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Knowledge management, intellectual capital, structural holes, economic complexity and national prosperity

Göran Roos
Intellectual Capital Services Ltd, London, UK

Abstract
Purpose – The purpose of this paper is to tie together the insights from the body of research relating to economic complexity theory, structural holes, non-price based competition, and knowledge management. The insights relating to generating national prosperity are synthesised through an intellectual capital lens.
Design/methodology/approach – The paper uses literature review combined with insights from an Australian project on state-based economic complexity.
Findings – The connectivist and autopoietic epistemological paradigms are found to be most aligned with the need to manage transformation between organisational and human resources that will achieve causal ambiguity and hence inimitability. This inimitability forms the basis for achieving non-price based competition and if there is a rich network of economic agents that, both individually and collectively through collaboration, have these characteristics a large share of the economy can operate on the basis of non-priced based competition. If all these agents have an export focus the economic complexity of the economy will be high, and likely increasing, which will enable both the creation and the appropriation of large amounts of value and hence result in increasing national prosperity.
Research limitations/implications – Findings are only relevant for OECD countries given the origins of the data used.
Practical implications – Managerial implications are outlined as are major implications for public policy.
Originality/value – This is the first time that these concepts are linked.

Keywords Knowledge management, Intellectual capital, Economic complexity, National prosperity, Non-price-based competition, Structural holes

Paper type Conceptual paper

National prosperity
Prosperity is a function of the value that an economy can both create and retain. Key drivers of national prosperity have been argued to be well-functioning institutions (North, 1990), good institutional infrastructure, capital accumulation, free trade, efficient markets, personal initiative, and appropriate role for government (Smith, 1776).

Today’s economists generally point to three important characteristics influencing growth: the extent of a country’s openness to trade and its integration with the rest of the world; the quality of a country’s institutional infrastructure; and the success of its policy makers in implementing the measures necessary for macroeconomic stability (Greenspan, 2002, p. 4). Additional drivers for economic growth through competitiveness are as follows: a highly and relevantly educated labour force[1] that together with the appropriate infrastructure can innovate and that through concentration (normally in cities) in the form of clusters generate untradeable spillovers (Berube, 2007).

Oprescu (2012) linked national intellectual capital to national competitiveness, and similar work aimed at linking national intellectual capital with economic growth, prosperity and/or national competitiveness have been carried out by[2], e.g. Bontis (2004), Andriessen and Stam (2005), Bounfour and Edvinsson (2005), Ståhle (2007), Edvinsson and Lin (2008), Lin and Edvinsson (2010), Käpylä et al. (2012), Lazuka (2012), Salonius and Lönnqvist (2012), Seleim and Bontis (2013), Januškaitė and Užienė (2015), and Mačerinskienė et al. (2016).
Some of the studies aim to explain the dynamics of intellectual capital at the national scale, while others focus on how national intellectual capital can be optimised and guided to enhance economic growth.

These approaches and studies all use an indicator-based approach towards capturing intellectual capital, and critical questions aligned with measurement theory can be asked around the selected indicators, e.g. is the chosen set of indicators complete? Are the indicators distinct from each other so that no double counting takes place? Is construct validity in place for the indicators chosen as relates to the construct that is to be captured? And finally, is the non-additive combinatorial behaviour of the indicators captured when they are aggregated? (For a detailed discussion of these issues see Pike and Roos, 2007). Since many of these answers would have to be negative there are questions to be asked around the meaning of the correlations between the intellectual capital indicators found and the national construct studied, that is frequently found. Based on these studies and the critique of the methodologies used it is neither possible to reject the relationship between national intellectual capital and prosperity nor to reject that there is no relationship. It seems likely that many of the indicators are, as far as can be judged from the published studies, also indicators of the previously mentioned known drivers of national prosperity.

The way the concentrating and dispersing forces of economic activity change over time impacts the benefit of proximity vs the benefit of dispersion as relates to competition for access markets and to increasingly scarce resources which in turn impacts a nation’s ability to capture the increasingly mobile flow of capital and people. Technological externalities add to the concentrating forces since networks of regionally clustered businesses and institutions provides for both the formal exchanges of knowledge through market relationships, where proximity allows the establishment of closer ties, and the informal exchange of knowledge in social networks of individuals (Döring and Schnellenbach, 2006). Those beneficial aspects of close proximity which firms cannot control or achieve in any other way than through close geographical and specialisation proximity have been named untraded interdependencies by Storper (1995). The importance of agglomerations has found empirical support in work by, e.g., Graham (2006, p. 26) who found that a 10 per cent increase in the level of agglomeration is associated on average with a 1.25 per cent increase in aggregate productivity in the UK.

Pecuniary externalities are a by-product of market interactions in imperfectly competitive markets in the presence of market mediated linkages which has a positive impact on the concentrating forces. The reduction in transportation costs and the diseconomies of scales for agglomerations (e.g. disease, waste handling, crime, etc.) has also contributed to the concentrating forces (Fujita and Thisse, 2013).

Our understanding today is not to dissimilar from the understanding articulated by Thünen (1826) and the conclusion is that the presence of attractive, well-functioning, well internally and externally connected large cities is an increasingly important driver for the creation of value that underpin national prosperity. This was confirmed by some statistics in Berube, 2007, p. 7) that show that in 2005 the 100 largest metropolitan areas in the USA had 12 per cent of the surface area and 65 per cent of the population but: generated recipients for 94 per cent of venture capital funding, had 81 per cent of all R&D employment, received 80 per cent of all NIH/NSF funding, generated 78 per cent of all patents, had 76 per cent of all knowledge economy jobs, and had 75 per cent of all degree holders. Further underpinning of this can be found in Devitt (2009) and in Naudin (2013) that estimated that around 66 per cent of global economic activity and about 85 per cent of technological and scientific innovation can be attributed to 40 urban mega regions.

In the intellectual capital literature, there has been several approaches to measuring the intellectual capital of cities, e.g. Carrillo (2004), Viedma (2005), Queiroz et al. (2005), Schiuma et al. (2008), Cabrita and Cabrita (2010), Ergazakis and Metaxiotis (2011),
López-Ruiz et al. (2014), Matos (2014), Dameri and Ricciardi (2015), and Krušinskas and Bruneckienė (2015). The same issues arise around these indicator-based approaches as around the ones for nations above albeit there seem to be some interesting insights gained that support research findings from, e.g., economic geography (see e.g. Swann, 2006). Adler and Kwon (2002) summarised several studies that found how social capital facilitates the creation of intellectual capital, the resource exchange between firms, innovation, entrepreneurship, and supplier relationships within clusters.

The key insight from this section is that the ability to capture value is increased if a large share of the economy has managed to achieve non-price based competition in the global market, which requires the ability to produce goods or services that cannot be produced by anyone else and for which there is a high demand on the global market. This normally requires continuous innovation that in terms in facilitated by being in proximity to relevant agents and being able to develop and deploy the exiting intellectual capital.

Economic complexity
Economic complexity analysis has been developed as a method to identify current export capability as well as predict future economic growth (Hidalgo and Hausmann, 2009; Hausmann and Hidalgo, 2013; Hausmann, Hidalgo, Stock and Yildirim, 2014). EC analysis has been used at a global level (Hausmann, Hidalgo, Bustos, Coscia, Simes and Yildirim, 2014; Felipe et al., 2012), the national level (Hausmann and Hidalgo, 2013), the sub-national state level (Reynolds et al., 2017), and at the city level (Nepelski and De Prato, 2015).

The core concept of economic complexity is that specific products are produced when a combination of different resources (e.g. monetary, physical, relational organisational, and knowledge) are deployed in a, for the economy, unique way. The economic complexity theory proposes that since physical endowment resources and monetary resources are scarce, the growth of available knowledge will determine the amount of new products that can be produced, specifically for export, in an economy. It is the differentiation of primarily knowledge capital between economies that will contribute to shaping a specific economy’s economic complexity.

The economic complexity of an economy is, as indicated above, also influenced by: relationship capital, e.g. cultural propensity to collaborate, the extent to which firms participate in global value chains, the extent to which firms are involved in export activities, network and agglomeration economic effects due to the density of economic agents, etc.; and organisational capital, e.g. institutions, institutional structure and stability, policy landscape and the predictability of this landscape, available information, etc. Due to the difficulty in capturing these two forms of capital they are not considered in the economic complexity modelling and hence economic complexity can only explain about 70 per cent of the prosperity development (or economic transformation) in an economy, using $r^2$ as a measure (Reynolds et al., 2017).

The integration of economic complexity and intellectual capital has shown to be fruitful in, e.g., Hartmann et al. (2014). Using indicators for intellectual capital (human capital, structural capital, and relational capital) combined with economic complexity they construct an innovation capability indicator on the national level which in turn is an indicator for future prosperity.

The amount of knowledge capital in an economy can be expressed in terms of how many different products are exported by an economy (labelled diversity) and how common, across all economies, the export of a given product exported by the economy is (labelled ubiquity). Diversity captures the breadth of the knowledge base of an economy and ubiquity captures both how close to (or far from) the knowledge frontier the economy is as well as if the economy has all the requisite knowledge for producing a given product. The more products the economy is able to export both in absolute terms and as a share of the products
produced, and the fewer other economies are able to produce and export these products, the more value can be captured by the economy. This information is captured in the economic complexity index articulated from the diversity and ubiquity of the economy.

The discussion in this section follows that achieving a high level of economic complexity means that a large share of firms will have achieved non-price based competition. This in turn means that we need to understand how non-price based competition is being achieved and how we can increase the share of firms that achieve non-price based competition.

Structural holes
The ability to generate and embody new knowledge into offerings (i.e. the ability to innovate) has a higher dependency on network structures within the economy the higher the economic complexity of the economy. A single company cannot innovate a new complex product offering, like, e.g., a conventional submarine, on its own but is instead highly dependent on the network of which the firm forms part. This network needs to be large, i.e. have the ability for any network participant to reach many other participants due to the size (number of participants) in the network. This size provides scale (Ahuja, 2000), speed (Moreira and Markus, 2013), complementarity (Richardson, 1972; Arora and Gambardella, 1990; Richardson, 2003; von Raesfeld et al., 2012; Broekel and Brachert, 2015), and knowledge sharing (Berg et al., 1982).

The network also needs to be complex, in the information theoretical sense (see Wilhelm and Hollunder, 2007), in order to both minimise the route from any given participant to any other participant and to maximise the number of new knowledge domains that can be created due to the interaction between exiting knowledge domains that resides within organisations that form part of the network (i.e. the network needs to be neither extremely democratic nor extremely dictatorial in the meaning of Wilhelm and Hollunder, 2007). All of this must also be underpinned by a high propensity for collaboration since coordination through collaboration is increasingly important when the focus is on the ability to develop and exchange knowledge (Andersen, and Drejer, 2006; Andreoni, 2014). A lack of connections between participants in a network indicates the presence of structural holes and if this lack of connections could be bridged the network would increase its productivity.

The positive impact by spanning or reducing the presence of structural holes are shown on the individual level within firms (Tortoriello, 2015), and on the firm level within intra-firm networks (Talmud, 1994; Dyer and Noeoka, 2000; Zaheer and Bell, 2005; Liao and Phan, 2015). The importance of network structures, structural holes, and the network centrality has been shown to matter for both innovation performance and inward investment on the sub-national level, national level, and global level (see e.g. Shi et al., 2012; Guan et al., 2015).

The linkage between intellectual capital and structural holes is discussed in, e.g., Burt (2002) with a focus on the social capital as the contextual complement to human capital and that, in the words of Putnam (1993, p. 167) can improve the efficiency of society by facilitating coordinated action, identified that areas of weak connections in networks create competitive advantage for those whose networks span this area of weak connections – or structural hole. The way in which Burt (2002) use the concept of social capital is very similar to the way in which relational capital is defined and used in parts of the intellectual capital literature (see McElroy, 2002; Pomeda et al., 2002; Roos et al., 2005). Lock Lee (2008) show a strong link between social capital and firm performance and Lock Lee and Guthrie (2011) builds social capital into intellectual capital and show how intellectual capital contributes to building firm and network performance by bridging structural holes.

Given that it is possible to scale the structural hole and intellectual capital linkage and reasoning from the level of the individual to the level of the firm, and from the level of the firm to the level of the network it is a logic of scalability that it can be further extended to the level of the economy as a whole.
The conclusion from this section is that national prosperity generation can be strengthened by filling structural holes, normally by attracting and introducing partners coming from ecosystems whose knowledge and resources are locally lacking (Padgett and Ansell, 1993; Klerkx and Leeuwis, 2008). The benefit of doing this within an otherwise large network structure is proportional to the collaboration propensity between the agents in the network.

Non-price based competition

Non-price based competition is most commonly observed in high-cost production locations. Firms operating in such locations have developed a series of inimitable strategies in response to price-based competition. Inimitability can be achieved by a combination of: customisation through co-production; superior service experience; design-based innovation; art-based innovation; reverse-hermeneutics-based innovation; science and technology-based innovation, normally in combination with a global niche strategy. Some insights from the literature (Piore and Sabel, 1984; Lohse and Spiller, 1998; Bagchi-Sen, 2001; Rugman and Verbeke, 2002; Tokatti, 2004; Bryson and Rusten, 2010; Bryson and Taylor, 2010; Tokatli, 2011; Mulhall, 2013) around this have been summarised in Table I.

On a resource basis, inimitability can arise from: property rights, path dependencies and time compression diseconomies in resource accumulation, or causal ambiguity (Bingham and Eisenhardt, 2008). Causal ambiguity can be further broken down into: resources resulting out of organisational processes unobservable from the outside, tightly coupled resources where the interrelationship and mutual synergistic effects are unobservable from the outside, processes that are a combination of simple heuristics with idiosyncratic and real-time improvisations are in practice both unobservable from the outside and un-inferable from any outcomes (Eisenhardt and Tabrizi, 1995; Miner et al., 2001; Bingham and Eisenhardt, 2008).

Further grounds for inimitability can arise out of the specific choices made as relates to which resources are leveraged in what specific way (e.g. Bingham and Eisenhardt, 2008):

<table>
<thead>
<tr>
<th>Inimitability strategy</th>
<th>Low-tech manufacturing firms</th>
<th>High-tech manufacturing firms</th>
<th>Consumer goods providers</th>
<th>Industrial goods providers</th>
<th>Consumer service providers</th>
<th>Industrial service providers</th>
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<tbody>
<tr>
<td>Customisation through co-production</td>
<td>X</td>
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<tr>
<td>Bundling (products or products with services)</td>
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<td>Superior skills or unique craftsmanship</td>
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<td></td>
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<td>X</td>
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<tr>
<td>Provenance</td>
<td>X</td>
<td>X</td>
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<td>High responsiveness</td>
<td>X</td>
<td>X</td>
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<td>Superior experience</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Unique and protected production processes</td>
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<tr>
<td>Intrinsic and/or extrinsic value delivery</td>
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<td>X</td>
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<td>X</td>
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<tr>
<td>Design-based innovation</td>
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<td>X</td>
<td>X</td>
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<td>Art-based innovation</td>
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<tr>
<td>Reverse-hermeneutics-based innovation</td>
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<td>X</td>
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<tr>
<td>Science and technology-based innovation</td>
<td></td>
<td>X</td>
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<tr>
<td>Note: Strategies used are identified by X</td>
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Table I

Inimitability-based strategies in different industry types
moderately linked core and complementary resources (normally with the aim of maintain strength in existing markets and to leverage into new markets by substituting for different complementary resources); mundane resources with tight mutually reinforcing linkages (normally with the aim of forming a defensible strategic position); and loosely linked, semi-structured processes comprised of simple and improvised action (normally with the aim of seizing narrow windows of opportunity).

From here on, this section follows that inimitability have its origins in resources and resource deployment systems and hence the intellectual capital lens is a useful tool for better understanding as well as creating the basis for resource-based inimitability.

Intellectual capital
The field of intellectual capital has its origins in practitioners and consultants and has, according to Dumay (2013), progressed through three phases.

The first phase had a first stage which lasted from inception to the take-off point for the field which developed frameworks in 1996 and focussed on awareness raising around intellectual capital as a concept and why it was important (Petty and Guthrie, 2000). In this phase, numerous frameworks for intellectual capital were developed and in this phase was also established the intellectual capital field’s tendency to classify rather than to define the intellectual capital construct. The key claims were (Dumay, 2012): that intellectual capital somehow represented the difference between market value and book value, and that intellectual capital understanding and management could result in greater profitability. These claims were at the time without empirical evidence and at least the first one turned out to be erroneous.


The first phase had a second stage which lasted from 1997 to around 2004. This period was characterised by a focus on classification systems, managerial aspects and the introduction of the resource transformation perspective, in addition to the resource perspective. Towards the end, there were some publications summarising the state of the field (e.g. Kaufmann and Schneider, 2004) as well as some publications questioning the field and its future (e.g. Kennie, 1999; Fincham and Roslender, 2003; Marr and Chatzkel, 2004). Key publications based on achieving more than 20 citations per year between the publication year and 2017 are listed in Table II.

The second phase continued the classification focus (a form of taxonomy focus) as well as aiming to find causality and correlation relationships between intellectual capital, or aspects thereof, and value creation and/or financial performance and/or achieving competitive advantage (Alwis, 2004; Firer, 2005; Roos et al., 2005; Wu et al., 2006; Edvinsson and Martin, 2007; Bismuth and Tojo, 2008; Kong and Prior, 2008; Kocoglu et al., 2009; Puntillo, 2009; Selamat and Hamzah, 2009; Nazari, 2010). There was also a continued focus on measurement, reporting, and disclosure (Burgman and Roos, 2007; Burgman et al., 2007; Steenkamp, 2007; Adams and Simnett, 2011).

This continued emphasis on classification and reclassification of the intellectual capital components as well as other aspects of intellectual capital is preventing widespread adoption.
among managers (Dumay and Garanina, 2013) as well as acceptance in neighbouring fields of research (Roos and Pike, 2007). A further reason for the poor uptake of intellectual capital among practitioners is articulated as “intellectual capital management can be carried out using typical general management approaches and therefore does not necessarily need any specific intellectual capital management model” by Kujansivu (2008, p. 432).

This phase also emphasised the dynamic aspects of intellectual capital (Kianto, 2007; Montemari and Nielsen, 2013; de Santis, 2016): in creating value as exemplified by IC navigators (Fernström et al., 2004; Roos et al., 2005), value creation maps (Marr et al., 2004b; Marr, 2008), combinations of both (Cuganesan and Dumay, 2009; Jhunjhunwala, 2009), knowledge asset value spiral (Carlucci and Schiuma, 2006), the analytical hierarchy process (Liu, 2006, 2007, 2010a, b; Carlucci and Schiuma, 2007; Grimaldi and Cricelli, 2009; Chen, 2009; Asonitis and Kostagiolas, 2010; Chang et al., 2010; Lee, 2010) and the further development of the analytical hierarchy process into the Conjoint Value Hierarchy approach (Pike and Roos, 2004; Roos et al., 2005; Marr et al., 2010), strategy maps (Kaplan and Norton, 2004), and causal performance maps (Abernethy et al., 2005), of which the two latter were not developed specifically for intellectual capital applications but include aspects of intellectual capital when used. In addition, there was greater insights into the role of intellectual capital within differing strategic logics, i.e. value chains, value shops, and value networks (e.g. Gottschalk, 2003; Ballow et al., 2004; Fernström and Roos, 2003; Pike et al., 2005; Roos et al., 2005) and therefore a greater insight into the complexity that follows from the interactions of the different components of intellectual capital as well as with other resources (Roos et al., 2005).

There is still during this phase a lack of empirical evidence underpinning many of the claims made and what evidence there is can be argued to suffer from survival bias of the sample or case. Dumay (2012, p. 12) points out that winners and losers frequently have the same or very similar strategies but differ in how they are executed. Dumay (2014) recommend researchers in the intellectual capital field to concentrate on research based on managing IC at the operating level of case/field study/interviews rather than taking a top-down approach.

The third phase moves on from the focus on understanding the causality relationship between intellectual capital and financial or other forms of value creation to the managerial implications around managing intellectual capital in all types of organisations. This includes broadening to a stakeholder perspective (Dumay, 2009) and to a broader understanding of value than just financial. This phase is characterised by an involvement...
with the practice of implementing intellectual capital management inside organisations (Dumay and Garanina, 2013; Döring and Papula, 2015). Dumay (2014) claims that there is an increasing interest in performative research (Mouritsen, 2006; Dumay, 2009; Kim and Kumar, 2009; Secundo et al., 2010). This means that research in the third stage should be based on either in-depth case studies to identify what works and what does not work in terms of managing intellectual capital in a given organisation (exemplified by Guevara-Espejel, 2011) or statistically valid causality studies across organisations (exemplified by Cabrita et al., 2007; Tovstiga and Tulugurova, 2007; Tovstiga et al., 2007; Moeller, 2009; Longo and Mura, 2010; Sharabati et al., 2010; Fan and Rongbin, 2011; Maditinos et al., 2011; Aramburu et al., 2013; Wang and Chen, 2013; Osman, 2014; Tsao and Hung, 2014; Roos and O’Connor, 2015; Verbano and Crema, 2016). The field is moving towards the third phase although a substantial amount of work is still taking place within the second phase thinking (Dumay and Garanina, 2013).

Using the insights from the discussions around economic complexity, structural holes, and non-price based competition we can apply the intellectual capital, language of resources and transformations as an extension of the resource-based view of the firm (Dragonetti and Roos, 1998). Although, as identified by Seoudi (2009), the RBV is one of three distinct “strategic views” of the firm (the others being the dynamic capability view (exemplified by the writings of Nelson and Winter, 1982; Teece et al., 1997) and the competence-based view (exemplified by Hamel and Heene, 1994; Sanchez and Heene, 1997)). The intellectual capital view can be applied as an extension of all these three views to better understand the drivers of firm performance (Johnson, 1999; Fernández et al., 2000; Riahi-Belkaoui, 2003; Herremans and Isaac, 2004; Marr et al., 2004b; Rialp-Criado et al., 2004; Reed et al., 2006; Mention and Bontis, 2013, exemplifies this for the resource-based view; Sveiby, 2001; Khalique et al., 2013 for the resource-based and the knowledge-based view of the firm; Grippa et al., 2009 for the dynamic capability view; and Bontis, 2002; Verma, 2016 for the competence-based view).

Against this backdrop Lerro and Schiuma (2008) and Chao et al. (2015) have shown that it is possible to look at a region through the intellectual capital lens and gain insight around a given regions development and this means that it is also possible to look at an economy as a whole through the intellectual capital lens and gain insight.

The intellectual capital perspective views the object under observation (e.g. the firm) as a bundle of resources possible to classify into resource types. The types used can be listed as (Mohtar et al., 2015): human capital, customer capital, structural capital, business capital, social capital, technological capital, and spiritual capital. The resource types that are most commonly used, including the traditional physical and monetary, are (based on a review of the literature and equalling the term structural with organisational and the term capital with resource) as follows:

- Physical: anything that can be touched, e.g. have a physical presence (e.g. what you would normally find under the heading of plant and equipment in the balance sheet).
- Monetary: financial resources that take the form of cash assets (such as marketable securities) that can easily be converted to pure cash.
- Relational: the relationships held by individuals on behalf of the firm or that are embodied in the form of contracts with firm as one party as well as the outcome of desires to hold explicit or implicit relationships with the firm by external parties (e.g. customer loyalty). (For an overview of the human capital definitions used in the literature see Martin-de-Castro et al., 2011, Table V, p. 659).
- Organisational: the result of human endeavours developed internally in the firm or acquired externally by the firm that is now owned by the firm and that are not physical in nature. (For an overview of the structural capital definitions used in the literature see Martin-de-Castro et al., 2011, Table IV, p. 657).
Human: all useful attributes to the firm that are embodied in people under the requirement that it cannot be replaced by machines or written down on a piece of paper. (For an overview of the human capital definitions used in the literature see Martín-de-Castro et al., 2011, Table III, p. 655).

The intellectual capital perspective further focusses on the way these resources are deployed, i.e. transformed to generate the ultimate desirable value (Roos and Roos, 1997; Fritzell and Cazacu, 2013; Roos, 2013). A good discussion of the relationship between resources grouped into the intellectual capital categories and firm performance can be found in Fernández et al. (2000). This transformation perspective can then be expanded to a regional or national view on prosperity generation (Roos, 2014; de Zubielqui et al., 2015).

The discussion in this section follows that non-price based competition has its root in intellectual capital (this since the resource-based view of the firm alludes to intangibles as having higher probability of being firm-specific and hence inimitable, Itami, 1987; Conner, 1991). In the intellectual capital terminology this would primarily refer to organisational (frequently information) and human (frequently knowledge in an explicit or tacit form and frequently embodied in behaviours and characteristics) resources resulting in inimitable path dependencies, time compression diseconomies in resource allocation which cannot be overcome, causal ambiguity linked to resource transformations, which by definition, and similar to property rights are inimitable, unique historical conditions under which resource bundles are created, and the social complexity of the resources (Nelson and Winter, 1982; Wernerfelt, 1984; Barney, 1986; Dierickx and Cool, 1989; Reed and DeFillippi, 1990; Barney, 1991; Armstrong and Shimizu, 2007; Wills-Johnson, 2008).

Knowledge management
Knowledge management have from its inception as a domain suffered from an epistemological confusion of the relationship between knowledge and information. It is necessary to outline the relevant epistemological paradigms to put to use the insights from the discussions in the previous sections.

The three epistemological paradigms discussed in Varela et al. (1991) and von Krogh and Roos (1996) are interpreted by Carter (2002):

- Cognitivist epistemological paradigm: the beginnings of cognitivist epistemology can be traced back to the mid-1950s and view organisations as open systems, that develop knowledge by formatting increasingly accurate representations of their predefined worlds (Venzin et al., 1998). The cognitivist epistemology was in a clear way first represented by Simon (1982). In the cognitivist epistemology, data accumulation and dissemination are the major knowledge activities. The cognitivist approach is to equate knowledge with information and data. The truth of knowledge is understood as the degree to which inner representations correspond to the world outside (Venzin et al., 1998). To a cognitivist, the human brain and organisation are machines of logic and deduction (von Krogh and Roos, 1995).

- Connectionist epistemological paradigm: in this paradigm, the process of representing reality is different and it has many similarities to the cognitivist viewpoint but there exist no universal rules. The connectionist epistemology was in a clear way first represented by Kogut and Zander (1995). As rules are team-based, organisations are seen as self-organised networks composed of relationships and driven by communication (Venzin et al., 1998). Connectionist models are founded on many interacting units that influence one another by sending activation signals down interconnecting pathways. For connectionists, the process of shaping an organisation depends not only on the stimuli entering the system but also the system...
itself. Information processing is the basic process of connectionist organisations; the network is the key.

- Autopoietic epistemological paradigm: the word autopoietic derives from the Greek, auto (self) and poiesis (production). Autopoiesis, a term coined by Maturana and Varela (1980) for application in theoretical biology, refers to the self-reproduction of living systems. It was redefined by von Krogh and Roos (1995) for application in an organisational context “as the internal and recursive self-reproduction of the basic elements of a social system to describe their autonomous and self-referential operations”. The autopoietic epistemological paradigm provides a fundamentally different understanding of the input coming from outside a system. The input is not information but data. The organisation is a system that is simultaneously open (to data) and closed (to information and knowledge). The system is controlled by its rules and organises itself. Information and knowledge cannot be transmitted easily, since they require internal interpretation within the system according to the individual’s rules. Individual knowledge is developed and respected in others. The cycle of self-production characterises the theory of autopoiesis (Venzin et al., 1998). In summary, autopoietics view knowledge as socially constructed, context sensitive, and dependent on history (von Krogh et al., 1994).

Roos (2005) have, grounded in empirical research executed by Marr et al. (2003), synthesised the intellectual capital resource framework with the different epistemological paradigms and arrived at a view of what epistemological paradigm provides the highest performing basis for managing a given resource transformation. The results are shown in Table III.

The conclusion is that the most prominent epistemological paradigms should be connectionist where specific groups develop knowledge relevant to their own environment and the local rules determine how knowledge is accumulated, the resulting knowledge resides in the connections of experts and is problem-solution orientated and the level of knowledge depends on the state of the network (which fits with the need for collaboration and co-creation) and autopoietic where knowledge is private and there is respect for different individuals in the organisation, the resulting knowledge resides in the complete system of mind, body, and social system. In this paradigm knowledge development is the process of interpreting incoming data through conversations enabling finer distinctions to be made and meaning to be created in accordance with observations and previous experiences (this fits with the need for continuous and integrated innovation).

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<th>From</th>
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<th>Human resources</th>
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<td>Monetary resources</td>
<td>Balanced cognitivist/autopoietic epistemological paradigm</td>
<td>Balanced connectionist/autopoietic epistemological paradigm</td>
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<td>Physical resources</td>
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Table III. The fit between epistemological paradigms and different resource transformations
The implicit preferences in individuals to hold one or the other of these paradigms is grounded in the personal value system of the individual influenced by the social differences that exist between cultures and the accompanying cognitive processes (Hofstede et al., 2010; Mason, 2007; Nisbett et al., 2001) as well as any influence from the economic, political, and technological setting (Ralston, 2008).

On the organisational level the predominant epistemological paradigm becomes a synthesis of the organisational epistemology and the epistemologies of all the individuals in the organisation (Jelavic, 2011).

If we now scale this to the national level, we find that we need firms that are successful in achieving a non-price based competitive position grounded in imitability achieved through resource transformations involving organisational and human resources and deploying a high level of individuals holding a connectionist and/or autopoietic epistemological outlook.

Conclusion

Findings

The key insights from the discussion in this paper are that:

1. Continuous maximisation of national prosperity is a critical objective as a means of achieving other societally desirable outcomes.

2. National prosperity can be increased if the economic complexity of the nation is increased.

3. Economic complexity is increased if:
   - Increasing number of firms through innovation manages to achieve a position of non-price based competition.
   - Policy measures are put in place that facilitates and encourages development of firms in, new to the economy, areas that have, in economic complexity terms, a close proximity to existing activity areas and that have, as areas, an economic complexity that is higher than the average economic complexity of the nation.
   - Policy measures are put in place to bridge structural holes in existing networks, enlarging of these existing networks, establishment of new networks, and increasing collaborative propensity. This since the increase in economic complexity is facilitated by the existence of large networks of agents with strong mutual connections allowing for achieving scale benefits, speed benefits, complementarity benefits, and knowledge sharing benefits.

4. On the firm-level achieving a non-price based competitive position requires inimitability. This inimitability is normally grounded in property rights, path dependencies, time compression diseconomies in resource allocation and causal ambiguity linked to resource transformations, unique historical conditions under which resource bundles are created, and the social complexity of the resources. Specifically, non-price based competition has its root in organisational resources (frequently information) and human resources (frequently knowledge in an explicit or tacit form and frequently embodied in behaviours and characteristics) and their associated transformation.

5. On the firm level the development and deployment of the necessary human and organisational resources must be well managed to achieve the desired inimitability. This will require the presence of individuals with a connectionist and/or autopoietic epistemological paradigm and this may be more or less easy to achieve given the cultural and social environment both of the environment in which the firm exists as well as the environment within the firm.
Limitations of the research and findings

The findings are limited to the economies from which date is drawn in the different studies used in the discussion in this paper. This means that the findings can only with certainty be said to be relevant for OECD countries.

Implications for practitioners and researchers

For managers, the implications are that a strategy aimed at achieving non-price based competition is desirable and will, for its success, require continuous innovation. Given that inimitability is achieved by developing and deploying resources, the intellectual capital lens provides useful insights around evaluating the effectiveness of the chosen resource deployment system. The management of this strategy will require a large share of individuals with a connectionist and/or autopoietic epistemological paradigm which means that the firms’ internal culture and ways of working must be aligned with these paradigms. This is visible by, e.g. a high propensity for collaboration, an understanding that personal interaction cannot be completely substituted for interaction via or through technology and that proximity matters.

For policy makers, there are clear insights regarding policies conducive to economic growth and the resulting prosperity. Most of these insights relates to the importance of growing economic complexity as an overarching policy objective. The intellectual capital lens is a useful conceptual lens to generate insights around which resources are weak and which aspects of the resource deployment system can be improved to facilitate achieving an increase in economic complexity.

For researchers, the above discussion opens the door for potentially fruitful interdisciplinary research aimed at improving national prosperity generation using an intellectual capital lens integrated with other economic and strategic fields of research.

Notes

1. This was well articulated as “Prosperity flows not just to those who generate new knowledge, but in even greater measure to those who find ways to make effective use of such knowledge” by the Canadian Council of Chief Executives (2006, pp. 3-4).

2. For a review of the different approaches to assessing intellectual capital on the national level see Labra and Paloma Sánchez (2013) and Mačerinskienė and Aleknavičiūtė (2015).

References


Devitt, A. (Ed.) (2009), Our Cities: Drivers of National Competitiveness, Forfas, National Competitiveness Council (NCC), Dublin.


Further reading


Corresponding author
Göran Roos can be contacted at: goran@roos.org.uk

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