural Products and Livestock	1. Agricultural Products and Livestock	1. Agricultural Products
		2. Livestock
2. Forestry	2. Forest Products	3. Forest Products
3. Fisheries	3. Fisheries	4. Fisheries
4. Minerals	4. Minerals	5. Minerals
5. Processed Food	5. Process Foods	6. Process Foods
6. Beverages, Tobacco and Alcoholic Beverages	6. Beverages	7. Beverages
	7. Tobacco	8. Tobacco
7. Fabrics	8. Textile Mill Products	9. Textile Mill Products
8. Garments, Apparel and Accessories	9. Wearing Apparel and Accessories	10. Wearing Apparel and Accessories
		11. Leather and Leather Products
9. Wood and Wooden Products	10. Wood and Wood Products	12. Wood and Wood Products
10. Paper and Paper Products and Printing and Publishing	11. Paper and Paper Products and Printed Matter	13. Paper and Paper Products and Printed Matter
11. Chemical Materials	12. Industrial Chemicals	14. Industrial Chemicals
12. Artificial Fibres, Plastics and Plastic Products	13. Artificial Fibres	15. Artificial Fibres
	14. Plastic	16. Plastic
	15. Plastic Products	17. Plastic Products
13. Misc. Chemical Products	16. Misc. Chemical Manufactures	18. Misc. Chemical Manufactures
14. Petroleum Products	17. Petroleum Refining Products	19. Petroleum Refining Products
15. Non-metallic Minerals	18. Non-metallic Mineral Products Manufacturing	20. Non-metallic Mineral Products Manufacturing
16. Steel and Iron	19. Iron and Steel Products	21. Iron and Steel Products
17. Misc. Metals and Metallic Products	20. Miscellaneous Metals	22. Miscellaneous Metals
	21. Metallic Products	23. Metallic Products
18. Machinery	22. Machinery	24. Machinery
19. Household Electrical Appliances	23. Household Electrical, Electronic Products	25. Household Electrical, Electronic Products
20. Electronic Products	24. Electrical Products	26. Information Products
		27. Communication Products
		28. Electronic Components and Parts
21. Electrical Machinery and Apparatus	25. Electrical Machinery and Other Appliances	29. Electrical Machinery and Other Appliances
22. Transport Equipments	26. Transport Equipment	30. Transport Equipment
23. Miscellaneous Products	27. Other Manufactures	31. Other Manufactures
24. Construction	**28. Construction**	**32. Building Construction**
		33. Public and Other Construction
25. Electricity	29. Electricity	34. Electricity
26. Gas and City Water	30. Gas and City Water	35. Gas
		36. City Water
27. Transportation, Communication and Warehousing	31. Transportation, Storage and Communication	37. Transportation, Storage and Communication
28. Wholesale and Retail Trade	32. Commodities Trading	38. Commodities Trading
29. Miscellaneous Services	33. Finance and Insurance Services	39. Finance and Insurance Services
	34. Real Estate Services	40. Real Estate Services
	35. Food, Beverage and Hotel Services	41. Food, Beverage and Hotel Services
	36. Business Services	42. Business Services
	37. Public Services	43. Public Services
	38. Education and Medical Services	44. Education and Medical Services
	39. Other Social, Personal and Related Community Services	45. Other Social, Personal and Related Community Services

1. Manufacturing sectors including sector 5–23 (1964–1976), sector 5–27 (1981–1994), sector 6–31 (1996–1999).
2. Service sectors including sector 28–29 (1964–1976), sector 32–39 (1981–1994), sector 38–45 (1996–1999).