

Defining and measuring factors explaining firm's intellectual capital in manufacturing and information technology industries – a contingency approach

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1. INTRODUCTION

1.1. Introduction / Background of the study

In today's economy, knowledge, skills and competence are appreciated. A glance through the intellectual capital¹ literature shows that many of the studies dealing with the issue are based on assumption (or providing evidence) that intellectual capital has significant influence on firm's value creation potential. A good question is then why? Why are intangible assets superior to conventional tangible assets in terms value creation potential? The answer lies in the nature of these assets. Knowledge for example, does not erode when used, but a machine does. The value creation potential of the machine vanishes by time and use, and thus, the law of diminishing returns holds. With the knowledge the situation is opposite. When knowledge is used in a process or exchanged with another party, it does not generally decrease in value. Instead of that, when used and challenged, it may even lead to new knowledge and the value of the knowledge increases. With intangible assets, the law of increasing returns is said to prevail.² (Andriessen 2004; Arthur 1996; Peppard & Rylander 2001.)

When considered more realistically, the law of increasing returns may hold for a certain level, but not for all time. An example from Peppard and Rylander (2001) describes the phenomenon as follows. The resource customer relationships (RC) often benefit initially from an increasingly growing customer base as the individual customer benefits from the improved service and learning effects this provides for the customer. When the network becomes too large to handle with the systems and processes in place, customers experience a negative impact on the service provided as a consequence. The law of increasing returns holds no more. In general, many intangibles are especially vulnerable to rapid technological changes, which often characterize intellectual capital intensive industries. Organizational capabilities are exposed to rapid substitution because of arising higher-order capabilities elsewhere (Collis 1994).

¹ In this paper intellectual capital, intellectual capabilities/resources and intangible assets (intangibles) are used as synonyms to describe all the intangible factors that firms utilize in their operations. In accounting, terms intangible assets and intangibles are often used instead of intellectual capital. They exclude elements of intellectual capital that the firms do not control or own, i.e. human capital.

² Both increasing and diminishing returns are possible for intangibles. For example, when knowledge is misused, the value is being destroyed.

The mainstream of intellectual capital research, which has focused on performance and valuation, has provided evidence that intellectual capital affects positively firm's market value (see e.g. Chen et al. 2005; Choi et al. 2000) and financial performance (see e.g. Wang & Chang 2005; Chen et al. 2005; Youndt & Snell 2004; Bontis et al. 2000). Although the number of studies is limited, some support for a negative association exists as well. Huang and Liu (2005) studied the relationship between innovation, IT and performance. Their results suggest that innovation capital alone has a non-linear relation (inverted U-shape) with firm performance. Firer and Williams (2003) found a negative association between human capital and VAIC³-measure in the South African market. Some studies report no relationship between certain elements of intellectual capital and performance (e.g. Chen et al. 2005; Fernandes et al. 2005). These results may hint that more intellectual capital is not always good and depending on the context, the level of intellectual capital within firms may vary substantially. This leads us to the contingency theory.

Contingency theory assumes that organizations attain effectiveness by fitting the characteristics of the organization to contingencies that reflect the situation of the organization, e.g. organizational environment, organizational size and organizational strategy (contingencies) determine organizational structure (characteristic) (Donaldson 2001). Contingency theory has some similarities with population ecology since the theory implicitly assumes that only the best best-performing firms survive and are observed at any point of time.⁴ 'Fit' is thus a result of a natural selection process. (Gerdin & Greve 2004). Whether this assumption of best-performing firms is realistic can be questioned and for example Gerdin (2005a; 2005b) has challenged this view by arguing that at least in the short term there may be misfit (fit) between contingency and structural variables resulting lower (higher) performance.

Elements of intellectual capital can be understood as characteristics of organization, which are affected by contingencies arising from the operational environment. Whether the firm is to survive and exist, there must be a fit between the elements of intellectual capital and the contingencies⁵. Despite of the theoretical reasoning and empirical results that support the idea that intellectual capital in general has a positive influence on firm's

³ Value Added Intellectual Coefficient™

⁴ This seems to be the dominant opinion, but opposite aspects exist as well.

⁵ Also called context or contextual factors

value and financial performance, there are few studies that would systematically try to conceptualize and explain the relationship between operational environment (context) and intellectual capital. Figure 1. illustrates the issue.

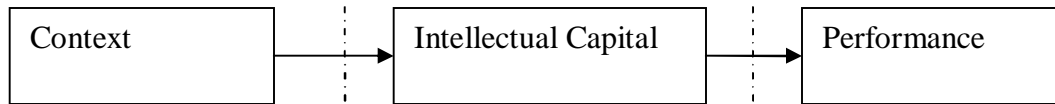


Figure 1. Context, intellectual capital and financial performance

As described above, intellectual capital literature provides somewhat parallel evidence that intellectual capital affects positively firm's financial performance. This line of research is described on the right-hand side in figure 1. This research applies contingency theory and seeks to explain the relationship between context and elements of intellectual capital, which is described on the left-hand side in the same figure. Based on the selection-type contingency theory it is assumed that firm's intellectual capital adapts to fit contextual factors (contingencies), which in turn results in optimization between contingency and structural variables (elements of intellectual capital) in question. Because of the assumed fit between contingency and intellectual capital variables, there is no need to study performance.⁶

In his book *Management Accounting and Control Systems – An Organizational and Behavioral Approach* Norman Macintosh (1994) reviews and adopts several approaches to examine the development of management control systems (MCS). Instead of technical and procedural aspects of accounting, an organizational sociology approach in control systems research is drawn. By the sociological approach Macintosh refers to systematic study of the development, structure, interaction and collective behavior of organized group of human beings. Contingency theory embodies one paradigm of organizational research, which can be categorized to represent structural functionalist (rational-contingency) paradigm in Macintosh's typologies of management accounting and control systems research (see Macintosh 1994, 4). Structural functionalists take power and political aspects of organization as given, assuming organization's social system to be

⁶ Theory predicts optimization through selection (context – intellectual capital variables) resulting only best-performing firms to exist and to be observed, and thus, theory does not predict any performance variances. Same selection-type contingency theory can not be used to predict differences in context – intellectual capital and intellectual capital – performance variables at the same time. See e.g. Gerdin (2005a); Hartmann (2005); Gerdin (2005b).

consisted of concrete, empirical phenomena, which is independent of the managers and employees working in the organization. The primary concern of the research is to improve efficiency and functioning of management accounting and control systems.

As the structural functionalist paradigm within management accounting and control system research is closely related to contingency approach, the literature can be used to anchor the ongoing contingency based intellectual capital research to this literature setting. This seems sensible as intellectual capital affects and is present in organizations in several forms and needs to be controlled and managed like other assets. Conceptualizing the relationship between intellectual capital and management control systems based on contingency approach yields new knowledge and understanding without adding any new components or variables of management control systems. Critics disclosed by Chenhall (2007) can thus be avoided:

While it is often claimed that the ultimate goal of MCS research is to provide findings that assist managers achieve their goals or those of their organizations, MCS research has continued to include dimensions of MCS, their use and usefulness, as the outcome variable.

This study utilizes the existing contingency based management control systems research to detect and validate the internal and external contingencies that may affect firm's intellectual capital, and to detect types of organizations. It must be highlighted that management control systems *per se* are not in the focus, although the literature will be used in the background throughout the process.

2. INTELLECTUAL CAPITAL

2.1. Intellectual capital literature

Intellectual capital literature has in general a practical orientation. This is probably due to the fact that the terminology and research in the academic field has not yet developed to the point, where a consensus of the key terms and general understanding of the underlying phenomenon would have been reached. There is no such a thing as intellectual capital theory, which would give a framework for intellectual capital studies. As companies are facing problems understanding, measuring, managing and valuing intellectual capital, this has left a plenty of room for practical studies and research. In addition to practical orientation, the literature seems to be biased towards describing the future value creation potential of intellectual capital instead of measuring the costs that are needed to generate these intangible items.

Review on intellectual capital literature shows that intellectual capital has been studied widely from several aspects and as a natural consequence of this, the terminology has developed after the scope of research of each community. Andriessen (2004) has recognized and classified five communities in the field of intellectual capital research based on the issue, terminology used and objective of the study. The *intellectual capital community*, which has very practical (non-theoretical) orientation, uses primarily the term intellectual capital to describe the phenomenon in question. The *accounting* and the *valuation community* and the key members of the *performance measurement community* use the term intangible assets in lieu of intellectual capital, whereas the *human resource community* refers to human resources or human assets instead of intellectual capital.

A common feature in intellectual capital research is that the studies often do not have a well-defined theoretical research framework. Those studies that provide some theoretical framework, the resource-based view seems to be the most adapted one (e.g. Galbreath 2005; Baxter & Matear 2004), but others such as the system theory (e.g. Pöyhönen & Smedlund 2004) and the knowledge-based view (e.g. Nonaka & Toyama 2003; Nickerson & Zenger 2004) exist as well. A starting point for intellectual capital studies is often that intellectual capital – or certain elements of it – increase firms' performance and value: "The importance of IC, as a prime value driver in today's knowledge-based economy, is undisputed." (Marr 2004), "The creation of value in today's information-age

economy is increasingly dependent on the effective use of intellectual capital factors..” (Usoff et al. 2002), “There is increasing recognition of the importance of intangible assets.” (Kalafut & Low 2001). As the “high-IC high-performance” concept is already a starting point for the studies, there are only limited number of studies explaining thoroughly why intellectual capital is superior to tangible assets in terms of future value creation potential and performance. Equally the literature is scarce when it comes to explain the relationship between intellectual capital and the context in a sound theoretical framework, i.e. what factors affect intellectual capital or elements of it to exist. This study contributes to the literature as it studies the relationship between context and intellectual capital within a contingency theory framework.

2.2. Intellectual capital measurement

The proportion of corporate value stemming from intangibles has increased substantially during the last decade(s). At the same time the research community widely agrees that there are both measurement and valuation problems concerning intellectual capital. (Mouritsen 2004; Andriessen 2004; Arvidsson 2003.) There are several attempts to solve these problems, both valuation and measurement. Andriessen (2004) has studied altogether 25 methods how to value or measure intellectual capital. Although his research fundamentally aims for intellectual capital valuation, the methods visited in his study are worth for further examination.

For those 25 methods studied Andriessen has classified 13 as being more focused on measurement purposes and the rest on valuation purposes. He has classified the methods based on some other characteristics as well, e.g. whether the methods are used for internal management or external reporting purposes, and whether the scope is on human resources or in some other intellectual capital subsets. To recall that the purpose of Andriessen’s study is valuation, there is an implicit need for the models presented to measure the intangible objects in some scale. For certain elements this is not a problem, but how about those intangible objects that are hard to measure such as knowledge then? Many of the methods measure knowledge indirectly, because knowledge is the factor behind most of the intangibles generated within the firm. It may be that a direct measurement of knowledge is not possible or even rational, but there is a need for further understanding how knowledge is used to create other intangibles in order to control it somehow.⁷

⁷ Knowledge-based view (theory) has focused more on this issue, see e.g. Nonaka & Toyama (2003).

The meaning of intellectual capital measurement is not just to generate descriptive statistics for reporting purposes. As Mouritsen (2004) points out, measurement is important because it enables intervention:

If intervention and measurement are coupled, then measurement is an input rather than output, and then measurement is not to be evaluated on its reflection of reality, but rather on its ability to help actors transform their reality.

One of the implications raised in the article is that intellectual capital measurement does not necessarily create clarity and that it does not create correspondence between the representation of the phenomenon and the phenomenon. The measurement however helps to intervene and act. Even though the measurement system and particular measures would not completely describe the phenomenon in question, there must be understanding about the phenomenon behind the measure. The context, in which the firm operates, affects the measurement objects and thus the measures describing the research object. The ongoing study attempts to measure firm's intellectual capital within a well-defined contingency theory framework, which takes operational context into account.

3. CONTINGENCY THEORY

3.1. Origins and key ideas

The ideas of the contingency theory lie behind the works of Burns and Stalker (1961) and Lawrence and Lorsch (1967). The theory differs from the classical management and organizational theories as it proposes that there is no one best way to organize, such as pure specialization, which would result in maximum performance. There are different communities that have applied contingency theory in different context. According to Donaldson (2001) the organizational structure has attracted most attention and the theory is therefore often called structural contingency theory. Leadership, human resource management and strategic decision-making processes have also been studied under contingency approach. In management accounting there are studies employing contingency theory, such as budgetary research (see e.g. Luft & Shields 2003; Hartmann & Moers 1999).

One of the underlying assumptions in the contingency theory is that the firms strive for the balance with the operational context in order to sustain (attain) maximum performance. In contingency literature the term 'fit' refers to this balance and effectiveness is often used as a synonym for performance. According to structural contingency theory the fit of organizational characteristics to contingencies leads to high performance and firms seek to attain this fit. Maximum performance results from adopting the appropriate level of structural variable that fits the contingency. The optimal structural level is thus seldom the maximum – it is dependent upon the level of the contingency variable. (Donaldson 2001.)

Gerdin and Greve (2004) have classified different forms of contingency fit in strategy-based management accounting research. This article describes well the controversies over the different contingency approaches. According to their classification the so called traditionalists (Cartesian approach) argue that the fit between the context and the structure is a continuum that allows frequent, small movements by organizations from one state to another, whereas the supporters of configuration approach argue that there are only few states of fit between context and structure. According to supporters of configuration approach the organizations must make quantum jumps from one state of fit to another. There are other divergent aspects as well. Some researchers have adopted the view that only the best performing organizations survive and these are the ones that can

be observed, while others assume that organizations may have varying degrees of fit and thus have variation in their performance. The research task in the former is to explore the nature of context-structure relationships without examining whether they affect performance. In the latter the research task is to address that the higher fit is associated with higher performance.

3.2. Intellectual capital in contingency framework

As mentioned earlier in this paper, many intellectual capital studies lack a well-defined theory framework. Intellectual capital literature carries some studies that have characteristics of contingency-based research, although the authors do not necessarily define or mention “contingencies” at all. Wang and Chang (2005) studied association between the elements of intellectual capital and firm’s financial performance in Taiwanese information technology industry, Claycomb et al. (2001) focused on the association between applied process knowledge and firm market performance in the context of environmental uncertainty, and Bontis et al. (2000) investigated the interrelationships between human, structural and customer capital and their influence on business performance on Malaysian industries. In management and organization studies human capital (human resources) and its effects on organizational performance has been studied in some extent (e.g. Youndt & Snell 2004).

4. RESEARCH FRAMEWORK

4.1. Purpose of the study

4.1.1. Research objectives

The aim of this research is to study firms' intellectual capital in an industry-specific context and to identify those contextual factors that explain the occurrence of intellectual capital elements within firms. Contingency theory and selection concept of fit within this theoretical approach is adopted to analyze the issue. Thus, the objective of the study is to theoretically model and explain – and empirically show - the relationship between elements of intellectual capital and contingency factors.

Existing management control systems research will be used to detect the relevant contingency variables and on the other hand to anchor the study to current contingency based accounting literature. It allows as well categorizing the firms in a systematic manner. Therefore, this research attempts to contribute to contingency based management control systems literature focusing especially on intellectual capital.

4.1.2. Research questions

To fulfill the above research objectives, following main research question (RQ_m) needs to be answered:

RQ_m: What contingency factors explain certain elements of intellectual capital within firms to exist in selected industries?

To detect all relevant issues that need to be settled in the study in order to answer the main research question, following sub-questions are derived from the main research question. To guide the research process, they are grouped into theoretical (SQ_{t1} – SQ_{t3}) and empirical (SQ_{e1} – SQ_{e2}) sub-questions. Tentative solutions to deal with the issue are added after each sub-question.

SQ_{t1}: What is intellectual capital and how to systematically define and validate all relevant elements of intellectual capital regarding this study?

Solution SQ_{t1}: A thorough and systematic review on existing intellectual capital research is needed. Intellectual capital research in micro and macro *economics* provides insight on national and industry specific issues. Resource-based view and knowledge-based view of the firm are theories used especially in the discipline of *management and organization* to study the use and certain forms of intellectual capital and many of the theoretically sound empirical intellectual capital studies rests on these theories. In *accounting* intellectual capital research has focused on internal management, external reporting and valuation. First one focuses on internal management of intellectual capital and the last two on external measurement and valuation of intangibles. Internal management research is important in recognition of intellectual capital and the last two provide insights for intellectual capital measurement. To review the literature systematically in order to detect relevant intellectual capital elements, some high reputation journals (citation indexed) within each discipline are chosen, and articles dealing with intellectual capital will be reviewed.⁸ See appendix 1 as an example of the process.

SQ_{t2}: What are contingency factors and how to systematically define and validate all relevant contingency factors regarding this study?

Solution SQ_{t2}: Following the solution of SQ_{t1}, some potential contingency factors will be examined and gathered simultaneously with the intellectual capital literature review process (see appendix 1). However, most of the relevant contingency factors can be found from the existing contingency-based management control systems research.

SQ_{t3}: What is the expected theoretical relationship between contingency factors and elements of intellectual capital?

Solution SQ_{t3}: Theoretical contingency-based model(s) explaining relationship between context and elements of intellectual capital will be formed on the basis of intellectual capital and operational environment analysis, from which hypotheses can be drawn as well (see table of contents, chapter 6).

⁸ Some non-indexed journals (e.g. Journal of Intellectual Capital) focusing solely on intellectual capital will be examined as well.

SQ_{e1}: How to measure firms' intellectual capital and contingency factors?

Solution SQ_{e1}: Survey will be constructed to gather the data from the firms within Industrials/Materials and Information Technology sectors..

SQ_{e2}: What econometric models are used to explain the relationships between contingency factors and elements of intellectual capital?

Solution SQ_{e2}: Structural equation or path models will probably be used.

4.2. Theory framework

Theory framework of the study consists of management control systems (MCS) and intellectual capital (IC) literature. Figure 2. illustrates the configuration.

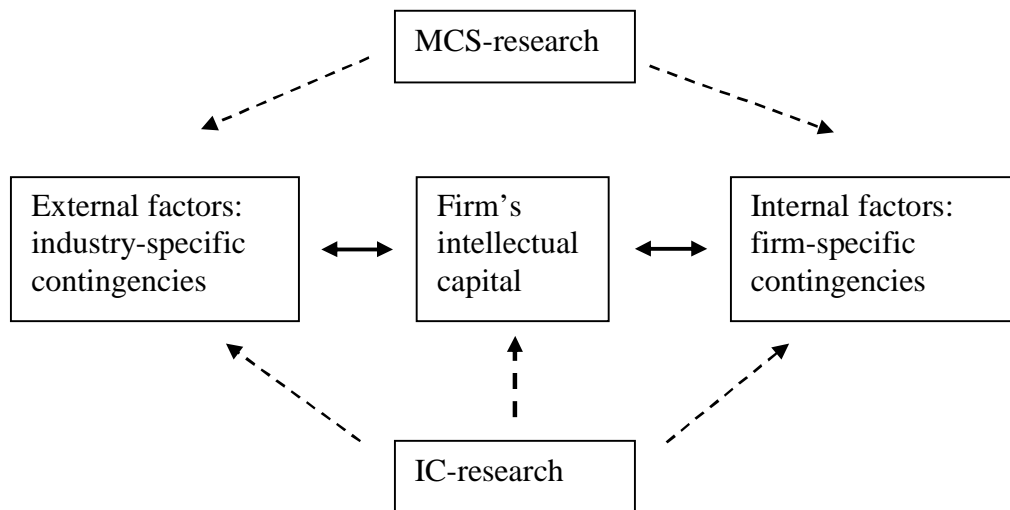


Figure 2. Theory framework of the study

The role of MCS-literature is to categorize the types of organizations and on the other hand to help to detect relevant factors (contingencies) that may affect the existence of certain elements of intellectual capital. As the contingency-based MCS-literature related to intellectual capital is scarce, the research is exposed to risk that not all relevant factors are obtained from this literature. Thus, intellectual capital literature will be reviewed systematically to detect potential contingency factors. At the same time, elements of intellectual capital will be reviewed and disclosed. Although the emphasis in intellectual capital literature is on accounting, some other fields (economics, management and

organization, others) will be examined as well concentrating on articles published in esteemed journals. Based on this literature analysis, models(s) predicting/explaining intellectual capital existence within firms in certain contexts will be formed.

Industry specific contingencies are external factors which are expected to affect the existence of firm's intellectual capital. These external factors such as the speed of technological progress, competition and availability of critical factors of production can strengthen, modify or dispose certain elements of intellectual capital. The bidirectional arrow between external factors and intellectual capital indicates that the causality is not supposed exclusively from external factors to intellectual capital, but can be the opposite as well. Although the latter is unlikely, it could happen when the firm is a global player in the industry affecting or creating the operational environment or standards within the industry.

Firm specific contingencies are related to the internal factors of the firm, most typical factors being size and structure. Strategy that the firm has chosen in order to maximize the long-term performance is somewhat doubtful and divides opinions. In one extreme the strategic choice can be cost leadership and in the other differentiation, however, indicating rational choice made by managers. A competing view states that the operational environment forces the firm to adapt the strategy to fit the environment and thus, the role of managers is to ensure this adaptation.

4.2 Empirical implementation

4.2.1 Survey as a research method

A prerequisite for theory consistent empirical results is a sound dialogue between the theory or literature and the chosen research method applied to study the underlying event or phenomenon. If these two do not co-operate neatly with each other, the results are exposed to lack of credibility. According to Van der Stede, Young and Chen (2007) survey research can be used for two main purposes: description and explanation. The former approach does not test theory, but are designed to discover characteristics of a given population. The latter approach tests theory (hypotheses) and focuses on expected relationships among the variables in question.

Like all the other research methods applied in social sciences, survey has its restrictions as well. Probably the major critics towards this method concerns the reliability of the data obtained, which can result for example from poor survey design or inappropriate data management. To avoid pitfalls in empirical implementation, a methodological article of Van der Stede et al. (2007) *Doing Management Accounting Survey Research* is kept as a guideline throughout the process. There are several reasons to take their paper as a starting point for empirical research. First, like in the ongoing study, the focus on their research is on management accounting. If management accounting survey research has idiosyncrasies, these should be revealed from the paper. Second, their paper addresses the quality of survey research based on published (mail) survey studies in eight esteemed accounting journals over a period of 1982-2001 indicating high quality *per se*. Third, the chosen article presents the latest research traditions and recommendations in this field.

Van der Stede et al. (2007) have used five general categories in their framework to address the quality of surveys. The first one, purpose and design of the survey, determines the use of data and design of the survey. To avoid inappropriate selection of samples of respondents and use of irrelevant misleading questions, a high-quality survey needs to be conducted with a specific research objective in mind. Second, population definition and sample selection, deals with the sample size, response rate and validity of inferences drawn from the sample. The third category, survey questions and other research method issues, focus on internal validity. Pre-test and follow-up procedures, non-response bias and types of dependent measures are dealt within this category. Fourth category, accuracy of data entry, includes checks and rules for reliability and accuracy, and rules for resolving inconsistencies. In the fifth and last category disclosure and reporting practices are discussed. Research procedures, data collection and presentation are described in this section.

4.2.2 Survey design

As mentioned above, a high quality survey needs to be conducted with a specific research objective in mind. Referring to research question “What contingency factors explain certain elements of intellectual capital within firms to exist in selected industries?” of the ongoing study, survey must be designed primarily to measure intellectual capital and contingencies concerning internal and external operational environment. In practice this means operationalization of objects being measured. To estimate intellectual capital

internally using survey as a measurement instrument, the questions need to be formed as follows:

Q₁: How important do you consider.. HC/SC/RC (certain elements/items).. to your company overall success?

Not important					Extremely important	
1	2	3	4	5	6	7

Q₂: How successful your .. HC/SC/RC .. in relation to industry average?

Considerably below average			Average	Considerably over average		
1	2	3	4	5	6	7

Q₃: How would you describe.. external contingencies (technological development etc.) .. of your industry?

Very low					Very fast	
1	2	3	4	5	6	7

A 1-to-5 or 1-to-7 Disagree-Agree type scale (Likert scale) will be used to score firms' intellectual capital and to estimate operational environment. When sending the survey, managers of accounting and personnel administration should probably be stressed.

4.2.3 Data

Data will be gathered from the companies operating in Industrials/Materials and Information Technology sectors. There are two primary reasons for this. First, most of the firms in Finland are relatively small and these two sectors are probably the ones that would guarantee adequate sample size. The interest is not in the start-up or smallest firms, so these will be cropped out.⁹ Second, companies are chosen from the sectors, which are expected to differ from the contingencies affecting the occurrence of certain elements of intellectual capital. Descriptive information on these firms can be found from the National Board of Patents and Registration of Finland and from the Statistics Finland.

⁹ The contingency theory approach chosen assumes that (in the long run) only the best-performing firms survive to be observed. When the smallest firms are in question, it is hard to interpret, whether they are to survive or not. They may run into bankruptcy in the early years or if run by a single entrepreneur, there is no one to run the business after retirement. With the larger firms, in general, this problem is avoided.

4.2.4 Econometrics

What is typical for the elements of intellectual capital is that they are often intertwined, for example, items of human capital may affect structural capital and relational capital. One of the things that must be taken into account is the issue of endogeneity. In the figure 2 equation (1) is a simple regression model, where variable X_1 explains some or most of the variation of Y and u contains rest of the factors that affect Y . Basic assumption is that the explanatory variable X_1 does not have correlation with the residual term u ($\text{cov}(X_1, u) = 0$), but when it has, there is an endogeneity problem. This happens because the equation (2) defines now variable X_1 from the equation (1) and affects at the same time the residual term u in equation (1). The situation is described in figure 2 on the right-hand side.

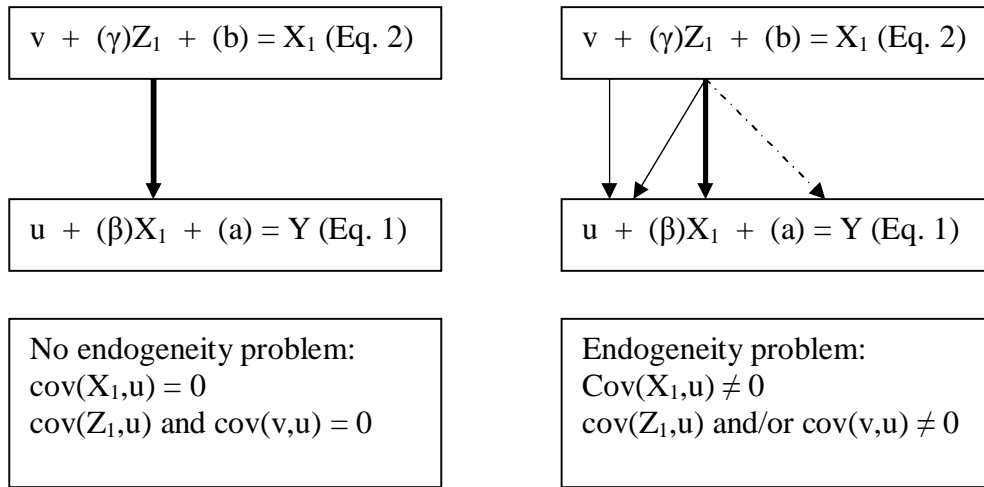


Figure 2. Endogeneity

Explanatory variable X_1 is determined by equation (2) $X_1 = b + \gamma Z_1 + v$ and X_1 is an endogenous variable. On the left-hand side of the figure there is no endogeneity problem, because explanatory variable X_1 is not correlated with the residual term u in equation (1), neither does Z_1 or v from equation (2) correlate with residual term u in equation (1). On the right-hand side the configuration is the same, but now Z_1 or/and v from equation (2) correlates also with residual term u in equation (1). Since Z_1/v affect(s) both residual term u and X_1 , there is an endogeneity problem. Causal relation between X_1 and Y is supposed

so that X_1 affects Y . If Z_1 is omitted from the analysis and it affects both explanatory variable X_1 and Y (indirectly via residual term u), much cannot be concluded from the supported causality between X_1 and Y in equation (1). Although the endogeneity can never be totally avoided in empirical research, a good theoretical modeling is the best way to minimize the problems. Some econometrical tools to deal with the problem exist as well.¹⁰

A statistical test that can be used to test the significance of the results varies alongside the theoretical interpretation of the fit. For example, a simple form of regression analysis is suitable, if additive interpretation of fit is supported. Moderated regression analysis is one application of multiple linear regression, which has been used to test interaction type of fit. If the theoretical interpretation supports intervening-variable model, then path analysis is the statistical tool to be used. (see e.g. Luft & Shields 2003; Gerdin & Greve 2004; Hartmann & Moers 1999.) Depending on the theoretical interpretation of the fit between intellectual capital and the context, the statistical model to test the significance will be chosen.

4.3 Potential results and schedule

As the purpose is to theorize the relationship between intellectual capital and context, the analysis ought to provide some clarifying interpretations and explanations about the existence of intellectual capital in certain type of environments.

Unchanged schedule: Doctoral thesis ready for review by the end of 2008, dissertation 2009.

¹⁰ See for example Nikolaev & van Lent (2005)

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INTELLECTUAL CAPITAL (IC) RELATED STUDIES IN ECONOMICS

APPENDIX 1.

N/A: Information not available/specified, multiple or derived models

AUTHOR(S) / JOURNAL	THEORY, MODEL OR PERSPECTIVE	METHOD	DATA	ELEMENTS OF IC Main element; subcateg.	CONTROL, CONTINGENT FACTORS	OTHER INFORMATION
Smulders, S. & van de Klundert, T. (1995) / EER	Endogenous growth model	Analytical	-	Innovation; R&D, knowledge capital	Market concentration	Innovation builds on firm-specific R&D; MICRO
Coe, D.T. & Helpman, E. (1995) / EER	Economic growth model	Statistical	Multiple databases: data from 22 countries	Innovation; R&D, knowledge capital	-	Foreign R&D affect beneficially dom. productivity; MACRO
Laussel, D. & Breton, M.L. (1995) / EER	Equilibrium model	Analytical	-	Human capital; individual unobservable skills	-	Explaining entrepreneurship via individual skills; MICRO
Orazem, P.F. & Vodopivec, M. (1997) / EER	N/A	Statistical	Multiple databases: country-level data (Slovenia)	Human capital; education, experience, gender, ethnicity	-	Increasing marginal returns on human capital in transition to a market system; MACRO
Young, H.P. (1998) / EER	Game theory	Analytical	-	Learning	Strategy, environment	Models of learning, social environment.

						MICRO
Menezes-Filho, N., Ulph, D. & Van Reenen, J. (1998) / EER	Game theory	Statistical	Two datasets: database (U.K. firms) + survey	Innovation; R&D / Social capital; training, morale (?)	Unions	Unions effect on relative R&D performance depends on union power. MICRO
Temple, J. & Voth, H.-J. (1998) / EER	Economic growth model	Statistical	Multiple databases	Human capital; education, training	Industrialization, equipment investment	Human capital enables adopting advanced techniques, increase their diffusion and increases equipment investment. MICRO
Feldman, M.P. & Audretsch, D.B. (1999) / EER	N/A	Statistical	Survey	Innovation; R&D	Diversity, specialization, geographic region	Diversity yields higher industry/firm R&D returns. MICRO
Peretto, P.F. (1999) / EER	General equilibrium model	Analytical	-	Innovation; R&D	Business environment; number and size of firms, barriers to entry, diversification	Number of firms, concentration and firm size. MICRO
Saint-Paul, G. (2002) / EER	N/A	Analytical	-	Innovation; R&D; new products, process innovations	Specialization	Specialization to primary/secondary innovations. MACRO
Herbertsson, T.H.	Economic growth	Statistical	Multiple	Human capital;	Capital, labor,	HC affects national

(2003) / EER	model		databases	education	productivity	growth. MACRO
Bottazzi, L. & Peri, G. (2003) / EER	N/A	Statistical	Multiple databases	Innovation; R&D; patents	Regions; manufacturing, education	R&D spillovers diffuse within 300 km from source region. MACRO
Mori, T. & Turrini, A. (2005) / EER	Core-periphery model	Analytical	-	Human capital; skills; education, experience, innate ability	Regions, segmentation	Workers with higher skills stay in high aggregate skill & salary locations. MACRO
Parisi, M.L., Schiantarelli, F. & Sembenelli, A. (2006) / EER	N/A	Statistical	Two surveys (indirect?)	Innovation; R&D; new products, process innovations	Fixed capital investment	R&D and fixed capital spending associated with new products and process innovations. MICRO

INTELLECTUAL CAPITAL (IC) RELATED STUDIES IN MANAGEMENT & ORGANIZATION

N/A: Information not available/specified, multiple or derived models

AUTHOR(S) / JOURNAL	THEORY, MODEL OR PERSPECTIVE	METHOD	DATA	ELEMENTS OF IC Main element; subcateg.	CONTROL, CONTINGENT FACTORS	OTHER INFORMATION

INTELLECTUAL CAPITAL (IC) RELATED STUDIES IN MANAGEMENT ACCOUNTING

N/A: Information not available/specified, multiple or derived models

AUTHOR(S) / JOURNAL	THEORY, MODEL OR PERSPECTIVE	METHOD	DATA	ELEMENTS OF IC Main element; subcateg.	CONTROL, CONTINGENT FACTORS	OTHER INFORMATION

INTELLECTUAL CAPITAL (IC) RELATED STUDIES IN FINANCIAL ACCOUNTING

N/A: Information not available/specified, multiple or derived models

AUTHOR(S) / JOURNAL	THEORY, MODEL OR PERSPECTIVE	METHOD	DATA	ELEMENTS OF IC Main element; subcateg.	CONTROL, CONTINGENT FACTORS	OTHER INFORMATION

CAPITAL MARKET-BASED INTELLECTUAL CAPITAL (IC) STUDIES IN ACCOUNTING

N/A: Information not available/specified, multiple or derived models

AUTHOR(S) / JOURNAL	THEORY, MODEL OR PERSPECTIVE	METHOD	DATA	ELEMENTS OF IC Main element; subcateg.	CONTROL, CONTINGENT FACTORS	OTHER INFORMATION

