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LINKAGE MEASURES OF THE REAL ESTATE SECTOR CONSIDERING THE EFFECT OF CAPITAL

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ABSTRACT. A significant limitation in previous linkage relevant research is that the flow of capital goods is not addressed. Using the OECD input-output tables, this research first generates a new input-output model considering capital as an intermediate factor. Using the new model, the real estate linkages are re-calculated and investigated in order to evaluate appropriately the impact of the real estate sector on national economies. The findings verify that the linkages of the real estate sector were extremely underestimated in previous research. A correct linkage measure of the real estate sector can contribute to produce correct information corresponding to the sectors responsible for the economic growth during the period under study and provide substantial contributions towards guiding the appropriate strategies for future economic development.

KEYWORDS: Real estate sector; Input-output table; Hypothetical extraction method; Capital; Linkage; OECD countries

1. INTRODUCTION

The real estate sectors have been considered vital productive drivers for economic development (Bon, 2000; Song *et al.*, 2005a). Theoretically, a sector's relationship with the rest of the economy through its direct and indirect intermediate purchases and sales is described as the sector's linkages (Miller and Lahr, 2001). The sectors with the highest linkages should be possible to stimulate a more rapid growth of production, income and employment than with alternative allocations of resources (Polenske and Sivitanides, 1990). The linkage concept has been recognized as playing a crucial role and providing substantial contributions towards guiding the appropriate strategies for future economic development.

With the importance of linkages in mind, the linkage analyses of real estate based on the input-output table have attracted a lot of research interest recently (Pietroforte and Gregori, 2003; Liu *et al.*, 2005; Song *et al.*, 2005a). Using the OECD input-output table, Liu *et al*. (2005) analyzed the real estate linkages of seven selected countries. Using the same set of tables, Song *et al*. (2005a) proposed a linkage measure framework to explore the linkages between the real estate sector and other sectors using the hypothetical extraction method. Song and Liu (Song and Liu, 2005)

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analyzed the economic performance and sectoral linkages of the Australian property sector in the 1990s. Additionally, many research efforts have concentrated on the linkage of the construction sector and the role of the construction sector based on the input-output table (Lopes, 1998; Bon, 2000; Lopes, 2003; Pietroforte and Gregori, 2003; Song *et al.*, 2005b). However, relevant studies based on the standard input-output model, have "a significant limitation" because "the flow of capital goods is not addressed", given the important effect of capital on the real estate sector (Bon, 2000).

This research therefore proposes an alternative input-output model to resolve this significant limitation using capital as a produced means of production. The new model is then applied to the real estate sector of seven selected OECD countries and the linkages are re-calculated and re-measured in order to explore appropriately the impact of the real estate sector. This paper comprises a review of linkage measures and capital as a intermediate production factor, a description of the research method used, an analysis of the empirical results, discussion of the capital effects for construction and finally some interesting conclusions.

2. LINKAGE MEASURES

In the context of input-output tables, the linkages can be categorized into two groups according to the direction of interdependencies. One is the backward linkage, which identifies how a sector depends on others for their input supplies. Another is the forward linkage, which identifies how the sector distributes its outputs to the remaining economy. The backward and forward linkages have extensively been used for the analysis of interdependent relationships between economic sectors in order to determine appropriate development strategies. More importantly, the two linkages can indicate a sector's economic pull and push because the direction and level of such linkages present the potential capacity of each sector to stimulate other sectors and then reflect the role of this sector accordingly (Pietroforte and Gregori, 2003). Existing methods for measuring linkages are rooted in the input-output tables and may be classified under two main categories, one refers to the traditional methods and the other is the hypothetical extraction method (HEM).

2.1. The traditional methods

The traditional methods mainly focus on the calculations of the Leontief model (Leontief, 1966) and the Ghosh model proposed by Ghosh (1958). Rasmussen (1956) adopted the concept of a multiplier to measure the backward linkages. The Leontief model can be shown as: $X=(I-A)^{-1}Y$, *w*here X denotes vector of gross output, A denotes matrix of technical coefficients ($n\times n$) and Y denotes vector of final demand, I denotes the identity matrix, and $(I-A)^{-1}$ denotes the Leontief inverse matrix. The backward linkage, based on the Leontief inverse matrix, can be defined as the column sums of the inverse matrix, namely, λL_{ij}, where λ is a summation column vector and L_{ij} is the ijth element of the Leontief inverse matrix. This backward linkage measures the extent to which a unit changes in the final demand for the product of sector j on overall output. Similarly, the Ghosh price model can be used to measure the total forward linkage and the model can be rearranged as: $X=V\ (I-B)^{-1}$, where B denotes direct output coefficients matrix ($n\times n$), V denotes vector of value added and $(I-B)^{-1}$ refers to the Ghosh inverse matrix. The forward linkage, derived from the Ghosh inverse matrix, can be defined as the row sums of the inverse matrix, namely, $\lambda' G_{ij}$, where λ' is a summation row vector and G_{ij} is the ijth element of the Ghosh inverse matrix. The forward linkage indicates the impacts on output of a unit increase in value added of i sector.

2.2. The hypothetical extraction method

An alternative linkage measure method is the HEM. The original idea of HEM is that it tried to extract a sector hypothetically from an economic system and examine the influence of this extraction on other sectors in the economy. In light of the basic ideal of HEM, it is assumed that the *n*-sector input-output technical coefficient *A* has been partitioned into two groups: group one (g_1) is a sector that are to be extracted from the economy and group two (g_2, $g_1+g_2=n$) consists of all the remaining sectors of the economy. Now, if g_1 has been extracted hypothetically from the economy, using the same final demand vector the Leontief model can be rewritten as $X^*=(I-A^*)^{-1}Y$, where X^* is the output after extraction and A^* is a reduced technical coefficients matrix ((n-1)×(n-1)). The reduction in output can be expressed as $X- X^*$, which reflects the linkage between g_1 and g_2 given that the technical production process is held constant. The linkage can be decomposed into backward and forward linkages according to different transformations.

The relevant studies based on the standard input-output model did not involve the effect of capital in the construction linkage research (Bon, 2000). In other words, previous research has treated capital as a primary factor of production because the capital goods are classified as final goods in most national income accounts and a standard input-output table therefore does not include the information about the sectoral distribution of capital goods produced in a given year (Bon, 2000). More importantly, based on an approach which treats capital as a primary factor of production, it tended to underestimate the rate of technical progress of production (Rymes, 1971; Peterson, 1979) and the linkages tended to be underestimated. In a more dynamic input-output model the problem seems capable of resolution, but, in a comparative-static model the problem is not yet well settled (Bon, 2000). In highly developed countries, capital is playing a significant role. Hence, considering capital in the linkage research of the real estate sector is needed.

3. CAPITAL AS A PRODUCED MEANS OF PRODUCTION

An alternative way, considering capital as an intermediate factor in the input-output framework, may overcome the limitation addressed by Bon (2000). In the early 1970s, Rymes (1971) pointed out that capital input should be measured as "real capital" rather than commodity capital since capital goods are themselves produced by processes which become more efficient through time as the result of technical change. Based on an approach which treats capital as a primary factor of production, the rate of technical progress of production tends to be underestimated because the full effects of interdependence between industries are ignored. Rymes proposed that capital should be an intermediate product. Peterson (1979) applied the theory to the input-output models in order to measure productivity growth and technical process within an input-output framework and concluded that the Rymes' measures appear to be more useful than the neoclassical measures because each industry's contribution to the rate of technical advance of the whole economy is apparent and the interdependence between industries is not ignored. Based on Peterson's method, Miller *et al*. (1992) performed vertically integrated productivity measures considering capital as an intermediate input in the context of input-output. Moreover, Wolff (1991, 1994) considered capital as a produced means of production, which has the advantage of incorporating changes in the primary resource requirements of producing capital in the measurement of overall technical change. In his research, Wolff adopted two different capital calculation methods to value the capital consumed in each sector.

In a standard input-output table, Wolff's method treated capital as an endogenous input and created an endogenous sector, whose

row is the capital stock replaced in each sector of the economy and whose column consists of the inputs required to produce the replacement capital stock. Final demand is valued net of replacement investment and labour becomes the only primary factor of production (Wolff, 1994). This method was usually used to investigate the productivity growth and technical progress. While applying it to other fields, some shortcomings still can be found in statistical practice. One problem is that the lack of perfect correspondence between the augmented table and the original table, because the two tables involve different rows and columns. Accordingly, the comparisons between the two tables are difficult to conduct. The other problem is that in some specific circumstances, the capital sector does not make sense. For example, when a researcher tries to explore the direct linkages between two production sectors, the effect of capital is not embodied. Hence it is necessary to find a new method to overcome these deficiencies.

4. A PROPOSED MODEL

The basic idea of this proposed methodology includes two steps. The first step extends the intermediate matrix from n sectors to n+1 sectors while considering capital as an intermediate production factor. The second step aggregates the n+1 sectors table into n sectors table.

4.1. Step one

The first step assumes that the gross fixed capital formation undertaken by each sector represents the flow of capital goods required to maintain the industry on its current growth. Since the gross fixed capital formations are known, the input-output matrix is augmented by additional rows and columns. Starting with a stand input-output table, an economy consists of n sectors and the basic balance equation of Leontief model can be shown as:

$$(I\text{-}A)X=Y \tag{1}$$

where X denotes the vector of gross output, A denotes the matrix of technical coefficients ($n\times n$) and Y denotes the vector of final demand. Following Wolff (1994), the augmented technical coefficients matrix $\overline{A}$ ($(n+1) \times (n+1)$) can be expressed as:

$$\overline{A}=\begin{pmatrix} A & C \\ K & 0 \end{pmatrix}=\begin{pmatrix} \overline{A}_{11} & \overline{A}_{12} \\ \overline{A}_{21} & \overline{A}_{22} \end{pmatrix} \tag{2}$$

where the vector C denotes the coefficients of the gross capital formation vector in final demand and the vector K denotes the actual increase in gross capital stock per unit of output in each sector. The modified final demand and gross output can be expressed as:

The modified final demand

$$\overline{Y}=\begin{pmatrix} Y-C(KX) \\ 0 \end{pmatrix}=\begin{pmatrix} \overline{Y}_1 \\ \overline{Y}_2 \end{pmatrix} \tag{3}$$

The modified gross output

$$\overline{X}=\begin{pmatrix} X \\ C(KX) \end{pmatrix}=\begin{pmatrix} \overline{X}_1 \\ \overline{X}_2 \end{pmatrix} \tag{4}$$

Thus, the augmented input-output model (n+1 sectors) can be expressed as:

$$(I-\overline{A})\overline{X}=\overline{Y} \tag{5}$$

or

$$\begin{pmatrix} I-\overline{A}_{11} & -\overline{A}_{12} \\ -\overline{A}_{21} & I-\overline{A}_{22} \end{pmatrix}\begin{pmatrix} \overline{X}_1 \\ \overline{X}_2 \end{pmatrix}=\begin{pmatrix} \overline{Y}_1 \\ \overline{Y}_2 \end{pmatrix} \tag{6}$$

4.2. Step two

Step two is an aggregation procedure which tries to aggregate the n+1 sectors table into an n sectors table. From Eq. (6), resolving X in terms of Y gives:

$$\begin{pmatrix} \overline{X}_1 \\ \overline{X}_2 \end{pmatrix}=\begin{pmatrix} \overline{B}_{11} & \overline{B}_{12} \\ \overline{B}_{21} & \overline{B}_{22} \end{pmatrix}\begin{pmatrix} \overline{Y}_1 \\ \overline{Y}_2 \end{pmatrix} \tag{7}$$

Matrix $\overline{B}$ is the inverse matrix of $\left(I-\overline{A}\right)$ and it is partitioned in conformity with the partitioning of $\left(I-\overline{A}\right)$ in Eq. (6).

So, the Eq. (7) can be split in two:

$$\overline{X}_1 = \overline{B}_{11}\overline{Y}_1 + \overline{B}_{12}\overline{Y}_2 \tag{8}$$

$$\overline{X}_2 = \overline{B}_{21}\overline{Y}_1 + \overline{B}_{2\,2}\overline{Y}_2 \tag{9}$$

Multiplying both sides of (8) by $\overline{B}_{11}{}^{-1}$, then gives:

$$\overline{B}_{11}{}^{-1}\overline{X}_1 = \overline{Y}_1 + \overline{B}_{11}{}^{-1}\overline{B}_{12}\overline{Y}_2 \tag{10}$$

Eq. (10) can be re-written as:

$$\left(I-\overline{A}_{11}{}^{*}\right)\overline{X}_1 = \overline{Y}_1^{*} \tag{11}$$

where $\overline{A}_{11}{}^{*} = I-\overline{B}_{11}{}^{-1}$, $\overline{Y}_1^{*} = \overline{Y}_1 + \overline{B}_{11}{}^{-1}\overline{B}_{12}\overline{Y}_2$. Eq. (11) is considered a reduced version of the original system. The relationship between elements of the reduced and the original matrix is displayed clearly if $\overline{A}^{*}$ is expressed directly in terms of the elements of the partitioned matrix $\overline{A}$:

$$\overline{A}_{11}{}^{*} = \overline{A}_{11} + \overline{A}_{12}(I-\overline{A}_{22})^{-1}\overline{A}_{21} \tag{12}$$

Because $\overline{Y}_2 = 0$, from Eqs. (2), (3) and (12), Eq. (11) can be expressed as:

$$[I-(A+CK)]X = Y - C(KX) \tag{13}$$

Thus, a new input-output model is created. The new model resolves the two shortcomings mentioned above. As can be seen, on the right hand side of Eq. (13), the capital item is deducted from the final demand *Y* and is added to the technical coefficients matrix *A*. The difference between the new system (13) and the original system (1) is that the new system considers the capital as a produced means of production and treats capital as an intermediate input, whereas the original system treats capital as a primary input. The difference between the new system (13) and the augment system (5) is that the new system comprises *n* sectors, whereas the augment system comprises *n*+1 sectors. The new technical coefficients matrix (*A*+*CK*) reflects implicitly the input requirements of capital. In fact, the matrix describes the combination of the original intermediate inputs and capital input directly and indirectly. For example, the construction column of the new matrix not only includes the amount of capital required, but also the amount of original intermediate inputs to produce a unit of construction. Hence, the new matrix reflects the technological characteristics of all the other sectors including the capital sector.

5. EMPIRICAL RESULTS

The OECD input-output database, which is published by the Economic Analysis and Statistics Division of the OECD, provides appropriate multinational economic data (OECD, 1995). This is the most comprehensive database for comparing the real estate sectors internationally so far (Pietroforte and Gregori, 2003; Liu *et al.*, 2005). Using the OECD input-output table, the new model is employed to analysis the linkages of the construction sector of Australia, Canada, Denmark, France, Japan, Netherlands, and United States over 20 years. Following Pietroforte and Gregori (2003), the examined period is divided into five comparative periods: early-1970s (1970-1972), mid/late-1970s (1975-1978), early-1980s (1980-1982), mid-1980s (1985-1986) and late-1980s (1989-1990). This research investigates two groups of linkages. The first group shows the backward (BL-I) and forward linkages (FL-I) using the traditional linkage calculation method. The second group represents the backward (BL-II) and forward (FL-II) linkages that are calculated according to the HEM.

5.1. Backward linkages of real estate

The backward linkage of a sector reflects this sector's dependence on local inputs that occurred within the production process of the economy. A strong backward linkage suggests a weak sectoral independence. On the other

hand, a high value represents a strong economic pull of the construction sector to the remaining sectors. Furthermore, the backward linkage indicator is a measure of the degree of the industrialization of the construction production process and the national technology difference in terms of intermediate and valued added inputs composition (Pietroforte and Gregori, 2003), because it is generally agreed that input-output tables reflect an equilibrium model of the economy where inputs are allocated according to technological availability.

Figure 1 reports the BL-I of the real estate sectors. Considering the effect of capital, the values of the BL-I are scattered between 1.5 % and 3.25 %. Moreover, Figure 1 shows two distinct groups of countries: Canada, USA and France with a relatively lower BL-I (from 1.5 % to 2 %) and the remaining countries with higher ones (from 2 % to 3.25 %).

The BL-I rankings of the real estates are reported in Table 1. Except for Japan, all rankings of the remaining counties keep constant. The main reason seems to be the real

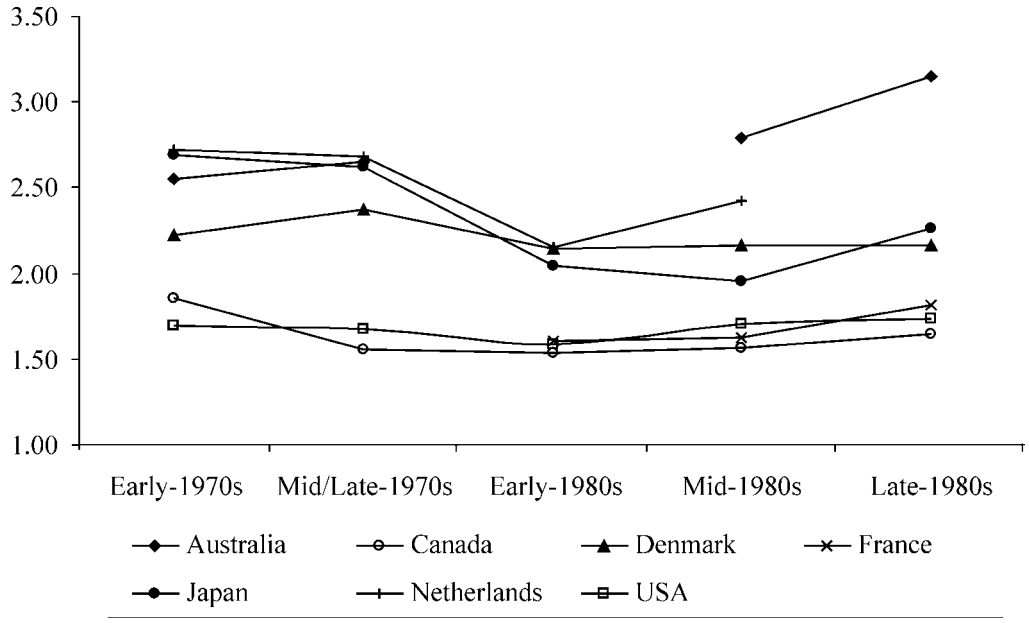

Figure 1. The BL-I of the real estate sectors

Table 1. The BL-I rankings of the real estate sector

	Early-1970s	**Mid/Late-1970s**	**Early-1980s**	**Mid-1980s**	**Late-1980s**
Australia	27	25	N/A	24	25
Canada	33	33	33	32	32
Denmark	28	27	29	27	27
France	N/A	N/A	29	31	30
Japan	23	27	32	32	31
Netherlands	17	21	23	21	N/A
USA	32	32	33	32	32

estate bubble happened in Japan in the late of 1980s. The ranking suggests a relatively lower industrialisation level of the real estate sector in short term, or in other words, the real estate sector's ability to pull the rest of the economy is weaker in short run. 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.

The values of BL-II are presented in Figure 2, and are dispersed between 0.02 % and 0.25 %. Most of BL-II are lower than 0.1 except for Australia. The BL-II rankings of the real estate sectors are reported in Table 2. Interestingly, most of BL-II are ranked as the top ten as shown in Table 2. In long run the real estate sector has a strong ability to pull the rest of the economy.

5.2. Forward linkages of the real estate sector

The forward linkage of a sector reflects the dependence of the remaining sectors in the economy on this sector's supplies that occurs within the production process. A weak forward linkage shows a strong sectoral independence and a weak economic push of the construction sector. The FL-I of the real estate sector for the seven selected countries are reported in Figure 3.

The values of FL-I are stabilising at a higher value between 2.01 % and 4.96 % com-

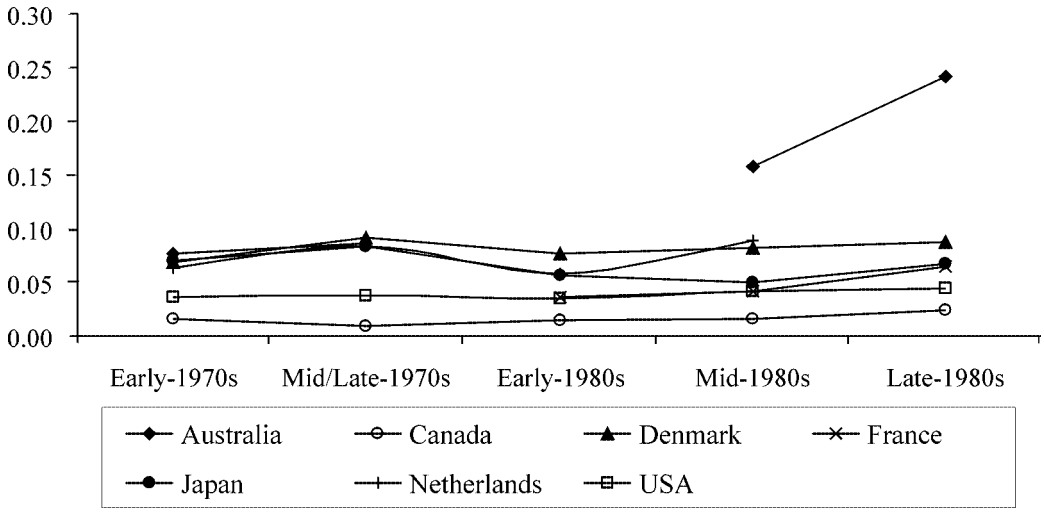

Figure 2. The BL-II of the real estate sector

Table 2. The BL-II rankings of the real estate sector

	Early-1970s	Mid/Late-1970s	Early-1980s	Mid-1980s	Late-1980s
Australia	8	7	N/A.	6	8
Canada	28	26	28	24	25
Denmark	11	12	9	7	6
France	N/A	N/A	8	6	6
Japan	7	5	9	8	8
Netherlands	8	8	11	9	N/A
USA	6	7	8	6	6

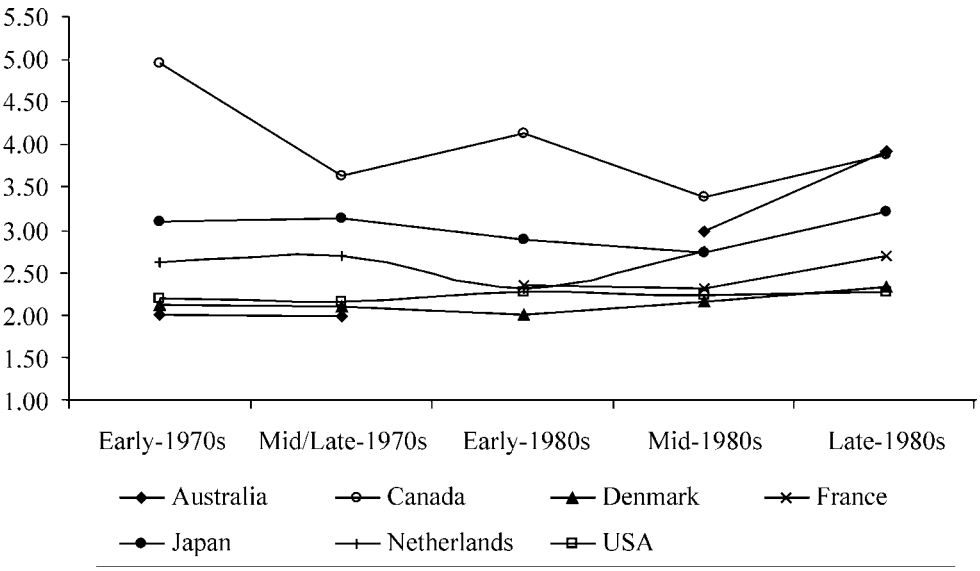

Figure 3. The FL-I of the real estate sector

pared with the BL-I. The real estate sector of Canada, Australia, Japan, and Netherlands show a stronger economic push and a weak sectoral independence with a higher FL-I, while the others have a weaker one. As can be seen in Table 3, most of rankings of forward linkages present a constant low ranking when considering capital as an intermediate input, which represent a weak economic push of the real estate sector as a whole in short term.

As can be seen in Figure 4, the FL-II of real estate stabilises at a value between 0.03 and 0.20. All ranking of FL-II are increasing over the examined periods as shown in Table 4. Compared with the FL-I, the FL-II has a higher rank even with a low value in the whole economy. The higher ranking 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 in long run.

6. THE EFFECTS OF CAPITAL ON REAL ESTATE LINKAGES

When considering capital as an intermediate input, the effects of capital on real estate linkages are worthy of investigation. The link-

Table 3. The FL-I rankings of the real estate sector

	Early-1970s	Mid/Late-1970s	Early-1980s	Mid-1980s	Late-1980s
Australia	30	31	N/A	27	25
Canada	11	10	14	14	14
Denmark	28	26	27	28	25
France	N/A	N/A	21	21	18
Japan	28	28	30	27	27
Netherlands	23	23	24	22	N/A
USA	23	25	23	25	23

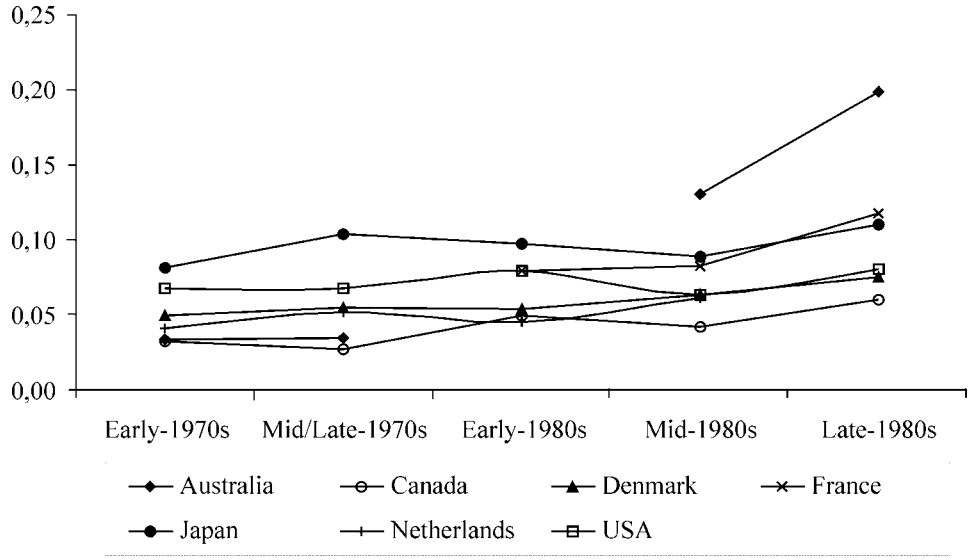

Figure 4. The FL-II of the real estate sector

Table 4. The FL-II rankings of the real estate sector

6 hem forward	Early-1970s	Mid/Late-1970s	Early-1980s	Mid-1980s	Late-1980s
Australia	14	14	N/A	2	1
Canada	14	14	6	6	6
Denmark	7	6	4	2	1
France	N/A	N/A	1	1	1
Japan	6	4	4	2	2
Netherlands	6	4	4	3	N/A
USA	2	2	1	1	1

age differences between the proposed model and the standard input-output model are compared horizontally and vertically. To some extent, the difference between the two models can demonstrate the effect of capital on the real estate sector.

6.1. The capital effects on the real estate sector over the examined period

For analytical convenience, the linkages derived from the new model are called Pattern A, while the linkages are from the standard input-output model are called Pattern B. The average values of two linkage groups for each country are calculated and reported in Table 5. As expected, Pattern A has a higher value than Pattern B, and the linkages from a standard input-output model are extremely underestimated. As a capital-intensive sector in highly developed countries, the real estate sector has both higher backward and forward linkages which represent the higher capital requirement and fix capital outputs.

Moreover, the average values of two linkage groups for each examined period are computed and presented in Table 6, which shows two characteristics. First, all linkages in Pattern B are far lower than Pattern A for each examined period. Second, both linkage groups show a increasing trend between the initial and final stage of the examined period, which con-

Table 5. The average real estate linkages of each country over the examined period

	Linkages	Australia	Canada	Denmark	France	Japan	Netherlands	USA
Pattern A	BL-I	2,975	1,633	2,216	1,685	2,316	2,498	1,680
	FL-I	3,458	4,007	2,155	2,466	3,021	2,598	2,235
	BL-II	0,200	0,016	0,082	0,048	0,066	0,074	0,039
	FL-II	0,165	0,043	0,060	0,094	0,097	0,050	0,072
Pattern B	BL-I	1,473	1,491	1,511	1,509	1,294	1,519	1,409
	FL-I	1,686	2,759	1,518	1,969	1,940	1,480	1,883
	BL-II	0,033	0,010	0,031	0,032	0,026	0,012	0,022
	FL-II	0,052	0,026	0,031	0,065	0,049	0,017	0,053

Table 6. The average real estate linkages of each examined period

	Linkages	Early-1970s	Mid/Late-1970s	Early-1980s	Mid-1980s	Late-1980s
Pattern A	BL-I	2,239	2,184	1,849	2,034	2,129
	FL-I	3,008	2,753	2,668	2,661	3,059
	BL-II	0,051	0,061	0,046	0,068	0,089
	FL-II	0,055	0,061	0,068	0,077	0,107
Pattern B	BL-I	1,452	1,437	1,415	1,456	1,528
	FL-I	1,917	1,933	1,915	1,863	1,987
	BL-II	0,017	0,019	0,021	0,024	0,030
	FL-II	0,028	0,033	0,041	0,041	0,054

firms the increasing role of the real estate sector with economic maturity over the examined period, given the effects of capital.

6.2. The capital effects of each country

Table 7 reports the changing magnitude of Pattern A compared to Pattern B for each country. The real estate linkages of Australia and Netherlands have the highest increasing rate, while France and USA has the lowest increasing rate, which means that capital has higher influence on the Australian and Netherlands real estate sector than on the USA and France.

Table 8 reports the changing rate of Pattern A compared to Pattern B over the examined period. Interestingly, the increasing rates of the linkages of the real estate sector also present a declining trend except for FL-II, which means that the effects of capital on real estate trace a

Table 7. The changing scale of Pattern A compared to Pattern B for each country

Linkages	Australia	Canada	Denmark	France	Japan	Netherlands	USA
BL-I	101,94%	9,56%	46,66%	11,69%	79,02%	64,41%	19,22%
FL-I	105,12%	45,22%	41,95%	25,20%	55,75%	75,57%	18,72%
BL-II	499,93%	66,50%	164,70%	50,40%	152,59%	521,93%	75,88%
FL-II	220,31%	63,74%	92,49%	43,94%	97,99%	189,70%	35,81%

Table 8. The changing rate of Pattern A compared to Pattern B over the examined period

Linkages	Early-1970s	Mid/Late-1970s	Early-1980s	Mid-1980s	Late-1980s
BL-I	54,16%	51,96%	30,70%	39,67%	39,34%
FL-I	56,95%	42,41%	39,36%	42,86%	53,94%
BL-II	206,10%	222,06%	124,05%	179,38%	196,57%
FL-II	95,09%	85,95%	65,69%	84,94%	100,17%

declining trend over the examined period. It has to be mentioned that the changing rate is reversed somewhat in the 1980s. The reason may be due to technical progress, relative price changes, government investments and the speculative real estate bubble in the late of 1980s in most countries. These factors promote the effects of capital on the real estate sector.

7. CONCLUSIONS

Using the OECD input-output tables, this research has generated a new input-output model considering capital as an intermediate factor. Using the new model, the linkages of the real estate sector were re-calculated and investigated. Empirical results show that the linkages from a standard input-output model are extremely underestimated. As a capital-intensive sector in highly developed countries, the real estate sector has both higher backward and forward linkages which represent the higher capital requirement and fix capital outputs. The average linkages show an increasing trend between the initial and final stage of the examined period, which confirms the increasing role of the real estate sector with economic maturity over the examined period, given the effects of capital. Moreover, the increasing rates of the linkages of the real estate sector present a declining trend except for FL-II, which means that the effects of capital on real estate trace a declining trend over the examined period.

The new model presented for the first time in this paper can aid government and business to measure accurately the linkages between sectors and then create a favourable competitive position in the modern economy. The multinational linkage analyses enable a better comprehension of their competitive capability and comparative advantage in modern economies. Considering the effects of capital, the linkages of the real estate sector can be examined transparently in order to produce correct information corresponding to the sectors re-

sponsible for economic growth during the period under study. Combined with analysis of the past and the current situation of the sector, it also makes possible a prediction of the emergence of certain problems in the future. Moreover, despite significant difference in national income accounting conventions, the linkage patterns of change of the real estate over time are universal. The lessons learned in the highly developed countries may be useful to developing countries. Future research based on the new model will include considering labour as an intermediate input or considering both labour and capital as intermediate inputs. The different treatment of capital and labour will help to meet the linkage measures requirements of capital-intensive sectors and labour-intensive sectors respectively.

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SANTRAUKA

NEKILNOJAMOJO TURTO SEKTORIAUS SĄSAJŲ MATAVIMAS, ATSIŽVELGIANT Į KAPITALO POVEIKĮ

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Ankstesni su sąsajomis susiję tyrimai buvo riboti, nes juose nekalbama apie gamybinio kapitalo srautus. Šiame tyrime pagal OECD sąnaudų ir rezultatų lenteles sukuriamas naujas sąnaudų ir rezultatų modelis, kuriame į kapitalą atsižvelgiama kaip į tarpinį veiksnį. Naudojantis naujuoju modeliu, perskaičiuojamos ir nagrinėjamos nekilnojamojo turto sektoriaus sąsajos, siekiant tinkamai įvertinti nekilnojamojo turto sektoriaus poveikį nacionalinei ekonomikai. Išvados patvirtina, kad ankstesniuose tyrimuose nekilnojamojo turto sektoriaus sąsajos buvo tikrai nepakankamai vertinamos. Naudojant tinkamą sąsajų matą nekilnojamojo turto sektoriuje, galima gauti teisingą informaciją pagal sektorius, atsakingus už ekonominį augimą nagrinėjamu laikotarpiu, ir iš esmės suformuoti tinkamas strategijas būsimai ekonominei raidai.