



National intellectual capital: comparison of the Nordic countries

National
intellectual
capital

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Abstract

Purpose – This study proposes a model to measure national intellectual capital that can be easily replicated for trend analysis. Key dimensions include human capital, market capital, process capital, renewal capital, and financial capital.

Design/methodology/approach – With longitudinal data spanning the period from 1994 to 2005, this study compares the national intellectual capital of 40 countries based on an IC map of 29 indicators.

Findings – The overall intellectual capital ranking of the five Nordic countries is: 1 Sweden, 2 Finland, (3 Switzerland), 4 Denmark, (5 USA), 6 Norway, and 7 Iceland in the 40-country list.

Practical implications – The results confirm the general perception that the Nordic countries have a high degree of national intellectual capital. The research findings clarify the status of national intellectual capital of the Nordic countries, thereby providing valuable information for stakeholders and policy makers to formulate effective strategies for building sustainable national competitiveness. In order to do this, it is necessary to elaborate on the proposed IC framework and to gather relevant and valid IC indicators.

Originality/value – The results of this study can provide a map for the Nordic countries – and other countries – as they prepare for future challenges, such as those associated with globalization and its implications on potential wealth creation. A deeper study of why and how might be a part of forthcoming studies.

Keywords Intellectual capital, Sweden, Denmark, Norway, Finland, Iceland

Paper type Research paper

Introduction

The five Nordic countries are among the world's top 20 most wealthy. Based on 2006 GDP per capita (PPP) in US dollars, Norway (47,800); Denmark (37,000); Finland (34,819); and Sweden (31,600) ranked number 3, 6, 12, and 19, respectively, in world wealth (<http://en.wikipedia.org/wiki>). Iceland (35,586) ranked number 5 in 2005; the data for Iceland has not been updated. Located in a cold-climate zone with a combined population of only 24 million people, how did this region achieve such outstanding economic performance and well-being? Does this region possess hidden capabilities

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that have allowed its citizens to overcome the rough physical environment and excel? Intangible assets is the most likely answer.

Despite this historical success, World Bank (2007) predicted in a *Global Economic Prospects 2007* press release that economic growth for 2007-2008 in high-income countries is expected to be 2.6 percent compared with a 6 percent increase in developing countries (<http://web.worldbank.org>). The challenges that rapid globalization, trade expansion, and technology diffusion present to developing countries may intensify stresses on the “global commons.” Are Nordic countries ready to cope with potential economic stagnation? Can the intangible assets they have accumulated sustain the competitiveness of this region? Our longitudinal study, spanning the years of 1994-2005, may provide some answers.

Over the past few decades, intangible assets, such as knowledge, patents, and innovation, have been identified as fundamental sources of wealth and progress. These assets represent a major concern for business firms and their stakeholders as well as for policy makers (Garcia-Ayuso, 2003). Drucker (1993) predicts the emergence of a society dominated by knowledge-based resources and a competitive landscape in the allocation of intellectual capital (IC) (Bontis, 2004). But how do we measure and map this new IC landscape?

IC is defined as “intellectual material – knowledge, information, intellectual property, experience – that can be put to use to create wealth” (Stewart, 1997). It is also described as the basis for future earning capabilities (Edvinsson and Malone, 1997) and as human capital functioning together with elements of structural capital. It is the combination of human capital and the associated factors surrounding IC dimensions that have turned out to be a key source of wealth at both organizational and national levels. Those countries with knowledge-intensive industries will be the winners in terms of future wealth creation (Bounfour and Edvinsson, 2004).

The IC of a nation requires the articulation of a comprehensive system of variables that helps uncover and manage that nation’s invisible wealth. Past studies, to be elaborated on in the literature review section, either propose models from a limited perspective (e.g. inputs or intellectual property rights) or models containing too many variables to be easily replicated for trend analysis. This study attempts to propose a moderate set of national IC indices that is valid and can be easily replicated for follow-up studies.

This study first built a measurement model to capture national IC, then used the Organization for Economic Co-operation and Development (OECD) and the International Institute for Management Development (IMD, 1994-2005) *World Competitiveness Yearbook* database to rank the IC of 40 countries, from 1994 to 2005, focusing on the five Nordic countries. In what follows, the authors will review relevant literature, propose a model for national-level IC mapping and measurement, elaborate research methods, and interpret research findings.

Literature review

During the past decade, knowledge assets and IC have been attracting an increasing amount of attention, not only from academics and CEOs, but also from national policy makers. A World Bank (1998) report points out that the adoption of policies to increase a nation’s intellectual wealth can improve people’s lives, besides giving them higher incomes. Knowledge assets are the intangible assets of a country, and they have significant implications for future national value, as they represent the source of the

competencies and capabilities deemed essential for national economic growth, human development, and quality of life (Malhotra, 2003). As a result, countries rich in intangible assets fare better in terms of national wealth than those whose assets are limited to land, tools, and labor (Malhotra, 2003; World Bank, 1998).

The measurement of intangible assets assists nations in analyzing and benchmarking their competencies and capabilities. Such assessments can facilitate the adoption of policies and practices to promote holistic national development (Malhotra, 2003). Since most measurements of national IC analyze existing data at the input and output level (Bounfour, 2003), the major problem lies in the lack of a comprehensive reference framework (Pomeda *et al.*, 2002). In addition, comparison among countries is based on the different content and quality criteria of different regional-national statistical systems, which may result in inconsistencies in comparison and analysis (Klein, 2000). Despite these constraints, there have been some initiatives to measure national IC as described hereafter.

Framework and main models used to measure and manage the IC of nations

Rembe (1999), in collaboration with others, examined the factors that invite foreign investment in Sweden and proposed a strategic plan for the future development of Sweden's human, market, process, and renewal capitals. Following Rembe, several researchers carried out similar initiatives to assess the IC of the state 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, which was adopted by this study. Table I summarizes the dimensions and main indicators/indices of these studies.

Measurements proposed by regional or world development organizations

Several world development organizations have joined the effort to help countries make better resource allocation decisions by proposing various assessment models. Among these proposed models, the following three models are the most well known.

The World Bank's knowledge assessment methodology

The aim of knowledge assessment methodology (KAM) is to illustrate and identify problems and opportunities that a country encounters for policy reference and for 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). KAM consists of 69 structural and qualitative variables classified into five dimensions. Four of these dimensions are considered decisive in the development of a knowledge-based economy: the economic and institutional regime, an educated and skilled population of citizens, a dynamic information infrastructure, and an efficient innovation system. The fifth dimension tracks the overall performance of the economy.

OECD measurement models

OECD regards inputs rather than outputs as significant when measuring national IC (Malhotra, 2003). In other words, the more a country invests in its higher education and in R&D and software, the more IC it has.

Because the value of input-based measurements at the firm level is questionable, researchers on a national level focus less on the amount of financial investment or financial input and more on the way that people manage and utilize these inputs (Collins, 2001; Malhotra, 2003; Carr, 2003).

Table I.
Dimensions and nature of
indicators for measuring
national IC

Country/researcher	General basic model	Dimensions	Nature of indicators
Sweden (Rembe, 1999)	Skandia navigator	Human capital Market capital Process capital Renewal capital	Financial indicators Descriptive indicators
State of Israel (Pasher, 1999)	Skandia navigator	Human capital Market capital Process capital Renewal and development capital	Financial indicators
Malaysia (Bontis <i>et al.</i> , 2000)	Skandia navigator	Financial wealth Human capital Market capital Process capital Renewal capital	Descriptive indicators Intangible indicators Financial indicators
Sweden (Spring Project, 2002)	Skandia navigator	Business recipe Human capital Structural capital Relational capital	Innovation indicators Competence indicators Industrial indicators Company-universities indicators
Madrid, Spain (Pomeda <i>et al.</i> , 2002)	Skandia navigator	Human capital Technological capital Social capital	Descriptive indicators Intangible indicators Innovation indicators
Arab Region (Bontis, 2004)	Skandia navigator	Financial wealth Human capital Market capital Process capital Renewal capital	Descriptive indicators Intangible indicators Financial indicators
EU (Boumfour, 2003)	IC-dVAL approach	Resources Processes Outputs	Financial indicators Descriptive indicators Innovation indicators

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

United Nations Economic Commission for Europe model

The United Nations' Economic Commission for Europe (ECE) model, with the objective of both facilitating innovation and commercializing knowledge assets, inspects the existing practices and methodologies for valuing IC and the valuation of inventions, patents, managerial flexibility, stock market, and R&D projects (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 ongoing adaptation of institutional, information, and innovation systems. This shift stems from the realization that the innovation and technological capabilities of a country are correlated with long-term growth and social progress.

The national IC measurement model proposed by this study

The measurement of IC of a nation requires the articulation of a system of variables to help uncover and manage the invisible wealth of a country. In the past, researchers from different backgrounds have proposed different models to evaluate IC. Because this field of study is still developing, a consensus regarding the set of determinants that should be employed has yet to be reached. Building on past research in this field, this study proposes a framework and model of measurement and then tests this model by using the widely accepted OECD and IMD databases, which contain both 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 most commonly used national IC framework, including human capital, market capital, process capital, and renewal capital (Table I).

Variables were selected in two rounds. In the first round, variables that were used at least two times in relevant studies (please refer to the Appendix for the source of these variables) were matched with the OECD database or the *IMD World Competitiveness Yearbook*. Market capital turned out to have the fewest number of variables supported by at least two studies. In the second round, a focus group was formed to obtain feedback regarding the appropriateness of the selected variables. With input from ten Taiwanese professors who also engage in IC-related research, focal variables were finalized, as shown in Table II. Financial capital is also included as it is a key indicator of national wealth. Consequently, a total of 29 variables were selected – seven each for human, market, process, and renewal capitals, 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 teamwork, and other specialized and communication skills. Education is the foundation of human capital. The variables used in this study include the amount of skilled labor, the degree of employee training, the rate of literacy, the level of enrollment in institutions of higher education, 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 external relational networking and social capital in a micro setting in that it represents a country's

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

<i>Human capital index</i>	<i>Market capital index</i>
1. Skilled labor ^a	1. Corporate tax ^a
2. Employee training ^a	2. Cross-border venture ^a
3. Literacy rate	3. Culture openness ^a
4. Higher education enrollment	4. Globalization ^a
5. Pupil-teacher ratio	5. Transparency ^a
6. Internet subscribers	6. Image of country ^a
7. Public expenditure on education	7. Exports and imports of services
<i>Process capital index</i>	<i>Renewal capital index</i>
1. Business competition environment ^a	1. Business R&D spending
2. Government efficiency ^a	2. Basic research ^a
3. Intellectual property right protection ^a	3. R&D spending/GDP
4. Capital availability ^a	4. R&D researchers ^a
5. Computers in use per capita	5. Cooperation between universities and enterprises ^a
6. Convenience of establishing new firms ^a	6. Scientific articles ^a
7. Mobile phone subscribers	7. Patents per capita (USPTO + EPO)
Notes: ^a Variables are rated qualitatively using a scale of 1-10. Financial capital is the logarithm of GDP per capita adjusted by purchasing power parity	

capabilities and successes in providing an attractive, competitive incentives in order to meet the needs of its international clients, while also sharing knowledge with the rest of world (Bontis, 2004). The present study takes into consideration investment in foreign countries and achievements in foreign relations, as well as exports of goods and services. In this study, the authors focus primarily on each country's openness to foreign cultures, degree of globalization, and transparency of economic information, as well as the image that the country projects abroad, the country's export and import of commercial services, and how the country's corporate tax policy facilitates trade and cross-border ventures.

The third type of national capital, process capital, comprises the non-human sources of knowledge in a nation. Embedded in a country's infrastructure, these sources facilitate the creation, accessibility, and dissemination of information. This type of capital is measured through corporate competitiveness, government efficiency, intellectual property rights protection, the availability of capital, the number of computers per capita, the ease with which new firms can be established, and the number of mobile phone subscribers.

The fourth type of national capital, renewal capital, is defined as a nation's future intellectual wealth and the capability for innovation that sustains a nation's competitive advantage. Business R&D spending, gross domestic investment, 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 (patent number recorded in both US Patent and Trademark Office & European Patent Office) per capita are included in this type of capital.

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 measurement of the financial wealth of a nation.

Methods

Using the variables listed in Table II, the authors collected data for 47 countries from the OECD database and the *World Competitiveness Yearbook*. Owing to the large number of missing values, the datasets for Colombia, Hong Kong, Indonesia, Israel,

Luxembourg, Slovenia, and Venezuela were excluded. The data analyzed in this study, therefore, describes 40 countries over a period of 12 years, from 1994 to 2005.

In this study, there are two different types of data: data with an absolute rating, such as “patents per capita”; and data with a qualitative rating based on a scale of 1-10, such as “image of country.” Although subjective, qualitative rating on the degree or magnitude of certain variables is unavoidable, because evaluating intangible assets cannot be fully represented by merely adding up absolute numbers. For a meaningful integration of the quantitative score and qualitative rating, the ratio of the absolute value relative to the highest value of each quantitative variable was calculated and multiplied by 10 to transform the number into a 1-10 score. The data transformation procedures have been repeated for all numerical indicators of human capital, market capital, process capital, and renewal capital. Financial capital is represented by 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 score. The overall index as shown in Table III is the total score of the five types of capital.

To assure the validity of the selected variables in measuring the four latent constructs (human capital, market capital, process capital, and renewal capital), the LISREL technique and “Amos 5” program were utilized to test the measurement model. Data analyses showed that all the variables are significant at $\alpha = 0.05$, which means the selected variables are sufficient to evaluate the latent constructs. Thus, the measurement model is valid for assessing national IC.

Results

Based on the data analysis described in the preceding section, Table III displays the score and ranking of the five types of national capital. The overall and individual indices provide valuable information for policy makers. Balance in the number of variables for each of the four types of capital (seven variables each, excluding financial capital) as well as in the number of quantitative and qualitative variables (13 vs 16) was achieved through the literature review, focus group discussion, and database matching.

With 12 years of data, the overall results confirm the general perception that the Nordic countries have the highest degree of national IC. The top ten countries in the composite list are, in order, Sweden, Finland, Switzerland, Denmark, the USA, Norway, Iceland, Singapore, The Netherlands, and Canada. All five Nordic countries are in this list.

A comparison of the Nordic countries

Since the five Nordic countries share not only similar environmental realities and traditional livelihoods but also similar historical and cultural backgrounds (<http://en.wikipedia.org/wiki/>), it is logical to examine them as a group (cluster). Among them, the overall ranking sequence, in descending order, is Sweden, Finland, Denmark, Norway and Iceland. Table IV shows the results of comparing types of capital within each country and between all Nordic countries.

Based on the within-the-country ranking, financial capital ranks first among all types of capitals in all five countries. That is, financial performance is the most outstanding achievement of the Nordic countries. Human capital, process capital, market capital, and renewal capital are ranked in descending order, for Denmark, Iceland and Norway. Finland's sequence is process, human, renewal, and then market capitals. Sweden's is human, renewal, process, and then market capitals.

Table III.
National capital
composite score and
ranking for 40 countries
covering 1994-2005 data

Country	Human capital		Market capital		Process capital		Renewal capital		Financial capital		Overall index	
	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking
Argentina	4.60	32	4.14	38	2.91	39	1.74	36	8.32	26	21.70	36
Australia	6.48	11	6.04	15	6.81	7	4.33	17	9.42	18	33.07	11
Austria	6.69	9	6.46	7	5.94	15	4.33	18	9.63	7	33.04	12
Belgium	6.39	13	5.58	21	5.50	18	4.60	15	9.57	11	31.63	16
Brazil	4.19	36	4.76	31	3.39	33	1.83	35	7.78	33	21.95	34
Canada	6.95	8	6.14	12	6.55	10	4.76	11	9.46	17	33.86	10
Chile	4.66	30	6.35	8	4.54	25	1.99	33	8.00	30	25.54	26
China	3.80	39	5.11	27	3.38	35	2.38	27	6.44	39	21.11	39
Czech Republic	4.90	28	5.41	23	4.18	28	2.54	25	8.22	27	25.24	27
Denmark	8.30	1	6.59	5	7.06	3	5.54	7	9.81	5	37.30	4
Finland	7.55	4	6.56	6	7.59	1	7.08	4	9.56	13	38.33	2
France	6.04	17	4.79	30	5.23	19	5.08	9	9.56	12	30.69	20
Germany	6.12	15	5.34	24	5.76	17	5.86	6	9.60	9	32.67	14
Greece	4.90	27	5.13	26	4.12	29	2.05	31	8.89	23	25.10	28
Hungary	5.68	22	5.84	17	4.47	26	2.48	26	8.16	28	26.63	24
Iceland	7.23	5	6.70	4	6.76	8	4.89	10	9.72	6	35.30	7
India	3.41	40	4.75	32	3.38	34	1.85	34	5.82	40	19.22	40
Ireland	5.76	20	7.10	2	6.25	13	3.88	20	9.54	14	32.54	15
Italy	6.00	18	4.59	36	4.57	24	2.70	23	9.39	19	27.25	23
Japan	6.50	10	4.40	37	4.98	20	7.17	3	9.85	3	32.91	13
Korea	5.57	23	4.72	33	4.66	23	4.07	19	8.72	25	27.73	21
Malaysia	4.95	26	6.11	13	4.94	21	2.22	28	7.89	31	26.12	25
Mexico	4.08	37	4.71	34	3.26	37	1.41	40	8.04	29	21.51	38
The Netherlands	6.47	12	6.92	3	6.60	9	5.20	8	9.57	10	34.77	9
New Zealand	6.05	16	6.25	10	6.26	12	3.54	21	9.14	20	31.24	19
Norway	7.81	3	5.96	16	6.99	4	4.69	13	9.92	2	35.37	6
Poland	4.36	34	4.89	29	3.29	36	1.67	38	7.80	32	22.00	33
Portugal	4.86	29	4.05	39	3.19	38	2.11	30	8.78	24	23.00	30

(continued)

Country	Human capital		Market capital		Process capital		Renewal capital		Financial capital		Overall index	
	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking
Mean	5.71	1.24	5.59	0.93	5.13	1.44	3.78	1.88	8.75	1.06	28.96	5.85
SD	1.24		0.93		1.44		1.88		1.06		5.85	
Philippines	5.49	24	5.24	25	4.43	27	2.01	32	6.75	38	23.92	29
Russia	4.64	31	3.89	40	2.70	40	2.94	22	7.42	36	21.57	37
Singapore	5.88	19	8.17	1	6.95	6	4.64	14	9.52	15	35.17	8
South Africa	4.19	35	4.67	35	4.11	30	2.21	29	7.65	34	22.83	31
Spain	5.32	25	5.66	20	4.77	22	2.60	24	9.12	21	27.47	22
Sweden	8.08	2	6.18	11	6.98	5	7.54	2	9.61	8	38.39	1
Switzerland	7.01	6	6.27	9	6.38	11	7.80	1	9.94	1	37.40	3
Taiwan	6.20	14	5.83	18	5.82	16	4.75	12	8.97	22	31.57	17
Thailand	4.48	33	5.55	22	3.80	31	1.57	39	7.38	37	22.78	32
Turkey	3.99	38	5.01	28	3.46	32	1.67	37	7.59	35	21.72	35
UK	5.74	21	5.67	19	6.17	14	4.43	16	9.51	16	31.52	18
USA	6.98	7	6.07	14	7.26	2	7.00	5	9.82	4	37.12	5

Table III.

Table IV.
Means and ranking
comparison of Nordic
countries

Mean of 1994-2005		Intellectual capital					
		Financial capital	Human capital	Market capital	Process capital	Renewal capital	
Denmark	Mean	9.814	8.302	6.589	7.057	5.537	
	Ranking	Within	1	2	4	3	5
		Between	2	1	2	2	3
Finland	Mean	9.558	7.551	6.558	7.586	7.082	
	Ranking	Within	1	3	5	2	4
		Between	5	4	3	1	2
Iceland	Mean	9.724	7.234	6.693	6.762	4.887	
	Ranking	Within	1	2	4	3	5
		Between	3	5	1	5	4
Norway	Mean	9.920	7.813	5.962	6.986	4.689	
	Ranking	Within	1	2	4	3	5
		Between	1	3	5	3	5
Sweden	Mean	9.612	8.077	6.181	6.978	7.540	
	Ranking	Within	1	2	5	4	3
		Between	4	2	4	4	1

As for the between-country comparison, each country has its own strength. Table IV shows that Denmark ranked highest in human capital, Finland in process capital, Iceland in market capital, Norway in financial capital, and Sweden in renewal capital.

Figures 1-5 show the characteristics and trends of intellectual capital in the Nordic countries. Since financial capital is relatively stable and the gaps are small among the five countries, the following comparisons focus on the other four types of capital. In Figure 1, Denmark's renewal capital steadily increased from around the 40th-60th percentile comparing to the perfect score of 10, yet it is still the lowest among the five types of capital. In Figure 2, Finland's renewal capital increased significantly, from around the 50th-80th percentile. Market capital is Finland's weakest type of capital. In Figure 3, Iceland's renewal capital grew from around the 30th-60th percentile, and in general all four types of capital had much steeper upward trends for Iceland than those of the other countries. In Figure 4, Norway's four types of capital were comparatively

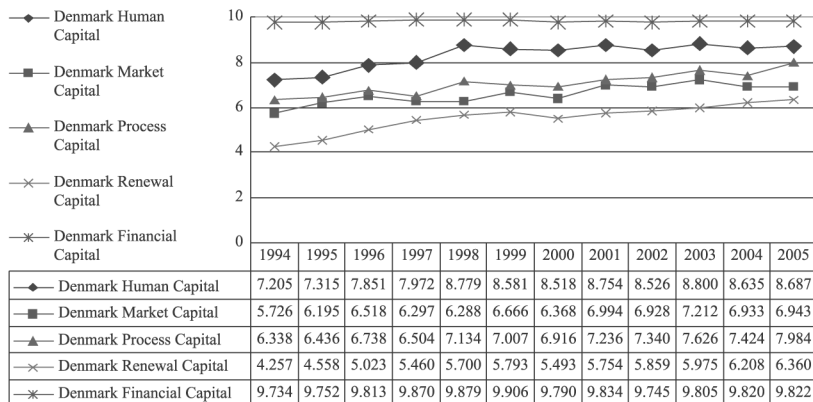


Figure 1.
Trends of intellectual
capital in Denmark

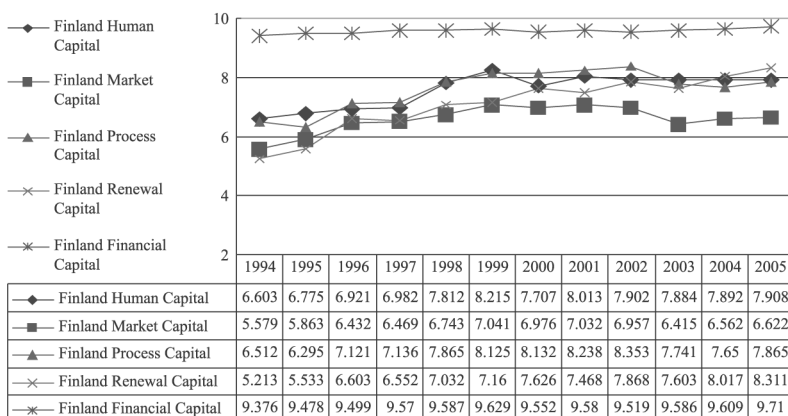


Figure 2.
Trends of intellectual
capital in Finland

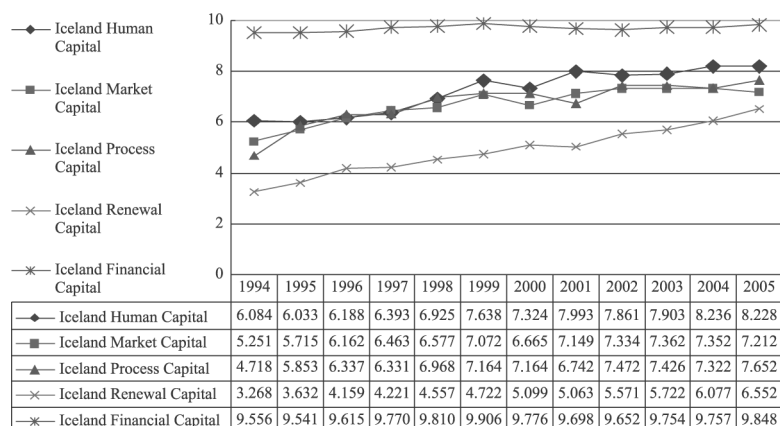


Figure 3.
Trends of intellectual
capital in Iceland

stable with renewal capital ranking last (around the 40th percentile) and without much improvement over the years included in this study. In Figure 5, Sweden's renewal capital increased from around the 60th-80th percentile, while the other types of capital remained relatively stable.

The intellectual capital of each Nordic country has increased over the 12-year research period. As shown in Figures 1-5, Finland and Sweden have a similar development pattern; that is, the four types of capital cluster between the 60th and 80th percentiles. For Denmark, from 1989 onward, the four types of capital cluster between the 60th and 90th percentile, though without overlap. Iceland and Norway's four types of capital increase between the 40th and 60th percentile, with continuous improvement in Iceland but a relatively flat and spreading trend in Norway. Although Norway does not have clear upward trends in the four types of capital, it did achieve the highest financial performance. This phenomenon poses an interesting topic for further investigation.

Figures 6-10 further compare the Nordic countries' five types of capital. Generally speaking, the variations in human, market, and process capitals among the five countries are very small, indicating little difference in the qualification of people, the

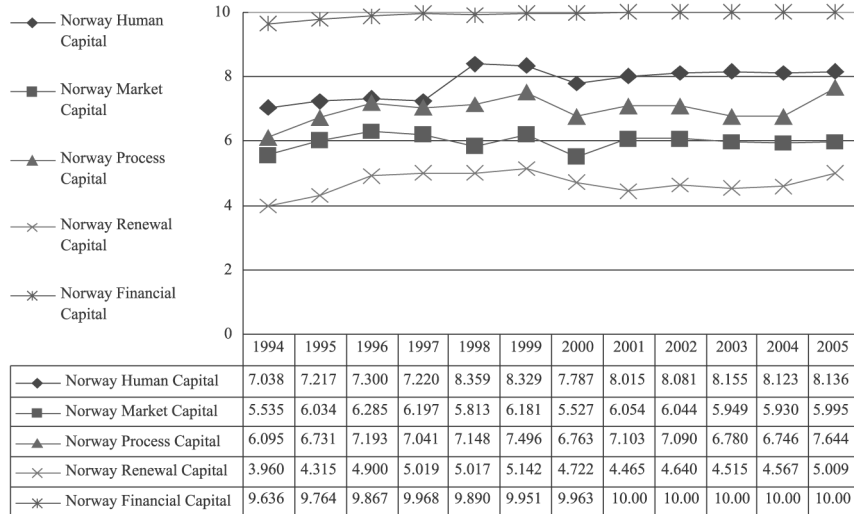


Figure 4.
Trends of intellectual capital in Norway

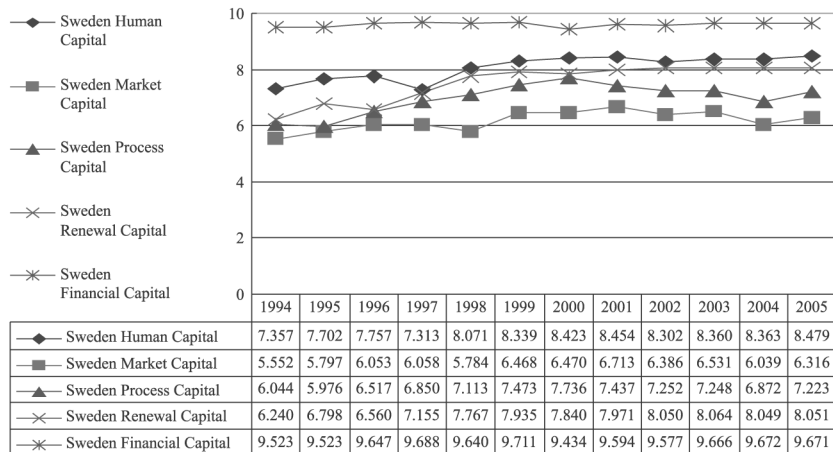


Figure 5.
Trends of intellectual capital in Sweden

international reputation, and the national infrastructure. However, as Figure 9 shows, there is greater variation among the countries in renewal capital, especially from the year 2002 until 2005, when Finland and Sweden are in one cluster, Denmark and Iceland are in another cluster, and Norway lags noticeably behind the other countries. Financial capital is almost identical among all countries, as shown in Figure 10.

These analyses reveal some interesting phenomena. For instance, the financial capital of Sweden and Finland ranked fourth and fifth among the five Nordic countries, yet their overall intellectual capital was first and second within the group. This seems to suggest that financial performance alone cannot explain the creation of wealth in light of intellectual capital. On the other hand, it implies that intellectual capital does not necessarily translate to financial performance. Of course, the time lag may be a concern, which presents another potential research topic.

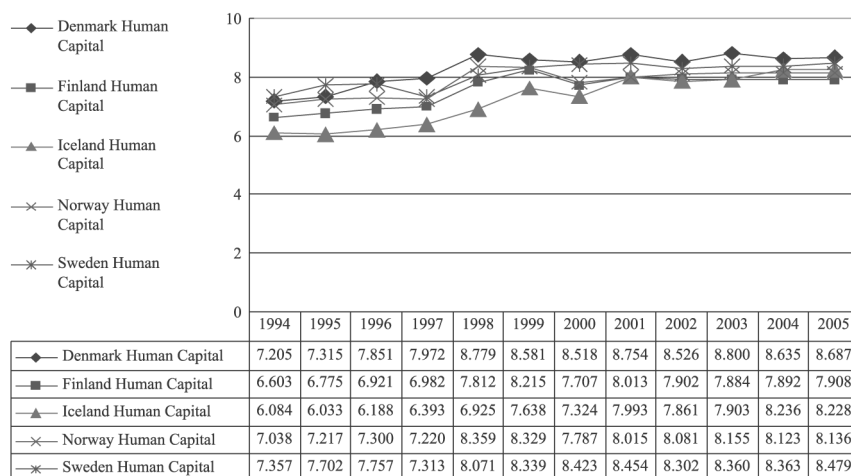


Figure 6.
Human capital
comparisons of the Nordic
countries

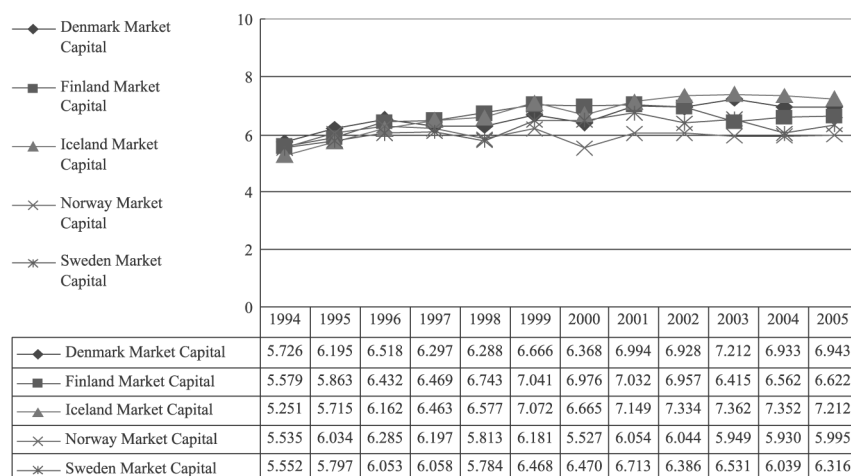


Figure 7.
Market capital
comparisons of the Nordic
countries

To further examine what types of capital best describe intellectual capital, the scores of nine groupings of two and three types of capital were calculated: human capital plus market capital, for instance. Out of the nine groups, only the combination of human capital and renewal capital produce the same national ranking order as the overall index. Although these are descriptive statistics only, they seem to indicate that the future-oriented (human and renewal) types of capital reflect overall intellectual capital most effectively.

The following section provides some background information for each country (<http://en.wikipedia.org/wiki>, accessed January 2007) that may help to explain the results of this study.

Currently, Denmark employs a modern services market economy featuring high-tech agriculture, up-to-date small-scale and corporate industry, extensive government welfare

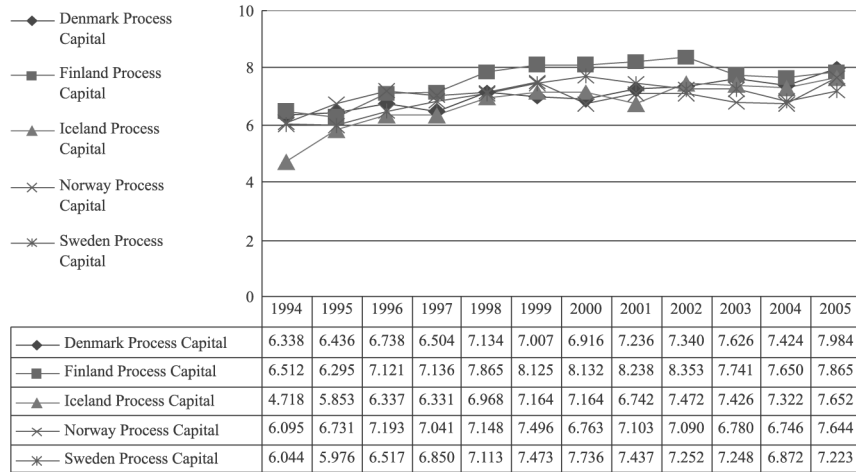


Figure 8.
Process capital
comparisons of the Nordic
countries

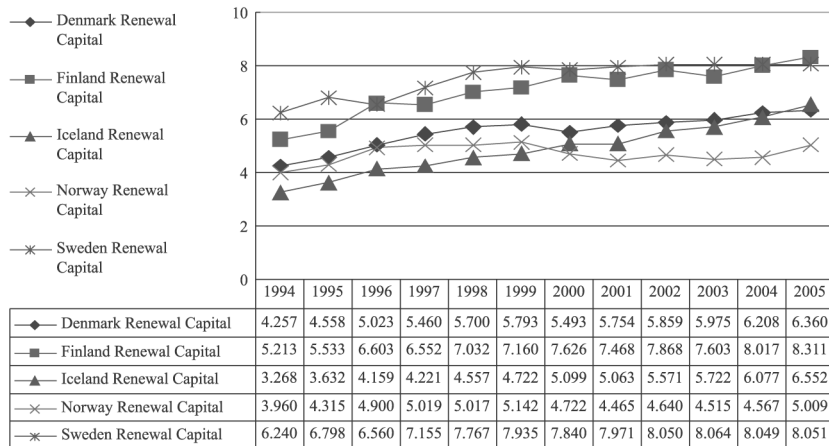


Figure 9.
Renewal capital
comparisons of the Nordic
countries

measures (basis for human capital), and high dependence on foreign trade (market capital). In addition, public school, high school and most forms of higher education are free; about 99 percent of the general population attends elementary school, 86 percent attend secondary school, and 41 percent pursue further education (human capital). Denmark also has a comfortable balance of payments surplus and zero net foreign debt (financial capital). Denmark's achievement ranked by various organizations further explains its high-intellectual capital: *World Economic Forum's Global Competitiveness Report 2006-2007*, 4th of 125 countries; *IMD International's World Competitiveness Yearbook 2006*, 5th of 61 countries; *The Economist Intelligence Unit's e-Readiness Rankings 2004, 2005, 2006*, 1st of 68 countries (process capital); and *Countries by GDP (PPP) per capita per hour*, 9th of 50 countries (financial capital).

Finland has been declared the most competitive country in the world for three consecutive years, 2003-2005, by the World Economic Forum. It has successfully made

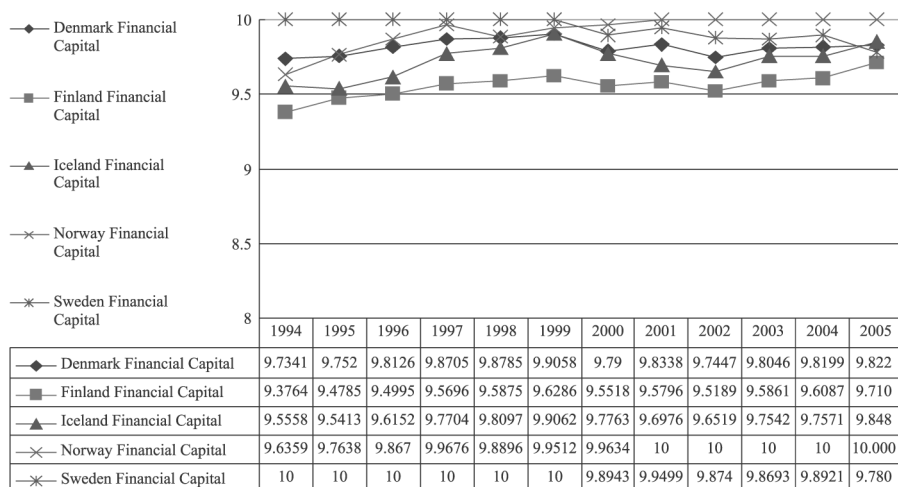


Figure 10.
Comparison of financial
capital of the Nordic
countries

the transition from a war-ravaged agrarian country to a technologically advanced market economy with a sophisticated social welfare system (basis for human capital). In the OECD's international assessment of student performance in 2003, Finnish 15-year-olds came first in literacy, science, and mathematics and second in problem solving. The World Economic Forum ranks Finland's tertiary education number one in the world (human capital). Foreign trade in Finland is highly important, as about a third of the gross domestic product comes from foreign trade (market capital). In recent years there has been a national focus on research and product development (renewal capital), with special emphasis on information technology. Finland is one of the most advanced information societies in the world with 67 percent internet penetration (process capital). The number of cellular phone subscribers and internet connections per capita in Finland is among the highest in the world (human capital and process capital).

Although Iceland's economic growth slowed between 2000 and 2002, its economy has expanded by 4.3 percent in 2003 and by 6.2 percent in 2004. Its economy has been diversifying into manufacturing and service industries in the last decade with new developments in software production, biotechnology, and financial services (renewal capital). The tourism sector is also expanding, with recent trends toward ecotourism (market capital). In addition, Iceland's literacy rate is among the highest in the world, and a love of literature, art, chess, and other intellectual pursuits is widespread. It is also ranked second on the 2005 United Nations Human Development Index (HDI) (human capital). In addition, it is one of the world's most technologically advanced and digitally connected countries. It has the highest number of broadband internet connections per capita among OECD countries (process capital).

Norway possesses the second highest GDP per capita in the world, and the highest position in the world on the HDI for the fifth consecutive year (human capital). The Norwegian economy is an example of a mixed economy, featuring a combination of free market activity and government intervention. Its Globalization Index 2005 is 14th out of 111 countries reported by A.T. Kearney/Foreign Policy. Norway's global competitiveness 2005-2006 is ranked 9th out of 117 countries, as reported by World Economic Forum (market capital). Particularly, its government pension fund is

invested in developed financial markets outside Norway. During the first half of 2006, the pension fund became the largest fund in Europe, totaling about US\$300 billion, representing 70 percent of GDP in Norway. This may partially explain Norway's outstanding financial capital, which ranks second out of 232 countries in GDP per capita in 2006. Of course, Norway's oil industry is also very lucrative.

Sweden is an export-oriented market economy featuring a modern distribution system, excellent internal and external communications, and a skilled labor force (process capital and human capital). Forests and iron ore constitute the resource base of an economy heavily oriented toward foreign trade (market capital). Following the World War II, Sweden took advantage of an intact industrial base, social stability, and its natural resources to expand its industry and supply the rebuilding of Europe, leading to its position as one of the richest countries in the world by 1960 (process capital, financial capital). In addition, Sweden's industry is overwhelmingly in private control. This situation may explain the high level of renewal capital, as private companies tend to be more innovative. As for human capital, 90 percent of school children continue with a three-year upper-secondary school, leading to a vocational diploma and further studies at a university or college (human capital). Both upper-secondary school and university studies are financed by taxes. Sweden's achievement reported by various organizations further explains its high-intellectual capital: World Economic Forum's *Global Competitiveness Report (2006-2007)*, 3rd of 125 countries; UN HDI (2006), 5th of 177 countries; and Nation Master's list by technological achievement, 4th of 68 countries.

In general, the high degree of intellectual capital in Nordic countries can be traced back to their social systems, which provide free or financed higher education, a factor that helps cultivate qualified human resources. In addition, heavy reliance on foreign trade and the external social networking (Sweden) and the development of a national infrastructure (Finland and Iceland) were conducive to technology advancement and e-environment. In other words, capitalizing on social capital with the mutual reinforcement of well-grounded human capital and structural capital has enabled this region to fully develop its potential in the past decade.

Returning to the questions posed early in this paper – are Nordic countries ready to cope with potential economic stagnation, and can their accumulated intangible assets sustain the competitiveness of this region? Based on this 12-year span of panel data, it is apparent that the Nordic countries have ranked high in national intellectual capital in the past for a reason. Their bountiful human capital and their social structure, infrastructure, and trading markets have taken time and resources – which cannot easily be replaced – to develop. As a result, this region has a very solid foundation for further advancement. Yet, while competitors are catching up, the key success factor in the future may lie in inspiring a national vision, leveraging human capital, consolidating roots of innovation, and enhancing social skills for networking in the global arena (Stahle, 2007) for renewal and effective transfer from intellectual capital to financial performance, or, in other words, to enhance human capital with components of structural capital. This will require more social innovation and societal entrepreneurship.

Limitations and future research

The limitations of this research include the following: first, international comparisons are limited by the availability of published data, a consistent problem in studies of national-level intellectual capital. Second, a forced combination of quantitative and

qualitative scores on a scale of 1-10 may attenuate the variance. Third, the panel data can describe only national intellectual capital in the past, rather than the current and future status. Finally, the value of the results relies heavily on the quality of the raw data in the OECD database and *IMD World Competitiveness Yearbook*, particularly for the qualitative rating.

Suggestions for future research include: first, weighting the variables in each type of capital according to experts' perceptions of their relative importance, as different variables may have different degrees of importance. Second, grouping the data into two or four time periods, such as three- or six-year periods, to more clearly identify important features. Third, employing time-lag analysis to test causal relationships between the four types of capital and financial capital. Fourth, replicating the study annually for a trend analysis. Finally, refining the forecasting importance of some of the IC indicators.

Conclusion

The Nordic countries' intellectual capital has an international reputation for excellence, and this study supports that perception. The intellectual capital of all five Nordic countries' was ranked among the top ten countries of the 40 countries included in this study, and three were in the top five. The various tables presented in this study provide some guidelines for countries that are seeking ways to improve their intellectual capital. For example, Finland may look into ways to convert intellectual capital into financial performance, Iceland needs to enhance their renewal capital, Norway can put more effort into expanding their market capital, and Sweden should examine why its financial capital, which ranked first in the first six years of this study (Figure 10), has begun to lag.

Assessing the intellectual capital of a nation reveals the hidden value of the individuals, companies, institutions, and communities that constitute current and potential sources for national wealth creation. Although assessing a nation's intellectual capital is a daunting task, the steady stream of research that has been published in the last few years has drawn the attention of managers and policy makers to the increasing importance of intangible assets issues as the basis for future wealth. The present study provides a platform that a country could use to examine its strengths and weaknesses and identify the areas on which it should focus as it strives for excellence now as well as sustainable wealth creation for future generations.

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Appendix. Variable data sources for each type of capital

Capital	Variables	Sources
Human capital	Skilled labor	1. World Bank
		2. OECD
		3. APEC
		4. US Department of Commerce (2000)
		5. Commission of European Community (2000)
		6. Singapore Department of Trade and Industry (2001)
	Employee training	1. World Bank
		2. US Department of Commerce (2000)
	Literacy rate	3. Australia Department of Industry, Science and Resource Branch (2000)
		1. World Bank
2. Australia Department of Industry, Science and Resource Branch (2000)		
Higher education enrollment	3. Bontis (2004)	
	1. World Bank	
	2. Australia Department of Industry, Science and Resource Branch (2000)	
Pupil-teacher ratio	3. Bontis (2004)	
	1. World Bank	
Internet users	2. Malhotra (2000)	
	1. APEC	
	2. US Department of Commerce (2000)	
	3. Commission of European Community (2000)	
Public expenditure on education	4. Australia Department of Industry, Science and Resource Branch (2000)	
	1. World Bank	
	2. Australia Department of Industry, Science and Resource Branch (2000)	
Market capital	Corporate tax	3. Pomedá <i>et al.</i> (2002)
		1. World Bank
		2. Focus group
	Cross border venture	Focus group
		1. World Bank
		2. Bontis (2004)
	Openness of national culture	3. Malhotra (2002)
		1. APEC
	Globalization	2. Malhotra (2000)
		World Bank
Transparency	Focus group	
	Malhotra (2003)	
Image of your country abroad	Focus group	
	1. APEC	
Exports of goods and service	2. Malhotra (2000)	
	1. World Bank	
Process capital	Competitive environment	2. APEC
		1. World Bank
Government efficiency		1. World Bank
		2. APEC

(continued)

Table AI.

Capital	Variables	Sources
	Intellectual property rights	1. World Bank 2. APEC
	Capital availability	1. World Bank 2. APEC 3. US Department of Commerce (2000) 4. Commission of European Community (2000) 5. Malhotra (2002)
	Computers per capita	1. World Bank 2. APEC 3. Australia Department of Industry, Science and Resource Branch (2000) 4. Singapore Department of Trade and Industry (2001) 5. Malhotra (2000)
	Ease of creating firms	1. World Bank 2. Commission of European Community (2000) 3. Singapore Department of Trade and Industry (2001)
	Mobile phone subscribers	1. World Bank 2. OECD 3. APEC 4. Australia Department of Industry, Science and Resource Branch (2000) 5. Singapore Department of Trade and Industry (2001)
Renewal capital	Business R&D spending	1. World Bank 2. OECD 3. APEC 4. US Department of Commerce (2000) 5. UK Department of Trade and Industry (2000) 6. Australia Department of Industry, Science and Resource Branch (2000) 7. Malhotra (2000)
	Basic research	1. World Bank 2. APEC
	R&D spending	1. World Bank 2. OECD 3. APEC 4. Commission of European Community (2000) 5. Australia Department of Industry, Science and Resource Branch (2000) 6. Singapore Department of Trade and Industry (2001) 7. Bontis (2004)
	R&D researchers	1. World Bank 2. OECD 3. APEC 4. Australia Department of Industry, Science and Resource Branch (2000) 5. Bontis (2004) 6. Malhotra (2000)

Table AI.

(continued)

Capital	Variables	Sources
	Cooperation between universities and enterprises	1. World Bank 2. OECD 3. APEC 4. UK Department of Trade and Industry (2000) 5. Australia Department of Industry, Science and Resource Branch (2000)
	Scientific articles	1. World Bank 2. UK Department of Trade and Industry (2000) 3. Malhotra (2000)
	Patents per capita	1. World Bank 2. US Department of Commerce (2000) 3. Commission of European Community (2000) 4. Australia Department of Industry, Science and Resource Branch (2000) 5. Singapore Department of Trade and Industry (2001) 6. Bontis (2004) 7. Malhotra (2000)

Table AI.

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