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ECONOMIC INDICATOR COMPARISONS OF INTERNATIONAL REAL ESTATE SECTORS USING THE OECD INPUT-OUTPUT DATABASE

Chunlu LIU[1], Yu SONG[2] and Craig LANGSTON[3]

School of Architecture and Building, Deakin University, Waterfront Campus, 1 Gheringhap Street, Geelong 3217, Australia. Emails:
[1]chunlu@deakin.edu.au; [2]yso@deakin.edu.au; [3]craigl@deakin.edu.au

Abstract

With its growing share in national economies, the real estate sector has been considered a vital contributor of economic development. Research efforts are needed in order to gain a better comprehension of the national specificities of the real estate sector and to identify its role in economic development. Due to limited comparable data, the economic indicators of real estate sectors are hard to compare between different countries. This paper aims to explore the quantitative interdependence amongst the real estate sector and other industries in developed economies using input-output analysis, and to investigate their significant linkages. Based on the recently published Organisation for Economic Co-operation and Development (OECD) input-output database at constant prices, the analysis focuses on the real estate's escalating role in terms of shares in gross output, value added and gross national product. With emphasis on the relative role of manufacturing, construction and services inputs, this paper also highlights the strengths of the push and pull of the real estate sector.

Keywords

economic indicator, input-output analysis, national economy, OECD, real estate sector

INTRODUCTION

The real estate capital stock has formed a significant portion of the national wealth in most developed economies. According to Washington Research Council (2001), the real estate stock represents over 40% of Americans' wealth, and 54.9% of total world wealth. On the other hand, the real estate service refers to the flow of services yielded during any period of time by real estate stock and also plays an important role in the entire economy as well as the growing influence in real estate capital stock (Tse, 1994). Improved country studies are needed in order to gain a better comprehension of the specificities of the real estate service and its role in economic development. The input-output analysis focuses on how inter-sector trading influences the overall demand for labour and capital within an economy (Leontief, 1966). By displaying all flows of goods and services within an economy, the input-output technology may describe the relationship between the real estate service sector and other industries, and reflect the importance of the real estate sector in the national economy.

Using an input-output approach, the role of the construction industry in national economies has been explored by several writers (e.g. Bon, 2000; Liu *et al*, 2003; Lopes, 2003). Bon (2000) focused on the research of input and output via applying the theory to the construction sector from the 1970s. More recently, Pietroforte and Gregori (2003) performed an input-

output analysis of the construction sector in highly developed economies. Lopes (2003) examined the relationship between construction outputs and gross domestic product in Portugal with the analysis of input-output tables. Liu *et al* (2003) emphasised the differences of economic indicators of Australian and Japanese construction sectors based on the OECD input-output database. In the area of real estate it is argued that the real estate service is a consumption concept whereas the real estate capital stock is an investment concept and different ways to measure service consumption will give different interpretations and results (Tse, 1994). Roulac (1996) examined the real estate financial input-output relationships in his paper, and Pagliari *et al* (1997) compared commercial real estate output in Australia, Canada, the United Kingdom and the United States over the period 1985-1995 by analysing separately office, retail and warehouse sectors. Furthermore, Roulac (1999) addressed the application of the value chain concept to how real estate facilitates the connection of inputs to the value creation process to deliver goods and services to consumers. However, over the past few decades relatively few papers have been completed on the analyses of input-output tables in the real estate service sector, except Li *et al* (2003), who just focused on the analysis of the Chinese economy. In general, because there is difficulty in data collection, it is hard to find publications that are concerned with the international comparisons of the real estate service sector using input-output tools at a macro level.

The OECD input-output database provides appropriate international economic data (OECD, 1995). This is the most comprehensive database so far (Pietroforte and Gregori, 2003). The OECD input-output database provides input-output data in current and constant prices for ten countries: Australia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, the United Kingdom, and the United States. The distinctive nature of this database comprises: (1) the use of a common industrial classification with 36 sectors by following the International Standard Industrial Classification (ISIC) version two, (2) the separation of transaction flows into domestically produced and imported goods and services, and (3) the inclusion of capital investment flow matrices as supporting tables.

Based on the OECD input-output database at constant prices, this paper aims to explore the role of the real estate sector in sectoral national economies and the quantitative interdependence amongst the real estate sector and other industries. The analysis describes the real estate's escalating role and highlights the difference between the strength of the push and pull of the real estate sector. The paper structure first provides an introduction of the OECD input-output database. The real estate sectors are then examined in terms of their shares in gross national product and gross national income. Further, the nature of linkages of the real estate sectors is analysed and differences between the direct forward linkage and the direct backward linkage are discussed. Finally, a concluding comment summarises the paper.

RESEARCH METHODS

Data preparation

As mentioned above, the OECD input-output database used in this research is the latest version published by OECD and the most comprehensive source for comparing structural changes in industries internationally. In this database, due to limited comparable and available data in the real estate sector, Germany, Italy and the United Kingdom are not considered, the data from France are discarded before 1980, and the data from Australia are unavailable before the mid-1980s. It is noticed that the OECD input-output database does not provide the data for all countries constantly. Generally, an input-output table is available about every five years. In

order to avoid the effect of non-uniform inflation rises in the 1970s and 1980s, the data are adopted at constant prices. The examined period is divided into five comparative periods as shown in Table 1: early-1970s (1970-1972), mid/late-1970s (1975-1978), early-1980s (1980-1982), mid-1980s (1985-1986) and late-1980s (1989-1990). According to the OECD classification, the 36 industries (sectors) in the input-output table are divided into seven sections (see Appendix 1): (1) agriculture, forestry and fishery, (2) mining and quarrying, (3) manufacturing, (4) construction, trade, transport, finance, real estate and service, (5) producers of government services, (6) other producers and (7) statistical discrepancy. This research just focuses on Section 3 and Section 4. In Section 4, the data of the construction industry, real estate and service industry are adopted correspondingly, where the service industry consists of restaurants and hotels, finance and insurance, real estate and business services, and community, social and personal services.

Table 1 OECD Input-output Database Coverage of the Real Estate Sector

	Early-1970s	Mid/Late-1970s	Early-1980s	Mid-1980s	Late -1980s
Australia	N/A	N/A	N/A	1986	1989
USA	1972	1977	1982	1985	1990
Netherlands	1972	1977	1981	1986	N/A
Canada	1971	1976	1981	1986	1990
Denmark	1972	1977	1980	1985	1990
France	N/A	N/A	1980	1985	1990
Japan	1970	1975	1980	1985	1990

For the convenience of research, the data in the OECD database are grouped and symbolised. The symbols and fundamental structure of the OECD input-output database are illustrated in Figure 1. In the OECD input-output database, the symbol X_{ij} represents the intermediate flow from sector i to sector j. The total output of the sector is divided into intermediate output $X_{i.}$ and final demand Y_i for its goods and services (consumption, investment, government

Figure 1 Fundamental Structure of OECD Input-output Database

expenditures, etc.). The total input of the sector is divided into intermediate input X_j and value added V_j, which represents the supply of primary inputs or factors of production needed by the sector (labour, capital, land, etc.). The total output X_i equals total intermediate output plus final demand, and the total input X_j equals total intermediate input plus valued added. A summary of these symbols is listed in Appendix 2. In terms of national product and income accounting conventions, the total final demand represents gross national product (GNP) and the total value added represents gross national income (GNI).

Formulation of the economic indicators

The economic indicators will be calculated, compared and analysed in the following sections. These indicators include the share in the gross national product S_1, the share in the gross national income S_2, the direct backward indicator D_1, the forward linkage indicator D_2, the direct output indicator C_1 and the direct input indicator C_2. Based on the above definitions of symbols, the value of these indicators can be determined as follows:

The share of sector i in gross national product	$S_1 = Y_i / Y$	(1a)
The share of sector j in gross national income	$S_2 = V_j / V$	(1b)
The direct forward linkage indicator	$D_1 = X_{i.} / X_i$	(2a)
The direct output indicator	$C_1 = X_{ij} / X_i$	(2b)
The direct backward linkage indicator	$D_2 = X^j_{.j} / X^j$	(3a)
The direct input indicator	$C_2 = X^j_{ij} / X^j_j$	(3b)

The indicators are divided into three groups: sectoral share of national product and income indicators, forward linkage and direct output indicators, and backward linkage and direct input indicators. The first group of indicators (S_1 and S_2) show the proportions of the real estate sector in the whole economy. The second group (D_1 and C_1) is of value for comparing the output and the allocation of the real estate sector at different points in time. The former indicator (D_1), named the direct forward linkage indicator, represents the intermediate to total output ratio of the real estate sector. The later indicator (C_1), called the direct output indicator, reflects the sector j to total output ratio of the real estate sector. The third group of indicators (D_2 and C_2) is useful for comparing the technical input and consumption relationship between the real estate sectors and other sectors of the national economy. The former indicator (D_2), named direct backward linkage indicator, represents the intermediate to total input ratio of the real estate sector. The latter indicator (C_2), named the direct input indicator, reflects the sector i to total input ratio of the real estate sector. The value of these indicators will be discussed in the section that follows.

NATIONAL ECONOMIC SHARES OF THE REAL ESTATE SECTOR

The national economic share represents the contributions of the real estate sector to gross national product and income, and reflects the importance of the real estate sector in the entire economy. It can be measured by the shares of the real estate sector in total final demand and total value added. A higher value implies larger contributions of the real estate sector to the national economy.

Shares in gross national product

The shares in GNP are calculated from Eq. (1a). The result is plotted in Figure 2. With the exception of Canada, the indicator is stabilising at a value between 6 and 12 percent. The

different values of the indicators represent the different developing levels of the real estate sector in different countries. The higher value reports a higher developing level. As the import of the real estate sector contributes a large proportion in the final demand in Canada, it seems that the real estate sector does not play an important role in economic growth with the share values lower than the average level. In the Netherlands, the share of the real estate sector is far lower than those of manufacturing, construction, trade and agriculture, forestry and fishery sectors. Conversely, the share is just lower than those of trade and agriculture, forestry and fishery sectors and even higher than the construction sector in Demark. Also in Australia, USA, France, and Japan, the real estate sectors contribute a larger rate than most of sectors in the whole national economy. With a higher share value in GNP, the real estate sector seems to be a relatively important engine for economic development in these countries.

In order to reflect the entire trend and average level, the arithmetic means of the shares are calculated and then plotted in Figure 2. Starting with a low value, the share of the real estate sector peaks in the mid-1980s, and then the pace of growth is reversed in all countries. Obviously, this waved trend of the share just follows the national economic growth cycle during the period studied. Theoretically this is due to the fact that there is high correlation between economic cycles and real estate performance (Pyhrr *et al*, 1999). With an ending recession in 1972-1975, the real estate sector recovered and upsurged during the mid/late 1970s and the early 1980s, and peaked in the mid-1980s. Subsequently, real estate declined in the late 1980s. The trend is a result of the economy, housing demand, construction, property values, volume of transactions, capital for real estate, investor interest and tax climate factors (Roulac, 1996; Birch and Sunderman, 2003). Compared with the construction sector, the share of the real estate sector is relatively low. However, compared to the downward trend in the construction sector, the time profile of the share value shows a slightly upward-waved trend from the early-1970s to the late-1980s. This represents the increasing importance of the real estate sector in national economies.
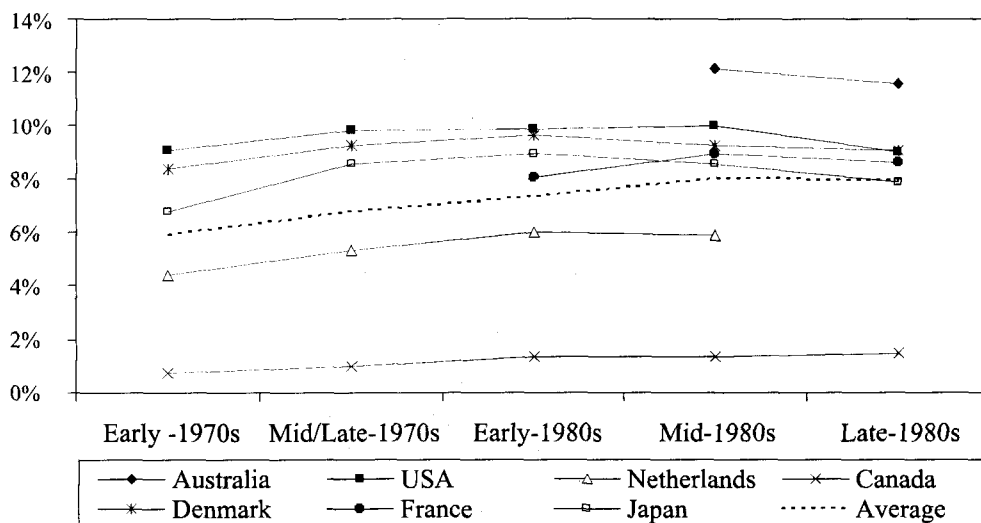

Figure 2 Shares of the Real Estate Sector in Gross National Product

Shares in gross national income

The share of the real estate sector to GNI for the seven selected countries are generated from Eq. (1b) and presented in Figure 3. The indicators tend to stabilise at a value between 10 and 20 percent with the exception of Canada and the Netherlands. The higher value indicates a higher proportion of the sectoral value added in total value added, and reflects the importance of the real estate sector from an output point of view. Compared with the lower value in the construction sector, the output of real estate to value added components is rather large and again represents the increasing importance of the sector.
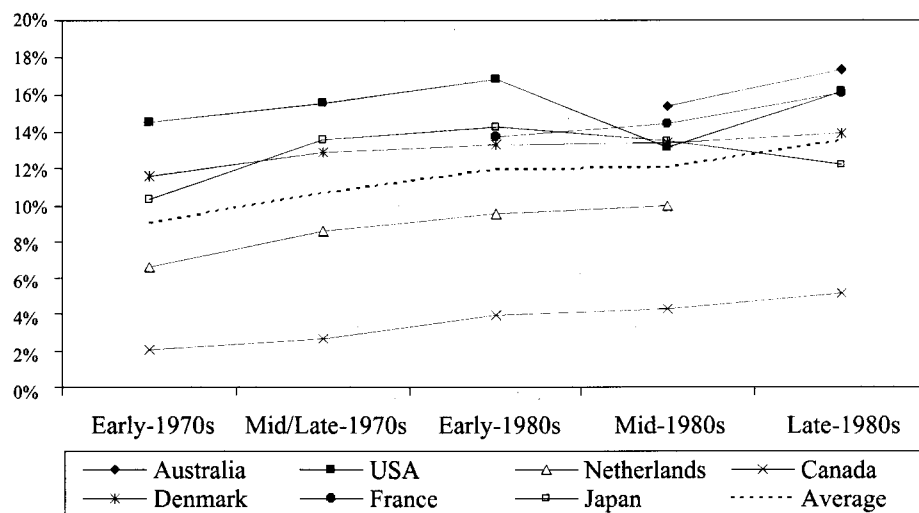

Figure 3   Shares of the Real Estate Sector in Gross National Income

In order to reflect the whole trend, the average value of the shares in GNI is plotted in Figure 3 as well. During the study period, the share shows a constantly increasing trend. Compared with the average value in GNP, these two indicators differ considerably. Firstly, the contribution of the real estate sector is higher for GNI than GNP. This is due to the fact that the value added is larger than the intermediate output of the real estate sector in most selected countries. As a service sector, the output of the real estate industry is produced mainly from the input of the value added components (wages, profit and interest, rent, etc.), and the real estate sector output to the domestic intermediate demand is very little due to the fact that real estate has a major role in creating demand (Roulac, 1999). Secondly, it is observed that all shares grow over the comparative period, and the curve of the share in GNI is flatter than the share in GNP. The reason may be due to the price elasticity of the value added components being less than that of the final demand, and the wave varies less with the economic cycle. Thirdly, it is noticed that the shares in GNP decrease as shares in GNI increase during the middle-late term of the 1980s. The main reason is that the real estate bubble rose during the mid 1980s, and the demand declined sharply (Zhu, 2002). This fact explains why the shares of real estate in GNI still illustrate an increasing trend, whereas the share in GNP traces a declining trend during the late-1980s. Lastly, the low share in GNP and GNI of Canada is due to small final demand and large imports. The whole industry is monopolised by the import service businesses in Canada.

LINKAGES BETWEEN THE REAL ESTATE SECTOR AND OTHER SECTORS

The push effects of the real estate sector

The direct forward linkage indicator shows the strength of the real estate sector's economic push. It represents the intermediate demand to total output ratio of the real estate sector as shown in Eq. (2a). The results are plotted in Figure 4(a). The higher value implies that the push of the real estate sector is larger. It can be noticed that direct forward linkage indicators have a medium value between 20 and 55 percent compared with the construction sector (with the exception of Canada), and their time profiles show stability during the observed period. The value of the indicator reflects that the proportion of final demand of the real estate sector is larger than its intermediate demand in most selected countries. The main reason seems to be that real estate has a major role in creating demand and attracting the buyer to the distribution system. Furthermore, it represents medium push strength to economic development.

Figure 4(a) shows two distinct groups of countries: Australia, Denmark, and the Netherlands with a relatively lower direct forward linkage indicator (from 23.13% to 44.2%) and the remaining countries with higher ones (from 42.92% to 107.5%). These differences can be explained in terms of the level of the intermediate demand in different countries. In Australia, Denmark and the Netherlands, the levels of intermediate demand are very low. The strength of push of the real estate sector in these countries is comparatively weak over the study period. In addition, most of the output of real estate flows into the final demands, that is, private domestic consumption and government consumption. For France, USA and Japan, the proportion between intermediate demand and final demand tends to be equal. These countries' push strength to economic growth is relatively strong. Compared to other countries, the value of the direct forward linkage indicator in Canada is extremely high, and over 70% of the products of the real estate are contributed to intermediate demand. In this regard, the push economic growth of the real estate sector mainly relies on the push to the construction sector in Canada as shown in Figure 4(c).

Figures 4(b), (c) and (d) plotted with Eq. (2b) represent the push contributions of the real estate sector to service, construction and manufacturing sectors respectively. The contributions to manufacturing tend to stabilise at an extremely low value and the contributions to construction
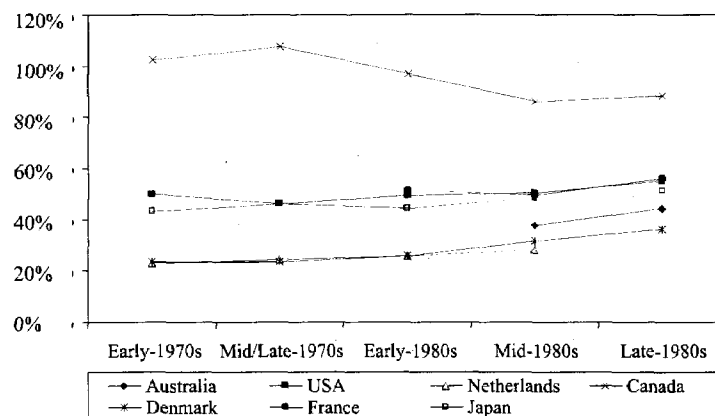
Figure 4 (a) Direct Forward Linkage Indicators of the Real Estate Sector
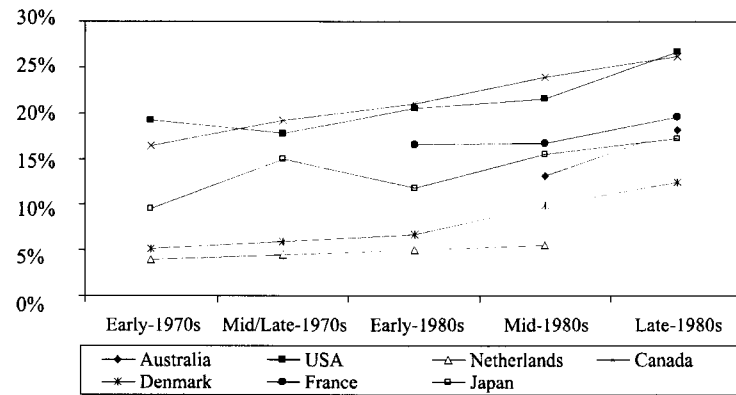
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Figure 4(b)   Direct Inputs from the Real Estate Sector to the Service Sector
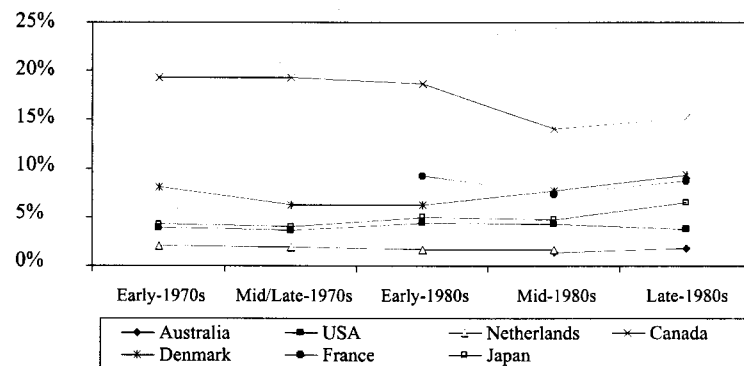

Figure 4(c)   Direct Inputs from the Real Estate Sector to the Construction Sector
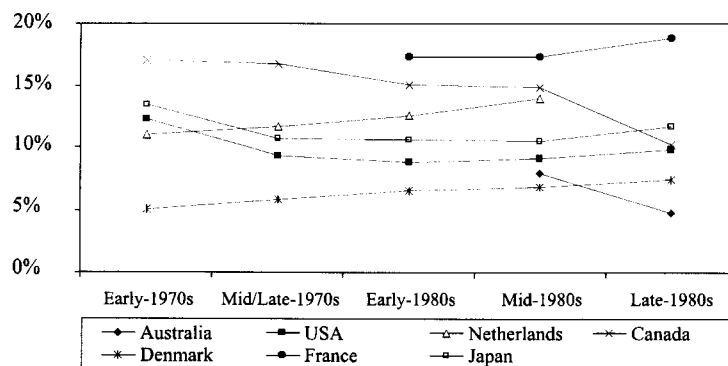

Figure 4(d)   Direct Inputs from the Real Estate Sector to the Manufacturing Sector

are stabilising at a relatively lower value. The low value suggests that the construction and manufacturing sectors do not have a high attractiveness to the real estate sector. The contribution to service is at a relatively large scale compared with other sectors, and a trend of growth is clearly apparent in the examined period. The high value implies the increasing economic importance of the service sector. According to the contribution of the real estate sector, the detail sectors are ranked based on their ranking in Australia. The top 10 sectors of Australia are compared with those of the other countries. In Australia, the wholesale and retail trade (14.04%), real estate and business services (7.10%), finance and insurance (4.89%), community, social and personal services (4.6%) and transport and storage (2.80%) are ranked as the top five. The rank in other countries is quite different owing to different economic agents. The different ranks are presented in Table 2. The wholesale and retail trade sector is ranked first in Australia, second in USA (9.80%), third in Canada and fourth in Denmark and France. The real estate sector is ranked first in USA (11.46%) and France (12.07%). For construction, Canada (17.75%) and Denmark (9.4%) can both be ranked first with different percentages. Basically, the contributions of the real estate sector to wholesale and retail trade, real estate and business services and finance and insurance sectors are ranked higher in almost all selected countries.

Table 2   Ranked Sectors of the Push Effects of the Real Estate Sector in the Late-1980s

	Australia 1989	USA 1900	Netherlands 1986	Canada 1990	Denmark 1990	France 1990	Japan 1990
Wholesale and retail trade	1	2	1	3	4	4	1
Real estate and business services	2	1	11	5	2	1	2
Finance and insurance	3	4	3	2	3	3	5
Community, social and personal services	4	3	8	7	5	14	4
Transport and storage	5	8	6	9	7	7	6
Construction	6	5	7	1	1	2	3
Restaurants and hotels	7	6	13	10	11	17	9
Mining and quarrying	8	9	25	8	25	20	34
Food, beverages and tobacco	9	7	2	13	6	5	7
Agriculture, forestry and fishing	10	12	16	15	9	25	32

The pull effects of the real estate sector

The direct backward linkage indicator (technical indicator) demonstrates the industrialisation of the real estate sector and the proportion of the intermediate input to total input of the real estate sector. It represents the strength of the real estate sector's economic pull. The larger the value, the higher is the national technologies level of the intermediate inputs and the stronger is the pull of the real estate sector. Figure 5(a) shows the results generated by Eq. (3a). The value of the direct backward linkage is stabilising at a value between 20% and 35% (with the exception of the Netherlands). Compared with the direct backward linkage indicator of the construction sector, the value suggests a relatively lower industrialisation level of the real estate sector than the construction sector, or in other words, the real estate sector's ability to pull the rest of the economy is weaker than is the construction sector's. Due to the fact that real estate plays a fundamental connecting role in the value chain (Roulac, 1999), the relatively lower technologies level is reasonable for the real estate sector. However, a slightly upward trend over the entire study period in all selected countries can be seen. In any industry, the progress of technology cannot be stopped.

As shown in Eq. (3b), Figures 5(b), (c) and (d), represent the input to the real estate sector from service, construction and manufacturing sectors respectively. On the other hand, these figures also demonstrate the consumption structure of the real estate sector. Not surprisingly, a strong upward trend of contribution of service is in evidence for almost all the countries, as Maddison (1987) states that the growing service is one of three broad trends that characterise the last hundred years of economic development. In fact, modern real estate really needs an increasing number of knowledge-based services. The downward trend of the contribution of the construction sector supports the argument of Bon (2000), who claims that one of the main historical trends is the decreasing economic importance of the construction industry itself. The value of the direct inputs from manufacturing to the real estate sector is scattered between 1% and 7% depending on different countries. It represents the manufacturing sector's limited role in the real estate sector.

In accordance with the method mentioned in the last section, the detailed sectors are also ranked according to the contribution to the real estate sector from other sectors. The top 10 sectors of Australia are compared with that of the other countries. In Australia, real estate and business services (7.10%), electricity, gas and water (4.61%), finance and insurance (4.41%), communication (1.52%), and community, social and personal service (1.23%) are ranked as
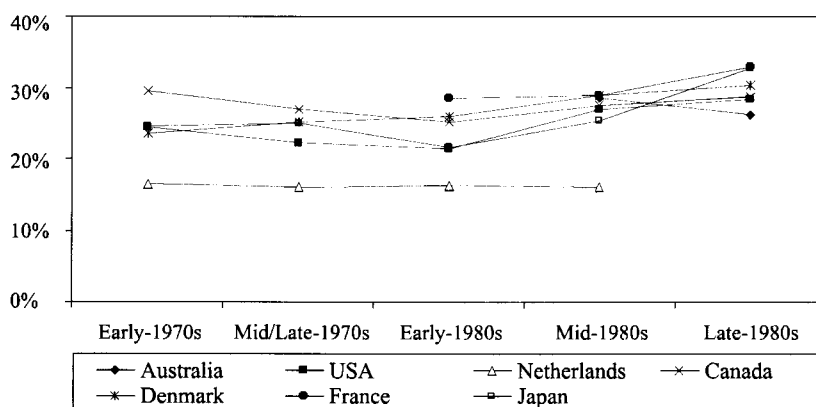

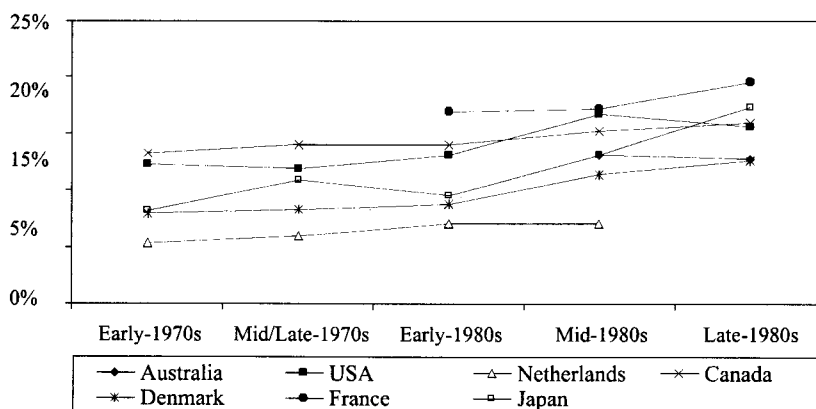**Figure 5(a)**   Direct Backward Linkage Indicators of the Real Estate Sector

Figure 5(b)   Direct Inputs from the Service Sector to the Real Estate Sector
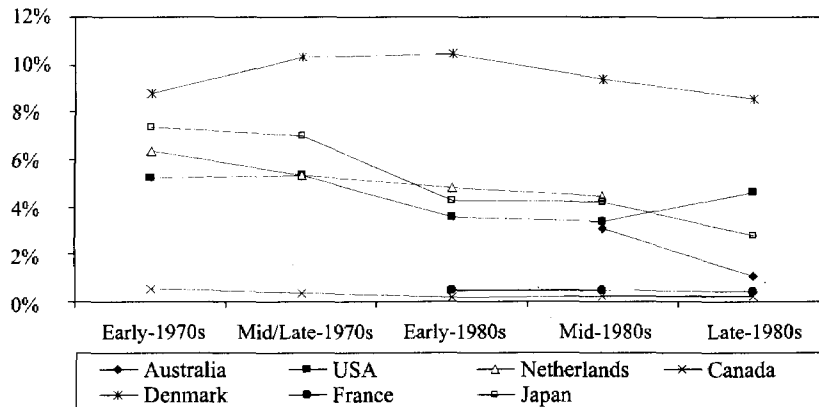
Figure 5(c) Direct Inputs from the Construction Sector to the Real Estate Sector
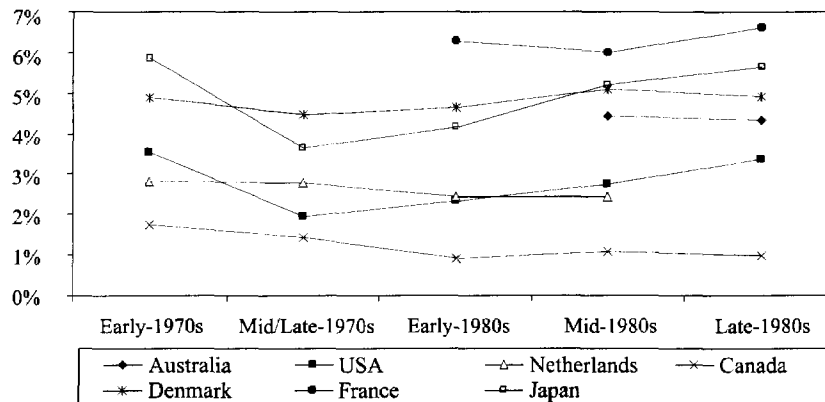

Figure 5(d) Direct Inputs from the Manufacturing Sector to the Real Estate Sector

the top five. The different rank in other countries is presented in Table 3 for the late 1980s period. Among these countries, the real estate and business services sector is ranked first in Australia, USA (11.46%) and France (12.07%). The finance and insurance sector is ranked first in the Netherlands (4.71%). For construction, Denmark (8.62%) is ranked first. Essentially, the real estate sector is ranked first in most countries, and the finance and insurance sector is ranked higher in almost all selected countries.

Table 3 Ranked Sectors of the Pull Effects to the Real Estate Sector in the Late-1980s

	Australia 1989	USA 1990	Netherlands 1986	Canada 1990	Denmark 1990	France 1990	Japan 1990
Real estate and business services	1	1	4	1	2	1	1
Electricity, gas and water	2	10	8	8	8	15	11
Finance and insurance	3	3	1	2	3	2	2
Communication	4	4	9	4	6	4	9
Community, social and personal services	5	6	3	5	5	5	5
Paper, paper products and printing	6	5	6	9	4	3	3
Construction	7	2	2	11	1	12	4
Industrial chemicals	8	16	14	17	16	16	6
Wholesale and retail trade	9	7	10	6	12	7	10
Transport and storage	10	9	12	10	9	6	17

Discussion of the push and pull effects of the real estate

By comparing the strength of the push and pull, the difference between them can be investigated. A positive value means the strength of the direct forward linkage is larger than the direct backward linkage, and the push of real estate is more efficient. A negative value suggests a larger direct backward linkage than the direct forward linkage, and higher efficiency in the pull of real estate. Figure 6(a) shows the difference between the direct forward linkage and the direct backward linkage. With the exception of Denmark before the mid-1980s, the direct forward linkage is larger than the direct backward linkage over the examined period in all selected countries. It reflects the strength of the push to economic growth is larger than that of the pull in the real estate sector. It also demonstrates that developing a national economy by promoting the real estate industry is not as effective as developing real estate through promoting the national economy (Li *et al,* 2003). In the Netherlands and Denmark, the difference values are comparatively lower than that of the remaining countries. This phenomenon can be interpreted by Figures 6(b) and (c), which represent the difference between the direct forward linkage and direct backward linkage among the real estate sector and service and construction sectors respectively. That is, the contribution of the service and the construction sector is larger than the contribution of the real estate sector to them. Figure 6(d) shows the positive difference value between the real estate sector and manufacturing sector. In all selected countries, the push strength of the real estate to the manufacturing sector is larger than its pull strength.
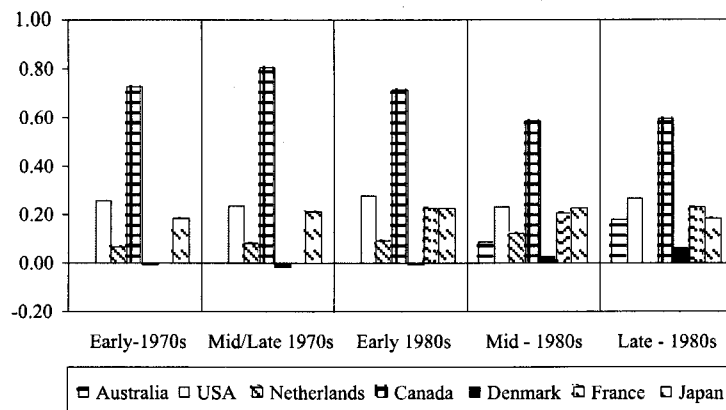

Figure 6(a)   Differences between the Direct Forward Linkage and Direct Backward Linkage
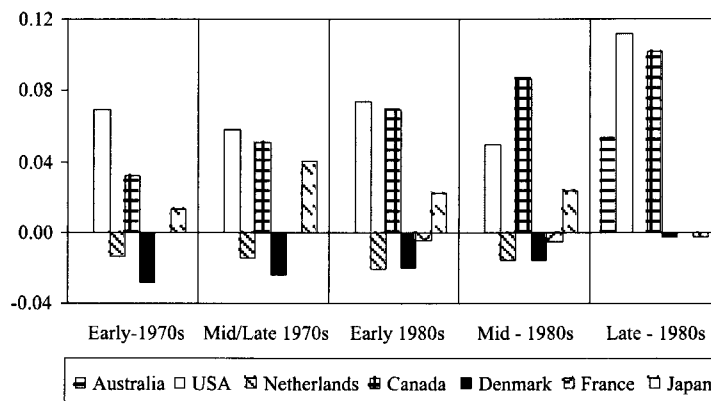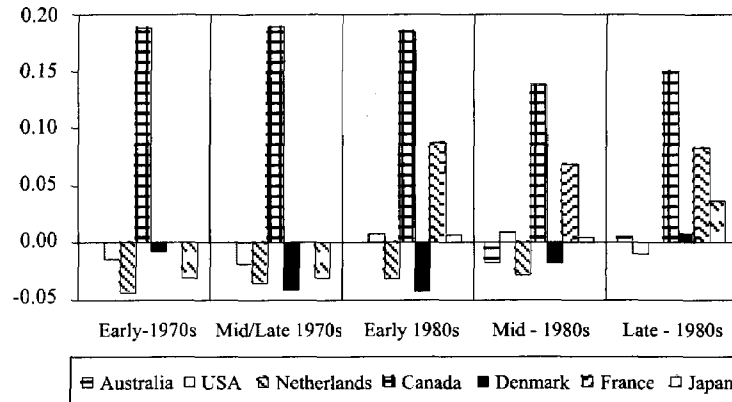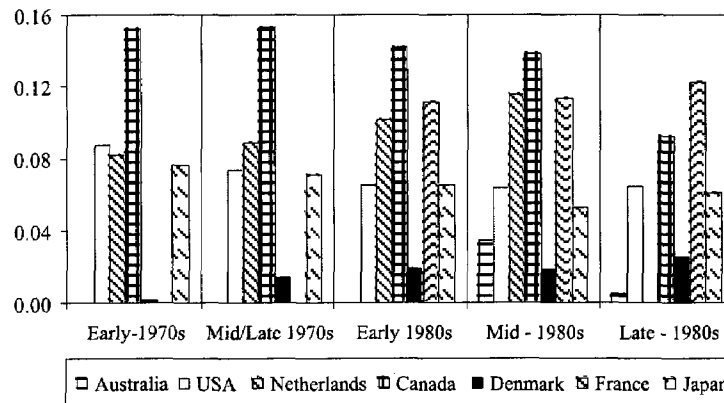

Figure 6(b)   Differences of Push and Pull Effects from the Real Estate Sector to the Service Sector

Figure 6(c)   Differences of Push and Pull Effects from the Real Estate Sector to the Construction Sector

Figure 6(d)   Differences of Push and Pull Effects from the Real Estate Sector to the Manufacturing Sector

The intersectional effects are also worth investigating. A pattern can be observed clearly from the above figures. Consumption and output of real estate focus mainly on the service, construction, wholesale and retail trade sectors. In different countries, the consumption and output of the real estate sector are slightly different. In Australia, consumption of the real estate sector focuses mainly on the service, construction, wholesale and retail trade sectors. The output focus is not only on the above sectors, but also on the agriculture and mining sectors. In the USA, the consumption structure of the real estate sector is the same as in Australia, but the output structure of the real estate sector is somewhat different. In other countries, the same model also can be inspected. The interrelationship amongst the real estate sector and other sectors is determined by the characteristics of real estate services. Except for agriculture, forestry and fishery, mining, and quarrying sectors, the remaining sectors in the national economy are easily affected by the real estate sector, and these sectors have a significant effect on the real estate sector as well.

CONCLUSIONS

By calculating and comparing economic indicators of the real estate sectors in seven selected countries based on the recently published OECD input-output database, this paper has analysed the real estate sector's shares in GNP and GNI in the period from the early-1970s to late-1980s. The nature of linkages of the real estate sectors and other sectors are discussed and compared. The following conclusions can be stated:

(1) It seems that the real estate sector does not play an important role in economic growth in Canada with the values lower than the average level. In other countries, such us Australia and USA, the real estate sector is a relatively important engine for economic development. Both the share in GNP and in GNI shows a slightly upward-waved trend between the pre-1973 and the late-1980s. This represents the increasing importance of the real estate sector in the national economy.

(2) The level of the intermediate demands is very low in Australia, Denmark, and the Netherlands; the strength of push of the real estate sectors in these countries is comparatively weak over the study period. Moreover, most of the output of real estate flows into final demand, that is, private domestic consumption and government consumption. For France, USA and Japan, the proportion between intermediate demand and final demand tend to be equal. In these countries, the push strength of the real estate sector to economic growth is relatively strong.

(3) The direct backward linkage suggests a relatively lower industrialisation level of the real estate sector compared with the construction sector, or in other words, the ability of the real estate sector to pull the rest of the economy is weaker than that of the construction sector. The relatively lower technologies level is reasonable for the real estate sector due to the fundamental connecting role of the real estate sector in the value chain.

(4) With the exception of Denmark before the mid-1980s, the direct forward linkage is larger than the direct backward linkage over the examined period in all selected countries. It means that the strength of push to economic growth is larger than that of pull of the real estate sector.

(5) The interrelationship amongst the real estate sector and other examined sectors is determined by the characteristics of real estate services. Except for agriculture, forestry and fishery, mining, and quarrying sectors, the remaining sectors in the national economy are easily affected by the real estate sector, and these sectors have a significant effect on the real estate sector.

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Appendix 1
OECD Section and Sectoral Classification

Section	Sector	
1	1	Agriculture, forestry and fishery
2	2	Mining and quarrying
3	3	Food, beverages and tobacco
	4	Textiles, apparel and leather
	5	Wood products and furniture
	6	Paper, paper products and printing
	7	Industrial chemicals
	8	Drugs and medicines
	9	Petroleum and coal products
	10	Rubber and plastic products
	11	Non-metallic mineral products
	12	Iron and steel
	13	Non-ferrous metals
	14	Metal products
	15	Non-electrical machinery
	16	Office and computing machinery
	17	Electric apparatus
	18	Radio, TV and communication equipment
	19	Shipbuilding and repairing
	20	Other transport
	21	Motor vehicles
	22	Aircraft
	23	Professional goods
	24	Other manufacturing
4	25	Electricity, gas and water
	26	Construction
	27	Wholesale and retail trade
	28	Restaurants and hotels
	29	Transport and storage
	30	Communication
	31	Finance and insurance
	32	Real estate and business services
	33	Community, social and personal service
5	34	Producers of government services
6	35	Other producers
7	36	Statistical discrepancy

(Source: OECD, 1995)

APPENDIX 2
A Summary of Symbols

Symbols	Definition
X_{ij}	Intermediate flow from the sector i to sector j
$X_{i.}$	Total intermediate output of sector i
Y_i	Final demand for the goods and services of sector i
$X_{.j}$	Total intermediate input of sector j
V_j	Valued added by sector j
X_j	Total input of sector j
X_i	Total output of sector i
Y	Total final demand
V	Total value added
C_1	The direct output indicator
C_2	The direct input indicator
S_1	The share of sector i in gross national product
S_2	The share of sector j in gross national income
D_1	The direct forward linkage indicator
D_2	The direct backward linkage indicator