

Understanding Dynamics of Intellectual Capital of Nations

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Abstract

The mode of wealth creation has changed from mass-production to an economy of knowledge, where the key drivers of economic growth are intangibles. The value-creating mechanisms of intangible assets and capabilities are radically different from those in the manufacturing era, and new theoretical and methodological approaches are needed for grasping them. The intellectual capital (IC) movement aims to tackle this challenge and construct methods for describing, measuring, reporting and valuating intangibles in organizations, regions, networks and nations.

In this paper, we concentrate on the *dynamic perspective* on IC, i.e. possibilities to tackle *the influence that IC has on performance*, in this case on national level. We argue that for a genuine contribution IC approach must be focused on the dynamic effects of knowledge and value creation, and that those effects must be reliably identified. By dynamics we mean the IC components which drive and boost economic growth in distinction from those being only results and antecedents of a booming economy. From a strategic point of view, it is important to identify the indicators that are strongest linked with economic (or otherwise desired) growth. On the other hand, if the analysis is made on a national scale, the possibility to identify even national specific economic IC drivers becomes eminent. The exercise we present here gives guidelines for reaching a higher growth level or to uphold an ascending growth trend of GNP. It could also act as an analytical framework for designing the context in which IC of nations can be adequately foreseen in a mid-long term perspective.

Key-words: Intellectual capital of nations, dynamic effects, dynamic capabilities, knowledge creation, value creation, value drivers

I- Introduction

Over the last ten years, intellectual capital (IC) has been the subject of several interesting developments, which led to its establishment as a recognised field of research and action. Yet, in spite of the already observed effort IC research is still in its infancy, and there is a need to consider to what extent it contributes in a sufficient way, to problematizing managerial and policy issues of the knowledge economy. One of these challenges lies in considering the dynamic aspects of performance, and how IC research can address it in a proper way.

To consider further this question, we briefly review the genesis of the IC perspective as a field of research, over the last fifteen years. The first wave started earlier-mid 1990s and adopted mainly a microeconomic perspective. It was for the most focused on how intellectual capital can be modelled, measured and reported on. Here, different models and taxonomies have been proposed [Edvinsson and Malone (1997), Sveiby (1997), Stewart (1997), Bounfour (1998a, 1998b), Roos et al. (1998), Canibano et al. (2002), Mouritsen, Bukh and Larsen, 2001, Lev 2001, Gu and Lev (2001), among others]. These contributions were useful in two ways. First they made evident the importance of intellectual capital for companies' competitiveness in the knowledge economy. And

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second, they help to establish a relatively homogeneous taxonomy by breaking down intellectual capital into three main blocks - human capital, structural capital, and relational capital, that is among those the most frequently used. Some of these taxonomies have extended to the analysis of intellectual capital performance at national level (Bontis, 2004, 2005).

Quite simultaneously, several scholars, taking a strategic management perspective, addressed the issue of IC management from a dynamic perspective. These scholars put forward the argument that we should go further the first generation of taxonomies, and instead of focusing on rather static categories of IC they emphasised that different elements of IC play different roles in different contexts, for specific types of companies or for specific types of organisations. The dynamic aspects of IC appear here as closely related to the idiosyncratic nature of performance.

The dynamic approach to intellectual capital has been developed by IC strategist scholars. Its roots can be found in the resource-base view of the firm (RBV) as well as in the dynamic capability approach. RBV considered the firm as a bundle of resources - mainly intangibles (Barney, 1991, Grant, 1996, Peteraf, 1993, Wenerfelt, 1984). From this framework resources that are of high relevance for competitive advantage are specifically those which are valuable, rare, inimitable and non-substitutable (the so-called VRIN attributes). This framework has been the subject of many critiques, related notably the difficulty of defining and identifying VRIN resources.

The dynamic capabilities approach aimed at addressing some of the RBV weaknesses, especially by providing a more operational analytical framework. Teece, Pisano and Shuen (1997) defined dynamic capability as "the firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments". A concept similar to the "combinative capabilities", as defined by Kogut and Zander earlier (Kogut and Zander, 1992). This definition has been criticised by Zollo and Winter, as they consider it "as troublesome near-tautology in defining a capability as ability" (Zollo, Winter, 1999: 4), and from their perspective the conditions of formation of capabilities are not explicitly defined by Teece et al. They connect *capability* with *routine*, especially in the context of what they called "knowledge evolution cycle". Therefore, the authors defined a dynamic capability as "a learned pattern of collective activity through which the organization systematically generates and modifies its operational routines in pursuit of improved effectiveness" (Zollo, Winter, 1999: 10). In a later paper Winter (2002) addressed in more details the issue of dynamic capabilities. He made a distinction between ordinary "zero level" capabilities, (i.e. those capabilities that "*permit to the firm to make living in the short term*") from dynamic capabilities that contribute to the extension, modification or creation of ordinary capabilities. These have been named elsewhere "high-order capabilities" (Collis, 1994).

Eisenhardt and Martin (2000) defined dynamic capabilities as a set of identifiable and specific processes (development processes or alliance processes etc.) dedicated to articulating resources and competencies within companies, e.g. Toyota's system for product development or Cisco's approach to competences building and web-based articulation or Nokia's development processes. These processes are endowed with commonalities in key features and idiosyncrasy in details. Recently Leoncini, Montresor and Vertova (2003) proposed an interesting literature review on dynamic capabilities from two perspectives: the organisational lens (strategic & evolutionary) and environmental lens (*milieu innovateur*, industrial district, regional system, new industrial space approaches). They also suggest a system approach for analyzing dynamic capabilities. A system-based dynamic IC view has also been developed in Finland by Ståhle (Ståhle & Grönroos, 2000, Ståhle & Hong 2002, Hong & Ståhle 2005, Ståhle et al 2003) and its practical applications have been widely implemented in the country. Kianto (former Pöyhönen) has further developed this Finnish approach on dynamic IC (Pöyhönen 2004) and she notably put forward the lack of a shared understanding with regards to

this dimension. Kianto concludes to the importance of developing a roadmap for intellectual capital dynamics in the research area and praxis (Kianto, forthcoming).

All these dynamic approaches have concentrated on IC at organizational level, and it is still an open question to what extent the organizational IC approaches can be extended to national levels. We think that organisational and microeconomic frameworks should be used and interpreted with care in the context of national levels (Bounfour, 2003b; Bontis, 2005; Pulic, 2005; Stähle & Stähle, 2006). However, some statements of the issue can be made. First, the performance of an organisation/a nation is mainly based on the deployment of a "combinatory function". Such a combinatory function is for the most organisation/nation specific and distinctive by nature. This is a fundamental basis in the current IC literature. And second, there is a clear opportunity to mobilise IC based resources for supporting an organization's/a nation's performance, provided that the effective IC drivers are properly identified. On the other hand, since there is no established framework for national IC, respective research must be deployed on experimental bases. Such a set of experimental approaches should constitute the hub of the analysis of country specific dynamic capabilities.

II- How to tackle IC dynamics of Nations?

When moving to national level IC dynamics, the organization level definitions of IC can be partly taken as a point of departure. The presented taxonomies help identify IC indicators, idiosyncrasy and systems perspectives refer to interdependency of various indicators, and dynamic capability approach emphasizes the strategic dimension of IC – all these are important also on national level analyses. However, the tools and methodologies presented by these IC approaches as well as the respective definitions of IC dynamics are still as such insufficient for reliable national level analyses. In this paper we mean by dynamic perspective simply the *influence and impact* that different elements of IC have on economical (or otherwise desired) performance. We argue that the focus on national level analyses must be put on the real effects of IC, and for basic analyses these need to be identified on national statistics and numerical data. The perspective of the analyses must be focused more on dynamic *IC drivers* than dynamic capabilities or IC taxonomies. In this paper we make an exercise towards a framework and principles for an analyses that could tackle IC dynamics of nations.

The point of departure

The core questions of the dynamic effects of national intellectual capital are:

1. How to identify and grasp the *real effects* of IC?
2. *On what bases* can an IC category or an IC driver be counted as a value driver for a nation?

In order to answer the first question we need effective tools and methods to recognize

- a. IC indicators as reflections or antecedents of GNP growth, i.e. cases where high R&D investment rates are a result of the GNP, not vice versa
- b. IC drivers that affect positively on GNP growth, i.e. cases where investments in infrastructure boost economy
- c. the net effect of both IC drivers and non-IC drivers on GNP, especially the ratio and relation between them.

The first two remarks (a and b) point out that there are cases where the present levels of IC as well as the investments in IC are results of a booming economy instead of being actual drivers for it. This is the case for such developing economies as China, India and Russia, where the investment in IC (i.e. education and R&D) is the result of the economic upswing.

The third remark (c) is more crucial in the context of this paper. To identify the real effects of IC we need to acknowledge also the non-IC drivers, and conceive GNP growth as the combined output of IC and non-IC factors. We state that direct comparison of IC and GNP growth is either misleading or completely wrong (see also Bergheim, 2005, Hoffman, 2005). If the analysis solely operates with the levels of IC indicators and GNP growth rates, it is incapable of identifying the various dynamics of the effects: sustaining effects, boosting effects, linear growth effects and exponential growth effects of IC drivers (see Stähle & Stähle, 2006 and Zanaki & Becerra-Fernandez, 2005, Diamantopoulos, 1999).

The focus of the analyses must be on dynamics, which means discerning cause and action from one another. Practically we need to focus on time dependent effects as well as on trends, not the mere static levels of IC components.

To demonstrate this we made the analyses on time dependent relations between IC and GNP growth. As a basis for the analysis we used the data of IMD Competitiveness report 2005 (IMD, 2005a), which covers 51 countries and the total of 331 indicators of each country, and data for each indicator from the span of 2000 - 2004. IMD has grouped the indicators in four sections for each country: 1) economic performance, 2) government efficiency, 3) business efficiency and 4) infrastructure on a national level. Infrastructure encompasses the main IC indicators, i.e. education, R&D expenditures, and ICT investments. Some IC linked indicators can be found in other sections too, i.e. "Attitudes and values" in the section of Business efficiency. We divided all the countries into three groups by using a weighted average of the IMD infrastructure ranking and the main IC linked indicators in the other sections as the criteria.

Thus we formed three groups, each including 17 countries:

1. Developed economies (possessing high infrastructure and IC).
2. Transitional economies (possessing elements of both high and low infrastructure and IC).
3. Developing economies (possessing low infrastructure and IC).

We proceeded by analyzing different relations between indicators and GNP annual growth, and focused on the differences between *level*, *growth* and *trend* for both indicators and GNP. As an analysis tool we used correlation between indicators and GNP with and without *time lags*, i.e. we analysed the correlation to previous years and years ahead respectively. *Growth* was calculated as the *annual percentage change* with respect to previous year, and growth trend as the trend value for annual growth 2005 based on 2000 - 2004 data. We chose *Annual growth of GNP* instead of *GNP* or *GNP per capita* as the base for the analyses for two reasons: 1) to stress the growth perspective in contrast to mere levels of GNP and 2) when processed in this way a positive trend reflects a booming economy.

In the analysis we found that IC with the related indicators had four kinds of effects on a nation's GNP and its annual growth:

- ❑ **Sustaining effect:** the present level of the indicator correlate to the present level of GNP annual growth.
- ❑ **Boosting effect:** the present level of the indicator correlate to the trend of GNP annual growth.
- ❑ **Linear growth potential:** the growth trend of the indicator correlates to the present level of GNP annual growth.
- ❑ **Exponential growth potential:** the growth trend of the indicator correlates to the trend of GNP annual growth.

Example of indicators relation to GNP growth

In figure 1 *Computer density* as a potential IC driver is analyzed through its relation to GNP growth in different groups of economies. The analysis shows that the effects vary significantly. First, the level of *Computer density* has no significant sustaining role in developing countries ($r= -0,02$). Secondly, the growth of *Computer density* strongly enforces economic growth in developing countries ($r= 0,11$). Thirdly, in the economy of the developed countries *Computer density* has both a sustaining function ($r= 0,14$) and a boosting effect ($r= 12$) by the present level. However, on the developed level of economies increasing computer density does not have any further impact on economic growth any more.

[TAKE 1]

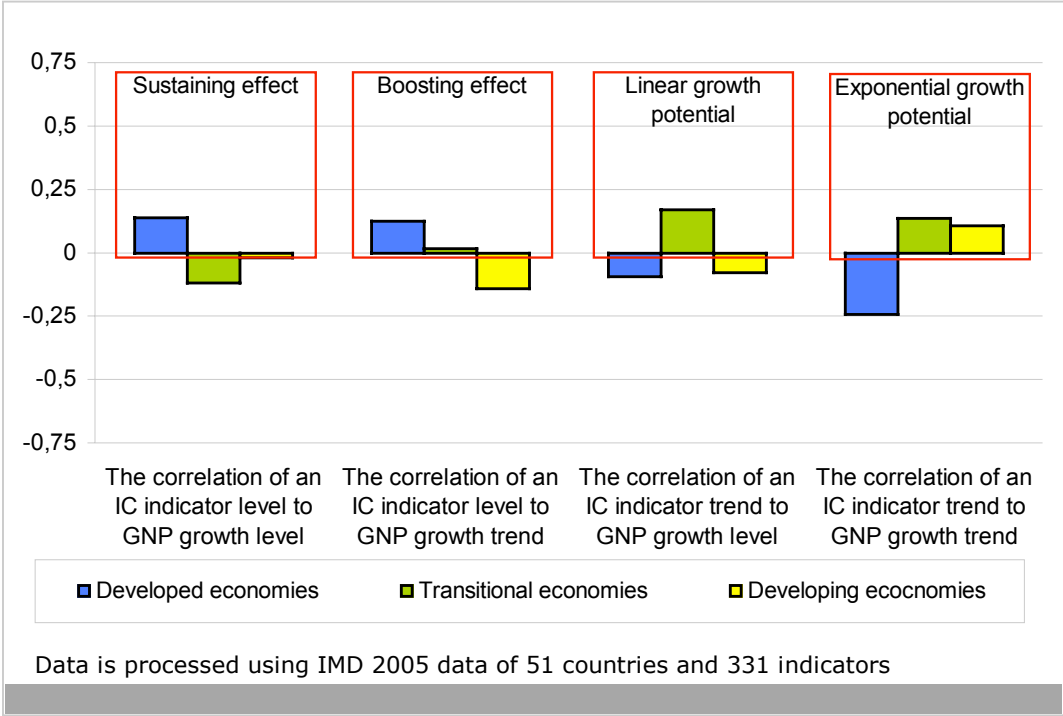


Figure 1: *Computer density as an economic IC driver in different groups of economies*

The example of the overall analysis clearly shows that we cannot speak about indicators and their relations to GNP growth just in general – or only as one kind of a relation (as in Bontis 2004 and 2005). It is always a question of a) which kind of relation we refer to and b) the socioeconomic context, i.e. developmental stage of the economy in focus. The connections are nonlinear and tediously complex, and every simple approach and formula is doomed to fail. If we neglect the diversity and extreme *dynamic interrelatedness* of the indicators, we cannot get any reliable results, since no simple regularities can be found. However, this example also demonstrates how the multidimensional analysis of individual IC indicators can give reliable information on the dynamics of the indicators. From a strategic point of view it is important to identify those indicators that are strongest linked with economic (or otherwise desired) growth. From the perspective of investments the analysis gives detailed guidelines according to the purpose, either for reaching a higher growth level or to uphold an ascending growth trend of GNP. On the other hand, if the analysis is made on a national and national specific scale the possibility to identify even *national specific economic IC drivers* becomes eminent.

Saturation of the drivers

The previous example (Fig 1) exposes also another phenomenon, which needs to be acknowledged, namely the *saturation* of IC drivers. Focusing on the effect of the driver in question, we note that in developed countries the driver can not be powered further by continuously increasing its level, for example by further increasing computer density. In developed countries the density has already reached its practical maximum where *more* becomes excessive and disproportionate. In general this means that the *boosting effect* of IC drivers tend to dry out, i.e. their capability to further advance economical growth or enforce increasing competitiveness may weaken or even vanish over time (see also Bergheim, 2005).

This is in fact self evident from a practical point of view: By necessity investments in general, and especially in IC, always reach the limits where the increase of the investment becomes unprofitable, useless or impossible. This finding is specifically true for economic drivers. For example Inglehart (1997) and Neuhaus (2005) have shown that democracy and trade openness effectively boost economy in certain circumstances. Nations can consequently benefit from the boosting effect on its economy when democracy is introduced (as in present Russia) and developed or market openness introduced and increasingly developed (as in present China). Likewise natural resources and their utilization strategies can in the opening global economy fundamentally change the economic basis for nations (as in present Russia and some Arab states, where economic growth is vastly based on energy and oil). However, democracy and market openness reaches levels and limits where *more* becomes inappropriate and the drivers have reached their practical climax at some point, as is the case for most western countries in their present stage. Likewise the importance of basic raw materials changes over time and may even vanish.

In our study all the saturated IC drivers were found in the economies that have both a high level of GNP/capita and low or medium growth rates of GNP. The saturation process can clearly be identified by analyzing the effects of the IC drivers separately in three groups of economies according to the developmental stage. Saturation occurs mainly in two ways:

- ❑ Drivers can turn into necessary ***pillars*** of developed economies, i.e. education in general. As this takes place over time the most saturated drivers are found in developed businesses, i.e. 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.
- ❑ The IC drivers are bound to ***time and context***, i.e. technical knowledge and usage of technology as IC drivers have a limited lifetime. Technological drivers can not only be transferred and repeated indefinitely with the expectation that they endlessly enforce national wealth creation as such, or even work at all as they used before. As a challenge for developed economies this calls for continuous renewal and knowledge enhancement.

To demonstrate this further we took another IC driver as an example, *Computer usage* (Figure 2).

[TAKE 2]

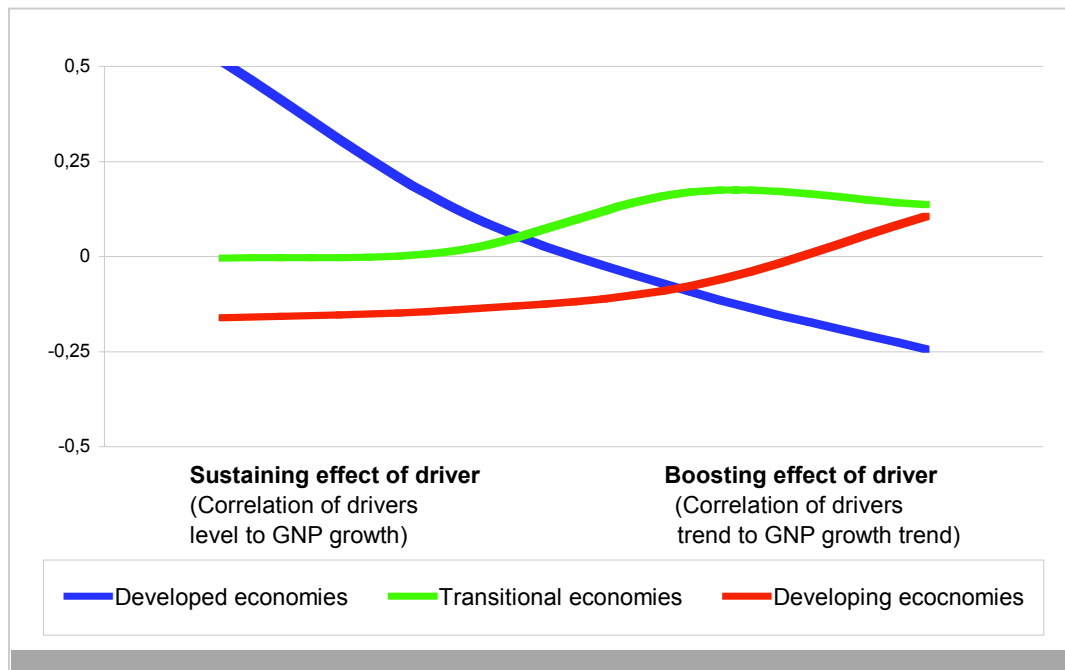


Figure 2: Computer usage as an economic IC driver in different groups of economies.

The result clearly indicates that computer usage has become a necessary pillar of a developed economy ($r = 0,51$), but in the same time it has lost its ability to significantly boost up economy any more ($r = -0,24$) or to give competitive advantages compared to other developed economies. The boosting effect of computer usage can only be found in transitional ($r = 0,14$) and developing economies ($r = 0,11$). The practical conclusion therefore is that the investments in computer usage have a major impact on GNP growth only in Transitional and Developing economies. Logically one could argue that using for example *Computer usage* as a main indicator of IC in developed countries has little or no relevance as the indicator due to its high level is saturated and gives no relevant or additional information as how the efficient IC varies by countries. But in the transitional and developing economies instead enhancing computer usage is a major economic IC driver. Accordingly when measuring IC on a national level the national socioeconomic differences that affect IC and its drivers must be taken in consideration. Only this way the effective national IC can be identified and measured.

Both results, saturation of IC drivers and their dependency of the developmental stage of the economy, refer to the following conclusion: ***The effect of IC and its components is situational.*** The actual value and present efficiency of economic IC drivers can never be evaluated independent of its context (i.e. the level of economy). Thus IC is both contextual and altering by nature. Accordingly it is impossible to measure or define IC of a country independent of its strategic environment and capability of exploiting it.

Socioeconomic dependency of economic IC drivers

In order to go further in understanding the dynamic effects of IC on national wealth creation, we wanted to know whether there are general structural differences between IC based economic drivers. We used the IC indicators in IMD 2005 data, 99 indicators in all and

- analyzed the IC indicators correlation to GNP growth using four classifications of correlation between indicator and GNP growth
 1. indicators' present level – present GNP growth level
 2. indicators' present level - trend of GNP growth
 3. indicators' growth trend - present GNP growth level
 4. indicators' growth trend - trend of GNP growth
- counted the percentage of those cases, where the indicator had the strongest positive linkage to *GNP growth* or *trend of GNP growth*, i.e. highest correlation on each level of economy.

[TAKE 3]

IC Drivers by type and economy			
IC drivers by type, percentage	Economy		
	Developing	Transitional	Developing
1. indicators present level - present GNP growth level	A 37,4	19,2	43,4
2. indicators present level - trend of GNP growth	35,4	43,4	21,2
3. indicators growth trend - present GNP growth level	16,9	59,6	23,6
4. indicators growth trend - trend of GNP growth	B 47,2	36,0	16,9
Drivers total	34,2	C 39,5	26,3

Table 1: IC drivers by type and economy in different groups of economies.

At this stage the following interpretations of the results (Table 1) of the analyses are tentative:

1. IC drivers function differently depending on the developmental stage of the economy.
2. The simple increase of IC levels (Case A) benefits developing economies. 43,4% of these drivers work best for developing economies, and only 37,4% for developed economies. This means that developing economies still have possibility to utilize a broad spectrum of non saturated IC drivers by simply increasing the level of specific drivers, e.g. education attainment. The developed economies have exhausted this possibility since the level of the driver has already reached its practical peak. This is the case for example primary education where enrolment ratios in developed countries are 90 – 100%, and 20 – 50% in developing countries. In line with the finding that one year of over all education of the population generally increases GNP per capita by 10% (Bergenheim 2005) – but years of education can not be increased infinitely.
3. For developed economies every additional effort put into the strengthening of IC drivers (Case B) affects the economy positively: 47,2% of the drivers add to economic growth for developed economies by the trend of the driver, compared to 16,9% for developing economies. This sustains the perception that developed economies utilize different drivers than developing economies, and the drivers work on different premises and with different dynamics. An example of this is presented in **figure 3**, where R&D intensity is analyzed in different economies. The example shows that R&D clearly works best for developed economies by how strongly the nation can increase its already high R&D intensity, i.e. R&D boosts

economy by the high volume of crisp dollars available to do the job. In this sense R&D investments as % of GNP have effect only when the GNP is on a sufficiently high level.

4. Transitional economies may utilize both aspects (Case C): focusing on basic IC together with advanced IC is an effective combination. It is created possessing the broadest spectrum of drivers, 39,5% of drivers total compared to 34,2% for developed economies and 26,3% for developing. This follows the logics that a) transitional economies may utilize both types of economic IC drivers (drivers typical for developed countries and drivers typical for developing countries) and b) developing economies need to focus more on pure basic economic IC drivers.

[TAKE 4]

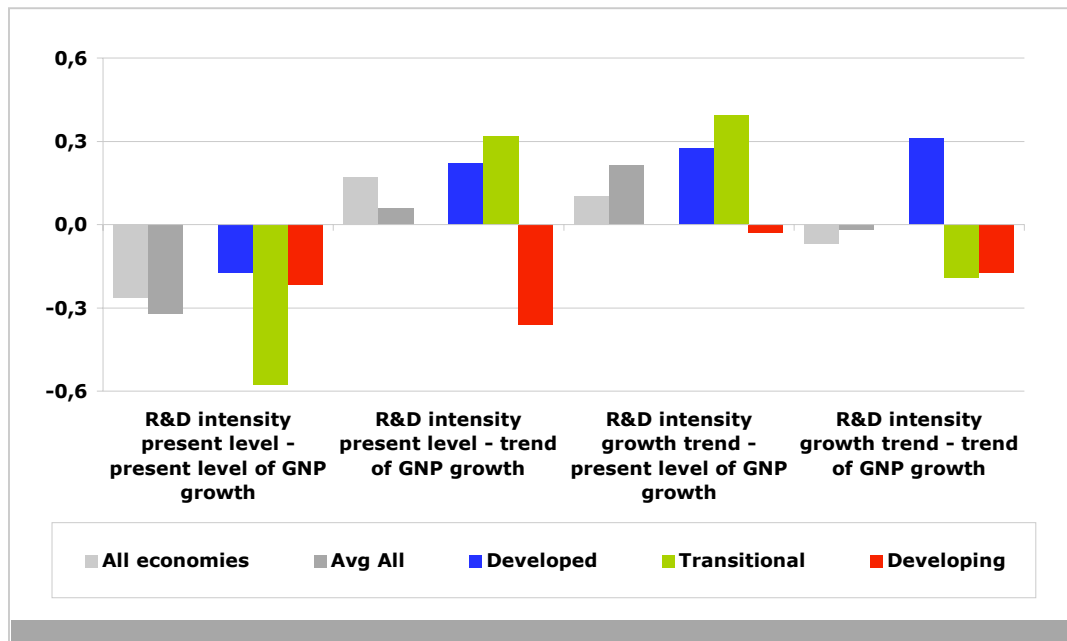


Figure 3: R&D intensity as an economic IC driver in different economies based on the correlation to GNP growth.

Acknowledging socioeconomic and dynamic differences

Two major institutions, World Economic Forum (WEF) and Institution for Management and Development (IMD) have in their reports from the present year (2007) acknowledged the importance of different economic levels in the analyses.

- WEF introduced the concept of **developmental stages of economies** in calculating the Global Competitiveness Index (WEF 2007). The developmental stages are defined as 1) Innovation-driven, i.e. high GNP per capita, 2) Efficiency-driven, i.e. medium GNP per capita, and 3) Factor-driven, i.e. low GNP per capita.
- IMD introduced **Customized rankings** of the Competitiveness Index (IMD 2007). The customizing factors are 1) level of GNP per capita, 2) population size (domestic market size) and 3) geographical area (Europe or South America etc.).

Both approaches are in line with the general findings presented in this paper, but do not entirely perceive the complexity involved. As for now IMD gives the user only the possibility to select countries by customizing selection of criteria, whereas the criteria do not affect the processing of the indexes as such. WEF on the other hand uses a rather cut down approach by typing developmental stages only by GNP per capita and weighting only main high-level sub indexes (Table 2).

[TAKE 5]

Weighting of subindexes at each stage of development			
	Basic efficiency	Efficiency enhancers	Innovation and sophistication factors
	Weight %		
Developmental stage			
Factor-driven	50	40	10
Efficiency-driven	40	50	10
Innovation-driven	30	40	30

Source: WEF, 2007

Table 2: Weighting of the sub indexes at each stage of development, WEF 2007.

Based on the comparison of Table 2 to the complexity of R&D intensity (Figure 3) or computer usage (Figure 2) as economic IC drivers we argue the following: in order to measure national IC (and its influence on national competitiveness) the impact of the dynamics and socioeconomic dependency of economic IC drivers need to be fully comprehended, analyzed and modelled in rigorous detail. This urge is appallingly evident when comparing *average* correlations of for instance R&D intensity to GNP growth (Figure 3) or correlations of the same driver over *all* countries to behaviour of the driver on different developmental stages of economy. Generalizing or over simplifying socioeconomic dependencies and differences in dynamics lead to simply wrong and misleading results.

To expose the full complexity we plotted 105 IC indicators in the same graph interpreting the weight of the indicator as = 1 + correlation of indicator to GNP growth. If the indicators' correlation to GNP growth was 0,5 the weight would be plotted as 1 + 0,5 =1,5. As can be seen in figure 4a and 4b the variation of behaviour leaves no room for generalization: Each indicator and its relation to GNP growth as a driver is specific and dependent on the developmental stage of the economy.

[TAKE 6]

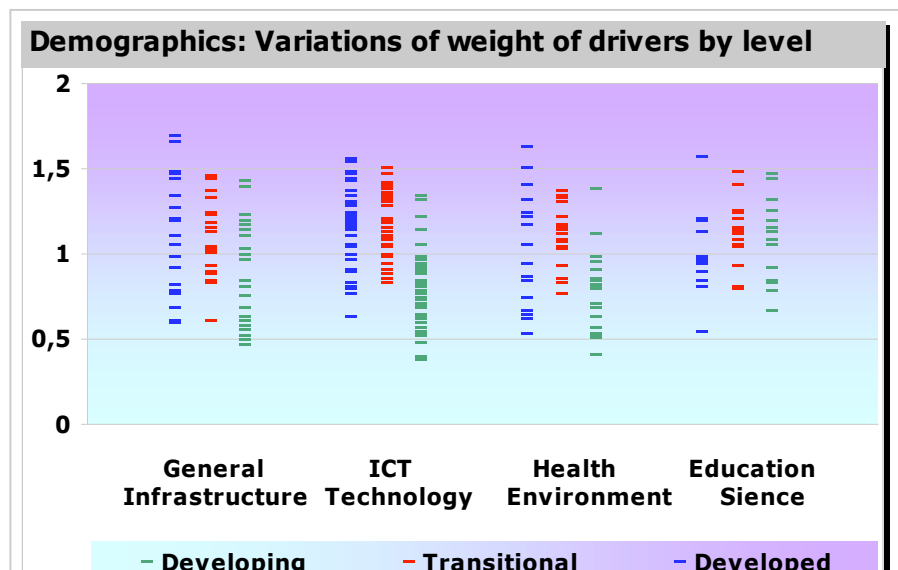


Figure 4a: Variations of weight of drivers by level of indicator and developmental stage of economy.

[TAKE 7]

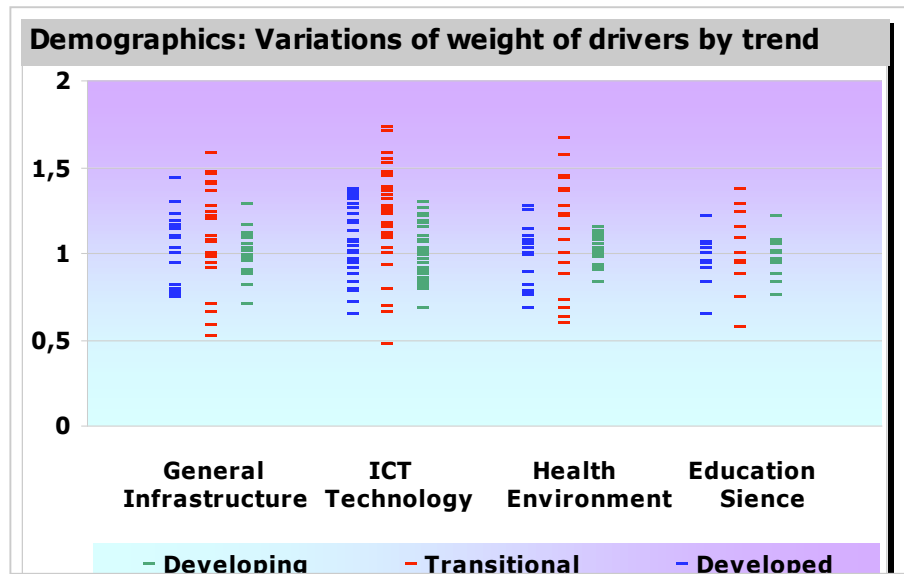


Figure 4b: Variations of weight of drivers by trend of indicator and developmental stage of economy.

III- Conclusions

Intellectual capital is no doubt a major factor for economical growth. Even if not all IC components boost economical growth, they are still necessary components of developed economies. Some IC components function as pillars, some as drivers for economical growth in developed economies, and these pillars and drivers are different in economies on dissimilar economic levels. These facts make IC analysis complex, since the results cannot be projected into different contexts without meeting developmental resemblances of the economies.

The analysis further shows, that not all economical drivers can be regarded as IC in its original meaning, e.g. trade openness or utilization of natural resources. This makes the identification of IC rooted economical effects even that more difficult. Our study outlines how analysis that focuses on the *dynamics of IC (= time dependent and driver specific relations)* gives new insight into how IC effectively is linked to national economical growth in different situations. This insight, though tedious to accomplish, sharpens insight on how to measure the real value of IC and how national specifics are to be acknowledged in the measures.

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