

STUDY OF LINKAGES BETWEEN CONSTRUCTION SECTOR AND OTHER SECTORS OF THE SRI LANKAN ECONOMY

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Abstract

Input–output analysis has been widely used to assess sectoral economic performance and production interdependence. This paper uses input–output tables compiled since 1960s in Sri Lanka to analyze the significance of construction in a developing economy and its relationships with other sectors of the national economy. Results show that construction indicates an above average, significant backward linkage while a below average, insignificant forward linkage in the forty sector economy of 1994. An aggregated sectoral analysis reveals high dependence of construction on manufacturing followed by services. The trend analysis shows an increasing dependence of construction on the services sector. The outputs of construction mainly satisfy the services sector. The paper shows that the trend of the profile of inputs and outputs are correlated to the economic policy regime in operation. It is argued that input and output profiles of construction not only mirror the technology that has been used for production as claimed by previous researchers, but also the governing economic policy.

Key Words: Input–output analysis, Construction sector, Backward Linkages, Forward Linkages, Economic Policy, Sri Lanka.

Introduction

The role of construction in the national economy has been addressed by a number of researchers. Strout (1958) provided a comparative intersectoral analysis of employment effects with an emphasis on the construction. Ball (1965) and Ball (1981) addressed the employment effects of the construction sector as a whole. Park (1989) has confirmed that the construction industry generates one of the highest multiplier effects through its extensive backward and forward linkages with other sectors of the economy. It is stated that the importance of the construction

industry stems from its strong linkages with other sectors of the economy (World Bank, 1984). However, interdependence between the construction sector and other economic sectors is not static (Bon, 1988; Bon, 1992).

Input-output analysis invented by Wassily Leontief (1936) continues to be a useful modeling technique which can be used to determine, define, measure and assess the linkages between sectors. Application of this concept to the construction industry of developed economies is evident from past research (Bon and Minami, 1986; Bon, 1988; Bon and Pietroforte, 1990; Bon 1991; Bon, 1992; Pietroforte, 1995; Bon and Yashiro, 1996; Lean, 2001; Pietroforte and Gregori, 2003). The input-output technique has been considered as an ideal framework to study the direct and indirect resource utilization in the construction sector and its interdependence with other sectors (Bon, 1988). Ofori (1990) noted the importance of construction in the national economy and attributed it to the high linkage with the rest of the economy. Construction industry is regarded as an essential and highly visible contributor to the process of growth (Field and Ofori, 1988).

Despite the extensive research on input-output analysis and sectoral linkages of construction, a lapse of literature is found in terms of developing economies. The literature available on this subject focus on developed economies. Polenske and Sivitanides (1990) is the only exception where the backward linkage indicators of several economies belonging to both developed and developing countries have been studied. However, the study does not provide an in depth analysis of the inter-sectoral relationships in the developing countries concerned.

The main objective of this paper is to fill this gap and show how the construction industry of a developing country is linked with other sectors of the economy. In addition, this paper analyses the impact of changing economic policies on construction. The trend of sectoral interdependence is analyzed with particular emphasis on input and output profiles of construction.

Data and Methodology

This study was primarily carried out based on the five input-output tables compiled for the Sri Lanka economy so far. The 1968 table was produced by the Department of Census and Statistics (Department of Census and Statistics, 1972). The rest were published by the Department of National Planning (Department of National Planning, 1979; Department of National Planning, 1983; Department of National Planning, 1988; Department of National Planning, 2001).

For analytical purposes, the original input-output tables consisting of different number of sectors are aggregated into five sectors based on International Standard Industrial Classification (ISIC). These sectors are Agriculture, Mining & quarrying, Manufacturing, Construction, and Services. The direct input coefficient matrix is constructed by dividing each flow shown in the input-output table by its column sum. Alternatively, when each flow is divided by the row sum, a direct output coefficient matrix is obtained. Direct input and output coefficient matrices are used to establish the direct linkages. Direct input/output coefficient matrices are inverted to obtain the total input and output coefficient matrices respectively. The elements of an inverse matrix represent both direct and indirect flows between two sectors. The total input coefficient matrix shows the total impact of changes in final demand on sectoral output, while the total output coefficient matrix shows the total impact of changes in value added on sectoral input.

Input-Output Analysis

Input-output analysis identifies the interdependence of production and consumption in an economy. It shows the interrelations among different sectors that purchase goods and services from other sectors and which in turn produce goods and services that are sold to other sectors. The input-output table is designed to provide a concise and systematic arrangement of all economic activities within an economy. It shows the intersectoral flows in monetary terms for a particular year where the flows represent intermediate goods and services. Construction sector is typically represented by a row and a column. The construction row shows where the construction output goes to, while the construction column shows where the construction inputs come from.

Two different approaches are found in measurement of linkages. Chenery and Watanabe (1958) proposed to use the column and row sums of technical coefficient matrix to measure the backward and forward linkages of a particular sector. This method measures only the first round effects generated by the interrelationships between sectors since it is based on direct input (or output) coefficients. Therefore, these indicators are called *direct backward* and *direct forward* linkage indicators. Rasmussen (1956) favoured the use of column (row) sums of the Leontief inverse matrix, $(I-A)^{-1}$, to measure the intersectoral linkages since it takes into account both direct and indirect effects generated by the interrelationships. These indicators are considered as total (direct plus indirect) backward and forward linkage indicators. *Total backward* and *total forward* linkage indicators are also called *output multipliers* and *input multipliers* respectively.

Significance of Construction in the Sri Lankan Economy

Sri Lanka is a developing country that gained independence from British Colonial rule in 1948. Over the five decades of post independence, the traditional agriculture based economy has slowly been proliferating to a manufacturing based economy. In Sri Lanka, construction has contributed 6-7% to GDP over the past decade and is responsible for more than 50% of the total Gross Domestic Fixed Capital Formation (Central Bank, 2002). Employment generation by construction is about 5-6 % of the total labour force of the country (Sri Lanka Labour Force Survey, 2002). Construction in Sri Lanka, as in many other developing countries, depends mainly on the national plan of each political group in power. In the 1960s, private contractors readily satisfied the demand placed on them. The period from 1970-77 did not regard construction as a key sector in economic development and there was not sufficient investment for essential infrastructure while housing was regarded as resource absorbing instead of resource producing (Medagedara, 1988). Sri Lankan economy underwent significant changes with the advent of an open market concept in the late 1970s'. Many local and international investments triggered a boom in construction during the post liberalization period. Land prices appreciated mainly due to proliferation of construction activities. All these changes led construction to become an important sector in the economy today.

Many development economists have used linkage indicators in identifying key sectors; Key sectors are defined as the sectors with above average forward and backward linkages (Soofi, 1992). The latest input-output table for Sri Lanka (1994) is aggregated to 40 sectors based on International Standard Industrial Classification (ISIC) to identify the key sectors. The results are given in Figures 1 and 2. Figure 1 is obtained by arranging the output multipliers of the economy in a descending order. The highest output multiplier is found for Hotels and Restaurants while the lowest for Ownership and Dwelling sector. Construction occupies the eighth place having an output multiplier of 1.80 within the 40-sector economy. Construction ranks above average and can be considered as a key sector. This indicates the nature of construction operations involving the assembly of many different products purchased from a large number of industries. The high output multiplier denotes the potential of construction to trigger off production in many sectors linked to it. Figure 2 gives the relative position of construction in terms of input multipliers. Having an input multiplier of 1.09, construction occupies the thirty-fifth position. This low value of input multiplier implies that major portion of construction output (about 95%) cater to final demand. The reason is that only the repairs and maintenance sub-sector is considered as intermediate input which is negligible compared to new construction. High backward linkages compared to forward linkages are observed in all five input-output tables of Sri Lanka.

Comparison of Table 2 and Table 3 in the next two sections demonstrate the above observation. This phenomenon is true for other countries too. Table 1 gives a comparison of construction linkages of 12 developed countries along with Sri Lanka.

Table 1: Comparison of input and output multipliers

Country	Output multiplier	Input multiplier	Source
Germany 1989	2.300	1.390	Pietroforte and Gregori, 2003
Denmark 1989	2.260	1.530	Pietroforte and Gregori, 2003
Netherlands 1985	2.240	1.515	Pietroforte and Gregori, 2003
Canada 1989	2.220	1.290	Pietroforte and Gregori, 2003
USA 1977	2.208	1.415	Miller and Blair, 1985
Italy 1982	2.200	1.260	Bon and Pietroforte, 1990
France 1989	2.160	1.115	Bon and Pietroforte, 1990
Japan 1990	2.153	1.151	Pietroforte and Gregori, 2003
Australia 1988	2.060	1.080	Pietroforte and Gregori, 2003
Turkey 1990	1.937	1.016	Bon, et.al; 1999
Singapore 1990	1.847	1.048	Lean, 2001
Sri Lanka 1994	1.808	1.086	Author
Finland 1985	1.780	1.170	Bon and Pietroforte, 1990

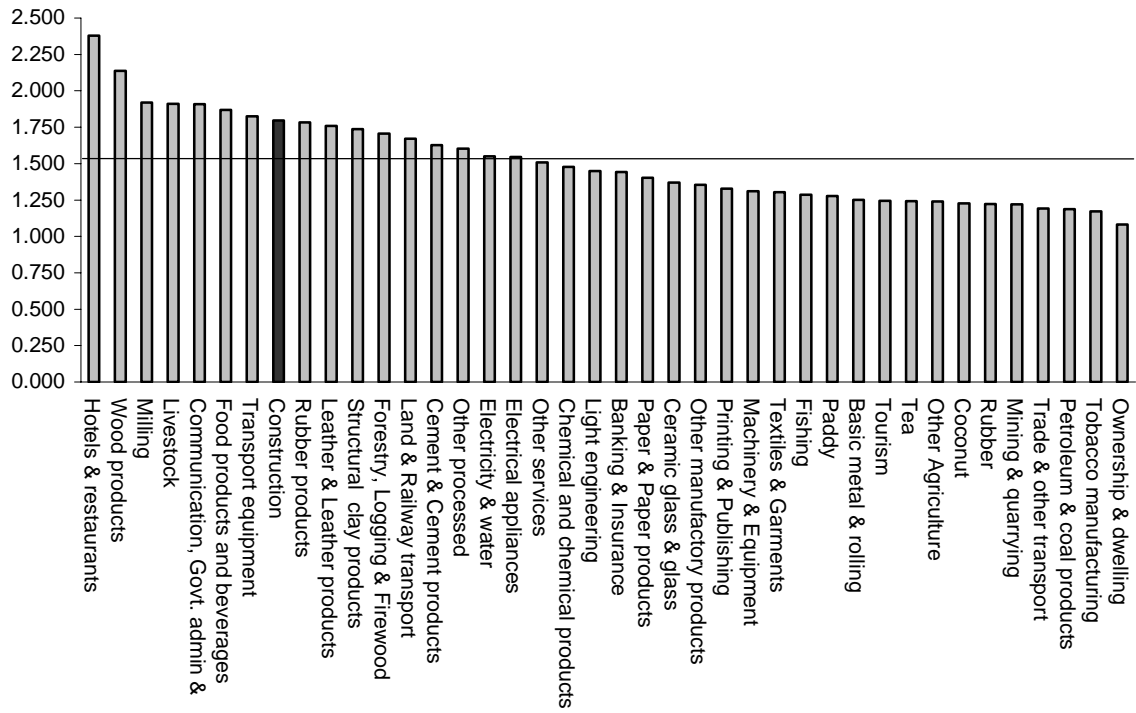


Figure 1: Position of construction in the 1994 economy - backward linkage

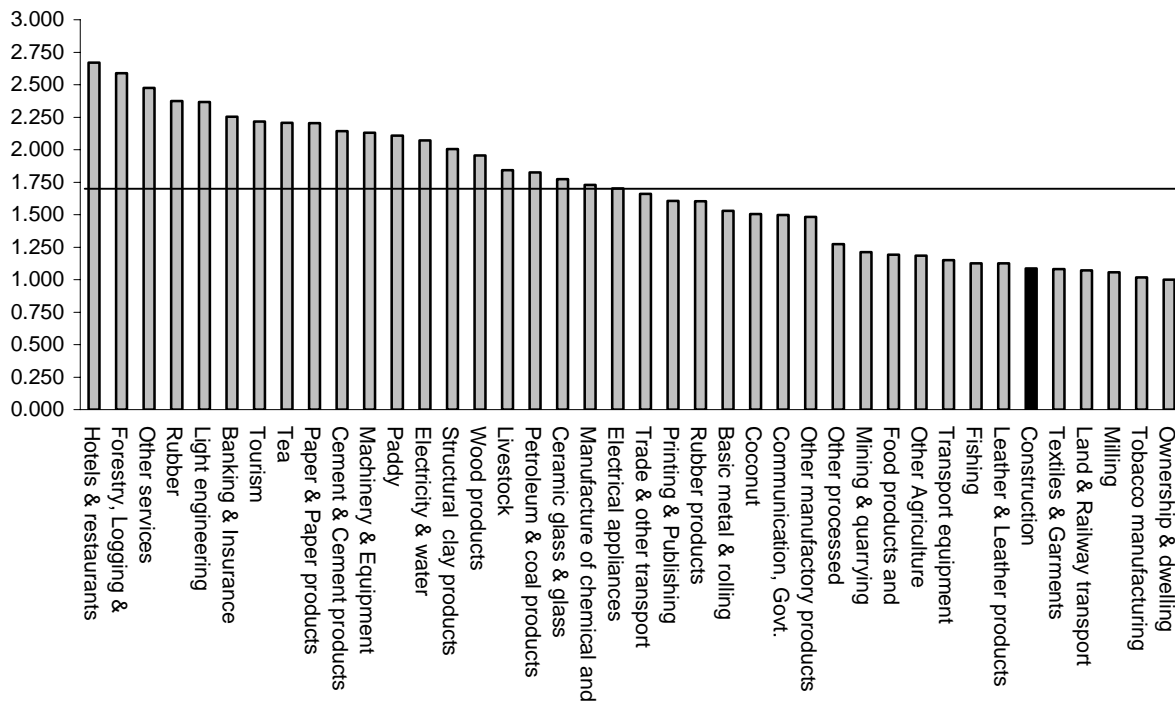


Figure 2: Position of construction in the 1994 economy - forward linkage

Linkage indicators of developed economies show higher values compared to the newly industrialized economies with the exception of Finland. It's an accepted phenomena that the share of new construction diminishes as a country develops. Nevertheless the output multipliers of developed economies indicate comparatively higher values. The reason could be that the standard of construction is high in developed economies compared to the quality of construction in developing economies.

Having identified the interdependence of construction with other sectors of the Sri Lankan economy, the following two sections discuss the backward and forward linkages in detail.

Trend of Backward Linkages (The Pull Effect)

Table 2 shows changes in backward linkage indicators and output multipliers over the last three decades. Both indicators show relative stability until 1980. Year 1980 shows a drop in both indicators. A sharp increase can be observed in 1994 recording the highest figures. It was found that construction depends mainly on manufacturing followed by services for its inputs. The inputs from mining & quarrying and agriculture are marginal. These observations remain almost same throughout the history as given in Figure 3. Manufacturing records the highest direct backward linkage indicator in all five Input–Output tables followed by services. The share of manufacturing remains stable while that of the services increases slightly over time. It could also be seen that the agricultural inputs increases up to 1986 and suddenly drops to zero in 1994.

Contrary to the Sri Lankan experience, the construction industry of highly developed countries characterizes a decreasing share of manufacturing inputs and an increasing share of services inputs (Pietroforte and Gregori, 2003). This shows that economic development leads to an increasing dependence of construction on services sector. The pull effect of the Sri Lankan construction sector is approximately equal to that of the Turkish construction sector over time. In the Turkish economy backward linkage indicators range between 0.477 to 0.564 during 1973-1990 period. Similarly output multipliers range between 1.793 to 1.937 during the above period (Bon et.al, 1999). Like in Sri Lanka, the construction sector of Turkey shows an increasing dependence on services sector. However, services is far from dominating the construction inputs while manufacturing remain as the main supplier of the Turkish construction industry (Bon et. al., 1999)

Table 2: Backward linkage indicators and output multipliers of construction

Linkage Indicators	1968	1976	1980	1986	1994
Backward Linkage Indicators	0.429	0.451	0.449	0.383	0.530
Output multipliers	1.670	1.664	1.637	1.484	1.804

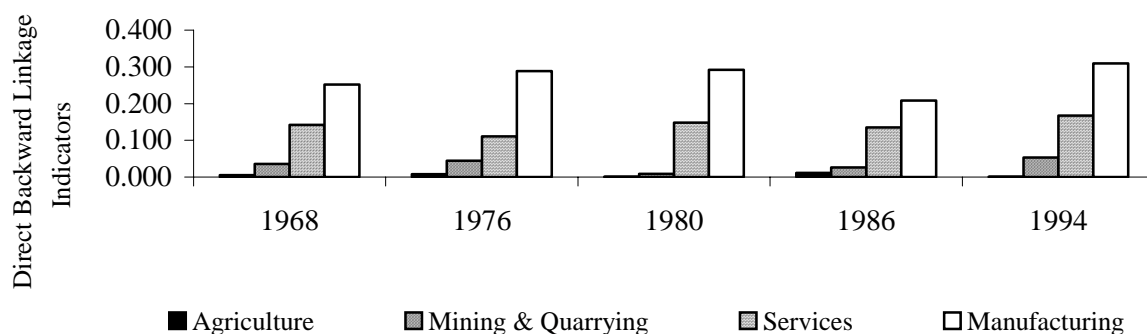


Figure 3: Trend of direct backward linkages of construction

Trend of Forward Linkages (The Push Effect)

Table 3 shows the changes in forward linkage indicators and input multipliers over the years. It demonstrates that the percentage of direct construction output going to other industries is around 2% and decreases to as low as 1% in 1994. The input multiplier is stable at around 1.0, indicating the lower value added of the maintenance and repair sub sector. A sudden increase in the indicators could be observed in 1986. As given in Figure 4, the repair and maintenance output of construction is significant to the services sector. Exceptions are in years 1976 and 1980. Both these years show equal shares of repair and maintenance consumption by agriculture and services sector. Further, an equal share of consumption by agriculture, manufacturing and services can be seen in 1980. The forward linkage indicator of Turkey ranges between 0.024 to 0.011, and input multipliers 1.034 to 1.016, during 1973-1990 period (Bon et, al., 1990). Similar to Sri Lanka, the main consumer of maintenance and repair sector in Turkey too is the services sector.

Table 3: Forward linkage indicators and input multipliers of construction

Linkage Indicators	1968	1976	1980	1986	1994
Forward Linkage indicators	0.022	0.011	0.019	0.045	0.012
Input multipliers	1.032	1.020	1.027	1.064	1.025

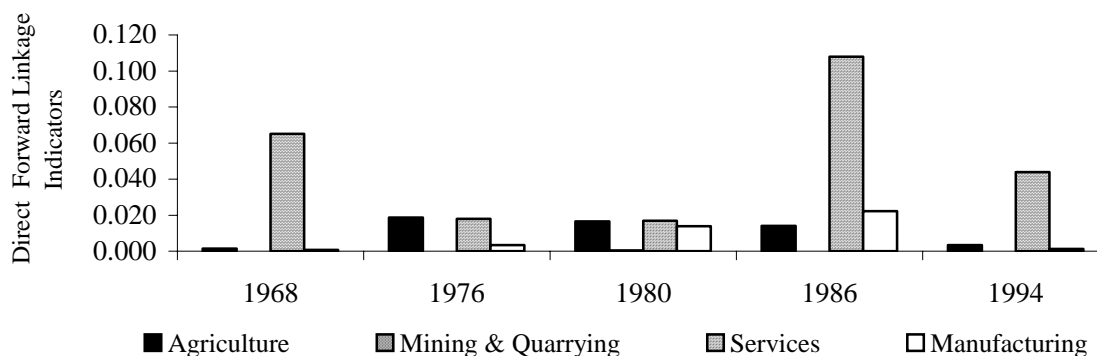


Figure 4: Trend of direct forward linkages of construction

Impact of Changing Economic Policies on Construction

Bon (1991) showed that the input-output profiles of construction sector offer a general representation of construction technology. Poleske and Sivitanides (1990) analyzed the differences in backward linkages over time in several countries and found three attributes for the variation: the product mix, relative prices, and technologies. This paper argues that it is not only the above three factors, but also the “economic policy” affects the input-output profiles of construction. The Sri Lankan economy provides a good opportunity to study the relationship between economic policy and input and output profiles of construction. In the Sri Lankan history of post independence there are three distinct phases; first a free market economy until 1969; second an inward looking growth strategy based on import substitution during 1970-1977; and third an outward looking growth strategy based on export promotion and economic liberalization (Bhargava, 1987). These three distinct phases render a sound framework to analyze the changing pattern of input and output profiles of construction in the Sri Lankan economy.

Sri Lanka emerged as an independent nation state in 1948. The government that came into power after independence represented the colonial legacy of welfare expenditure and an export oriented, free market, outward looking growth strategy until 1969. However towards the latter part, the import substitution/ inward looking strategy was identified essential for development of the domestic industries. These strategies were implemented by the socialist led coalition government

that came into power in 1970. The success of the inward looking growth strategy depended on the responses of domestic economy and the world capitalism. Both did not respond favourably. Responses of the domestic economy were limited by poor sectoral linkages and lack of domestic demand. Response of world capitalism reflected mainly in the declining commodity terms of trade and making foreign loans and exchange scarce for the economy. Returns on investment in the industries were generally poor. Capacity utilization was low. Import content in raw material remained high. Economies of scale were not realized. In these circumstances the economy stagnated. To overcome the stagnation, Sri Lanka changed over to export oriented growth strategy in 1977. The growth of the economy now depended more on world capitalism and less on domestic responses. World capitalism demanded an open economy. The Sri Lankan economy opened up resulting in increase of growth rates and per capita income. Consumption of imported commodities increased (Bharagava, 1987). Figure 5 shows the growth rates of construction, manufacturing and services from 1960-2000. During the closed economic policy regime both construction and manufacturing growth have declined. Both these sectors show a rising trend immediately afterwards.

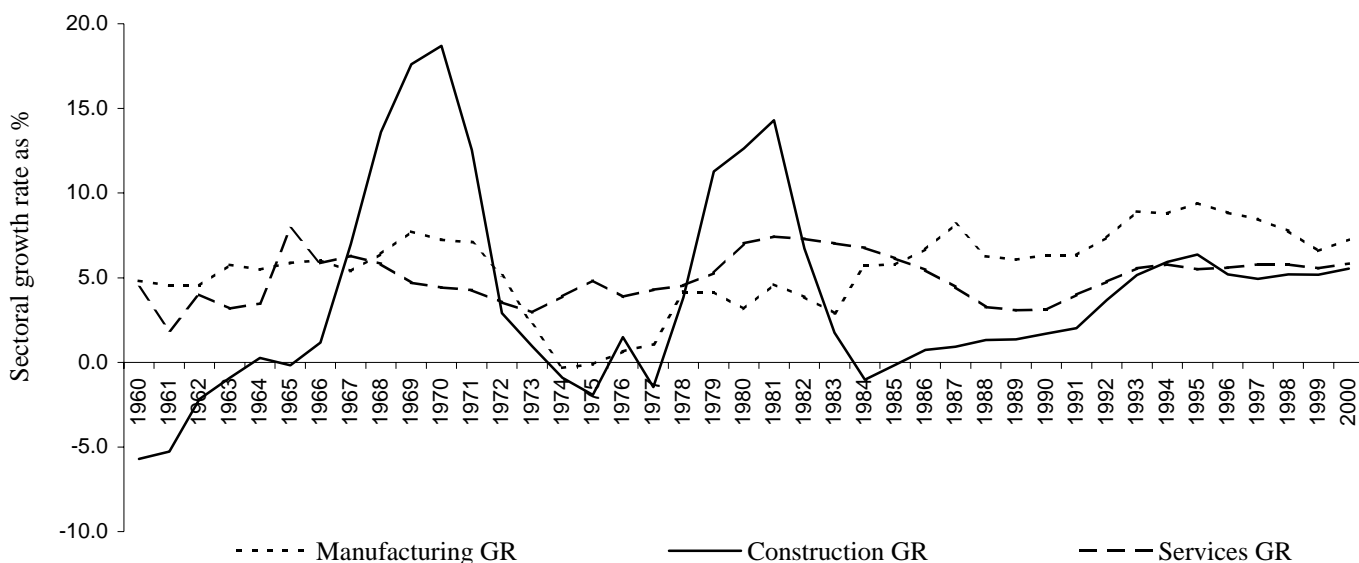


Figure 5: Trend of sectoral growth rates-3 year moving average

The trend of the profile of direct construction inputs (backward linkage indicators) analyzed using the percentage contribution from various sectors is given in Table 4. The table clearly shows that the contribution of services sector to construction follow the changing nature of economic policy from open-closed-open systems. When the economy moves from open to closed, the share of services contribution decreases. When it moves from closed to open it

increases. The vacuum thus created by the reduction of services input is absorbed by the other three sectors, especially the manufacturing sector during the closed system. Thus the share of services sector during open economic periods is between 31-35%. It reduces by about 10% during the closed economic system.

Table 4: Direct construction input shares over time

	1968	1976	1980	1986	1994
Policy Regime	<i>Open</i>	<i>Closed</i>	<i>Open</i>	<i>Open</i>	<i>Open</i>
Agriculture	1.22	1.71	0.11	3.07	0.10
Mining	8.30	9.82	1.90	6.84	9.98
Manufacturing	57.84	64.02	64.98	54.71	58.37
Services	32.64	24.45	33.01	35.38	31.55
Total	100.00	100.00	100.00	100.00	100.00

The trend of the profile of direct construction outputs (forward linkage indicators) analyzed using the percentage contribution from various sectors is given in Table 5. The instability of direct construction output pattern during different periods is apparent from the table. The share of outputs to services sector drops dramatically during the closed economic system and recover very slowly afterwards. It reduces from over 90% to 45% during the transition. Agriculture sector filled the gap created by the services sector during the closed system. When these observations are combined, it is clear that the services sector has been the most volatile in changing economic policy regimes.

One would argue that it is not a perfect mirror image of the policy change. Nevertheless the above analysis has shown a high correlation between the economic policy and input-output profiles of construction.

Table 5: Direct construction output shares over time

	1968	1976	1980	1986	1994
Policy Regime	<i>Open</i>	<i>Closed</i>	<i>Open</i>	<i>Open</i>	<i>Open</i>
Agriculture	2.23	46.62	34.66	9.72	6.82
Mining	0.00	0.00	0.63	0.00	0.00

Manufacturing	1.19	8.27	29.20	15.40	2.48
Services	96.58	45.11	35.51	74.88	90.70
Total	100.00	100.00	100.00	100.00	100.00

Conclusions

In the 40-sector economy of 1994, construction occupies the eighth rank in terms of backward linkages with an indicator of 1.80. However, the forward linkage indicator occupies thirty-fifth rank with indicator of 1.09. The high backward linkage is due to high dependence on other sectors for construction inputs. Lesser significance in forward linkages is due to the fact that major part of construction output cater to the final demand. It demonstrates the insignificance of maintenance and repair sector in Sri Lanka. A trend analysis based on the five Input-output tables published in Sri Lanka over the past four decades shows a similar observation. This observation is true for other countries as well.

Construction in Sri Lanka depends mainly on manufacturing followed by services for its inputs. The share of the manufacturing sector remains stable while that of services increases slightly over time. Contrary to the Sri Lankan experience, the construction industries of highly developed countries have been characterized by a decreasing share of manufacturing inputs and an increasing share of services inputs. On the other hand the outputs of construction are primarily consumed by the services sector. This may be due to the need for maintaining high standards in building stock of this sector to remain competitive in the market.

It was shown that the trend of the input and output profiles of construction are correlated to the economic policy regime in operation. The backward and forward linkages of construction with the services sector seem susceptible to changing economic policies compared to other sectors. It demonstrated that input and output profiles of construction not only mirror the type of technology utilized for production, but also the economic policy in operation.

It should be noted that the most recent data in this study is for 1994. This is considered as a limitation of this study. More recent data should be incorporated into the analysis in order to draw more reliable conclusions.

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