National intellectual capital: exploring Taiwan's standing

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Abstract: This study proposes a set of National Intellectual Capital Indices (NICI) that can be used to rank the countries in the chosen data set, thereby clarifying Taiwan's intellectual capital standing. The 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.

The top ten countries in the rankings obtained for the present study include Finland, Sweden, Denmark, Iceland, the USA, Switzerland, Singapore, the Netherlands, Canada and Norway. Taiwan is 20th in the list. The major contributions made by the present study include the proposal of a simple and effective national intellectual capital framework that can be easily replicated every year and the research findings will provide valuable information for stakeholders and policy-makers, thereby helping them to formulate effective strategies for the building of national competitiveness.

Keywords: intellectual capital; national level; National Intellectual Capital Indices; NICI; Taiwan.

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1 Introduction

Over the past few decades, intangibles have become a major concern not only for academics, but also for practitioners and policy-makers. An examination of the situation today and in the past shows that intangibles have become fundamental sources of wealth and progress and represent a major concern for business firms, their stakeholders and policy-makers (Garcia-Ayuso, 2003).

Drucker (1993) highlighted the emergence of a society that is dominated by knowledge resources and a competitive landscape of intellectual capital allocation (Bontis, 2004). Intellectual capital is defined as the "intellectual material – knowledge, information, intellectual property, experience – that can be put to use to create wealth" (Stewart, 1997). Since knowledge has turned out to be the key source of wealth at an organisational as well as a national level, the countries with knowledge-intensive activities will be the

winners in terms of future wealth creation (Bounfour and Edvinsson, 2004).

The rankings presented in the International Institute for Management Development's (IMD's) World Competitiveness Yearbook attract considerable attention from governments and policy-makers throughout the world. They are eager to compare their performance with that of their country's main competitors and neighbours and to identify the areas in which their country is deficient, thereby facilitating the formulation of strategies to sustain and enhance their competitiveness. The Organization for Economic Cooperation and Development (OECD) also estimates and reports the potential future wealth of its member countries. A number of intellectual capital assessments have also taken place at the national level with the support of the World Bank (e.g., Sweden, Denmark, the Nordic Project and Israel), as well as at the regional level (e.g., the United Nations initiative for benchmarking the Arab nations and a similar initiative for the Pacific Islands) (Bounfour, 2003).

Although the intellectual capital concept has been extended from the micro (organisational) 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 utilising the OECD database and the IMD's World Competitiveness Yearbook and matching the Taiwanese data, this study proposes a set of National Intellectual Capital Indices (NICI) 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. The key features of this study that add 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.

2 Literature review

National knowledge assets or intellectual capital can be regarded as the 'hidden' assets that underpin and fuel a country's growth. There is an increasingly widespread recognition that knowledge management is the key driver of innovation and learning, national wealth and a country's Gross Domestic Product (GDP) (Malhotra, 2000). In this section, we begin by describing the background of the research and the obstacles that hinder the measurement of national intellectual capital, summarising afterwards the models that are currently in use and then presenting the model proposed in the study.

2.1 The measurement of national intellectual capital: the background and obstacles

During the past decade, knowledge assets and intellectual capital have been attracting an increasing amount of attention, not only from academics and company CEOs, but also from national policy-makers. As they are important to private enterprise organisations, they should also be important to the productivity and competitiveness of the public sector. A World Bank report (1998) pointed out that the adoption of policies to increase a nation's intellectual wealth can improve people's lives in a myriad of ways, besides giving them higher incomes. Since national knowledge assets are the 'intangible' assets of a country that have significant implications for future national value, they represent the fount of a nation's competences and capabilities that are deemed essential for economic growth, human development and the quality of life (Malhotra, 2003). As a result, the countries that are rich in these intangible assets fare better in terms of national wealth than those whose assets are limited to land, tools and labour (Malhotra, 2003; World Bank, 1998).

Consequently, the managers of business enterprises and government officials who are responsible for promoting national economic development are trying to find reliable ways to measure knowledge assets and to gain a clearer understanding of how these relate to future performance (Malhotra, 2000). From a micro perspective, the traditional balance sheet provides the concept of historic costs, which assume that

the cost reflects the actual value of the asset. However, it does not account for the hidden value inherent in intangible assets. Although some agreement has been reached regarding the measurement of a few categories of intangible assets such as patents and trademarks, the measurement systems are still limited in their ability to account for tacit knowledge assets (Malhotra, 2000).

From a macro perspective, the measurement of intangibles assists nations in analysing and benchmarking their competences and capabilities. Such assessments can facilitate the adoption of good policies and practices for holistic national development (Malhotra, 2003). Since most national intellectual capital measurements analyse the existing data at the input and output levels (Bounfour, 2003), one difficulty that has been reported in the literature is the problem of trying to undertake a systematic collection of data without a comprehensive reference framework (Pomeda et al., 2002). In addition, comparison among countries is based on the different quality criteria and contents of different regional-national statistical systems, which may result in inconsistencies in comparison and analysis (Klein, 2000). These problems hinder the translation of the models from the business management area to the regional or national scope.

2.2 The current national intellectual capital measurement models

Recognising the importance of intangible assets, a number of national governments have launched national knowledge initiatives to develop measurement models. Malhotra (2003) reported that four accounting firms were invited to conduct a practice-oriented study of the Netherlands' intangible assets and provide a preliminary appendix, the Danish Agency for Trade and Industry sponsored the development of comprehensive intellectual capital indicators based on the experiences of several Nordic and Danish companies and the Norwegian government sponsored the development of a competence capital model including intellectual capital. All of these endeavours attempt to leverage the private sector's experience in this area in order to increase the wealth of a nation. However, the level of complexity involved makes it impossible to simply transplant micro models to the national level to measure national intellectual capital. Some changes need to be made.

In addition to national governments, several world development organisations, such as the World Bank, the OECD and various United Nations agencies, have proposed a variety of knowledge asset measurement models as well. These models were originally developed for industrial and agricultural economies and focus on tangible assets and structural capital. Nevertheless, some of these models also assessed national growth in terms of investment (using a scale of 1–10, rather than precise quantitative data), describing input and process-related measures and allowing the assessment, comparison and benchmarking of individual national economies (OECD, 2001; UNDP, 2000; World Bank, 2001). To provide an overview of the strengths and limitations of the existing measurement models (with the aim of developing a more effective and reliable model) we summarise several of the national intellectual capital models below.

2.3 The main models used to measure and manage the intellectual capital of nations

There have been some initiatives to measure national intellectual capital. Rembe (1999) examined the components of national attraction from the viewpoint of foreign investments in Sweden and proposed a strategic plan for the future development of Sweden's human capital, market capital, process capital and renewal capital. Following Rembe, several researchers carried out similar initiatives to assess the intellectual capital of Israel (Pasher, 1999), the Arab region (Bontis, 2004) and Sweden (Spring Project, 2002). These researchers confirmed the main focus in this field of study. Table 1 summarises the dimensions and main indicators/indices of these studies.

2.4 The measurements proposed by regional or world development organisations

2.4.1 The World Bank's knowledge assessment methodology 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 that are 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 uses knowledge for its overall economic development and include:

1 the economic and institutional regime

2 an educated and skilled population of citizens

3 a dynamic information infrastructure

4 an efficient innovation system.

Approximately 14 out of the 69 structural and qualitative variables were compiled using the 'standard' scorecards. They are expected to capture the essence of a country's preparedness for developing a knowledge-based economy. Table 2 presents the 14 'critical' variables of the standard scorecards.

Table 1 The dimensions and nature of the indicators for measuring national intellectual capital

Country/Researcher	*General basic model*	*Dimensions*	*Nature of indicators*
Sweden	Skandia Navigator	Human capital	Financial indicators
(Rembe, 1999)		Market capital	Descriptive indicators
		Process capital	
		Renewal capital	
Israel	Skandia Navigator	Human capital	Financial indicators
(Pasher, 1999)		Market capital	
		Process capital	
		Renewal and development capital	
Malaysia	Skandia Navigator	Financial wealth	Descriptive indicators
(Bontis *et al.*, 2000)		Human capital	Intangible indicators
		Market capital	Financial indicators
		Process capital	
		Renewal capital	
Sweden	Skandia Navigator	Business recipe	Innovation indicators
(Spring Project, 2002)		Human capital	Competence indicators
		Structural capital	
		Relational capital	Industrial indicators
			Company-university indicators
Madrid, Spain	Skandia Navigator	Human capital	Descriptive indicators
(Pomeda *et al.*, 2002)		Technological capital	Intangible indicators
		Social capital	Innovation indicators
Arab region	Skandia Navigator	Financial wealth	Descriptive indicators
(Bontis, 2004)		Human capital	Intangible indicators
		Market capital	Financial indicators
		Process capital	
		Renewal capital	
EU	IC-dVAL Approach	Resources	Financial indicators
(Bounfour, 2003)		Processes	Descriptive indicators
		Outputs	Innovation indicators

Source: Revised from Pomeda *et al.* (2002)

Table 2 The variables of the 'standard' scorecards

Economic and institutional regime	*Education and skilled human resources*
Tariff and nontariff barriers	Adult literacy rate
Property rights	Secondary enrolment
Regulation	Tertiary enrolment
Dynamic information infrastructure	*Efficient innovation system*
Telephones per 1000 persons	Researchers in R&D
Computers per 1000 persons	Manufacturing trade as percentage of GDP
Internet hosts per 1000 persons	Scientific and technical journal articles per million people
Performance indicators	
Average annual GDP growth	
Human development index	

Source: World Bank (2002)

2.4.2 The OECD measurement models for national intellectual capital

The 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 the public and private spending on higher education, expenditure on Research and Development (R&D) and investment in software in terms of the percentage of GDP investments. Put in another way, the more investment a country makes in its higher education, expenditure on R&D and software, the more intellectual capital it has.

As the value of the measurements based on the investments in input resources has been called into question at the firm level because of their apparent constraints, national-level researchers have started to shift their attention away from the amount of financial investment or financial input and towards the way that people manage and utilise these inputs (Collins, 2001; Malhotra, 2003; Carr, 2003).

2.4.3 The United Nations economic commission for Europe model

Another model proposed by a world development organisation is the Economic Commission for Europe (ECE) model, developed by the United Nations Economic Commission for Europe (UNECE). With the objective of facilitating the innovation and commercialisation 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), the valuation of managerial flexibility, the stock market valuation of companies and R&D project valuation (United Nations Economic Commission for Europe, 2003).

This model provides a holistic view of the sustainable innovation process, focusing in particular on the valuation of intellectual property rights. Since innovation is closely linked to human resources, governments have gradually begun to provide more support for human resources development and the ongoing adaptation of institutional, information and innovation systems, realising that the innovation and technological capabilities of a country are correlated with long-term growth and social progress.

2.5 The national intellectual capital measurement model proposed in this study

The intellectual capital of a nation requires the articulation of a system of variables that helps to uncover and manage the invisible wealth of a country. In the past, researchers from different backgrounds proposed different models or concepts to evaluate national intellectual capital. However, due to the embryonic nature of this field of study, a consensus has yet to emerge regarding the exact nature of the set of determinants

that should be employed. Building on the past research in this field, this study proposes a model of measurement and then tests this model by using the widely accepted OECD and IMD databases, which contain both the quantitative and qualitative indicators. Although national wealth can be assessed from different perspectives, including health, poverty and gender empowerment (Bontis, 2004), the main focus of this paper is on the ranking of national intellectual capital in order to clarify the standing of Taiwan.

The present study adopts the most commonly used national intellectual capital framework that contains human capital, market capital, process capital and renewal capital (Table 1). The selection of the seven variables for each capital (as displayed in Table 3) was mainly based on the literature (please refer to the Appendix for the source of these variables). The variable selection was implemented in two rounds. In the first round, the requirement was that the variables must be supported by at least two studies and must be included in the OECD database 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 selected variables. With input from ten Taiwanese professors who have 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 and 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 realising national goals (Bontis, 2004). According to the OECD (2000), human capital consists of knowledge about facts, laws and principles, in addition to knowledge relating to specialised, 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 labour 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 labour, the degree of employee training, the literacy rate, a higher education enrolment, the pupil-teacher ratio, the number of internet subscribers and the public expenditure on education.

Table 3 The variables included in each type of capital proposed in this study

Human capital index	*Market capital index*
Skilled labour*	Corporate tax*
Employee training*	Cross-border venture*
Literacy rate	Openness to foreign culture*
Higher education enrollment	Globalisation*
Pupil-teacher ratio	Transparency*
Internet subscribers	Image of your country*
Public expenditure on education	Exports and imports of services
Process capital index	*Renewal capital index*
Business competition environment*	Business R&D spending
Government efficiency*	Basic research*
Intellectual property rights protection*	R&D spending/GDP
Capital availability*	R&D researchers*
Computers in use per capita	Cooperation between universities and enterprises*
Convenience of establishing new firms*	Scientific articles*
Mobile phone subscribers	Patents per capita (USPTO + EPO)

Notes: Remark: *Financial capital* is the logarithm of GDP per capita adjusted by purchasing power parity.

Those variables marked with an asterisk (*) are those rated using a scale of '1–10'.

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 contextualisation (Bontis, 2004). Therefore, one major factor that determines market capital is international trade. The flow of people, technologies and ideas between countries is the key to overall market success. The present study, therefore, incorporates the variables concerning investments and achievements in foreign relations, coupled with the exports of quality products and services. In this study, we focus primarily on whether corporate tax policy facilitates trade, cross-border ventures, openness to foreign cultures, the degree of globalisation, the transparency of economic information, the image that the country projects abroad and the exports and imports of commercial services.

The third type of national capital – process capital – comprises the nonhuman powerhouses of knowledge in a nation that are embedded in a country's infrastructure and 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, the 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 that will sustain a nation's competitive advantage. R&D and patents are the two key parameters in renewal capital. Their significance derives from the direct relationship between the success of a country's financial system and the effectiveness of its R&D sector (Bontis, 2004). Foreign patent applications represent the acknowledgement and renewal of ideas and innovation within industries throughout a country. Therefore, we selected business R&D spending, the 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 United States Patent and Trademark Office (USPTO) and European Patent Office (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.

3 Methods

In this section, we describe the data collection and data analysis methods. Using the variables listed in Table 3, 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 Centre, to match the 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 Colombia, Hong Kong, Indonesia, Israel, Luxembourg, Slovenia and Venezuela were excluded. The data analysed in this study, therefore, covers 40 countries for a period of 11 years, extending from 1994 to 2004.

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 the 'image of your country'. Although subjective, rating the degree or magnitude of certain variables is unavoidable, as we are evaluating intangible assets and the 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 type of 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 used 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 types of capital to come up with the overall index, as shown in Table 4.

4 Results

Based on the data analysis described in the last section, Table 4 displays the scores and rankings of the five types of national capital that were investigated. The overall index is particularly revealing, because it provides valuable information for policy-makers to reflect on. As mentioned earlier, 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 the 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 (seven variables each, excluding financial capital) and balancing the number of quantitative and qualitative variables (13 versus 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 countries, five are Nordic countries, two are in other parts of Europe, two are in North America and one is in Asia. Taiwan is 20th in the list.

Among the top five countries, Finland is second in process capital, first in renewal capital and fourth in market capital. Sweden is second in terms of human capital and renewal capital. Denmark is first in human capital and third in process capital. Iceland is third in human capital and fourth in process capital. The USA is fourth 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 sixth to tenth in the overall index, Switzerland is third in renewal capital and second in financial capital, Singapore is first in both market capital and process capital, the Netherlands is third in market capital, Canada is fourth in human capital and Norway is first in financial capital and fifth in human capital.

The bottom five countries in the list are India, Argentina, Mexico, Brazil and Turkey. Two of the Brazil, Russia, India and China (BRIC) nations, which are currently showing so much promise, are among the bottom five probably because the rankings are based on historical data covering an 11-year period and not on the last few years. In addition, the populations of these countries are 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 28th), while Brazil had a relatively high ranking for market capital (ranked 29th).

5 Taiwan's standing

Taiwan is 20th in the overall index ranking. It is comparatively weak in market capital (ranked 18th) and financial capital (ranked 25th), however, it ranked 15th, 14th and 14th for human capital, process capital and renewal capital, respectively.

Figures 1–4 shows some figures and trends that warrant further discussion. Based on a scale of 1–10, the top four mean scores include those of the literacy rate (9.439), openness to foreign cultures (8.002), the convenience of establishing new firms (7.556) and cross-border ventures (6.842). The four lowest mean scores include those of business R&D expenditures (1.947), the exports and imports of commercial services (2.764), computers in use per capita (4.100) and government efficiency (4.494). The positive trends from 1994 to 2004 include an improvement in higher education enrolment (from 3.434 to 7.961), public expenditure on education (from 4.874 to 6.937), globalisation (from 4.95 to 8.10), mobile phone subscribers (from 2.753 to 10.0) and patents per capita (from 3.202 to 6.915). The negative trends include basic research (from 5.858 to 4.589) and government efficiency (from 6.75 to 4.51).

Table 4 The composite scores and rankings for the different types of national capital index for 40 countries from 1994 to 2004 (see online version for colours)

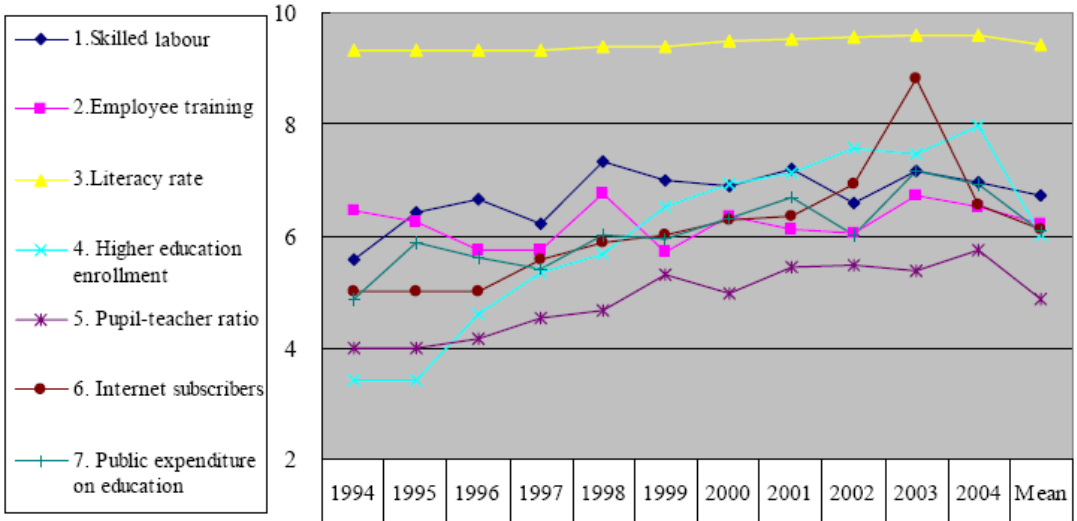
	Human capital index		*Market capital index*		*Process capital index*		*Renewal capital index*		*Financial capital index*		*Overall index*	
Mean	*6.39*		*5.91*		*5.15*		*3.72*		*8.74*		*29.91*	
SD	*1.30*		*0.90*		*1.41*		*2.10*		*1.10*		*6.05*	
Country	*Score*	*Ranking*	*Score*	*Ranking*	*Score*	*Ranking*	*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

Table 4 The composite scores and rankings for the different types of national capital index for 40 countries from 1994 to 2004 (see online version for colours) (continued)

	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*
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
The 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

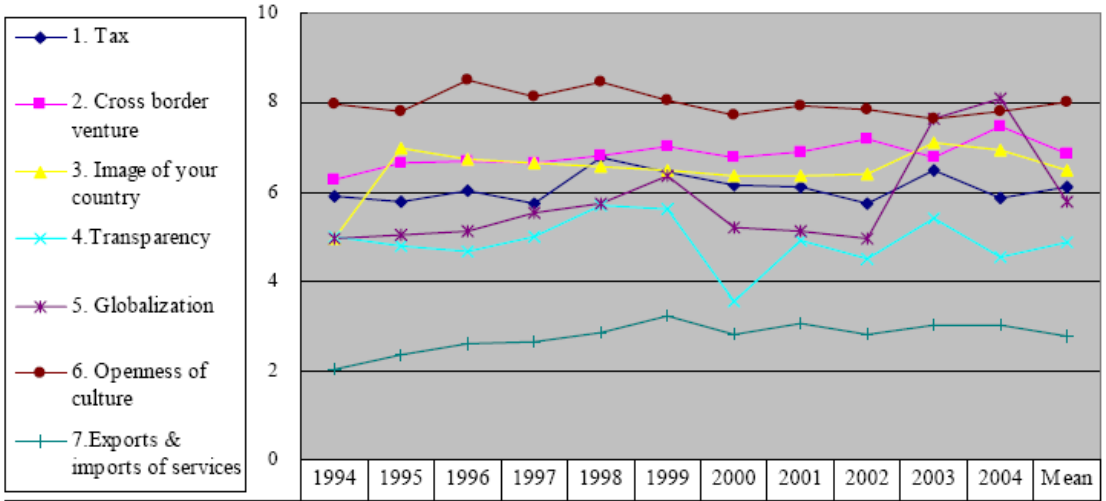
The statistics presented above carry some important messages for policy-makers to contemplate on. For the past 11 years, Taiwan has been working to enhance the quality of its human resources, which may have led to improvements in terms of patents per capita, openness to foreign cultures, globalisation and high-technology development represented by the prevalence of mobile phones. On the other hand, the national market capital is still comparatively weak, ranked 18th among the 40 countries. It appears that there is an urgent need for Taiwan to improve the government efficiency that facilitates the exports and imports of commercial services. The limited size of Taiwan's domestic market makes the exportation of high-value products or services to world markets especially important. The top five countries in terms of market capital are Singapore, Ireland, the Netherlands, Finland and Denmark. These countries have a similar natural environment in terms of having a small territory and limited natural resources, but possess high-quality human resources. In particular, Taiwan should focus on learning from Singapore as it is also in Asia, has a very small territory that is only 1/61 the size of Taiwan (585 sq. km. compared to 35.961 sq. km.) and a majority of its population are ethnic Chinese. Singapore's overall ranking of seventh points out the competitiveness of this very small country. From the statistics, Singapore can readily be seen as strong in globalisation, government efficiency and capital availability. These intangible assets have important implications for small countries to capitalise on limited resources.

Figure 1 The numbers and trends of Taiwan's human capital (see online version for colours)



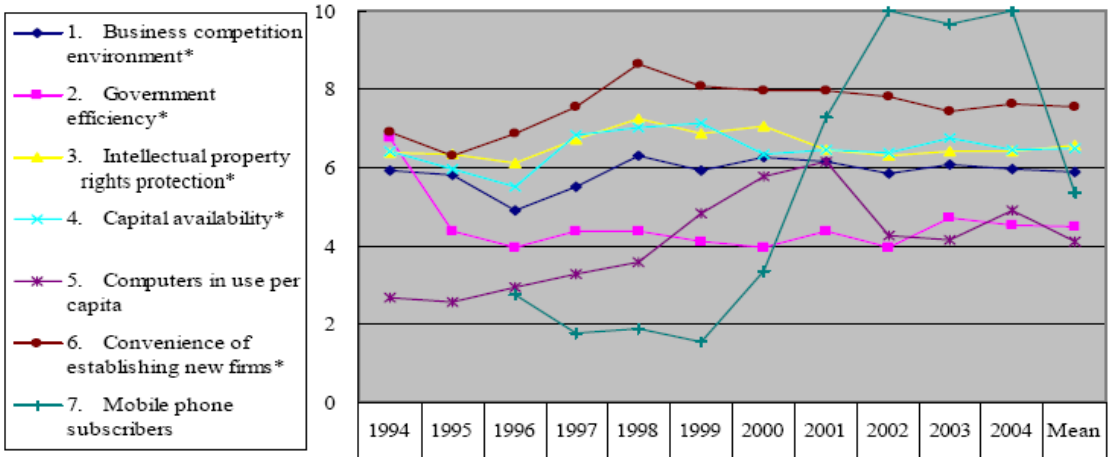
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Mean
1.Skilled labour	5.590	6.410	6.670	6.210	7.333	7.000	6.883	7.210	6.580	7.170	6.950	6.728
2.Employee training	6.470	6.250	5.750	5.741	6.760	5.729	6.350	6.110	6.056	6.740	6.510	6.224
3.Literacy rate	9.310	9.320	9.320	9.320	9.400	9.400	9.490	9.530	9.560	9.580	9.600	9.439
4. Higher education enrollment	3.434	3.434	4.587	5.329	5.689	6.532	6.914	7.128	7.560	7.479	7.961	6.004
5. Pupil-teacher ratio	4.000	4.000	4.167	4.545	4.651	5.314	4.975	5.436	5.474	5.376	5.761	4.882
6. Internet subscribers	5.011	5.021	5.021	5.565	5.865	6.023	6.271	6.343	6.939	8.812	6.552	6.129
7. Public expenditure on education	4.874	5.883	5.598	5.423	6.012	5.957	6.324	6.688	6.024	7.180	6.937	6.082

Figure 2 The numbers and trends of Taiwan's market capital (see online version for colours)



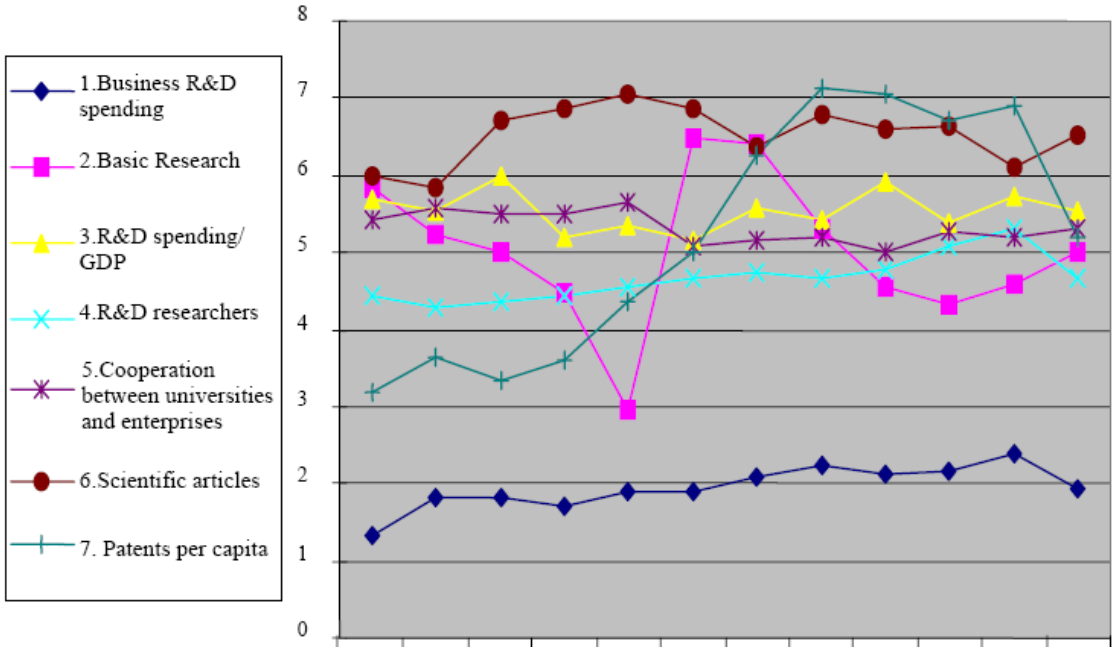
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Mean
1. Tax	5.920	5.790	6.050	5.760	6.760	6.433	6.177	6.130	5.750	6.490	5.850	6.101
2. Cross-border ventures	6.280	6.670	6.700	6.640	6.830	7.033	6.785	6.920	7.171	6.770	7.460	6.842
3. Image of your country	4.94	6.99	6.75	6.64	6.56	6.47	6.354	6.37	6.42	7.1	6.93	6.502
4.Transparency	5.020	4.780	4.650	4.990	5.710	5.627	3.570	4.920	4.510	5.420	4.540	4.885
5. Globalisation	4.950	5.030	5.120	5.540	5.750	6.367	5.190	5.110	4.944	7.660	8.100	5.796
6. Openness of culture	7.97	7.83	8.5	8.12	8.49	8.067	7.747	7.95	7.861	7.66	7.83	8.002
7.Exports & imports of services	2.028	2.352	2.584	2.648	2.844	3.242	2.812	3.052	2.811	3.017	3.010	2.764

Figure 3 The numbers and trends of Taiwan's process capital (see online version for colours)



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Mean
1. Business competition environment*	5.940	5.830	4.920	5.510	6.320	5.933	6.278	6.160	5.855	6.070	5.950	5.888
2. Government efficiency*	6.750	4.360	3.950	4.380	4.360	4.130	3.949	4.370	3.972	4.700	4.510	4.494
3. Intellectual property rights protection*	6.380	6.330	6.100	6.706	7.258	6.867	7.038	6.470	6.310	6.430	6.400	6.572
4. Capital availability*	6.410	5.970	5.500	6.820	7.020	7.133	6.354	6.470	6.360	6.760	6.440	6.476
5. Computers in use per capita	2.665	2.556	2.953	3.267	3.567	4.826	5.788	6.166	4.249	4.146	4.915	4.100
6. Convenience of establishing new firms*	6.92	6.32	6.85	7.54	8.64	8.067	7.949	7.970	7.803	7.450	7.610	7.556
7. Mobile phone subscribers			2.753	1.761	1.895	1.550	3.374	7.279	9.985	9.679	10.000	5.364

Figure 4 The numbers and trends of Taiwan's renewal capital (see online version for colours)



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	mean
1.Business R&D spending	1.327	1.809	1.803	1.688	1.907	1.881	2.100	2.231	2.128	2.152	2.389	1.947
2.Basic research	5.856	5.232	5.015	4.493	2.955	6.486	6.391	5.319	4.543	4.332	4.589	5.019
3.R&D spending/GDP	5.705	5.538	5.993	5.184	5.348	5.141	5.582	5.407	5.910	5.389	5.738	5.540
4.R&D researchers	4.430	4.295	4.375	4.432	4.565	4.662	4.721	4.673	4.767	5.066	5.290	4.661
5.Cooperation between universities and enterprises	5.430	5.580	5.490	5.503	5.650	5.080	5.150	5.200	5.022	5.267	5.180	5.323
6.Scientific articles	5.982	5.840	6.7	6.867	7.04	6.867	6.380	6.792	6.603	6.618	6.112	6.528
7. Patents per capita	3.202	3.623	3.346	3.585	4.346	4.995	6.269	7.142	7.038	6.695	6.915	5.196

6 Limitations and future research

The limitations of this research include the following:

- The country comparison is limited by the availability of published data, which has always posed a problem in studies of national-level intellectual capital.
- A forced combination of quantitative and qualitative scores on a scale of 1–10 may attenuate the variance.
- The historical data can only describe the past national intellectual capital, rather than the current status.
- The value of the results relies heavily on the quality of the raw data in the OECD database and World

Competitiveness Report, particularly for the qualitative rating.

The suggestions for future research include the following:

- The measurement models of human capital, market capital, process capital and renewal capital can be tested to validate the indicators of macro-level national intellectual capital
- The variables in each type of capital can be weighted according to experts' perceptions of their importance, as some of them may have different degrees of importance.
- The data can be grouped into two or three time periods, such as the first five years and the second five years, which can then be compared to identify any important similarities and differences.
- The study can be replicated every year; this would be particularly valuable in terms of making it possible to examine the status and trends of the four BRIC countries, which are now considered to have such a high growth potential.
- The casual relationships between the different types of national capital can be examined to provide further insights.

7 Conclusion

Assessing the intellectual capital of a nation reveals the hidden values of the individuals, companies, institutions and communities that constitute the current and potential sources of wealth creation. The expectation is that finding a reliable measurement of knowledge assets will help governments achieve a 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. 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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