National Intellectual Capital as an Economic Driver – Perspectives on Identification and Measurement

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Abstract

Intellectual Capital (IC) is a rather recent line of research that has attracted interest along with the development of the global knowledge economy. Currently there is a relatively common understanding about the importance of knowledge as a source of economic competitiveness, and several IC models have been presented to operationalize its essence, function and benefits. The early phase of the research concentrated on conceptualizations of IC, mainly in the context of business companies. Recently, however, the community, regional and national perspectives as well as the identification, measurement and scaling of IC metrics have increasingly been in focus.

In the global economy IC research has the potential to make an important contribution to understanding the new nature of competitiveness. The development of methodologies for identifying, assessing and measuring national IC may help in terms of coping in the knowledge economy. The main challenges are on the one hand to find reliable methodologies through which to identify IC and its economic impact, and on the other hand to establish how national intellectual capital can be optimized and steered to enforce economic growth. This paper describes the tools and responses to these challenges the IC community has produced so far, and discusses what still needs to be done. The analyses produced via the chosen measurement models provide the antecedents for use in future research efforts.

Key words: measurement of Intellectual Capital, Intellectual Capital models, economic influence of Intellectual Capital, national Intellectual Capital.

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1. Introduction

There is rather unified understanding about the importance of knowledge as a source of economic competitiveness, since an increasing proportion of GDP currently resides in economic commodities that have little or no physical manifestations. However, the methods and models used for measuring intellectual capital (IC) and its effects have not yet established indisputable standards or metrics that could be widely beneficial to the knowledge society (e.g. Malhotra, 2003; UNPAN, 2003).

The early phase of IC research in the 80s and 90s concentrated mainly on the micro-economic context, but recently regional and national perspectives have also attracted interest within the IC community (Amidon, 2001; Bounfour, 2003; Bounfour and Edvinsson, 2005). Alongside the challenge of applying IC on the national scale is the increasingly serious problem concerning measurement and related IC metrics.

National IC (NIC) refers to the concept "that applies the principles of intellectual capital measurement and management on a macro-economic level, in such a way that it helps to give direction to future economic development" (Andriessen and Stam, 2004, p. 11). According to this definition, IC research could at best both make a significant contribution to the strategic steering of knowledge economies and act as a support for national foresight. However, this stage has not yet been reached. Currently *there is not enough knowledge about the economic effects of intellectual capital*. On the one hand, some measurements show that IC acts as an economic driver (e.g. Choo and Bontis, 2002; Lerro *et al.*, 2005; Alexander, 2006; Cabrita and Vaz, 2006), but on the other its influence on economic growth has not been proved (e.g. Firer, 2003). These contradictory results do not necessarily imply a disconnection between IC and economic growth, but might also be attributable to flaws in the models and related methodologies for measuring and scaling IC metrics.

The main objective of this chapter is to analyze the preconditions for measuring national IC as an economic driver. The aim is to find a model or models that could reliably identify and measure its effect on economic growth, especially in the macro context.

2. Identifying and measuring Intellectual Capital

2.1 The IC taxonomy of three

Intellectual capital is an abstract and complex concept that is difficult to identify and operationalize – be it on the organizational or national level. Over the last decade various models and classifications have been presented with many measurement and reporting applications. Currently there is rather unified understanding about its structure and dimensions, and several measurement exercises involving comparative indicators have been conducted. The taxonomy of three – human, organizational and relational capital – is the most established view of IC, and has been applied in most of the measurements. This model is sufficiently established that it "has proven to be a sound basis for measuring and comparing IC on both firm and national level" (Andriessen and Stam, 2004, p. 10). The taxonomy was originally presented by Karl-Erik Sveiby, whose work from the mid-1980s has been identified as the root of the whole IC movement (Sullivan, 1998; Edvinsson, 2005; Andriessen and Stam, 2004). It has been further developed by many academics, most notably by Edvinsson and Malone (1997).

Macro-level research on IC started to emerge at the beginning of the 2000s. National measurements have been mainly based on the model introduced by Edvinsson and Malone (the E&M model), and no specific macro models have been developed. The common view among academics is that there is no need for a specific NIC model since the IC concept is relatively transferable from the micro to the macro level (Edvisson, 2002; Andriessen and Stam, 2004). No serious questioning of this notion has arisen.

In addition to the academic studies, comparative analyses and rankings of nations based on the basic IC taxonomy have also been conducted by international institutions such as the UN[1], the World Bank[2], the EU[3] the OECD[4] and several private institutions including the WEF[5] and the IMD (2005 and 2007). All of these have used the E&M model or parts of it as the basic framework.

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[1] Human Development Index, UNPAN 2003
[2] Knowledge Assessment Methodology (KAM) and Knowledge Economy Index, KAM 2007
[3] Innovation Scoreboard, EIS 2006; EIS 2007; see also EU 2004, 2005, 2006a, 2006b
[4] Measurement recommendations following the MERITUM project and EU recommendations, OECD 2006
[5] The Lisbon review 2006, WEF 2006

2.2 Towards the identification of IC as an economic driver

The IC taxonomy of three is evidently becoming a standard on both the micro and macro levels of measurement. The interesting questions are, however, whether this emerging practice is able *to show the connection of IC with economic growth* – and what other kinds of approach are possible.

Since thorough reviews of IC measurement methods have been presented elsewhere (Sveiby, 2000 and 2007; Andriessen, 2004; Malhotra, 2003), it is unnecessary to give one here. Instead, I have chosen three of the models for closer analysis based on their unparalleled contribution specifically in the present context.

In the context of this study, three approaches are chosen for closer analysis:

1. The model developed by Edvinsson and Malone (1997) since it established the taxonomy of three and introduced the *core concepts and categories* that have provided the basis for national IC metrics in many cases. The model itself was originally used for reporting a company's IC (Skandia Navigator, 1994), and its later applications have produced specific metrics and indexes aimed at IC measurement.

2. The model developed by Ante Pulic (2000 and 2003), since he was the first to transform the established core concepts of the E&M model into pure economic figures. He operates solely in the realm of money, and is genuinely interested in the economic value and efficiency of IC.

3. The model developed by Baruch Lev (2005; Gu and Lev, 2002), since he analyzed the effect of intangibles on economic performance and introduced the concept of *intangible driven earnings*. Lev's perspective has no roots in the IC tradition or in the E&M model. He is exclusively interested in the *effects of intangibles*, not in their components – and he is also the only one to incorporate *time* as an essential measurement variable. He measures the effect of intangibles over the course of time by analyzing the relation of intangible driven earnings to *future success.* Thus he has developed a potential instrument for economic steering and foresight.

The two latter models were chosen for closer analysis because they aim at measuring IC by identifying its effects on economic performance, and they both take a unique and promising approach. Both are clearly economic, and the focus on efficiency guarantees their usefulness.

The contributions of all three approaches are important in terms of seeking to identify the influence of IC on economic growth. They are analyzed in the next sections in accordance with their contribution to measuring the effect of national IC. Each one is then examined in the light of three essential questions:

1. How reliably is the model able to *identify* national Intellectual Capital?
2. How valid and reliable is the method for *measuring* national Intellectual Capital?
3. Is the method capable of showing the *influence of IC on economic growth*?

Finally, conclusions are drawn on the special features and problems of macro-level IC measurement that need to be acknowledged as the next generation of measurement evolves.

3. Measurement applications in the Edvinsson & Malone (E&M) model

3.1 The problems of the model

The model developed by Edvinsson and Malone (1997) presents a clear conceptual and structural base for IC. It divides it into two main categories, *Human Capital* and *Structural Capital*: the latter is further divided into *Market capital* (or Customer Capital) and *Organizational Capital*, which again is divided into *Process Capital* and *Renewal Capital* (or Innovation Capital). The multi-level hierarchy of the model is the most detailed, and it is also the one most frequently used in both conceptual and measurement applications, as explained earlier. The original IC perspectives contained in the taxonomy of three are further refined: *Relational Capital* is called *Market Capital* or *Customer Capital*, and is positioned as a subcomponent of *Structural Capital*; thus the elements are the same but their hierarchical order is different. The measurement problems that both models cause are similar however, and their applications are, in principle, close to each other.

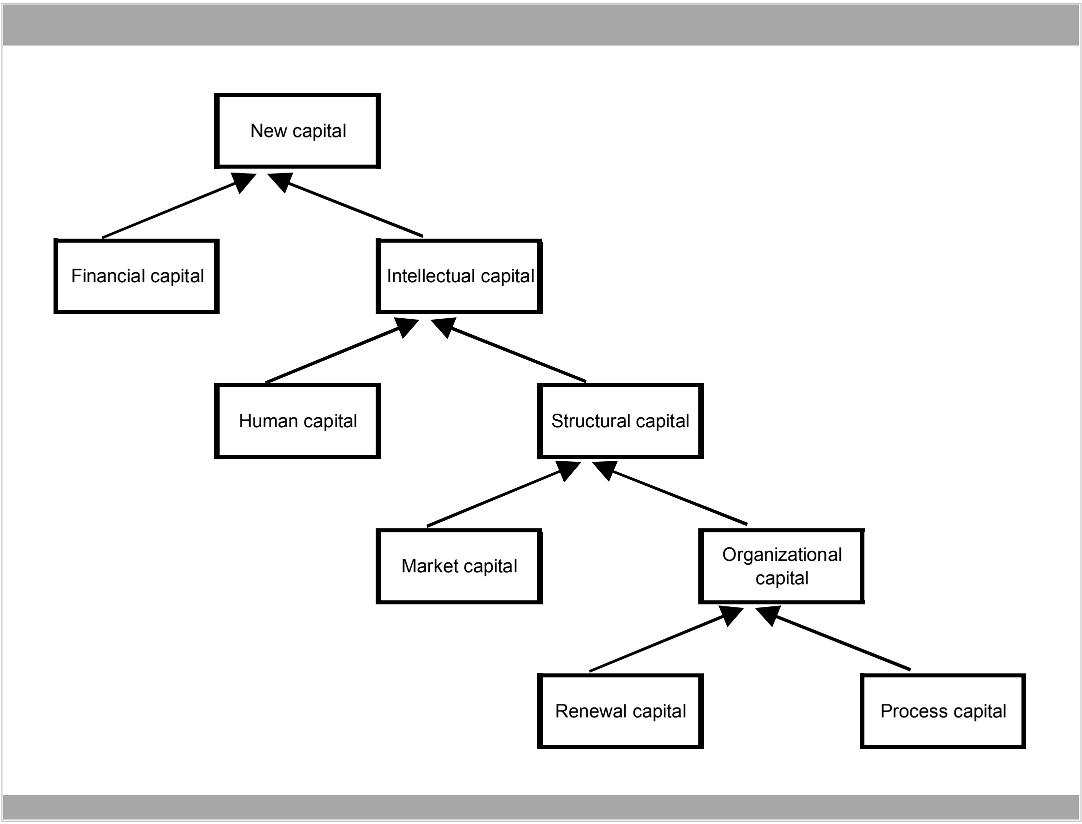

Figure 1: The IC model developed by Edvinsson and Malone (1997)

Even though the E&M model offers a clear and structured understanding of the elements of IC, it has some serious problems from the measurement perspective. First, conceptual problems arise in choosing the indicators for the sub-categories (e.g. Lönnqvist and Mettänen, 2002), and secondly, measurement problems arise when attempts are made to form composite indexes for IC.

There is, for example, clear confusion concerning the definitions of *Structural, Organizational* and *Process Capital*. Marr and Starovic (2005) consider *Organizational* and *Structural Capital* equivalents, whereas generally the latter is defined solely through the related concept of infrastructure (e.g. Sullivan, 1998, p. 178; Bontis, 2002, p. 632). Malhotra (2000) defines *Organizational Capital* in terms of *organizational structures, patents and trademarks*, for example, which clearly mix *Renewal and Market Capital* metrics with those of *Organizational Capital*. For the same reason of conceptual vagueness, *ICT usage,* for instance, is sometimes considered part of *Structural Capital* (Andriessen and Stam, 2004) or *Organizational Capital* (Malhotra, 2000) and sometimes part of *Process Capital* (Bontis, 2004). Since current IC studies use the underlying metrics differently – even if the core concepts misleadingly remain the same – the measurement results cannot be generalized and must always be interpreted case by case (Marr and Starovic, 2005).

The other problem concerns measurement and metrics, i.e. the question of how to form the indexes and ensure their validity. Even if the model itself is well structured and consistent, it does not offer any guidelines for making valuations between the subcomponents of IC. For example, before we can create the index for the total IC level of a country we need to know how *Human Capital* and *Structural Capital* or *Renewal Capital* and *Process Capital* relate to each other. The model does not give clear underlying metrics or straightforward guidelines for conducting reliable and unambiguous analyses.

3.2 Andriessen and Stam's Application

The Intellectual Capital of the European Union by Andriessen and Stam (2004) effectively illustrates both the conceptual strengths of the E&M model and the weaknesses concerning the scaling of the indexes.

Andriessen & Stam further develop the taxonomy of three by introducing new perspectives combined with the effect of IC. They cross-categorize the chosen statistical indicators and three new categories - *Assets, Investments* and *Effects*. With this categorization they also attempt to tackle the problem of time, since assets could be regarded as a demonstration of the present, the effects of the past, and the investments of the future.

	Human Capital	Structural Capital	Relational Capital
Assets			
Investments			
Effects			

Table 1: The Intellectual Capital Monitor developed by Andriessen and Stam (2004, p. 11)

The introduction of the three separate categories of assets, investments and effects is constructive, but problems emerge depending on the indicators used to measure effects. The table below (Table 2) raises the following question: Whereas the indicators clearly (aim at) measuring IC they de facto do not reveal whether they are the results of high GNP driven by other than IC drivers of the economy, which means that they do not conclusively measure IC effects.

	Human capital	Structural capital	Relational capital
Effects	• GDP per hour worked (as % of US) (7)	• Percentage of businesses using the Internet for purchasing and selling (1) • Value added of high tech industry, relative to GDP (2) • Birth rate of enterprises (3) • Birth rate of enterprises (5) • The share of persons with an equivalised disposable income below the risk-of-poverty threshold (9) • Life expectancy at birth (9)	• Breadth of international scientific collaboration (2) • Percentage of patents with foreign co-inventors (2) • Export of royalty and license fees (2) • Export of services (2) • High tech export (2)

Indicators for measuring the IC of the EU

Table 2: Indicators for the Effects of IC (Andriessen and Stam, 2004, p. 14)

To solve the problem of the scaling of the indexes Andriessen & Stam normalize all measurements by subtracting the minimal value and dividing it by the total length of the scale, i.e. maximum value minus minimum value. The result is a number between zero and one for each indicator: zero denotes the threshold of uselessness and one the maximum value achieved. This requirement means in practice that a maximum value – which acts as a yardstick – needs to be defined separately for every indicator. The authors define rules for combining various value streams, arguing that when it comes to combining value, the additive rule (1 + 1 = 2) is an exception. The so-called G-rule (=goal-oriented) is much more common and heavily recommended, according to which in order to achieve a certain goal a trade-off between different values is needed, i.e. the weighting of measures above a threshold value. When the different indicators are combined into one, Andriessen & Stam use "the correct combinatory rule" that follows from the value hierarchy. The exact implementation of the G-rule and the trade-off values nevertheless remain undefined. In practice, they combine the different indicators into a composite index based on speculative weightings instead of the established relations between the subcomponents (see Andriessen and Stam, 2004, p. 30).

3.3 Applications put forward by Nick Bontis

In "Benchmarking the Arab states" Bontis (2001 and 2004) rather successfully uses the concepts, metrics and indicators incorporated into the E&M model. However, the core problems of index formulation remain. For example, he uses seven indicators for the *National Human Capital Index* of the countries, and weights each of them speculatively between 10% and 30% (Table 3, the last line). Also another problem is evident in the calculation of national IC, which is formed as a direct average of *Market, Human, Process and Renewal Capital*. These solutions are understandable, since some choices must be made in order to obtain any comparable results. However, the choices as such lack a reliable scientific basis, even if they are in the right ballpark, as in this case.

EXHIBIT 4 NATIONAL HUMAN CAPITAL INDEX (NHCI) CALCULATION

Index Metric	H1 HC02	H2 HC05	H3 HC11	H4 HC16	H5 HC23	H6 HC25	H7 HC26	NHCI
Algeria	0.633	0.124	0.930	0.496	0.368	0.82	0.79	0.508
Egypt	0.553	0.077	0.995	0.544	0.793	0.88	0.85	0.647
Jordan	0.896	1.000	0.467	1.000	1.000	0.63	0.63	0.842
Kuwait	0.823	0.151	1.000	0.672	0.923	0.63	0.62	0.726
Morocco	0.489	0.135	0.910	0.453	0.374	0.55	0.51	0.401
Oman	0.719	0.114	0.990	0.274	0.135	0.75	0.75	0.537
S. Arabia	0.770	0.114	1.000	0.585	0.308	0.87	0.75	0.630
Sudan	0.571	0.241	0.611	0.084	0.173	0.46	0.41	0.302
Tunisia	0.706	0.183	0.933	0.560	0.430	0.87	0.85	0.644
Yemen	0.462	0.236	0.743	0.156	0.110	0.63	0.51	0.410
Weighting	30%	10%	10%	15%	15%	10%	10%	

H1 HC02 literacy rate
H2 HC05 number of tertiary schools per capita relative to highest value
H3 HC11 percentage of primary teachers with required qualifications
H4 HC16 number of tertiary students per capita relative to highest value
H5 HC23 cumulative tertiary graduates per capita relative to highest value
H6 HC25 percentage of male grade 1 net intake
H7 HC26 percentage of female grade 1 net intake

Table 3: An example of the weighting of metrics (Bontis 2004, p. 26)

Even if Bontis is partly trapped by the impreciseness of the E&M model, he also develops it further – and lays the ground for devising solutions to some of the problems embedded in it. He does a remarkable job in analyzing *inter-relational dependencies* (correlations) between the IC components and the financial figures. The results of his study show that the inter-relational dependencies of different IC components range from negative to positive, significant and non significant. Furthermore, different IC components may relate to the level of GNP (here interpreted as financial capital) either directly or via other IC components (Figure 4, Bontis 2004, p. 31).

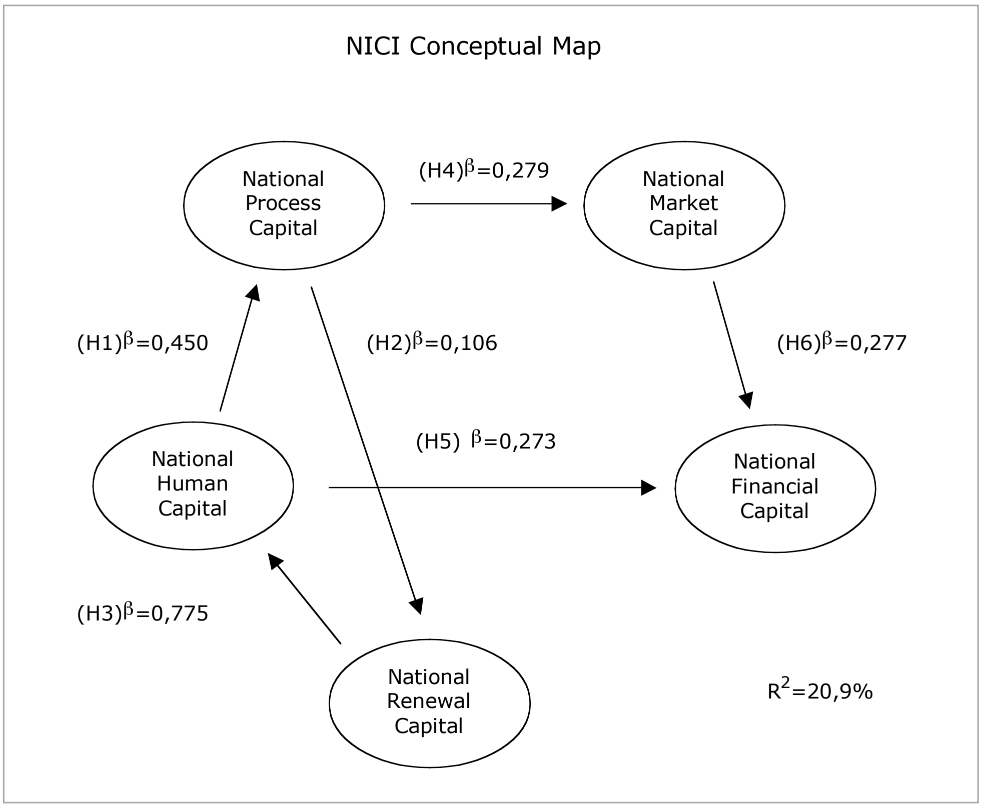

Figure 2: The relations between IC components according to Bontis (2004) in terms of LPS relation values (LPS = Least Partial Square ranges between 0 to 1 where 0 indicates there is no inter-relationship and 1 that the relationship is evident).

The results are important as they clearly indicate that the weighting of components may be based on the analysis of inter-relational dependencies rather than speculative choices.

In a more recent study based on Bontis' approach the inter-relations have been studied in more detail (Bontis and Wu, 2005, see also Bontis, 2002). The results show that the internal dynamics of IC are nested and complex: whereas *Human Capital* in this study seems to enforce economic performance only moderately (Figure 5, upper section), it relates strongly to economic performance via *Process Capital*, as does *Innovation (Renewal) Capital* (Figure 5, lower section). Thus, many of the IC components rely on each other and must be calculated through the inter-relational effects. This case study indicates, for example, that *Innovation Capital* must be factored into a comprehensive IC index by taking into account the level of *Process Capital*, i.e. the high level of *Innovation Capital* has an effect only when *Process Capital* is also on a high level.

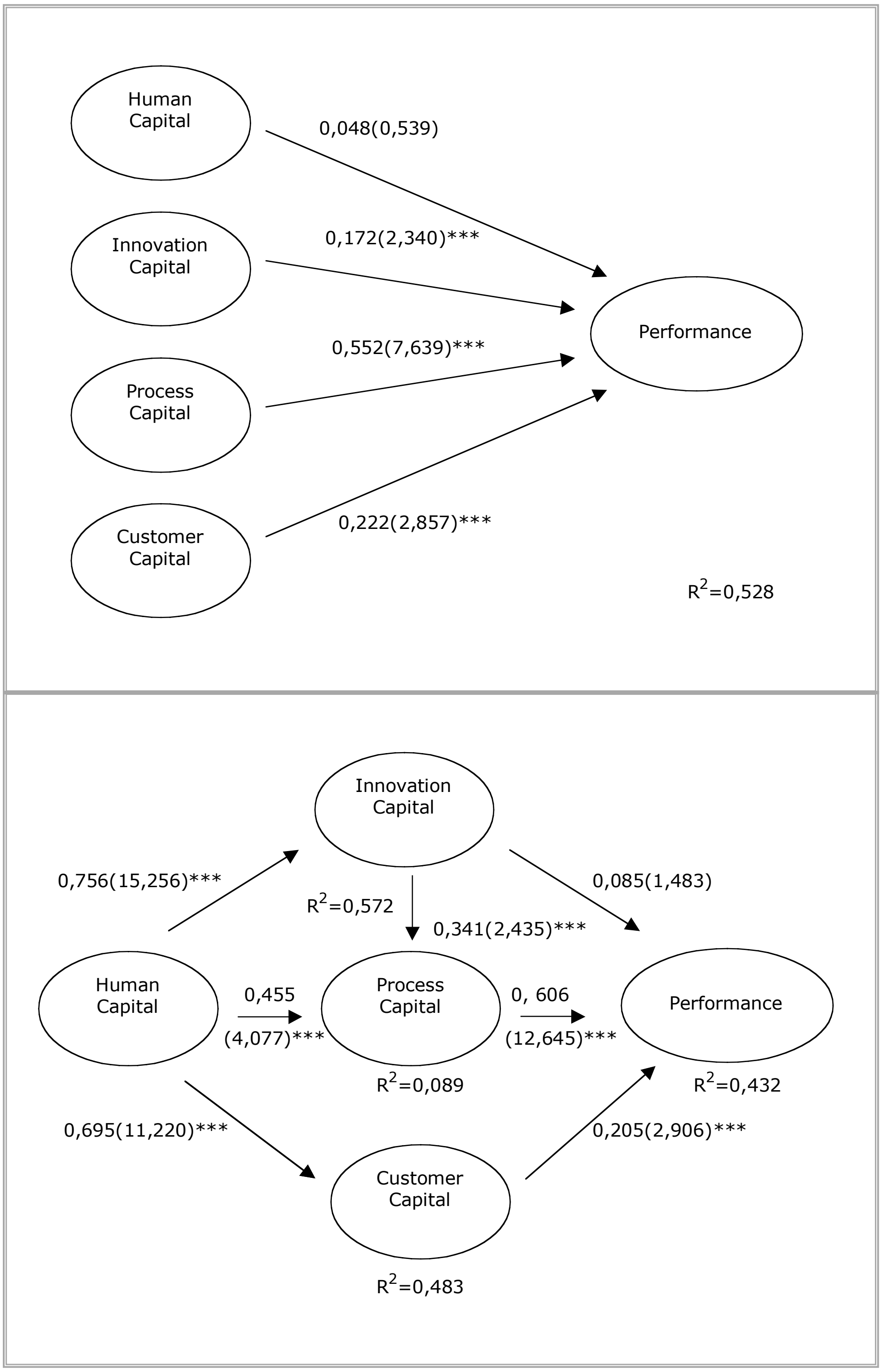

Figure 3: The empirical results concerning the direct and indirect impact of elements of intellectual capital on performance (Wang and Chang 2005, pp. 230-232)

Bontis' study is an important contribution to IC research, on both the micro and macro levels of analysis. The core finding also supported by other research results (e.g. Cabrita and Vaz,

2006) is, that IC components, as well as their inter-related connections and dependencies, affect economic performance, but non-directly, in an interconnected and dynamic manner.

3.4 Open questions

Researchers using the E&M model for indicator-based analysis need to solve the following problems:

1. How should *Structural* and *Organizational Capital* be defined? Are they only composite blocks constituted of their subcomponents, or do they have their own content? For instance, does *Structural Capital* have unique metrics or indicators that as such do not refer to *Market Capital* and *Organizational Capital*?

2. How should one choose the relevant indexes? Is there a problem when moving from the micro to the macro level?
    - The national perspective on IC and its measurement opens up a set of specific problems. These are linked partly to the established IC taxonomy and partly to the fact that the national perspective differs from the corporate perspective, not only in scale but also intrinsically. When micro-level models are applied directly to the national level, the hypothesis in the IC community is that they function in a similar way. However, we might not find the same kind of indicators on company- and national-level balance sheets – and even if they are to be found, their functions may be different. For example, how should we understand the significance of brand value as part of *Market Capital* on a national scale, or R&D investments as part of *Renewal Capital* given that R&D is effective only when it results in sufficient project-specific funding? Furthermore, the inter-relational dependencies between indicators and IC components may or may not be the same on a national scale.

3. How should we calculate the composite IC index from lower-level components? For example, is *Structural Capital* to be understood as a sum, as a weighted sum, or as a product of *Market Capital* and *Organizational Capital*?
    - These questions have been solved either through the straightforward use of the 1:1 summation (Marr, 2005; Marr and Starovic, 2005) or through simple benchmarking (Bontis, 2001). In the latter case the highest value or score of a specific metric is set to 100 (or 1), and the same metric for comparatives is expressed as percentages (or ratios) of the highest. This is an adequate and

acceptable solution when dealing with only a few metrics, but when the number grows (as is always the case when using the E&M model with around 20 metrics per block) the comparison becomes diffuse, even impossible. This is why the problem is often solved by using general summations, i.e. the higher-level index is produced as an average or weighted average of its underlying metrics (e.g. Bontis, 2001). However, this results in an illusion of clarity at the cost of reliability and adequacy, since the procedure lacks theoretical justification.

4. How should upper-level indexes be compared? For example, *Educational levels* and *Years of practical experience* are both part of *Human Capital*, but how should these (together with other *Human Capital* metrics) be factored in and thereby produce the final national *Human Capital* index?
    - This is a question of determining the proper weighting of indexes when producing higher-level indexes, and of identifying the *most significant* indicators for each IC metric. Bergheim (2005), for example, argues that human capital can be measured exactly through only one indicator, years of education, as all other indicators are linked to and reflected in it. If this is true, adding further indicators only mixes up and distorts the results if not weighted with full accuracy.

5. How should metrics, indexes and cross-nation comparisons be scaled? What are the principles for making IC comparatives across cases?
    - This problem arises when the focus shifts from mere levels of IC (e.g., levels of education) to its effect on national wealth creation. When the focus is on the latter it is a question of both finding a methodology that will identify its effect as an economic driver together with other drivers of the economy (e.g., natural and financial resources) and identifying the developmental and socio-economic dependencies affecting the economy. For example, when the openness of trade has been proven to be a single effective (IC) driver (Miller and Mukti, 2000; Söderbom and Teal, 2003; Neuhaus, 2005), how are we to weight this in cases like China or Russia?

4. Ante Pulic's Value Added Intellectual Coefficient

A totally different approach towards defining and measuring the *effect* of IC on economic performance is proposed by Ante Pulic (2000, 2003 and 2005). He was the first to focus explicitly on the connection between IC and economic performance and to operate solely with financial indicators. Unlike the other researchers in the field of economic IC (e.g. Hwang *et al*., 2003) Pulic uses established IC concepts. His model ties *Human and Structural Capital* to economic figures and produces an unambiguous *Value added intellectual coefficient* (VAIC) index as the output. The model has been applied in various companies as well as for regional and national purposes. It has also been referred to by other researchers, but has not yet been analyzed or further developed.

Pulic's VAIC model measures the extent to which the economy produces added value based on intellectual efficiency or by exploiting intellectual resources. VAIC calculations (Figure 6) are based on:

a. *Human Capital* (HC), which is interpreted as *Employee Expenses*
b. *Structural Capital* (SC), which is interpreted as the difference between *Produced Added Value* (VA) and *Human Capital* (HC).

Efficiency figures are calculated as ratios of:

a) *Capital Employed Efficiency* (CEE)
b) *Human Capital Efficiency* (HCE)
c) *Structural Capital Efficiency* (SCE).

Theoretically, VAIC is a relational index in which produced *Added Value* is compared to *Capital Employed* and *Human Capital*. When *Added Value* is zero (or negative) VAIC may take negative values. The calculated VAIC index normally ranges between 1 and 3, and in practice it is created by the sum of the ratios of value-added to capital employed and *Human Capital* as employee expenses.

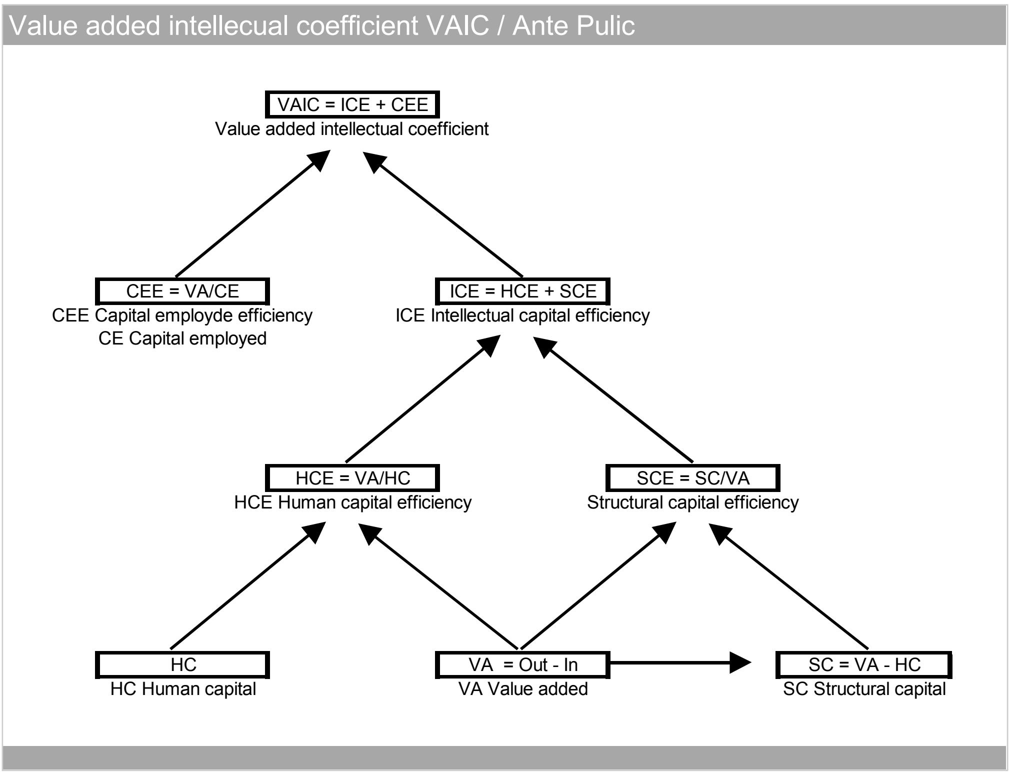

Figure 4: The construction of the Value Added Intellectual Coefficient VAIC

4.1 Conceptual problems

In terms of calculating *Intellectual Capital Efficiency* (ICE) VAIC follows the applications – and problems – of the E&M model, as ICE is the net sum of *Human and Structural Capital Efficiency*. However, compared to the E&M applications VAIC takes a clear operational approach, and to some extent gives clear metrics for all its concepts on the corporate, regional and national levels of the economy (e.g. Sitar and Vasi'c, 2004).

Results based on Pulic's model have been contradictory concerning the influence of IC on economic growth. Some cases have revealed a clear relation between VAIC and economic performance (Pulic, 2000, 2003 and 2005), but in others there has been no evidence of such a relation (Kujansivu, 2006; Kujansivu and Lönnqvist, 2007; Firer, 2003). This exposes two basic problems inherent in the model.

First, Pulic implants the IC concepts into economic analysis rather loosely, e.g., uses *Personnel Expenses* as a substitute for the concept of *Human Capital*. The problem becomes evident in the cross-national comparisons according to which, for example, among the highest levels of IC efficiency in Europe are, surprisingly, Greece and Italy (Pulic, 2003, p. 6).[6] This result is possible since *Human Capital* is calculated solely in terms of personnel expenses, and wages and salaries vary from country to country and are strongly dependent on socio-economic factors. It is evident that results calculated in this way mainly refer to other components of IC.

Secondly, the same problem occurs when *Value Added* minus *Personnel Expenses* (VA – HC) is used as a substitute for *Structural Capital*. When *Human Capital* in some logical (although limited) way can be linked to *Personnel Expenses*, the linking of *Structural Capital* to the difference between *Value Added* and *Personnel Expenses* is difficult to justify on any basis.

4.2 Calculation problems

An interesting application is the use of VAIC in order to establish a connection between companies' market value and their IC. In this VAIC is used to explain the difference between the market and the book value. Here Pulic uses the straightforward hypothesis that companies' market value is in direct proportion to *Capital Employed* and VAIC (Pulic, 2000, p. 3; see also Williams, 2000). He succeeds in showing that a company's VAIC and its market value have a

[6] For comparison: Italy's IC is one of the weakest in the EU countries according to Andriessen & Stam, 2004.

tight correlation (Figure 7), and even if "the VAIC method is primarily focused on the measurement of value creation efficiency of resources it also provides a possibility to calculate the approximate market value of companies which are not noted at the stock exchange" (Pulic 2000, 3, p. 39).

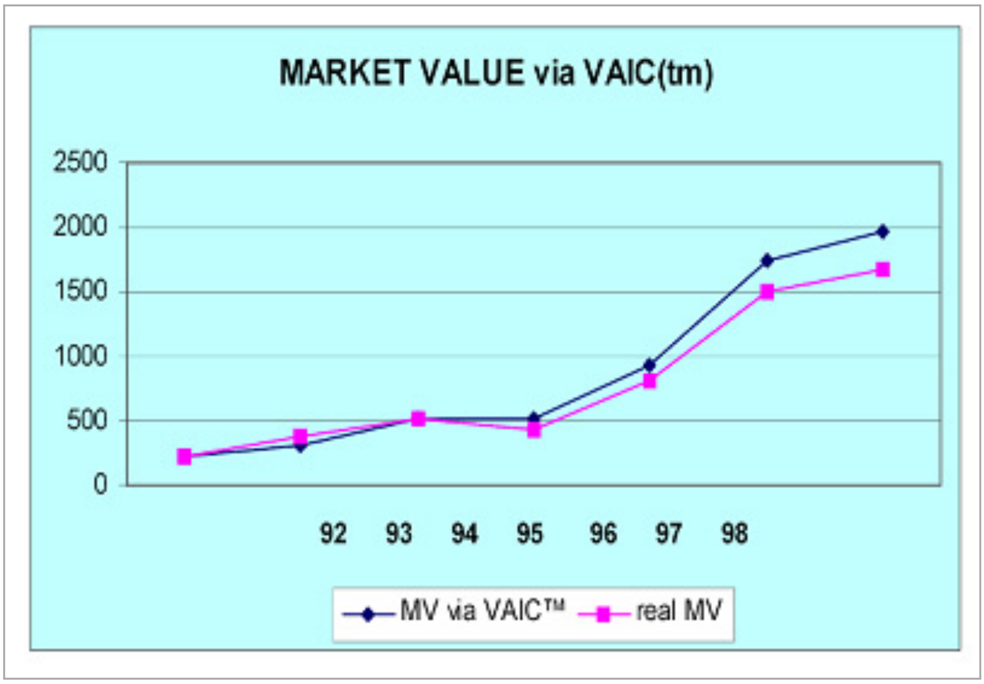

Figure 5: The relation between market value and VAIC (Pulic, 2000, p. 40)

Pulic claims that companies' market value can be calculated de facto from their *Capital Employed* (CE) and VAIC. However, according to the VAIC calculation the results expose the general value trends of company stocks, which always tend to rise according to:

- capital employed (CE)
- high value-added performance (when value added per human capital (VA/HC) and value added per capital employed (VA/CE) are high)
- low cost structures (when the difference between added value produced and human capital per value added (SC/VA) is high).

Because VAIC is based on these figures, it is clear that both developments go together. For this reason it does not really give any new knowledge about the development, but takes instead some chosen economic figures and uses them as a separate index, very much as only a index for economical efficiency *per se* (see also Kujansivu and Lönnqvist, 2007).

In spite of the above shortcomings, Pulic makes a brave start both in opening up a new perspective on IC and in understanding its function. He transfers the core IC concepts to the economics context and gives them purely economic interpretations. Thus he makes IC computable by presenting rather straightforward formulae for calculating the value-added intellectual coefficient, or the VAIC index. The core contribution lies in the fact that various IC components, such as *Human* and *Structural Capital,* are certainly reflected in the company and national balance sheets. However, the challenge ahead is to disclose this reflection in more explicit and reliable detail.

5. Baruch Lev's intangible driven earnings

The third model, developed by Baruch Lev (2001; Gu and Lev, 2002), offers a completely different method compared to the two presented above. His approach focuses explicitly on the economic effects of intangibles, and the roots of his thinking are in no way in the IC taxonomy of three. His genuine interest is purely economic, but unlike Pulic he exposes the effect of intangibles without using any explicit indicators or definitions.

Referring to the economic *effects of intangibles,* Lev simply divides the source of (all) economic performance into three categories, physical, financial and intangible. He transforms *intangible driven earnings* into financial figures by reducing the effects of physical and financial driven earnings on total earnings. Accordingly, the effects of intangibles cannot be measured directly, but they can be measured as a residual from the effects of physical and financial driven earnings. As a result, the intangible driven earnings identified this way are ratios or percentages of overall earnings.

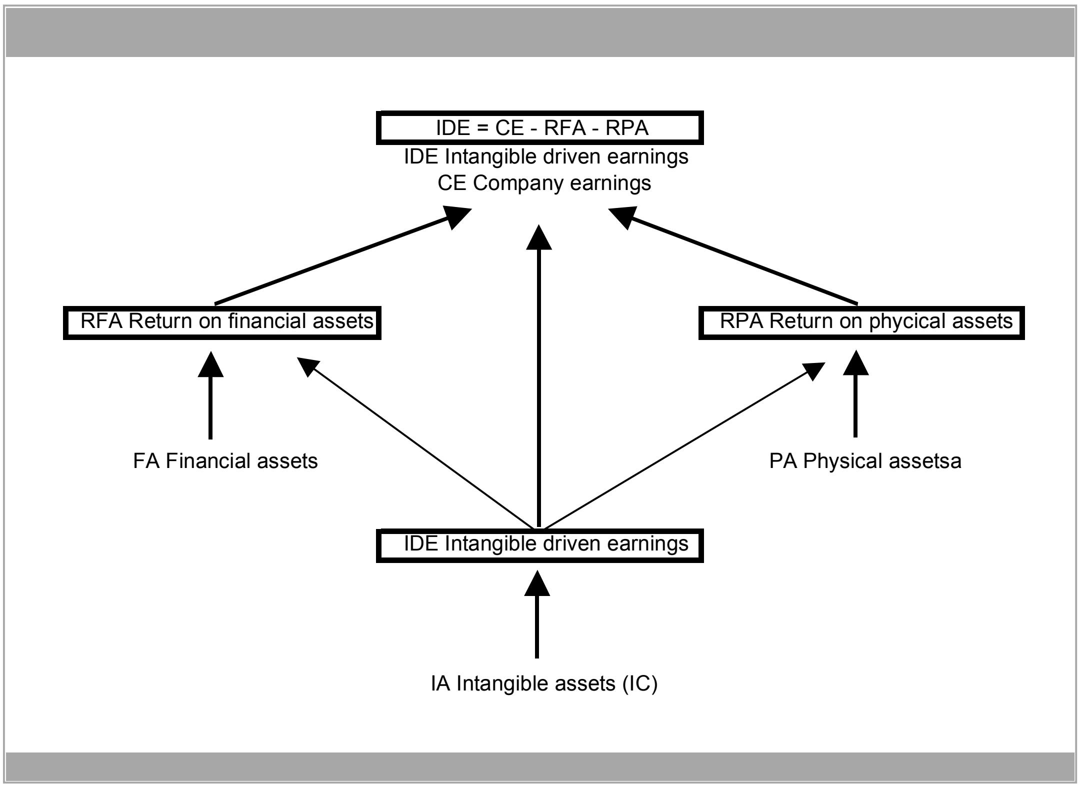

Figure 6: Intangible driven earnings based on Baruch Lev

Lev's approach focuses on measuring the real *effects of active intangibles*, not on measuring or even defining the intangibles themselves. This is, in fact, both the strength and the weakness of the model. In some sense it is undisputable that the sources of economic performance are physical (e.g. plants, properties and equipment), financial (e.g. cash, stocks or financial instruments) or intangible (e.g. brands, processes and human resources). The weakness in Lev's model is, however, that it lacks the detailed indicators of the intangibles. Thus the very concept of intangibles remains unexplained and hidden. This rather complicates matters, since calculated in this way we do not in fact know what has been measured. Lev (2002) defines intangibles as "a source of future benefits that doesn't have a physical embodiment" but in practice it is difficult to know what kind of elements they cover. In any case, Lev's concept of intangibles is more extensive that the established IC taxonomy of three, including necessarily also such elements as strategic position and market demand, which are not included in physical or financial driven earnings.

This may be the reason why Baruch Lev – despite the revolutionary results attained – is not more established in the field. On the other hand, his method has been criticized for being too complicated and difficult to apply (Steenkamp, 2003). The main difficulty is in explicitly determining how return on physical and financial assets is to be calculated. Even if the approach is theoretically sound, defining financial and physical assets explicitly in figures may cause problems in practice. However, Lev has extensively elaborated the problem (Gu and Lev, 2002).

Many researchers have applied the model to national stock markets (e.g. Colwell *et al.*, 2001 and 2007). In all cases, the results have proved that companies in the same industry with the greatest share of intangible driven earnings also manage better in the long term, i.e. from five to twelve years (Gu and Lev, 2002). This result is noteworthy for two reasons. First, Lev was the first to show reliably the influence of intangibles on future earnings, and secondly, the same dependency between intangible driven earnings and economic performance has been verified also by other researchers.

Lev's context of measurement is micro economic, but the model has successfully been applied to stock markets on a national scale. The method may have an important contribution to make in attempts to grasp the effect of IC on the national level. However, further development is needed. Lev's approach could be refined, for example, by conducting a comparative analysis of companies with high and low percentages of *Intangible Driven Earnings.* The similarities and dissimilarities may open up the elements of IC and give a more detailed picture of intangible drivers.

6. Towards the identification and measurement of national IC

The three IC approaches described above have both strengths and weaknesses from the measurement perspective. How reliably are the models able to *identify* national Intellectual Capital? How valid and reliable are they in terms of *measuring* it? Are they capable of showing the *influence of IC on economic growth*?

In terms of identification, the taxonomy of three in its most established form developed by Edvinsson and Malone has had a major influence. In concept and structure it makes it easy to communicate about IC, even if as such IC is a highly complex and abstract phenomenon. This is its most valuable contribution. For measurement purposes on the other hand, the E&M model is too general, even if it has served as a good basis for the first-generation measurement methodologies. It gives some general guidelines for choosing the indicators for different IC categories, but no principles for calculating the weightings or the indexes. Finally, it does not focus at all on the influence of IC on economic growth.

Pulic's model takes a important step forwards in linking IC concepts to financial figures, but at this stage it confuses the basic concepts: their meanings change and become diffuse as the relations to financial figures are based on semantic intuition more than analyzed facts. The challenge ahead it to clarify how different IC components are reflected in the financial figures on the balance sheet of a company or a nation.

Neither the E&M model nor VAIC is able to establish the connection between IC and GNP *growth* through cause and effect. Cause and effect (of IC) necessarily involves either 1) the concepts of time or 2) the concept of inter-related dependency. Measuring IC levels and comparing them to GNP does not de facto reveal whether high GNP is the precondition for high IC or vice versa. It may well be that high IC is the antecedent of high GNP, for example the result of investments made possible through high GNP driven and sustained by non-IC factors (rich countries can afford higher education). Likewise, a high VAIC does not really reveal whether the added value is caused by market factors, i.e. by the difference between supply and demand. Neither model differentiates the cause and the effect.

Baruch Lev, on the other hand, is excellent in terms of demonstrating the effect, but he totally loses the essence of IC. This makes it difficult to identify what is behind the effect, i.e. what is really meant by intangibles. Evidently the residual from financial and physical capital also includes factors other than those included in the established view on IC, such as in the strategic or market-based perspectives.

The three IC approaches discussed in this chapter (Figure 9) focus on three facets of the same phenomenon, IC and its dynamics. The model developed by Edvinsson & Malone gives the conceptual tools and building blocks for understanding IC; Ante Pulic's model links IC in a structured manner to economics, and suggests the close connection between IC and economic performance; and the model put forward by Baruch Lev links economic performance to the real effects of intangibles. Thus the three models complement each other, and all make a clear contribution to IC research in general, and to IC measurement on the national level. However, there are still several open questions concerning national-level IC measurement, that have not been dealt with properly in any measurement approaches. These are introduced in the next section.

Figure 7: The contribution of the presented models to IC identification and measurement

7. National IC – measurement black spots

7.1 How could the effects on the economy caused by IC and other drivers be delineated?

The most frequently used way of showing the effect of IC on the national economy is to calculate correlations between IC indicators and GNP. However, this is misguided because the method does not recognize that 1) there are also other drivers that influence economies, such as natural resources, whose share in the national economy must be excluded before the IC-based effects are calculated, and 2) the level of GNP as such says nothing about its annual growth rate or growth trend.

Many national IC measurements have dealt with this problem. For example, in their IC evaluation of EU countries Andriessen & Stam found no statistical correlation between GDP and IC assets, but there were significant correlations between the effects of *Human* and *Relational Capital* and GDP per capita. "This indicates that the effects we are measuring are not only the result of intellectual capital, but also the effect of financial wealth. This may explain why Germany and Luxembourg score high on effects but much lower on assets." (Andriessen and Stam, 2004, p. 23). Bontis also takes up this issue. In measuring the IC of the Arab countries he points out that the effect of natural resources – such as oil – also needs to be accounted for. He clusters Arab states into the rich and the poor, and analyzes IC behavior in each group separately (Bontis, 2004, p. 32). In another study (Firer, 2003) the effect of natural resources in South Africa is assumed to explain why this country with high GNP and high productivity still has a low VAIC index.

National wealth is influenced by various economic non-IC drivers, which need to be acknowledged in order to expose the true relation between national IC and national economic growth. Focusing on GNP is misguided, especially when it comes to nations relying heavily on natural resources such as oil and energy, as these non-IC-based drivers alone produce high GNP levels. Likewise, having a high GNP, like most developed countries, does not necessarily ensure that growth is IC-driven: it could also be vice versa in that IC is produced as the outcome of wealth. The research task would then be to adjust GNP by reducing the effect of non-IC drivers in the economy. This should be evident, even based on the E&M model, as it clearly contains *Financial Capital* as a (mainly neglected) non-IC driver affecting national wealth, e.g., GNP and GNP growth. Furthermore, in order to distinguish between causes and effects, it is more informative to following developments over time than to measure the levels at a certain point. Thus the focus of the analyses must be transferred from GNP levels to GNP growth trends (see Ståhle and Ståhle, 2007; Ståhle and Bounfour, 2008). Most of the IC measurements have focused on its level, although it is evident that this cannot be regarded as an equivalent measure of its general effect.

7.2 IC as an economic driver is dependent on the developmental stage of a country

National economic drivers (IC level being one of them) are heavily dependent on the GNP level of the nation, and thus they are contextual in nature. The economic basis of a nation determines which set of IC drivers is most effective in boosting the economy (WEF, 2007). The preliminary results of Ståhle and Ståhle (2007) and Ståhle and Bounfour (2008) show that IC drivers of the economy (calculated in terms of IC-related indicators) have different effects on and relations with GNP growth:[7]

a. *Sustaining effect*: the present level of the indicator correlates with the present level of GNP annual growth.
b. *Boosting effect*: the present level of the indicator correlates with the GNP annual growth trend.
c. *Linear growth potential*: the growth trend of the indicator correlates with the present level of GNP annual growth.

[7] For the correlation analysis GNP was not corrected by taking into consideration nation-specific physical or financial drivers, i.e. natural resources. The countries were divided into three groups based on their economic levels, which to some extent corrected the errors, as those in the same groups had relatively similar economic structures. In order to verify and produce more reliable results the analysis will be conducted using corrected GNP values.

d. *Exponential growth potential*: the growth trend of the indicator correlates with the GNP annual growth trend.

Furthermore, the study found that the effect of a driver varies according to the developmental stage of the nation, and tends to saturate, i.e. to lose its power to enforce economic growth. Not surprisingly, all of the saturated IC drivers were found in economies with both a high level of GNP/capita and low or medium GNP growth rates. The saturation process could clearly be identified by analyzing the effects of the IC drivers separately according to the developmental stage of the economy. Saturation occurs mainly in two ways:

a. Drivers may turn into necessary *pillars* of developed economies, e.g. education in general. As this takes place over time the most saturated drivers are to be found in developed economies, e.g. the loss of mass-production efficiency as a competitive advantage or the transfer of literacy as an IC driver into media literacy in developed countries.
b. IC drivers are bound to *time and context*, e.g. technical knowledge and technology usage have a limited lifetime. Technological drivers cannot be merely transferred and repeated indefinitely in the expectation that they will endlessly enforce national wealth creation as such, or even work as they used to. As a challenge for developed economies this calls for continuous renewal and knowledge enhancement.

These and similar findings (e.g. Ortiz, 2006) highlight the necessity to acknowledge both intrinsic variations in IC drivers and their contextual dependency, i.e. that the effects of different IC drivers are specific and are dependent on the developmental stage of the nation (e.g. Weziak, 2007; Manuelli and Seshadri, 2006).

7.3 The next-generation measurement of national IC

The models and approaches used until now for measuring national-level IC and its economic effects form a good basis for further development. The results gained this far goes back to the groundbreaking conceptual work and the development of various methodologies by the IC community, starting from the initial work of Karl-Erik Sveiby and continuing to the present. In striving to gain ever more reliable knowledge on the effects of IC, however, we need the established measurement practices of the next generation.

In this sense there are at least six challenges to be met:

1. The inaccuracies in the definitions of the IC categories must be clarified. The current confusion reflects the choice and use of indicators, and results in various different applications in the analysis. This makes general cross-case comparison impossible.

2. The fit between the IC concepts and the corresponding a) statistic indicators and b) financial figures must be confirmed.

3. The problem of constructing composite indexes based on lower-level indexes must be solved in a scientifically reliable manner based on the interdependences of the subcomponents and their connection with economic growth.

4. The influence of non-IC drivers on GNP must be acknowledged in order to facilitate reliable analysis of the economic effects of IC.

5. Hypotheses concerning the similarity of micro- and macro-level indicators and their economic effects need to be proved correct or incorrect. The differences and similarities must be explicated from the measurement perspective.

6. The state of the economy must be taken into account in analyses of the effects of IC on GNP, since the IC drivers tend to saturate, and the dynamics of the effects are different at different economic levels.

The strategically sound steering and development of national IC will be possible after these problems, or some of them, are solved. Accurate and precise identification of the effect of specific IC components and their inter-relational dependencies will give decision makers a powerful tool for steering knowledge intensive economies.

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