Apply DANP to Investigate the Determinants of Foreign Enterprises Investing in Taiwan Hi-Tech Industries

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Abstract
Foreign direct investment plays an important role in Taiwan's economic development. This paper investigates the criteria that MNEs use to assess the investment determinants in Taiwan. There are thirteen criteria extracted from past literature and classifies into five groups based on the OLI (Ownership, Location, International) theory proposed by Dunning (1980). The initial criteria are consulted with ten advanced experts and scholars through questionnaires to consolidate the research structure, then interviews another ten senior MNE managers face-to-face to collect their opinions for the relative importance of each pair of criteria by pair-wise comparison questionnaires. This paper adopts the DANP approach developed by Ou Yang et al. (2008) which combines DEMATEL and ANP procedures to analyze the priority of assess criteria. The research results show that the Government Policies Group and the Cluster Driven Seeking Group are the "main cause-factor" while the Market Seeking Group is the "main effect-factor" among the five groups. Cluster Driven Seeking Group also has significant relationships with other groups. Finally, the top three priority criteria are Re-Exports Opportunity, Governmental Incentives, and Industrial Clusters, while the last three priority criteria are Political Stability, Infrastructure, and Economic Environment. Even Taiwan faces the severe geopolitical tension, MNE managers still rank the Geopolitical Risk Criterion at the tenth priority.

Keywords: MCDM, DANP, FDI, Economic Development, High Technology Industries

1. Introduction

From the database of World Bank, the global economic growth rate increases steadily over the past six decades except for the impact of covid-19 in 2020. At the same period of time, the global inward and outward flows and stock of foreign direct investment (FDI) concurrently surges recorded by UNCTADSTAT (United Nations Conference on Trade and Development, Statistic). The rationale advocated by Jaiblai & Shenai (2019) is that FDI is an important factor in world economic development. For lacking capital countries, FDI inflows capital from foreign MNEs results in domestic capital accumulation and fosters jobs creation, local manufacturing and labor skills enhancement, and trade sectors improvement in host country. These can benefit to raise local production and exports capability, and further to improve infrastructure, enlarge the base of corporate tax revenues that stimulate host country's economic development and contribute to sustainable economic growth.

Dunning (1980) proposed the OLI (Ownership, Location, International) theory and divided the motivation of FDI into four categories: Efficiency-seeking, Resource-seeking, Market-seeking, and Strategic Asset-seeking". Porter (1990) submitted the phases of FDI from the perspective of national competitive development in four basic stages: The factor-driven stage, the investment-driven stage, the innovation-driven stage, and the wealth-driven stage. Base on Porter's national competitive theory. Ozawa (1992) combined Dunning's and Porter's theory and argued that FDI affects the national economic development stages. At the first factor-driven stage, resource-seeking or labor efficiency-seeking attracts inward FDI; at the second investment-driven stage, market-seeking attracts FDI in capital and intermediate goods industries; till the third innovation-driven stage, technology asset-seeking attracts FDI in technology-intensive industries. The traits of economic development in Taiwan seem to more follow the Porter's theory.

Inward FDI is acknowledged as a means of promoting economic development in Taiwan, particularly in high-tech industries, which have experienced rapid growth due to increased investment from MNEs. Retrospect the history of economic development in Taiwan, Taiwan had also experienced significant economic growth rate contributed from inward FDI. The growth of FDI has led to an increase in GDP, demonstrating its significant contribution to economic growth in Taiwan. Since 1981, the Manufacturing of Information and Electronic industry has been developing rapidly, this paper focuses on high-tech manufacturing, specifically on electronic parts and components and computers, electronic and optical products.

This paper tries to identify and rank the critical criteria for assessing the attracting determinants on inward FDI in Taiwan. The research findings may deliver recommendation to government to enhance the existing economic conditions and revise the current incentive policies, and finally can provide suggestion to those foreign MNEs who are willing to invest in Taiwan.

The research results show that both the Government Policies Group and the Cluster Driven Seeking Group have the strongest influence on the other groups. It reminds that MNEs managers will put higher weights on those two groups while engaging FDI in Taiwan's high-tech industries. On the contrary, the market size of Taiwan is relatively small, the main consideration of Market Seeking Group for MNEs managers is decided by the re-export opportunity of the FDI products.

For attracting inward FDI, this paper suggests that the government authorities must dedicate to sign Economic Cooperation Agreement (ECA) and Free Trade Agreement (FTA) with foreign

countries; launch more beneficial practices to the MNEs; put more effort to cultivate more new critical industries. The political stability, infrastructure facilities, and economic environment are well performed in Taiwan, the government authorities only pay attention to maintain current performance. The finding of this paper can also provide as the assessment baseline for the potential foreign investors who prepare to invest in Taiwan and help them to raise the probability of investment success and lessen the risk of fail investment.

The organization of his paper is arranged as follows: Section 2 reviews the past literature concerning about the attracting factors of FDI and extracts the criteria for determining the MNEs' decision making; Section 3 will portray the adopted research methodology; The research results are shown in Section 4; Section 5 expresses the conclusion of this paper.

2. Literature Review

For investigating the determinants of MNEs invested in Taiwan, this section reviews past literature in the fields of the FDI determinants based on Dunning's OLI theory and considering the economic development in Taiwan, constructs the research structure. From literature survey, this paper extracts thirteen criteria and classifies them into five groups, namely Market Seeking Group, Efficiency Seeking Group, Cluster Driven Seeking Group, Government Policies Group, and Operation Environment Group.

2.1 Market Seeking Group

Market seeking aims at penetrating the local markets in the host countries (Wadhwa & Reddy, 2011). Okafor, Piesse, & Webster (2015) denoted that the objectives of some MNEs' investment in host country are to serve the local market. Therefore, the raise of size in local market can be viewed as an attractor for entering host market (Asiedu, 2002). Nevertheless, there still exist some MNEs will exploit the resources of host country to produce products or services for re-exporting to other outside markets. In this paper, Market Seeking Group includes Market Size Criterion and Re-exports Opportunity Criterion.

1. Market Size Criterion: MNEs engage in FDI will consider the following market size indicators in host country such as population (Gabriel et. al., 2016), GDP (Grčić & Babić, 2003), GDP growth rates (Banga, 2003; Chen & Khan, 1997; Bhattacharya et al., 1997), GDP per capita (Goodspeed et al., 2006), GNP, or GNP per capita (Ali & Guo, 2005).

2. Re-Exports Opportunity Criterion: MNEs engage in FDI will consider (1) the facilities such as transport hubs (e.g., big harbors) (Rettab & Azzam, 2008) or export processing zones (e.g., industrial parks, & science parks) (Papadopoulos & Malhotra, 2007); (2) the possibility to avoid tariffs or infringe quotas set by the consuming countries government (Prakash & Chand, 2022) to facilitate re-exports opportunity.

2.2 Efficiency Seeking Group

The efficiency seeking of MNEs is motivated by creating new sources of competitiveness and dedicate to search for the host countries with much lower production costs (Wadhwa & Reddy, 2011). In Efficiency Seeking Group, this paper discusses Infrastructure Criterion, Human Resource Criterion, and Operation Cost Criterion into Efficiency Seeking Group.

1. Infrastructure Criterion: MNEs engage in FDI will consider the infrastructure of host country, including power plants and electricity network (Sovacool, Gilbert, & Nugent, 2014), water supply (Sargentis et al., 2019), telecommunication facilities (Tang et al., 2022), railways and roads, air and sea ports (Kabiru, 2016; Vlahinić-Dizdarević & Biljan-August, 2005; Wadhwa & Reddy, 2011), sanitation (Wang, 2019; Lawhon et al., 2023), internet popularization (Briglauer et al., 2018; Pazienza & Vecchione, 2009; Wadhwa & Reddy, 2011) and their combination.

2. Human Resource Criterion: MNEs engage in FDI will consider the abundant of skilled labors and knowledge workers who are represented by technicians and professionals in a specific field, qualified domestic education systems (Shatakishvili, 2021), foreign skilled immigrants (Porter, 1990) in the host country, and the learning by working ability of employees and organizations (Tynjälä, 2008; Senge, 1990; Pedler, Boydell, & Burgoyne, 1991).

3. Operation Cost Criterion: MNEs engage in FDI may enjoy the operation costs reduction from lower tax rates (De Mooij & Ederveen, 2003), capital raising fee and interest rates (Rockefeller, 1998), utility expenditure (Róka-Madarász, 2016), and labor costs (Khachoo & Khan, 2012; Hamermesh, 1983) in host country. MNEs can also reduce operation cost via economy of scale and economy of scope (Kurtishi-Kastrati, 2013; Bonomi et al. 2012; Panzar & Willig, 1981; Saal et al., 2013).

2.3 Cluster Driven Seeking Group

Many related industries or firms always tend to locate themselves in the close geographical proximity to form a cluster (Birkinshaw, 2000) for improving productivity. Productivity improving in the cluster mainly comes from enjoying common resources provided by the specific area or exploiting the unique abilities owned by a distinctive company. Under such perspective, the Cluster Driven Seeking Group consists with Industrial Clusters Criterion and Supply Chain Partnership Criterion.

1. Industrial Clusters Criterion: MNEs engage in FDI will concern about the gathering of specialized skills labors, knowledge workers, and infrastructure (Ketels & Memedovic, 2008), enjoying the benefit of common suppliers and exploit techniques and knowledge spillover effect (Tallman et al., 2004), and drawing on more specialized assets and suppliers to shorten reaction times (Porter, 2001) in an industrial cluster.

2. Supply Chain Partnership Criterion: The basis of supply chain is built by the workflow interdependence between partners (Capaldo & Giannoccaro, 2015). MNEs engage in FDI are to establish or join a supply chain to serve their international customers, support existing customers, or follow the globalization in their specific buyer-industries (Ivarsson & Alvstam, 2013).

2.4 Government Policies Group

Host government policies focus mainly on providing incentives and removing restrictions for FDI. In this perspective, Governmental Incentives Criterion and Government Institution Criterion are discussed in Government Policies Group.

1. Governmental Incentives Criterion: MNEs engage in FDI will attract by the host government incentive policies, including tax incentives (e.g., capital allowances or preferential tax rates)

(Zee et al., 2002; Hubert & Pain, 2002), financial incentives (e.g., monetary grants) (Olubunmi & Skitmore, 2016; Shazmin, Sipan, & Sapri, 2016; Hubert & Pain, 2002; Curtin et al., 2017; Tasdoven et al., 2012), and non-financial measures (e.g., subsidized infrastructure likes ready-use industrial sites or preferential government contracts) (Hubert & Pain, 2002).

2. Governmental Institutions Criterion: MNEs engage in FDI will be affected by the host governmental institutions. For example, the government concludes the rigid formal codified rules, procedures, requirements, regulations, and laws to ensure contract enforcement (Ahlquist & Prakash, 2010), guarantee trade agreements execution (Corcoran & Gillanders, 2015), protect intellectual property rights (Jandhyala, 2013; Khoury & Peng, 2011; Seyoum, 1996), and promise minority investment (Choi, Lee, & Shoham, 2016).

2.5 Operation Environment Group

Operation environment denotes the external factors that affect MNEs' performance while operating in host countries. Generally, operation environment is formed by governmental and non-governmental factors, it is complex and difficult to control. This paper focuses Operation Environment Group on Economic Environment Criterion, Trade Openness Criterion, Political Stability Criterion, and Geopolitical Risk Criterion.

1. Economic Environment Criterion: MNEs engage in FDI will consider the economic environment, including exchange rates (Tolentino, 2010), interest rates (Singhania et al., 2011), and inflation rate (Silajdzic & Mehic, 2022; Kersan-Skabic & Orlic, 2007) conditions in host country.

2. Trade Openness Criterion: MNEs engage in FDI will consider the host country's business climate, such as encourages inward FDI (Boateng et al., 2015), adopts the liberal trade policies (Azam & Lukman, 2010; Bissoon, 2012; Akin & Vlad, 2011), subtracts trade restrictions, allows the importation of intermediate and capital goods (Paus et al., 2003), has a high percent of the sum of imports and exports to GDP (Asiedu, 2006), can exchange capital, goods, and services easily (Edwards, 1992), and moves capital in or out of the country without constraint (Chakrabarti, 2001).

3. Political Stability Criterion: MNEs engage in FDI will concern about stable politics in host country (Shahzad et al., 2012), includes the change of regime, government intervention the economic environment (Frey & Schneider, 1979), ethnic tensions, and internal and external conflict (Howell, 2011).

4. Geopolitical Risk Criterion: MNEs engage in FDI will concern about stable politics in host country (Shahzad et al., 2012), includes the change of regime, government intervention the economic environment (Frey & Schneider, 1979), ethnic tensions, and internal and external conflict (Howell, 2011).

3. Research Methodology

3.1 Theorical Background and Research Procedure

This paper employs a DANP hybrid MCDM model originally proposed by Ou Yang et al. (2008). DANP combines DEMATEL with ANP to examine the factors that influence MNEs' investment decision making. DANP is a procedure to deal with the problems of criteria interdependence and feedback. The philosophy of DANP is to apply DEMATEL to calculate the degree of influence among Groups and weights to rectify the inadequate assumption of equivalent Group weight in ANP. In this section, the development and implementation of DANP will be elaborated.

This paper screens thirteen criteria from past literature as discussed in section 2, and classifies those criteria into five Groups. The “Description of MNEs Investing Determinants Criteria in Taiwan Hi-Tech Industry” is established as Table 1. In order to determine the degrees of influence and importance among the five Groups, this paper consults ten scholars and experts excellent in the related field, then interviews another ten senior managers in the Hi-Tech foreign companies invested in Taiwan to collect their real considerations while engage in FDI in Taiwan.

Table 1 The Description of MNEs Investing Determinants Criteria in Taiwan Hi-Tech Industry

Groups	Criteria	Description	Sources
(M) Market Seeking	(M1) Market Size	MNEs engage in FDI will consider the following market size indicators in host country, such as population, GDP, GDP growth rates, GDP per capita, GNP, or GNP per capita.	Gabriel et. al., 2016; Grčić & Babić, 2003; Banga, 2003; Chen & Khan, 1997; Goodspeed et al., 2006; Ali & Guo, 2005
	(M2) Re-Exports Opportunity	MNEs engage in FDI will consider (1) the facilities such as transport hubs (e.g., big harbors) or Technology Industrial Park (e.g., industrial parks, and science parks); (2) the possibility to avoid tariffs or infringe quotas set by the consuming countries government to facilitate re-exports opportunity.	Rettab & Azzam, 2008; Papadopoulos & Malhotra, 2007; Prakash & Chand, 2022; Scholar A
(E) Efficiency Seeking	(E1) Infrastructure	MNEs engage in FDI will consider the infrastructure of host country, including power plants and electricity network, water supply, telecommunication facilities, railways and roads, air and sea ports, sanitation, internet popularization and their combination.	Sovacool, Gilbert, & Nugent, 2014; Sargentis et al., 2019; Tang et al., 2022; Kabiru, 2016; Vlahinić-Dizdarević & Biljan-August, 2005; Wadhwa & Reddy, 2011; Wang, 2019; Lawhon et al., 2023; Briglauer et al., 2018
	(E2) Human Resource	MNEs engage in FDI will consider the abundant of skilled labors and knowledge workers who are represented by technicians and professionals in a specific field, qualified domestic education systems, foreign skilled immigrants in the host country, and the learning by working ability of employees and organizations.	Shatakishvili, 2021; Porter, 1990; Tynjälä, 2008; Senge, 1990; Pedler, Boydell & Burgoyne, 1991
	(E3) Operation Cost	MNEs engage in FDI may enjoy the operation costs reduction from lower tax rates, capital raising fee and interest rates, utility expenditure, and labor costs in host country. MNEs can also reduce operation cost via economy of scale and economy of scope.	De Mooij & Ederveen, 2003; Rockefeller, 1998; Róka-Madarász, 2016; Khachoo & Khan, 2012; Hamermesh, 1983; Kurtishi-Kastrati, 2013; Panzar & Willig, 1981; Saal et al., 2013
(C) Cluster Driven Seeking	(C1) Industrial Clusters	MNEs engage in FDI will concern about the gathering of specialized skills labors, knowledge workers, and infrastructure; enjoying the benefit of common suppliers; exploiting techniques and knowledge spillover effect; and drawing on more specialized assets and suppliers to shorten reaction times in an industrial cluster in host country.	Ketels & Memedovic, 2008; Tallman et al., 2004; Porter, 2001
	(C2) Supply Chain Partnerships	The basis of supply chain is built by the interdependent workflows between partners. MNEs engage in FDI are to establish or join a supply chain to serve their international customers, support existing customers, or follow the globalization in their specific buyer-industries.	Capaldo & Giannoccaro, 2015; Ivarsson & Alvstam, 2013
(G) Government Policies	(G1) Governmental Incentives	MNEs engage in FDI will attract by the host government incentive policies, including tax incentives (e.g., preferential tax rates), financial incentives (e.g., capital allowances or monetary grants), and non-financial measures (e.g., subsidized infrastructure likes ready-use industrial sites or preferential government contracts).	Zee et al., 2002; Hubert & Pain, 2002; Olubunmi & Skitmore, 2016; Shazmin, Sipan, & Sapri, 2016; Curtin et al., 2017
	(G2) Governmental Institutions	MNEs engage in FDI will be affected by the host governmental institutions. For example, the government concludes the rigid formal codified rules, procedures, requirements, regulations and laws to ensure contract enforcement, guarantee trade agreements execution, protect intellectual property rights, and promise minority investment.	Ahlquist & Prakash, 2010; Corcoran & Gillanders, 2015; Jandhyala, 2013; Khoury & Peng, 2011; Seyoum, 1996; Choi, Lee, & Shoham, 2016

Table 1 The Description of MNEs Investing Determinants Criteria in Taiwan Hi-Tech Industry (Con't 1)

Groups	Criteria	Description	Sources
(O) Operation Environment	(O1) Economic Environment	MNEs engage in FDI will consider the economic environment, including exchange rates, interest rates, and inflation rate in host country.	Tolentino, 2010; Singhania et al., 2011; Silajdzic & Mehic, 2022; Kersan-Skabic & Orlic, 2007
	(O2) Trade Openness	MNEs engage in FDI will consider the host country's business climate, such as encourages inward FDI, adopts the liberal trade policies, subtracts trade restrictions, allows the importation of intermediate and capital goods; has a high percent of the sum of imports and exports to GDP; can exchange capital, goods, and services easily; and moves capital in or out of the country without constraint.	Boateng et al., 2015; Azam & Lukman, 2010; Bissoon, 2012; Akin & Vlad, 2011; Paus et al., 2003; Asiedu, 2006; Edwards, 1992; Chakrabarti, 2001
	(O3) Political Stability	MNEs engage in FDI will concern about stable politics in host country, includes the change of regime, government intervention of the economic environment, ethnic tensions, and internal and external conflict.	Shahzad et al., 2012; Frey & Schneider, 1979; Howell, 2011
	(O4) Geopolitical Risk	MNEs will consider the host country's geopolitical risk before engage in FDI.	Gulen and Ion, 2016; Kim and Kung, 2017; Kim et al., 2019; Scholar C

3.2 Data Processing Steps

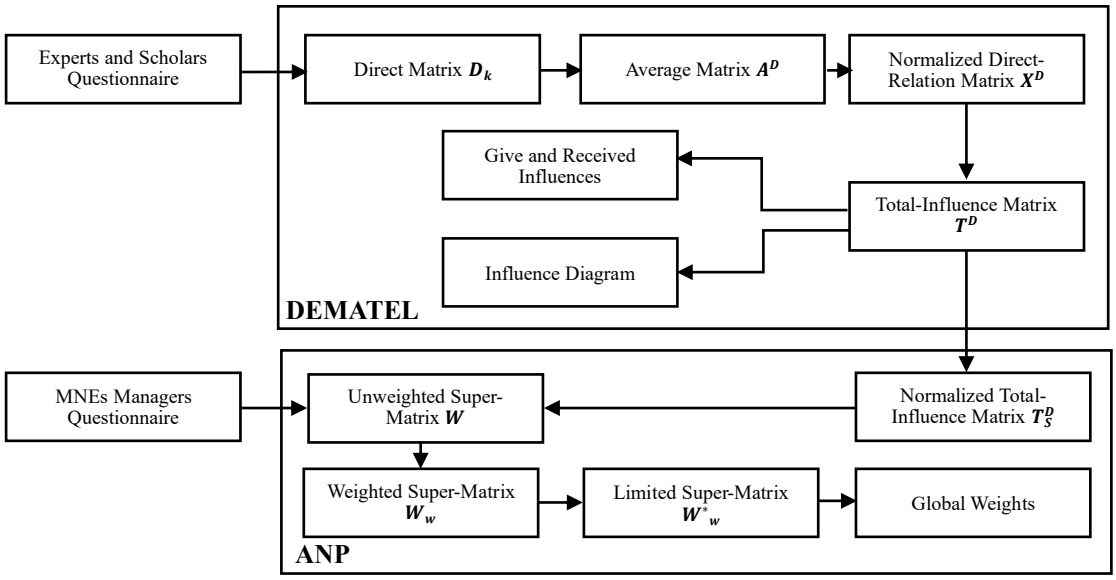

Fig. 1 The Flowchart of DANP Model (Source: Revised by This Paper)

This paper utilizes the data processing steps which were originally proposed by Ou Yang et al. (2008) and modified by Lee (2021). Fig. 1 illustrates the flowchart of DANP model. The detail steps are shown in the following subsections.

3.2.1 Apply DEMATEL for Network Relationship

The steps of processing the received DEMATEL data are summarize as follows.

Step D1: Calculate the direct relation matrix $\boldsymbol{D_k}$

After collecting the questionnaire from experts/scholars, every direct matrix represents the opinions of an expert/scholar, $\boldsymbol{D_k}$, where $k = 1, 2, \cdots$, n, and n is the number of experts/scholars. The factors of $\boldsymbol{D_k}$, denoted by d_{ij}^k, represents the initial direct effects that Group i impacts on and receives from Group j, shown as Eq. (1)

$$\boldsymbol{D_k} = \begin{bmatrix} d_{11}^k & \cdots & d_{1j}^k & \cdots & d_{1n}^k \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ d_{i1}^k & \cdots & d_{ij}^k & \cdots & d_{in}^k \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ d_{n1}^k & \cdots & d_{nj}^k & \cdots & d_{nn}^k \end{bmatrix} \quad (1)$$

Step D2: Averaging the direct-relation matrix $\boldsymbol{A^D}$

The average matrix $\boldsymbol{A^D}$ represents the same factors in various direct matrices received from experts/scholars, is calculated by taking the mean of $\boldsymbol{D_k}$. Each element in matrix $\boldsymbol{A^D}$, represented as a_{ij}^D, is computed by Eq. (2).

$$a_{ij}^D = \sum_{k=1}^{n} d_{ij}^k / n \quad (2)$$

Step D3: Normalizing the direct-relation matrix $\boldsymbol{X^D}$

The direct-relation matrix $\boldsymbol{X^D}$ can be normalized by applying Eqs. (3) and (4) to matrix $\boldsymbol{A^D}$, with all diagonal factors set to zero.

$$\boldsymbol{S^D} = min\left[\frac{1}{max\sum_{j=1}^{n}\left|a_{ij}^D\right|}, \frac{1}{max\sum_{i=1}^{n}\left|a_{ij}^D\right|}\right] \quad (3)$$

$$\boldsymbol{X^D} = \boldsymbol{S^D} \times \boldsymbol{A^D} \quad (4)$$

Step D4: Deriving the total influence matrix $\boldsymbol{T^D}$

Matrix $\boldsymbol{T^D}$ represents the direct and indirect influences from Group i to Group j and can be obtained by Equation (5), where $\boldsymbol{I}$ denote the identity matrix. The factors t_{ij}^d in $\boldsymbol{T^D}$ indicate the magnitudes of the direct and indirect influences from Group i to Group j, when $\lim_{k\to\infty} \boldsymbol{X^{D^k}} = [\boldsymbol{0}]_{n\times n}$, the total-influence matrix is listed as follows:

$$\boldsymbol{T^D} = \lim_{k\to\infty}\left(\boldsymbol{X^D} + \boldsymbol{X^{D^2}} + \boldsymbol{X^{D^3}} + \cdots + \boldsymbol{X^{D^k}}\right) = \lim_{k\to\infty} \boldsymbol{X^D}\,(\boldsymbol{I} - \boldsymbol{X^D})^{-1} \quad (5)$$

Step D5: Analyzing the results of influences and relationships

Vector r and vector c are defined respectively as the vector of row sums and the vector of column sums of the total relation matrix $\boldsymbol{T^D}$. Vector r and vector c are given by Eqs. (6) and (7).

$$r = (r_i)_{n\times 1} = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1} \quad (6)$$

$$c = \left(c_j\right)_{1\times n} = \left(c_j\right)'_{1\times n} = \left[\sum_{i=1}^{n} t_{ij}\right]'_{1\times n} \quad (7)$$

The i th row sum of the matrix $\boldsymbol{T^D}$, denoted as r_i, represents the total direct and indirect influences of Group i exerts on the other Groups. Similarly, the j th column sum of $\boldsymbol{T^D}$, denoted as c_j, represents the total direct and indirect influences of Group j received from the other Groups. If $i=j$, $(r_i + c_i)$ is the sum of the row sum and column sum of Group i which is called "prominence" and indicates the overall strength of Group i's influence impacts on and received from the other Groups. A higher value of $(r_i + c_i)$ indicates that Group i plays a central role and has stronger connections with the other Groups, and thus is assumed to have higher priority. Moreover, $(r_i - c_i)$ is referred as "relation". If $(r_i - c_i)$ is positive, Group i is affecting other Groups, and if $(r_i - c_i)$ is negative, Group i is being influenced by the other Groups. A higher value of $(r_i - c_i)$ indicates that Group i has a stronger influence on other Groups than it receives from them, and is assumed to have lower priority (Maqbool & Khan, 2020; Yazdi, 2020).

Step D6: Setting an α-cut as a threshold to filter the minor clusters

Each element t_{ij} in $\boldsymbol{T^D}$ provides information about the influence of Group i on Group j. For eliminating the Groups with minor influence, Ou Yang et al. (2008) recommended to set a threshold to eliminate the element of original value is less than α, where $\alpha = \sum_{i=1}^{n}\sum_{j=1}^{n} t_{ij} / n^2$, n is the number of Groups. This paper refers to the previous researches such as Shen et al., (2014), Chiu et al. (2013), and Hsu et al., (2013) to distinguish the strength of Group influence. If the element values in $\boldsymbol{T^D}$ are less than α, the element value will be signed a "*" symbol to label it as a minor influence Group. The modified α-cut total relation matrix is symbolized as $\boldsymbol{T_\alpha^D}$.

3.3.2 Priority Assessments by ANP

The processing steps about the received ANP data are summarized as follows.

Step A1: Building the direct super matrix $\boldsymbol{A_k}$

By conducting interviews with ten senior managers from MNEs involved in FDI affairs and collecting real-world messages, this paper generates a direct matrix $\boldsymbol{A_k}$, k = 1, 2, ⋯, n), where n represents the number of respondents. By collecting the answers of each respondent, every element of $\boldsymbol{A_k}$, represented by a_{ij}^k, illustrates the initial direct effects that each criterion exerts on and receives from other criteria. $\boldsymbol{A_k}$ is expressed as Eq. (8).

$$\boldsymbol{A_k} = \begin{array}{c} \\ \boldsymbol{G_1} \\ \\ \boldsymbol{G_2} \\ \\ \vdots \\ \boldsymbol{G_n} \end{array} \begin{array}{c} \begin{array}{cccc} \boldsymbol{G_1} & \boldsymbol{G_2} & & \boldsymbol{G_n} \\ e_{11} \cdots e_{1m_1} & e_{21} \cdots e_{2m_2} & \cdots\cdots & e_{n1} \cdots e_{nm_n} \end{array} \\ \begin{bmatrix} a_{11}^k & a_{12}^k & \cdots & a_{1n}^k \\ a_{21}^k & a_{22}^k & \cdots & a_{2n}^k \\ \vdots & \vdots & \vdots\vdots\vdots & \vdots \\ a_{n1}^k & a_{n2}^k & \cdots & a_{nn}^k \end{bmatrix} \end{array} \tag{8}$$

Step A2: Averaging the direct matrix $\boldsymbol{A_k}$

The average matrix $\boldsymbol{A^A}$ is obtained by taking the mean of the corresponding elements from each of $\boldsymbol{A}_k$. Each element in the average matrix, denoted as a_{ij}^A, is calculated by Eq. (9).

$$a_{ij}^A = \frac{\sum_{k=1}^{n} a_{ij}^k}{n} \tag{9}$$

Step A3: Calculating the initial direct-relation matrix $\boldsymbol{X^A}$

The direct-relation matrix $\boldsymbol{X^A}$ is obtained by normalizing the $\boldsymbol{A^D}$ by Eqs. (10) and (11), all diagonal elements in $\boldsymbol{X^A}$ are zero.

$$\boldsymbol{S^A} = \min\left[\frac{1}{max\sum_{j=1}^{n}\left|a_{ij}^A\right|}, \frac{1}{max\sum_{i=1}^{n}\left|a_{ij}^A\right|}\right] \tag{10}$$

$$\boldsymbol{X^A} = \boldsymbol{S^A} \times \boldsymbol{A^A} \tag{11}$$

Step A4: Deriving the total influence matrix $\boldsymbol{T^A}$

The direct/indirect matrix $\boldsymbol{T^A}$ can be obtained through Eq. (12), where $\boldsymbol{I}$ is the identity matrix. The elements t_{ij}^A of $\boldsymbol{T^A}$ represent the direct and indirect influence from criterion *i* to criterion *j*. When $\lim_{z\to\infty} \boldsymbol{X^z} = [\boldsymbol{0}]_{n\times n}$, the total-influence matrix is listed as follows:

$$\boldsymbol{T^A} = \lim_{\boldsymbol{k}\to\infty}\left(\boldsymbol{X^A} + \boldsymbol{X^{A^2}} + \boldsymbol{X^{A^3}} + \cdots + \boldsymbol{X^{A^k}}\right) = \lim_{\boldsymbol{k}\to\infty} \boldsymbol{X^A}\,(\boldsymbol{I} - \boldsymbol{X^A})^{-1} \tag{12}$$

Step A5: Normalizing the total influence matrix $\boldsymbol{T_N^A}$

The normalized total influence matrix $\boldsymbol{T_N^A}$ is presented by Eq. (13).

$$\boldsymbol{T_N^A} = \begin{array}{c} \\ \mathrm{G_1} \\ \\ \\ \mathrm{G_2} \\ \\ \\ \vdots \\ \mathrm{G_n} \end{array} \begin{array}{c} \begin{array}{cccc} \mathrm{G_1} & & \mathrm{G_2} & & & \mathrm{G_n} \\ e_{11}\cdots e_{1m_1} & e_{21}\cdots e_{2m_2} & \cdots\cdots & e_{n1}\cdots e_{nm_n} \end{array} \\ \begin{bmatrix} T_N^{A^{11}} & T_N^{A^{12}} & \cdots & T_N^{A^{1n}} \\ & & & \\ T_N^{A^{21}} & T_N^{A^{22}} & \cdots & T_N^{A^{2n}} \\ \vdots & \vdots & \vdots & \vdots \\ T_N^{A^{n1}} & T_N^{A^{n2}} & \cdots & T_N^{A^{nn}} \end{bmatrix} \end{array} \tag{13}$$

The calculation of $\boldsymbol{T_N^{A^{11}}}$ is illustrated by Eqs. (14) and (15).

$$b_{ei}^{11} = \sum_{j=1}^{m1} t_{e_{ij}}^{A^{11}}, i = 1,2,\cdots,m_1 \tag{14}$$

$$\boldsymbol{T_N^{A^{11}}} = \begin{bmatrix} t_{11}^{A^{11}}/b_{e1}^{11} & t_{12}^{A^{11}}/b_{e1}^{11} & \cdots & t_{1m_1}^{A^{11}}/b_{e1}^{11} \\ t_{21}^{A^{11}}/b_{e2}^{11} & t_{22}^{A^{11}}/b_{e2}^{11} & \cdots & t_{2m_1}^{A^{11}}/b_{e2}^{11} \\ \vdots & \vdots & \vdots & \vdots \\ t_{m_1 1}^{A^{11}}/b_{em_1}^{11} & t_{m_1 2}^{A^{11}}/b_{em_1}^{11} & \cdots & t_{m_1 m_1}^{A^{11}}/b_{em_1}^{11} \end{bmatrix}$$

$$= \begin{bmatrix} t_{N_{11}}^{A^{11}} & t_{N_{12}}^{A^{11}} & \cdots & t_{N_{1m_1}}^{A^{11}} \\ t_{N_{21}}^{A^{11}} & t_{N_{22}}^{A^{11}} & \cdots & t_{N_{2m_1}}^{A^{11}} \\ \vdots & \vdots & \vdots & \vdots \\ t_{N_{m_1 1}}^{A^{11}} & t_{N_{m_1 2}}^{A^{11}} & \cdots & t_{N_{m_1 m_1}}^{A^{11}} \end{bmatrix} \tag{15}$$

Step A6: Acquiring the unweighted super-matrix $\boldsymbol{W}$

The unweighted super-matrix $\boldsymbol{W}$ is obtained by transposing the matrix $\boldsymbol{T_N^A}$, shown as Eq. (16).

$$\boldsymbol{W} = \begin{array}{c} \\ \boldsymbol{G_1} \\ \\ \\ \boldsymbol{G_2} \\ \\ \\ \vdots \\ \boldsymbol{G_n} \end{array} \begin{array}{c} \begin{array}{cccc} \boldsymbol{G_1} & & \boldsymbol{G_2} & & & \boldsymbol{G_n} \\ e_{11}\cdots e_{1m_1} & e_{21}\cdots e_{2m_2} & \cdots\cdots & e_{n1}\cdots e_{nm_n} \end{array} \\ \begin{bmatrix} W_{11} & W_{12} & \cdots & W_{1n} \\ & & & \\ W_{21} & W_{22} & \cdots & W_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ W_{n1} & W_{n2} & \cdots & W_{nn} \end{bmatrix} \end{array} \tag{16}$$

Step A7: Acquiring the normalized total-influence matrix $\boldsymbol{T_N^D}$

Normalized the total-influence matrix $\boldsymbol{T^D}$ by utilizing different Group weights established from DEMATEL. The resulting normalized total-influence matrix is $\boldsymbol{T_N^D}$, which is obtained by Eqs. (17) and (18).

$$\boldsymbol{T^D} = \begin{bmatrix} t_{11}^D & \cdots & t_{1j}^D & \cdots & t_{1n}^D \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}^D & \cdots & t_{ij}^D & \cdots & t_{in}^D \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1}^D & \cdots & t_{nj}^D & \cdots & t_{nn}^D \end{bmatrix}, \; d_i = \sum_{j=1}^{n} t_{ij}^D \tag{17}$$

$$\boldsymbol{T_N^D} = \begin{bmatrix} t_{11}^D/d_1 & \cdots & t_{1j}^D/\ d_1 & \cdots & t_{1n}^D/\ d_1 \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{i1}^D/d_i & \cdots & t_{ij}^D/\ d_1 & \cdots & t_{in}^D/\ d_i \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{n1}^D/d_n & \cdots & t_{nj}^D/\ d_1 & \cdots & t_{nn}^D/\ d_n \end{bmatrix} = \begin{bmatrix} t_{N_{11}}^D & \cdots & t_{N_{1j}}^D & \cdots & t_{N_{1n}}^D \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{N_{i1}}^D & \cdots & t_{N_{ij}}^D & \cdots & t_{N_{in}}^D \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{N_{n1}}^D & \cdots & t_{N_{nj}}^D & \cdots & t_{N_{nn}}^D \end{bmatrix} \tag{18}$$

Step A8: Acquiring the weighted super-matrix $\boldsymbol{W_W}$

By multiplying the transpose of the normalized total-influence matrix by the unweighted super-matrix $\boldsymbol{W}$, the weighted super-matrix $\boldsymbol{W_W}$ can be produced, that is $\boldsymbol{W_w} = \boldsymbol{T_N^{D'}} \times \boldsymbol{W}$, shown as Eq. (19).

$$\boldsymbol{W_w} = \begin{bmatrix} t_{N_{11}}^D \times W_{11} & \cdots & t_{N_{1j}}^D \times W_{1j} & \cdots & t_{N_{1n}}^D \times W_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{N_{i1}}^D \times W_{i1} & \cdots & t_{N_{ij}}^D \times W_{ij} & \cdots & t_{N_{in}}^D \times W_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ t_{N_{n1}}^D \times W_{n1} & \cdots & t_{N_{nj}}^D \times W_{nj} & \cdots & t_{N_{nn}}^D \times W_{nn} \end{bmatrix} \tag{19}$$

Step A9: Acquiring the limited super-matrix $\boldsymbol{W^*_W}$

The DANP weights are obtained from the limited super-matrix $\boldsymbol{W^*_W}$, which is produced by raising the weighted super-matrix $\boldsymbol{W_W}$ to a large enough power until it converges to a long-term stable state.

$$\lim_{k\to\infty} W_W^k \tag{20}$$

Step A10: Ranking the global weights

The global weights are determined by ranking based on the global priority vector obtained from the limited super-matrix $\boldsymbol{W^*_W}$.

4. Research Results

Following the data processing steps, this paper firstly analyzes the datum collected from ten scholars/experts by DEMATEL to examine the impact of relationships among groups, then employs the interview outcomes from the ten senior MNE managers to determine the priority of criteria for MNEs while making FDI decisions.

4.1.1 Calculating the Average direct-relation Matrix $\boldsymbol{A^D}$

In DEMATEL stage, from the ten scholars/experts questionnaires, establishes ten direct-relation matrixes. Averaging the ten direct-relation matrixes by Eq. (2), receive the average direct-relation matrix $\boldsymbol{A^D}$. Normalizing $\boldsymbol{A^D}$ by Eqs. (3) and (4), the normalized direct-relation matrix $\boldsymbol{X^D}$ is obtained as Table 2.

By Eq. (5), the total influence matrix $\boldsymbol{T^D}$ is shown as Table 3. Adopting Eqs. (6) and (7), computes the values of $r_i + c_i$ and $r_i - c_i$ to obtain the given and received influences of the five groups, which are presented in Table 4.

Table 2 The Direct-Influence Matrix X^D

Group	M	E	C	G	O
M	0	0.16522	0.1913	0.15652	0.16522
E	0.21739	0	0.24348	0.14783	0.22609
C	0.28696	0.28696	0	0.24348	0.18261
G	0.21739	0.2	0.22609	0	0.24348
O	0.22609	0.2	0.22609	0.23478	0

Table 3 The Total Influence Matrix T^D

Group	M	E	C	G	O
M	0.93347	0.99534	1.03918	0.92823	0.96024
E	1.28942	1.01546	1.24170	1.07370	1.15687
C	1.49900	1.38923	1.20139	1.27514	1.27421
G	1.34578	1.23348	1.28422	0.99229	1.22081
O	1.34989	1.23181	1.28250	1.18065	1.02318

Table 4 The Gives and Received Influences of the Five Groups

Group	r_i	c_i	$r_i + c_i$	$r_i - c_i$
M	4.85647	6.41755	11.27	-1.56
E	5.77716	5.86533	11.64	-0.09
C	6.63898	6.04899	12.69	0.59
G	6.07656	5.45002	11.53	0.63
O	6.06803	5.63532	11.70	0.43

Based on the information of Table 4, the cause-effect diagram of the total relationship is illustrated as Fig. 2.

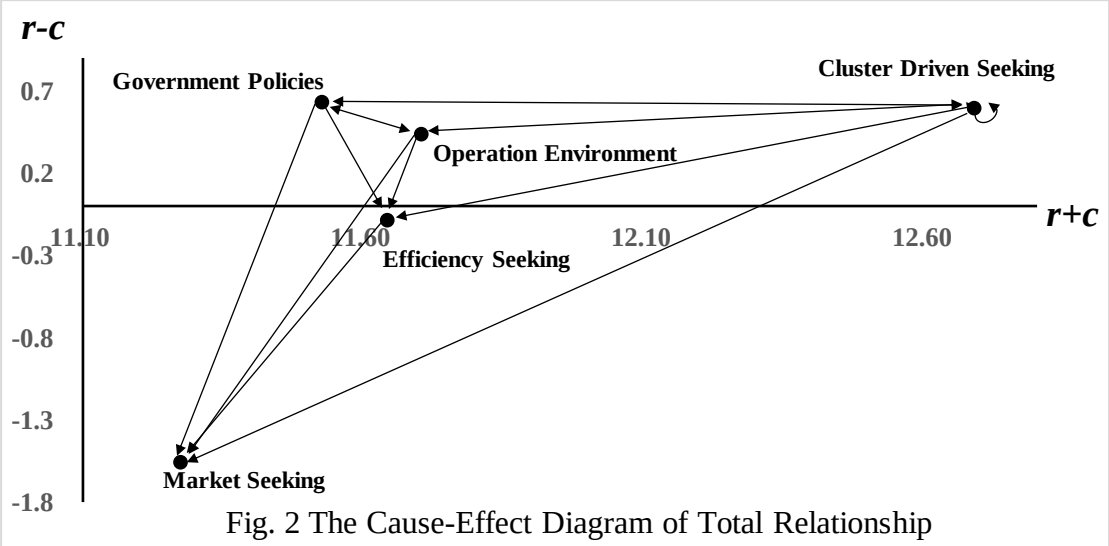

Fig. 2 The Cause-Effect Diagram of Total Relationship

Observing Fig. 2, it shows that the Government Policies Group has the highest positive value of ($r_i - c_i = 0.63$) and nearly follows by the Cluster Driven Seeking Group ($r_i - c_i = 0.59$)

posited at the second place among the five groups. It indicates that Government Policies Group and Cluster Driven Seeking Group exercise the strong influence on the other groups and can be regarded as the "main causal factor". This result implies that Government Policies Group and the Cluster Driven Seeking Group play the central role for the decision makers of MNEs when engaging in the decision makings of investing in Taiwan's high technology industry. On the other hand, Market Seeking Group has the lowest negative value of ($r_i - c_i = -1.56$), which infers that it receives the most influence from the other groups and can be regarded as the "main effect factor" among the groups. Spotting at the Cluster Driven Seeking Group, it has the highest ($r_i + c_i$) value and the second highest positive ($r_i - c_i$) value, which demonstrates that Cluster Driven Seeking Group has significant relationships with other groups at the same time. Finally, the Market Seeking Group has the lowest negative ($r_i - c_i$) value, it expresses that the managers of MNEs do not focus on promoting market share while they decide to invest in Taiwan.

A threshold value α is established to distinguish the significant and minor influences among clusters in matrix $\boldsymbol{T^D}$. The resulting matrix is the α-cut total influence matrix $\boldsymbol{T_\alpha^D}$, presented as Table 5. The influence diagram of the five clusters is depicted as Fig. 3 based on the information of $\boldsymbol{T_\alpha^D}$.

Table 5 The Total Influence Matrix $\boldsymbol{T_\alpha^D}$

Group	M	E	C	G	O
M	0.93347*	0.99534*	1.03918*	0.92823*	0.96024*
E	1.28942	1.01546*	1.24170	1.07370*	1.15687*
C	1.49900	1.38923	1.20139	1.27514	1.27421
G	1.34578	1.23348	1.28422	0.99229*	1.22081
O	1.34989	1.23181	1.28250	1.18065	1.02318*

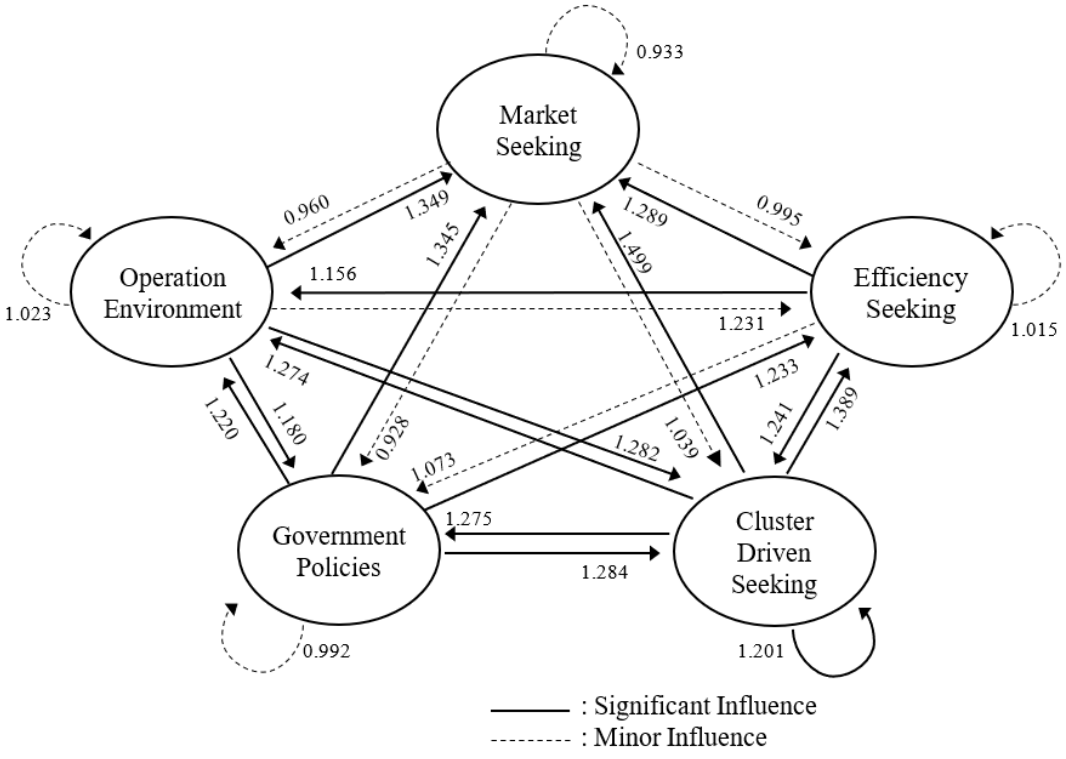

Fig. 3 Influence Diagram of the Five Groups

Fig. 3 illustrates that Government Policies Group and the Cluster Driven Seeking Group emit the significant influences to all the other groups, while Market Seeking Group absorbs the significant influences from all the other groups. These results indicate that Government Policies Group and the Cluster Driven Seeking Group play as the "source nodes" and reveal the facts that the initiation for MNEs to invest in Taiwan's high-tech industries arises from Taiwan government's favorable policies and their own strategies to integrate into Taiwan's high-tech industrial cluster. On the other hand, Market Seeking Group performs as a "sunk node", it suggests that to raise the market share in Taiwan is not the major attention for those MNEs' investment consideration.

4.2 Apply ANP to Measure the Priority of Criteria

In ANP stage, the data is collected by face to face interviewing ten senior MNEs managers who are in the high-tech MNEs invested in Taiwan to collect their real considerations while engage in FDI in Taiwan. The ANP methodology is employed to evaluate the relative importance of each pair of criteria by the pair-wise comparison questionnaire.

From the ten pair-wise comparison questionnaires, results in the direct super matrixes $\boldsymbol{A}_k$, k=1, 2, 3, ..., 10. By Eq. (9), receive the average direct super matrix $\boldsymbol{A}^{\boldsymbol{A}}$. By Eqs. (10) and (11), the initial direct-influence matrix $\boldsymbol{X}^{\boldsymbol{A}}$ is shown as Table 6.

Table 6 The Direct-Influence Matrix $\boldsymbol{X}^{\boldsymbol{A}}$ (n=10)

	M1	M2	E1	E2	E3	C1	C2	G1	G2	O1	O2	O3	O4
M1	0.021	0.058	0.042	0.092	0.114	0.123	0.114	0.067	0.019	0.027	0.096	0.058	0.040
M2	0.010	0.021	0.018	0.042	0.081	0.102	0.092	0.012	0.009	0.020	0.047	0.021	0.027
E1	0.017	0.037	0.021	0.067	0.096	0.121	0.114	0.047	0.020	0.017	0.083	0.029	0.026
E2	0.005	0.019	0.008	0.021	0.034	0.085	0.078	0.026	0.009	0.009	0.050	0.019	0.018
E3	0.004	0.006	0.005	0.028	0.021	0.052	0.055	0.021	0.006	0.007	0.022	0.008	0.010
C1	0.004	0.005	0.004	0.006	0.019	0.021	0.013	0.013	0.006	0.006	0.019	0.009	0.010
C2	0.004	0.012	0.005	0.009	0.019	0.046	0.021	0.021	0.011	0.015	0.023	0.015	0.013
G1	0.008	0.042	0.015	0.045	0.029	0.080	0.067	0.021	0.009	0.008	0.055	0.029	0.031
G2	0.038	0.052	0.026	0.056	0.079	0.087	0.080	0.060	0.021	0.030	0.092	0.065	0.065
O1	0.043	0.045	0.040	0.054	0.069	0.096	0.080	0.060	0.023	0.021	0.087	0.055	0.061
O2	0.005	0.016	0.005	0.018	0.030	0.035	0.034	0.018	0.005	0.006	0.021	0.014	0.013
O3	0.010	0.040	0.026	0.037	0.065	0.078	0.065	0.037	0.008	0.016	0.040	0.021	0.026
O4	0.018	0.029	0.026	0.040	0.058	0.074	0.065	0.030	0.008	0.016	0.044	0.025	0.021

By Eqs. (12) and (13), the total influence matrix $\boldsymbol{T}^{\boldsymbol{A}}$ and the normalized total influence matrix $\boldsymbol{T}_{\boldsymbol{N}}^{\boldsymbol{A}}$ are calculated respectively as Table 7. Transposing $\boldsymbol{T}_{\boldsymbol{N}}^{\boldsymbol{A}}$ obtain the unweighted super-matrix $\boldsymbol{W}$ as Table 8.

Table 7 The Normalized Total Influence Matrix $\boldsymbol{T}_{\boldsymbol{N}}^{\boldsymbol{A}}$ (n=10)

	M1	M2	E1	E2	E3	C1	C2	G1	G2	O1	O2	O3	O4
M1	0.277	0.723	0.163	0.364	0.473	0.526	0.474	0.760	0.240	0.124	0.432	0.248	0.196
M2	0.326	0.674	0.135	0.310	0.555	0.531	0.469	0.663	0.337	0.161	0.416	0.195	0.228
E1	0.312	0.688	0.125	0.360	0.515	0.523	0.477	0.711	0.289	0.117	0.497	0.200	0.186
E2	0.245	0.755	0.135	0.338	0.527	0.529	0.471	0.734	0.266	0.109	0.491	0.203	0.196
E3	0.366	0.634	0.110	0.466	0.424	0.506	0.494	0.753	0.247	0.140	0.450	0.198	0.212
C1	0.386	0.614	0.146	0.266	0.588	0.582	0.418	0.686	0.314	0.133	0.432	0.215	0.220
C2	0.287	0.713	0.163	0.309	0.527	0.634	0.366	0.671	0.329	0.193	0.372	0.228	0.208
G1	0.206	0.794	0.164	0.442	0.394	0.543	0.457	0.714	0.286	0.090	0.439	0.231	0.240
G2	0.387	0.613	0.160	0.349	0.491	0.530	0.470	0.740	0.260	0.124	0.384	0.247	0.246
O1	0.432	0.568	0.212	0.339	0.449	0.543	0.457	0.725	0.275	0.106	0.403	0.237	0.254
O2	0.260	0.740	0.120	0.339	0.541	0.523	0.477	0.765	0.235	0.124	0.399	0.242	0.234
O3	0.236	0.764	0.189	0.310	0.501	0.544	0.456	0.786	0.214	0.147	0.402	0.209	0.242
O4	0.364	0.636	0.190	0.332	0.478	0.535	0.465	0.763	0.237	0.142	0.419	0.234	0.205

Table 8 The Unweighted Super-Matrix $\boldsymbol{W}$

	M1	M2	E1	E2	E3	C1	C2	G1	G2	O1	O2	O3	O4
M1	0.277	0.326	0.312	0.245	0.366	0.386	0.287	0.206	0.387	0.432	0.260	0.236	0.364
M2	0.723	0.674	0.688	0.755	0.634	0.614	0.713	0.794	0.613	0.568	0.740	0.764	0.636
E1	0.163	0.135	0.125	0.135	0.110	0.146	0.163	0.164	0.160	0.212	0.120	0.189	0.190
E2	0.364	0.310	0.360	0.338	0.466	0.266	0.309	0.442	0.349	0.339	0.339	0.310	0.332
E3	0.473	0.555	0.515	0.527	0.424	0.588	0.527	0.394	0.491	0.449	0.541	0.501	0.478
C1	0.526	0.531	0.523	0.529	0.506	0.582	0.634	0.543	0.530	0.543	0.523	0.544	0.535
C2	0.474	0.469	0.477	0.471	0.494	0.418	0.366	0.457	0.470	0.457	0.477	0.456	0.465
G1	0.760	0.663	0.711	0.734	0.753	0.686	0.671	0.714	0.740	0.725	0.765	0.786	0.763
G2	0.240	0.337	0.289	0.266	0.247	0.314	0.329	0.286	0.260	0.275	0.235	0.214	0.237
O1	0.124	0.161	0.117	0.109	0.140	0.133	0.193	0.090	0.124	0.106	0.124	0.147	0.142
O2	0.432	0.416	0.497	0.491	0.450	0.432	0.372	0.439	0.384	0.403	0.399	0.402	0.419
O3	0.248	0.195	0.200	0.203	0.198	0.215	0.228	0.231	0.247	0.237	0.242	0.209	0.234
O4	0.196	0.228	0.186	0.196	0.212	0.220	0.208	0.240	0.246	0.254	0.234	0.242	0.205

Adopting the five groups' weights in DEMATEL to normalized the $\boldsymbol{T^D}$ matrix by Eqs. (17) and (18), obtains the normalized total-influence matrix $\boldsymbol{T_N^D}$ as Table 9. By Eq. (19), the weighted super-matrix $\boldsymbol{W_W}$ is shown as Table 10.

Table 9 The Normalized Total Influence Matrix of the Five Groups $\boldsymbol{T_N^D}$

Group	M	E	C	G	O
M	0.192	0.204	0.213	0.191	0.197
E	0.223	0.175	0.214	0.185	0.200
C	0.225	0.209	0.180	0.192	0.191
G	0.221	0.202	0.211	0.163	0.200
O	0.222	0.203	0.211	0.194	0.168

Table 10 The Weighted Super-Matrix $\boldsymbol{W_W}$

	M1	M2	E1	E2	E3	C1	C2	G1	G2	O1	O2	O3	O4
M1	0.053	0.063	0.070	0.055	0.082	0.087	0.065	0.046	0.086	0.096	0.058	0.053	0.081
M2	0.139	0.130	0.154	0.168	0.142	0.139	0.161	0.176	0.136	0.126	0.165	0.170	0.141
E1	0.034	0.028	0.022	0.024	0.019	0.031	0.034	0.033	0.033	0.043	0.024	0.038	0.039
E2	0.075	0.064	0.063	0.059	0.082	0.056	0.065	0.090	0.071	0.069	0.069	0.063	0.067
E3	0.097	0.114	0.091	0.093	0.074	0.123	0.110	0.080	0.100	0.091	0.110	0.102	0.097
C1	0.113	0.114	0.112	0.114	0.109	0.105	0.115	0.115	0.112	0.115	0.111	0.115	0.113
C2	0.101	0.100	0.103	0.101	0.106	0.076	0.066	0.097	0.099	0.097	0.101	0.096	0.098
G1	0.145	0.127	0.132	0.136	0.140	0.132	0.129	0.117	0.121	0.141	0.149	0.153	0.148
G2	0.046	0.064	0.054	0.049	0.046	0.060	0.063	0.047	0.042	0.053	0.046	0.042	0.046
O1	0.025	0.032	0.023	0.022	0.028	0.025	0.037	0.018	0.025	0.018	0.021	0.025	0.024
O2	0.085	0.082	0.099	0.098	0.090	0.083	0.071	0.088	0.077	0.068	0.067	0.068	0.071
O3	0.049	0.039	0.040	0.041	0.040	0.041	0.044	0.046	0.050	0.040	0.041	0.035	0.039
O4	0.039	0.045	0.037	0.039	0.043	0.042	0.040	0.048	0.049	0.043	0.039	0.041	0.035

Finally, applying Eq. (20), the limited super-matrix $\boldsymbol{W^*_w}$ is calculated and presented as Table 11.

Table 11 The Limited Super-Matrix W^*_w

	M1	M2	E1	E2	E3	C1	C2	G1	G2	O1	O2	O3	O4
M1	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
M2	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150
E1	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
E2	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
E3	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
C1	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112
C2	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094
G1	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133
G2	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
O1	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
O2	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
O3	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
O4	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042

4.3 Ranking the Criteria

Based on W^*_w, the weights and rankings of criteria can be determined by ranking the global weights. Then, the local weights of each group can be obtained by summing up the global weights of each criterion within the group. By dividing the local weights by a criterion within the group, the local weight of that criterion can be determined. Table 12 displays the weights and ranks of criteria. The global weights of the criteria indicate their priority as determinants of MNEs investing in Taiwan's high-tech industries within the entire evaluation system, while the local weight of a criterion reflects its relative importance within the concerned group.

Table 12 Weights and Ranks of the Evaluation Criteria

Group	Criterion	Local Weights	Global Weights	Rank
Market Seeking	(M1) Market Size	0.30610	0.06629	8
	(M2) Re-Exports Opportunity	0.69389	0.15027	1
	The sum of the Global weights	**0.21656**		
Efficiency Seeking	(E1) Infrastructure	0.14933	0.02976	12
	(E2) Human Resource	0.34934	0.06962	7
	(E3) Operation Cost	0.50132	0.09991	4
	The sum of the Global weights	**0.19929**		
Cluster Driven Seeking	(C1) Industrial Clusters	0.54322	0.11210	3
	(C2) Supply Chain Partnerships	0.45677	0.09426	5
	The sum of the Global weights	**0.20636**		
Government Policies	(G1) Governmental Incentives	0.71807	0.13339	2
	(G2) Governmental Institutions	0.28192	0.05237	9
	The sum of the Global weights	**0.18576**		
Operation Environment	(O1) Economic Environment	0.13404	0.02574	13
	(O2) Trade Openness	0.42576	0.08176	6
	(O3) Political Stability	0.21923	0.04210	11
	(O4) Geopolitical Risk	0.22095	0.04243	10
	The sum of the Global weights	**0.19203**		

Table 12 displays the priority of the thirteen determinants ranked by MNEs' managers. From the local weights in Table 12, the most important criterion in each group is described as follows: Re-Exports Opportunity Criterion in Market Seeking Group; Operation Cost Criterion in Efficiency Seeking Group; Industrial Clusters Criterion in Cluster Driven Seeking Group; Governmental Incentives Criterion in Government Policies Group; and Trade Openness Criterion in Operation Environment Group.

Further observe the rank of global weights in Table 12, this paper shows the relative five important criteria and lists as follows:

1. Re-Exports Opportunity Criterion with a weight of 0.15027 has the highest priority among all determinants, indicating that MNEs invest in Taiwan primarily focus on Taiwan's role as a regional transportation hub, providing convenient industrial parks, and the possibility to avoid tariffs or to infringe quotas set by consuming countries government to facilitate the operation for re-exports. This also implies that investing in Taiwan will benefit MNEs in expanding to other countries in the future.

2. Governmental Incentives (0.13339) is ranked the second, shows that Taiwan government's incentive policies, including tax incentives, financial incentives, and non-financial measures are important for MNEs.

3. The third determinant is Industrial Clusters Criterion (0.1121), means that MNEs consider the industrial cluster in Taiwan can offer appropriate prospect for them to access specialized skills labors, knowledge workers, infrastructure, common suppliers, exploiting techniques and knowledge spillover, and drawing on more specialized assets and suppliers to shorten reaction times for market change.

4. Operation Cost Criterion (0.09991) is ranked the fourth, indicating that MNEs engage in FDI to reduce operation costs from lower tax rates, capital raising fees and interest rates, utility expenditure, and labor costs in Taiwan. MNEs can also achieve cost reduction via economy of scale and scope.
5. The fifth determinant is Supply Chain Partnerships Criterion (0.09426), expressing that it is essential for MNEs to invest in Taiwan for establishing or joining a supply chain to serve their international customers, support existing customers, or following the globalization trend in specific buyer-industries.

5. Conclusion

Taiwan is an isolated island located in the Southeast Asia and is suffered from scarce natural resources and insufficient local capital accumulation. Retrospect the history of economic development, inward FDI played the most important role to surge the economic growth under such disadvantageous conditions. In nowadays, Taiwan's export-oriented economy still heavily relies on inward FDI. Therefore, how to attract MNEs to invest in Taiwan is always a desirable task for the policy makers in Taiwan. In addition, high-tech industries are the major pillars to support Taiwan economic development in recent decades, this paper aims to explore the determinants of MNEs investing in Taiwan's high-tech industries.

The research results show that both the Government Policies Group and the Cluster Driven Seeking Group have the strongest influence on the other groups. It reminds that MNEs managers put higher weights on those two groups while engaging FDI in Taiwan's high-tech industries. On the contrary, due to the market size of Taiwan is relatively small, the main consideration of Market Seeking Group for MNEs managers is decided by the re-export opportunity for the FDI products.

For attracting inward FDI, the suggestions of this paper are narrated as follows. From the top three priority criteria ranked by MNE managers reveal that MNEs invest in Taiwan concern mostly on the re-export opportunity for their products produced in Taiwan. The Taiwan government authorities must dedicate to sign ECA/FTA with foreign countries or territories. The second priority criterion is governmental incentives, it indicates that the government authorities may consider to launch some more beneficial practices to the MNEs. Finally, the

third priority criterion is industrial clusters, it means that many MNEs invest in Taiwan are attracted by a key industry and play as peripheral products/services providers or a member of its supply chain. Therefore, the government authorities have to put more effort to cultivate more new critical industries. As for the last three priority criteria, it reflects the facts that the political stability, infrastructure facilities, and economic environment are well performed in Taiwan from the perspective of MNEs, the government authorities have only to pay attention to maintain current performance.

The finding of this paper can also provide as the assessment baseline for the potential foreign investors who are evaluating the feasibility to invest in Taiwan. The assessment criteria may help them to raise the probability of investment success and lessen the risk of fail investment.

Even Taiwan contemporary faces the severe geopolitical tension with mainland China, yet, MNE managers still rank the Geopolitical Risk Criterion at the tenth priority, this result seems beyond the intuition and violate the discussion in section 2.5.4. The explanation of this paper is that all the interviewees come from the MNEs who have already invested in Taiwan, and may just adopt the “wait and see” strategy in the status quo. Further researchers might try to interview the potential foreign investors abroad and a different conclusion may be expected to conclude.

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