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國家智慧資本初探與智慧資本之動態分析(1/2)

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執行單位：國立政治大學企業管理學系

中 華 民 國 年 月 日

一、計畫中英文摘要

(一)計畫中文摘要

國家智慧資本初探與組織智慧資本之動探分析

本計畫為「總計劃」與「子計畫一」之合併，因此擔負著兩項任務。一為宏觀之國家智慧資本初探，二為微觀之組織智慧資本動態研究。納入宏觀研究的主要目的在於與既有的文獻進行國家間的比較研究，增加台灣在此新興學術領域的曝光度。

國家智慧資本之研究架構基本上參考加拿大管理學者智慧資本專家 Prof.Bontis 之五構面含國家人力資本、流程資本、市場資本、更新資本與財務資本，探討前四項資本對於國家財務資本(GDP)之影響。組織智慧資本動態研究植基於計畫主持人先前之相關研究，發現組織之人力資本、結構資本，與關係資本係動態性的演進，失衡的發展將導致組織智慧資本之溶蝕。本計劃第一年將以國家智慧資本初探為主軸，搭配智慧資本動態文獻之探討；第二年將進行智慧資本動態之個案研究並探討其意涵。

關鍵詞：國家智慧資本、智慧資本、動態研究

(二)計畫英文摘要

An Exploratory Study of National Intellectual Capital Index and the Dynamics of Organizational Intellectual Capital

This project is a combination of the “Main Project” and “Sub-Project Number #1” and carries two missions: explore national intellectual capital index (NICI) at a macro-level and investigate the dynamics of organizational intellectual capital at a micro-level. The motivation to include a macro perspective study is to have country comparisons, which may facilitate the exposure of Taiwanese studies in the global intellectual capital research communities.

The research framework of NICI will basically based on Prof. Bontis’ model of five dimensions, namely national human capital, process capital, market capital, renewal capital, and financial capital. The effects of the former four capitals on the national financial capital, which is represented by GDP will also be explored. The study on the dynamics of organizational intellectual capital will be based on the project leader’s preliminary finding that human capital, structural capital, and relations capital co-evolve progressively. Unbalanced development of the three capitals will result in the erosion of intellectual capital. Central focus of the first year project will mainly be placed on NICI, accompanying by the literature review of the dynamics of intellectual capital. Focus of the second year will be placed on case studies of the dynamics of organizational intellectual capital.

Keywords: National intellectual capital index, NICI, Intellectual capital, Dynamic

二、報告內容

Research Background

Although the intellectual capital concept has been extended from a micro (organizational) level to the macro (national and regional) levels, the creation of national intellectual capital models suffers from the lack of widely accepted methodologies, mainly due to the embryonic nature of this field (Pomeda, et al., 2002). In other words, more studies need to be done to refine the existing national intellectual capital models. Up to now, there has been little research focusing on the East Asian region. A study of a nation like Taiwan that relies heavily on the output of its knowledge workers should enrich this field of study and provide a different perspective.

By utilizing the OECD database, the IMD's World Competitiveness Yearbook and matching Taiwanese data, this study proposes a set of national intellectual capital indices that can be used to rank the countries in the chosen data set, thereby clarifying Taiwan's intellectual capital standing from an East Asian perspective. Key features of this study that adds value to the existing literature include the fact that it is a longitudinal study spanning the period from 1994 to 2004 and covering a total of 40 countries. Furthermore, the study focuses on an emerging economy – Taiwan and provides a set of indices for future researchers to refine.

Research Purpose

In the research, we will modify Bontis' (2004) NICI model and employ a refined data analysis to fit Taiwan's context. Hopefully, this macro perspective research will result in a country comparison study. Research questions to be answered include:

1. What is the National Intellectual Capital Index in Taiwan?
2. What are the key factors of a successful link between intellectual capital and organizational competitiveness?

Literature Review

The World Bank's Knowledge Assessment Methodology (KAM) and scorecards

The aim of the World Bank's Knowledge Assessment Methodology (KAM) is to illustrate and identify the problems and opportunities that a country encounters for policy reference and to facilitate future investment. It can also be used to benchmark "how an economy compares with

its competitors or countries it wishes to imitate” (World Bank, 2002). As a comprehensive tool for reviewing world development, KAM consists of 69 structural and qualitative variables classified into five dimensions. Four of these are considered decisive in the development of a knowledge-based economy, while the fifth tracks the overall performance of the economy. The four key factors illustrate how well an economy is using knowledge for its overall economic development; they include: the economic and institutional regime, an educated and skilled population of citizens, a dynamic information infrastructure, and an efficient innovation system.

OECD measurement models for national intellectual capital

OECD regards inputs - rather than outputs - as having the most significance when measuring national intellectual capital (Malhotra, 2003). However, by nature, measuring knowledge assets is a major challenge, according to “OECD Science, Technology, and Industry Scoreboard 2001: Towards a Knowledge-Based Economy”. A gross indicator may contain public and private spending on higher education, expenditure on R&D, and investment in software in terms of percentage of GDP investments. To put another way, the more investment a country makes in its higher education, expenditure on R&D and software, the more intellectual capital it has.

United Nations Economic Commission for Europe (ECE) Model

Another model proposed by a world development organization is the ECE Model developed by the United Nations Economic Commission for Europe (UNECE). With the objective of facilitating innovation and commercialization of knowledge assets, the model inspects the existing practices and methodologies for valuing intellectual capital. The model also examines the valuation of intellectual assets (inventions), intellectual property rights (patents), valuation of managerial flexibility, stock market valuation of companies, and R&D project valuation (United Nations Economic Commission for Europe, 2003).

The national intellectual capital measurement model proposed by this study

The present study adopts the most commonly used national intellectual capital framework, containing human capital, market capital, process capital and renewal capital. Selection of the seven variables for each capital was mainly based on the literature. Variable selection was implemented in two rounds. In the first round, the requirement was that variables must be supported by at least two studies, and must be included in the OECD databank or the IMD World Competitiveness Yearbook. “Market capital” turned out to have the fewest identified variables. To remedy the unbalanced number of variables in market capital, a focus group was formed to obtain initial feedback regarding the appropriateness of the variables selected. With input from ten Taiwanese professors who also engaged in intellectual capital related research, the authors

were able to revise the variables, finally settling on those shown in Table 3. Financial capital is also included, as it is a key factor of national wealth. Consequently, a total of 29 variables were selected; seven each for human capital, market capital, process capital, renewal capital and a single variable (GDP per capita) representing financial capital.

The first type of national capital - human capital – is defined as the competencies of individuals in realizing national goals (Bontis, 2004). According to OECD (2000), human capital consists of knowledge about facts, laws and principles in addition to knowledge relating to specialized, teamwork and communication skills. Education is the foundation of human capital. It is through education that knowledge and skills are developed. Students are taught a variety of subjects, not only to improve their labor productivity, but also to enrich their lives, make them better citizens and create additional value for the nation. However, formal education alone is not sufficient for the continuing development of human capital. Post-education training institutions, including private companies, must provide ongoing training to enable citizens to cope with a rapidly changing world. Therefore, the variables used in this study include the amount of skilled labor, the degree of employee training, the literacy rate, higher education enrollment, the pupil-teacher ratio, the number of Internet subscribers, and public expenditure on education.

The second type of national capital - market capital - is similar to social capital in a micro setting in that it represents a country's capabilities and successes in providing an attractive, competitive solution to meet the needs of its international clients, while also sharing knowledge with the rest of world through knowledge coordination and contextualization (Bontis, 2004). Therefore, one major factor that determines market capital is international trade. The flow of people, technology, and ideas between countries is the key to overall market success. The present study therefore incorporates variables concerning investment and achievements in foreign relations, coupled with exports of quality products and services. In this study, we focus primarily on whether corporate tax policy facilitates trade, cross border venture, openness to foreign cultures, the degree of globalization, transparency of economic information, the image that the country projects abroad, and exports and imports of commercial services.

The third type of national capital – process capital – comprises the non-human powerhouses of knowledge in a nation, embedded in a country's infrastructure, which facilitate the creation, accessibility and dissemination of current data, information and knowledge. The overall environment, government, capital and information technology appear to be the decisive factors here. Apart from these factors, countries with inadequate resources in terms of computers, Internet access and telecommunications are at risk of falling even further behind their competitors in the world market (Bontis, 2004). Therefore, the business competition environment, government efficiency, intellectual property rights protection, capital availability, the number of computers per capita, the convenience of establishing new firms, and the number of mobile phone subscribers are included in this category of capital.

The fourth type of national capital - renewal capital – is defined as a nation’s future intellectual wealth, which sustains a nation’s competitive advantage. Research and development (R&D) and patents are two key parameters in renewal capital. Their significance derives from the direct relationship between the success of a country’s financial systems and the effectiveness of its R&D sector (Bontis, 2004). Foreign patent applications represent the acknowledgement and renewing of ideas and innovation within industries throughout a country. Therefore, we selected business R&D spending, degree of basic research to enhance long-term economic development, R&D spending as a percentage of GDP, the number of R&D researchers, the level of cooperation between universities and enterprises, scientific articles, and USPTO & EPO per capita for inclusion in this capital type.

The fifth type of national capital – financial capital – is represented by a single indicator: the logarithm of GDP per capita adjusted by purchasing power parity. This is the most common metric denoting the financial wealth of a nation.

Method

In this section, we describe the data collection and data analysis methods. Using the variables listed in Table 1, we collected data from several sources including the OECD database, the World Competitiveness Yearbook published by the IMD, and the Taiwan Economic Statistical databank provided by the Taiwan Economic Data Center for matching Taiwanese data. A comprehensive list of 47 countries was compiled from these data sources. Due to the large number of missing values, the datasets for Columbia, Hong Kong, Indonesia, Israel, Luxembourg, Slovenia and Venezuela were excluded. The data analyzed in this study therefore covers 40 countries for a period of 11 years extending from 1994 to 2004.

Table 1 Variables included in each type of capital proposed by this study

Human Capital index	Market capital index
<ol style="list-style-type: none"> 1. Skilled labor* 2. Employee training* 3. Literacy rate 4. Higher education enrollment 5. Pupil-teacher ratio 6. Internet subscribers 7. Public expenditure on education 	<ol style="list-style-type: none"> 1. Corporate Tax* 2. Cross border venture* 3. Openness to foreign culture* 4. Globalization* 5. Transparency* 6. Image of your country* 7. Exports & imports of services
Process capital index	Renewal capital index
<ol style="list-style-type: none"> 1. Business competition environment* 2. Government efficiency* 3. Intellectual property right 	<ol style="list-style-type: none"> 1. Business R&D spending 2. Basic Research* 3. R&D spending/GDP

protection*	
4. Capital availability*	4. R&D researchers*
5. Computers in use per capita	5. Cooperation between universities and enterprises*
6. Convenience of establishing new firms*	6. Scientific articles*
7. Mobile phone subscribers	7. Patents per capita (USPTO + EPO)

Remark:

- **Financial capital** is the logarithm of GDP per capita adjusted by purchasing power parity.
- Those variables marked with an asterisk are the ones rated using a scale of “1-10”.

In this study, there are two different data types, one with an absolute number such as “patents per capita”; the other with a qualitative rating on a scale of “1-10”, such as “image of your country”. Although subjective, rating on the degree or magnitude of certain variables is unavoidable as we are evaluating intangible assets, and intangibles cannot be fully represented by merely adding up certain quantitative variables. For a meaningful integration of the quantitative score and qualitative rating in each capital, we calculated the ratio of the absolute value relative to the highest value of each quantitative variable and multiplied it by 10 to transform the number into a 1-10 scale. The data transformation procedures have been repeated for all number indicators of human capital, market capital, process capital, and renewal capital. For financial capital, we use the logarithm of GDP per capita adjusted by the purchasing power parity of each country, calculated its ratio to the highest value and then transformed it into a “1-10” scale. Finally, we totaled the scores of the five capitals to come up with the Overall Index in table 2.

Result

Based on the data analysis described in the last section, Table 4 displays the score and ranking of the five types of national capital investigated. The overall index is particularly revealing because it provides valuable information for policy makers to reflect on. As mentioned earlier in this paper, one of the purposes of this study is to provide another version of the national intellectual capital model for future researchers to replicate and refine. We have tried to identify variables that are well represented based on the literature review, while at the same time balancing the number of variables for the four capital types (7 variables each, excluding financial capital) and balancing the number of quantitative and qualitative variables (13 vs. 16).

With 11 years of data spanning the period from 1994 to 2004, the overall results agree with the general perception that the Nordic countries have the highest degree of national intellectual capital. The top ten countries in the list are, in order, Finland, Sweden, Denmark, Iceland, the USA, Switzerland, Singapore, the Netherlands, Canada, and Norway. Of these, five are Nordic countries, two are in other parts of Europe, two are in North America, and one is in Asia. Taiwan

is number twentieth in the list.

Among the top five countries, Finland is number two in process capital, number one in renewal capital and number four in market capital; Sweden is number two in terms of human capital and renewal capital; Denmark is number one in human capital and number three in process capital; Iceland is number three in human capital and number four in process capital; the USA is number four in renewal capital. These countries consistently and stably accumulated national intangible assets over the 11 years covered by the study.

As for the countries ranked number six to ten for the overall index, Switzerland is number three in renewal capital and number two in financial capital, Singapore ranked number one in both market capital and process capital, the Netherlands ranked number three in market capital, Canada ranked number four in human capital, and Norway is number one in financial capital and number five in human capital.

The bottom five countries in the list are India, Argentina, Mexico, Brazil, and Turkey. Two of the BRIC (Brazil, Russia, India, and China) nations, which are currently showing so much promise, are among the bottom five, probably because the rankings is based on historical data covering an 11-year period, and not the last few years; in addition, the population of these countries is relatively large, which may lead to their efforts in certain areas being stretched too thin. Mexico performed relatively well in terms of financial capital (ranked 28), while Brazil had relatively high ranking for market capital (ranked 29).

Table 2 Composite Score and Ranking for the Different Types of National Capital Index for 40 Countries from 1994 to 2004

	Human capital index		Market capital index		Process capital index		Renewal capital index		Financial capital index		Overall Index	
Mean	6.39		5.91		5.15		3.72		8.74		29.91	
SD	1.30		0.90		1.41		2.10		1.10		6.05	
Country	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking
Argentina	5.00	33	4.76	37	2.24	40	1.42	36	7.57	35	20.99	39
Australia	7.28	11	6.47	14	6.91	5	4.32	17	9.47	17	34.44	11
Austria	6.95	14	6.53	10	6.31	10	4.38	15	9.62	9	33.79	13
Belgium	7.42	9	6.04	19	5.32	20	5.20	9	9.56	13	33.53	14
Brazil	4.64	35	5.28	29	2.95	37	1.60	34	7.44	36	21.90	37
Canada	8.14	4	6.67	9	6.21	11	5.07	10	9.49	16	35.57	9
Chile	5.37	31	6.77	7	4.96	25	1.62	33	7.96	30	26.69	28
China	4.16	38	5.58	26	4.18	31	1.94	29	6.55	38	22.41	35
Czech Republic	5.68	28	5.68	25	4.70	27	2.35	26	8.49	26	26.91	26
Denmark	8.64	1	6.82	5	7.04	3	6.35	6	9.82	4	38.66	3

Finland	7.89	6	6.92	4	7.11	2	8.31	1	9.61	12	39.84	1
France	6.84	17	5.18	30	5.65	17	4.89	12	9.56	14	32.11	18
Germany	6.48	23	5.84	23	5.29	21	6.04	8	9.53	15	33.18	16
Greece	5.78	27	5.28	28	4.52	28	2.14	27	9.00	22	26.72	27
Hungary	6.60	22	6.14	17	5.16	22	2.50	24	8.43	27	28.83	23
Iceland	8.36	3	6.80	6	6.94	4	6.16	7	9.76	5	38.01	4
India	3.90	39	4.86	35	3.46	33	1.35	38	5.83	40	19.40	40
Ireland	6.60	21	7.37	2	6.13	12	3.88	20	9.82	3	33.81	12
Italy	6.10	26	4.92	34	4.42	30	2.63	22	9.43	18	27.50	25
Japan	7.32	10	4.69	38	5.11	24	6.72	5	9.63	8	33.47	15
Korea	6.73	18	4.85	36	5.12	23	3.99	18	8.76	24	29.45	22
Malaysia	6.17	25	6.47	13	5.39	19	1.85	30	7.73	31	27.62	24
Mexico	4.62	37	5.14	31	2.63	39	1.11	40	8.04	28	21.54	38
Netherlands	7.17	12	7.24	3	6.59	8	5.01	11	9.61	10	35.61	8
New Zealand	6.88	16	6.69	8	5.50	18	3.68	21	9.18	21	31.94	19
Norway	8.12	5	6.23	16	6.32	9	4.46	14	10.00	1	35.14	10
Poland	5.07	32	5.34	27	2.98	36	1.38	28	8.01	29	22.77	33
Portugal	5.64	29	4.32	39	3.40	34	1.73	37	8.86	23	23.95	30
Philippines	6.65	20	5.71	24	4.89	26	2.02	32	6.36	39	25.63	29
Russia	5.50	30	4.15	40	2.67	38	2.48	25	7.62	34	22.41	34
Singapore	6.97	13	8.21	1	7.16	1	4.72	13	9.29	19	36.36	7
South Africa	3.85	40	4.98	33	4.50	29	1.76	31	7.73	32	22.81	32
Spain	6.23	24	5.96	21	5.73	16	2.57	23	9.21	20	29.69	21
Sweden	8.36	2	6.49	11	6.81	6	7.78	2	9.67	7	39.12	2
Switzerland	7.59	8	6.46	15	6.04	13	7.42	3	9.89	2	37.39	6
Taiwan	6.94	15	6.13	18	6.00	14	3.92	19	8.72	25	31.70	20
Thailand	4.96	34	5.88	22	3.93	32	1.16	39	7.18	37	23.11	31
Turkey	4.64	36	5.11	32	3.11	35	1.43	35	7.65	33	21.93	36
UK	6.65	19	5.97	20	5.99	15	4.38	16	9.61	11	32.60	17
USA	7.79	7	6.48	12	6.81	7	7.12	4	9.70	6	37.91	5

Conclusion

Assessing the intellectual capital of a nation reveals the hidden values of individuals, companies, institutions, and communities that constitute current and potential sources for wealth creation. The expectation is that finding a reliable measurement of knowledge assets will help governments to achieve more effective management of the intangible resources that increasingly determine the success of their economies (Bontis, 2004). Although assessing a nation's

intellectual capital is a daunting task, the steady stream of research results that have been published in the last few years has made managers and policy makers begin to pay more attention to the increasing importance of intangible assets issues. The present study provides a platform that a country can use to examine its strengths and weaknesses and identify the areas on which it should be focusing as it strives for excellence.

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三、計劃結果自評

本研究旨在探討構成國家智慧資本之四大資本：國家人力資本、流程資本、市場資本、更新資本對國家財務資本之影響，透過四大資本衡量國家智慧資本，並據以衡量與比較各國智慧資本存量之多寡。研究內容即以四大資本為基礎，探討構成四大資本之主要變數，並透過主要變數以達成衡量四大資本之目標，藉由四大資本之建構，比較各主要國家之智慧資本存量，且深入探討智慧資本存量領先之國家其各資本之存量狀況。故研究內容符合原計畫之構想與目的，並已達成原計畫之預期目標，即透過四大資本衡量以比較各國智慧資本存量。

綜觀本研究之學術與應用價值，及國際期刊之發表潛力，由於本研究之領域屬於新興領域，對於國家智慧資本之研究仍屬於未全然開發的部分，本研究透過初步的探討與分析，藉由四大資本之概念，嘗試發展出適合台灣地區的國家智慧資本衡量方法，此舉除有助於台灣地區智慧資本領域之曝光度增加外，並有助於政策制定者，成為未來制定政策之方針，故不論於學術或應用價值，皆不可忽視；除此之外，本研究結果已發表於政治大學所舉辦 2006 International Intellectual Capital Conference，並以投稿至國際學術期刊 World Development 為目標，著手進行修改及其他投稿相關作業。