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Exploring critical realism as the theoretical foundation of mixed-method research: Evidence from the economics of IS innovations

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Abstract
Despite the call for pluralism in IS research there is a lack of multi-method research published in information systems journals. While many researchers might find the idea of using multiple methods attractive, there are barriers that prevent them from employing this approach in practice. In this paper we try to address key philosophical concerns that often deter more extensive use of multiple methods, encourage openness to innovative methodological choices, and deepen practical understanding about how critical realism can be used as the foundation of IS research designs. We begin by exploring the value of critical realism as a theoretical foundation for mixed-method information systems research. After discussing the debate surrounding quantitative methods (especially economics) among critical realists, we propose making the identification of demi-regularities pivotal to the design of qualitative fieldwork. To provide support for this approach we present evidence from a study of IS innovation adoption in financial services which we believe highlights the value of multiple methods to inspire and inform the research process as it unfolds.

Keywords: IS Research Methods; Critical Realism; Methodology; Mixed Methods; Qualitative and Quantitative Research.

Introduction

Over the last couple of decades pluralism in information systems research has increased significantly attracting a lot of attention from researchers and decision-makers in the field. The variety of methods used can be traced back to theoretical traditions within reference disciplines that constitute the IS field but also reflects the broad range of issues addressed by IS researchers since the 1980s (Benbasat and Weber 1996). Such diversity in research traditions has been the cause of much debate leading to a variety of responses about how these distinctive approaches should be treated. For example, Jones (2000) draws our attention to the challenges involved in integrating approaches that may come from incommensurable theoretical positions. He notes that these philosophical issues have practical consequences as our choice of approach influences the status and nature of data which has implications for the standing of any research findings. Others remind us that there should not be methodological prescriptions in research because choice of method depends upon the nature of the phenomena under study (Landry and Banville 1992; Nandhakumar and Jones, 1994; Walsham 1995b; Myers 1997). In this paper we take up Lee and Sarker's call for us to regard established philosophical and methodological writings "…not as bodies of rules, regulations, and other directives whose purpose is to receive our unquestioning obedience and complete submission, but instead as a source of other scholar's wisdom and insights inspiring us to innovate ways of looking at and combining different research methods, whether the differences are seen as quantitative versus qualitative, positivist versus interpretive, or otherwise" (2008 pp. 3). While having respect for the nature and type of differences in methodologies, we put affiliations to methodological camps to one side in order to explore the value of critical realism as a theoretical foundation for mixed method IS research. To illuminate and provide support for this approach we present evidence from a study of innovation adoption in financial services which we believe highlights the value of multiple methods to inspire and inform the research process as it unfolds.

Beyond philosophical debates about the "legitimate" use of various research methods there have been many insightful discussions about how we might put combined methodological approaches into practice within information systems (Kaplan and Duchon 1988; Lee 1991; Mingers 2001). The value of mixed methods is that they mutually inform one another highlighting relationships between local practices and changes that are occurring at another level of analysis. This can be useful throughout the research process (Kaplan and Duchon 1988; Tashakkori and Teddlie 1998): providing grounds to link research questions in multi-level analysis; systematically cross-reference findings in-depth; and provide substantive cases to ground proposals for change at the level of policy or practice. The design and use of multiple research methods, each with their own philosophical nuances and practical challenges, can offer new insights to research by encouraging creativity and expanding key aspects of the study (Mingers 2001).

Qualitative and quantitative approaches can be mixed within a particular paradigm (for example where qualitative case studies are used to test hypotheses), research traditions may be combined (on a multi-

disciplinary project team), or integrated in a theoretically sympathetic way within the same study. It is the latter, most controversial form of mixed methods that is the focus of this paper. We take research methods that are usually kept separate within interpretive and positivist approaches and propose mixing them using the distinct underlying philosophical approach offered by critical realism. In this way, we try to address key philosophical concerns that often deter more extensive use of multiple methods, encourage openness to innovative methodological choices, and deepen practical understanding about how critical realism can be used as the foundation of IS research designs. The paper is structured as follows: in the next section, we briefly review the debate surrounding the use of multiple methods in research methodology. We then explore ideas from critical realism emphasizing the distinct characteristics that differentiate it from the other popular paradigms in IS and how this allows for a mixed method approach. Finally, we illustrate this approach by drawing from a study where multiple qualitative and quantitative methods were employed to investigate the benefits from the implementation of a financial network innovation and messaging standard in the banking sector. The research methods employed in our case largely fall into the methodological categories of a historical narrative, econometric analysis, interviews, case studies, and survey research. Because this study was conducted by two of the coauthors of this paper, we have privileged access to the data, details of methodological strategies and research approach, as well as the results.

Combined Methodology: using qualitative and quantitative methods in a research design

Despite the call for pluralism in IS research, Mingers (2003) reports a lack of multi-method research published in IS journals. He argues that while many researchers might find the idea of using multiple methods attractive, there are barriers that prevent them from employing this approach in practice. The most important of these is, as discussed above, the distinct worldview of various paradigms that make the relevant methodologies seem incompatible. In addition to the apparent philosophical issues that this creates, there are more practical difficulties that need to be overcome. These can be grouped into three broad categories: cultural, psychological, and practical barriers (Mingers and Gill 1997; Mingers 2001). Researchers may encounter cultural barriers within their research environment deterring them from using a specific research method. For example, qualitative (largely interpretive) approaches are usually the norm within European IS research groups whereas quantitative approaches tend to dominate the field in North America (Walsham 1995a). This is likely to mean that training, skills development and support from mentors that are expert in a particular method is not so readily available to students which may result in low confidence and create psychological barriers among those wishing to explore alternative options. Background and individual aptitude play important roles since we tend to prefer using methods in which we are not only well-versed but also most likely to succeed. On a practical level, single-method research is tried and tested which means there is plenty of advice available to guide researchers through the research process. In contrast, not only does it take a considerable investment of time to establish coherent philosophical foundations for an integrated methodology, the pursuit of findings based upon both statistical and case study research can prove time-consuming. Our intention is to delve deeper into the philosophical issues and relate these more closely to the practical process of multi-method research. In so doing, we hope to help develop a body

of work that will give scholars the impetus to overcome the local cultural and individual psychological barriers that they may encounter.

We explore the philosophical ground between entrenched camps (positivism/interpretivism) and pragmatism which mixes methods from the two major paradigms on the basis of "what works" (Cherryholmes 1992; Howe 1988) with relatively little regard for the philosophical consequences. The latter position is typified by Tashakkori and Teddlie (1998) who maintain that "for most researchers committed to the thorough study of a research problem, method is secondary to the research question itself, and the underlying worldview hardly enters the picture, except in the most abstract sense" (pp. 21). Pragmatists also view concepts like "truth" and the "real" as normative, and believe that researchers can never be sure that what they observe (even if this is seen in its social, historical, or political context) is the "real world" or an insight that reflects their own values (Cherryholmes 1992; Tashakkori and Teddlie 1998; Rorty 1982). Much methodological practice lies between the two and we maintain that this provides interesting terrain for further investigation.

Mingers (2004) analysis of this landscape divides supporters of mixed methodologies[1] into three broad categories: those who accept plurality "for its own sake"; those who actively embrace alternative methods in pursuit of particular research questions or circumstances; and those who assert that research should "be trans-pragmatic, routinely combining philosophically distinct research methods" (pp. 88). In this paper we seek to extend the motivation for adopting mixed methods in IS research by developing both its theoretical grounding and contributing an empirical study to the growing body of work that illustrates the value of such an approach. In the next section, we consider the role that critical realism can play as the foundation of mixed method IS research.

Critical Realism in IS Research

Despite its prevalent position among the rest of the paradigms, positivism has been criticized for a "naïve realism" in which reality is apprehendable and knowledge can easily be captured and generalized in a context-free form (Guba and Lincoln 1994). More specifically, realism has been heavily criticized from the philosophies of empiricism and conventionalism (Mingers 2004). As a reaction to this critique, a number of post-positivism paradigms have emerged that strive to address the ontological and epistemological flaws of positivism. Among the most prominent of these is critical realism which was largely established by the writings of Bhaskar (1975, 1978, 1989, 1998). Critical realism is often seen as a middle way between empiricism and positivism on the one hand and anti-naturalism or interpretivism on the other, thus, reinventing a new and more sophisticated version or realist ontology. Critical realism simultaneously confronts the central concerns of both natural and social science regimes. This makes critical realism of particular interest in the study of information

[1] Those that accept and welcome a diversity of research paradigms and methods are often called "Pluralists" (Mingers 2004). On the other hand, "Imperialists" and "Isolationists" are described those who argue in favour of one single paradigm and those who may accept different paradigms but believe that research should develop separately respectively (Reed 1985).

systems which bears significant relevance to natural science (due to their technological characteristics) and social science (due to their applications in deeply human contexts such as organizations).

An important characteristic of critical realism is that it maintains a strong emphasis on ontology. As a consequence, the first and foremost tenet of critical realism is that the world exists independently of what we think about it. Importantly, this leads us to accept the fallibility of our knowledge and the possibility of getting things wrong. Bhaskar (1998) argues that there are two sides of knowledge and distinguishes between the transitive and intransitive objects of knowledge. Intransitive objects of knowledge are the ones that don't depend on human activity. In other words, it is the knowledge of things which are not invented by humans e.g. gravity, death etc. On the other hand, transitive phenomenons are "artificial objects fashioned into items of knowledge by the science of the day" (pp. 11). These can be established facts, theories, paradigms, models, methods and techniques of study that are used by a particular researcher.

In addition to making a distinction between transitive and intransitive dimensions of knowledge, critical realism distinguishes between the "real", the "actual", and the "empirical" (Bhaskar 1975). This stratified ontology is what differentiates critical realism from empirical realism which treats the world as if it consists of atomistic objects (or events) that can be easily observed without any hidden characteristics. Even though critical realism accepts that there is one "real" world it does not follow that we, as researchers, have immediate access to it or that we are able to observe its every aspect. Objects (physical or social), have certain structures and powers that can behave in particular ways and cause change. This potentiality still exists even if it remains unexercised. Therefore the "actual" refers to the changes that occur when those powers are activated. Finally, the "empirical" is defined as the domain of observation. The "real" and the "actual" as part of the critical realist ontology presuppose that not all the structures of the things that we experience may be in fact observable. Sayer (2000) argues that "observability may make us more confident about what we think exists, but existence itself is not dependent on it" (pp. 12). However, critical realists recognize that there is a causal criterion too (Collier 1994). This means that the observable events that are being causally generated from the complex interactions of mechanisms can give some information on the existence of these unobservable entities. This makes it possible to understand how things would have been different, for example, if those mechanisms did not interact the way they did.

In general, critical realists' view of causation is quite distinct from that of empiricists and interpretivists. In the former, Hume (1967) argues that causation is the observation of a constant conjunction of (observable) events. This interpretation leaves out anything that remains unobservable like deeper structures and mechanisms. Critical realists believe that these regularities have nothing to do with what causes something to happen. So, instead of looking for "social laws" we should be looking for causal mechanisms and how they work. According to critical realists, consistent regularities are only likely to arise under special circumstances in "closed systems". However, "open systems" like the social world (or sociomaterial phenomena like information systems in organizations) are far too

complex, and therefore the same causal powers can produce different outcomes. Given this variety and continuous change in society (or organizations and technology), one can expect a lack of regular relations between causes and effects. In the case of interpretivism, critical realism shares the same view that social phenomena are concept-dependent and need interpretive understanding. However, unlike interpretivism, it does not exclude causal explanation (Sayer 2000).

Research methods: the case of econometric modeling

Based upon our discussion so far, it is evident that critical realism does not commit to a single type of research but rather endorses an extensive variety of research methods which are chosen according to the type of the project and the aims of the study. In the introduction we discussed the "inability" of other paradigms to accommodate multiple research methods. Critical realism is quite unique in that respect because its stratified ontology allows for the "legitimate" combination of qualitative and quantitative methods. Despite this fact, critical realists have had humanist leanings, which mean that they have tended to emphasize the merits of "intensive" methods over "extensive" ones[2] (Layder 1990). This is mainly because qualitative methods, such as interviews, ethnography, and historical narratives, largely concentrate on the interactions of the various complex mechanisms that cause the events we observe. The drift toward humanism has been accompanied by extensive critique of quantitative methodologies in social science and an interesting debate regarding their position with the ontology of critical realism. In this paper we are going to focus on the criticism that statistical modeling, and in particular econometrics, has received from critical realists. Econometric modeling is based upon the development of statistical methods for testing economic theories and estimating economic relationships (Wooldridge 2006). Similarly, in the IS field, econometrics will often be used to estimate economic relationships emerging from the use of technology in organizations or from the adoption of innovations by individuals. As such, it has achieved considerable prominence among IS researchers and represents a body of award-winning work which makes understanding its further integration into our methodological repertoire a topic that should be of interest.

In general, the arguments of those that criticize statistical modeling from a critical realist perspective vary depending on the field of research. By and large they can be categorized into two groups: those that completely disregard statistics as a realist methodology or partially accept it in the form of descriptive statistics, and those that see a particular kind of value in statistical analysis and propose its use under a critical perspective. At one extreme in this debate is a critique aimed at the field of economics which takes a highly negative view of its use of econometrics (Lawson 1994, 1997; Fleetwood 1999; Cartwright 1989; Hoover 1997; Hands 1999; Downward and Mearman 2002; Bache 2003). In 1996, the Nobel laureate in Economics, Milton Freedman, claimed that "economics has become increasingly an arcane branch of mathematics rather than dealing with real economic problems" (Snowden and Vane 1999). He was not the only economist to argue that excessive quantification has led economic science to bear little relation to what happens in the real world; in his

[2] Intensive and extensive methods are discussed later in the context of our empirical example, however, a summary on intensive and extensive research can be found at Sayer (2000), pp. 21.

book, “Economics and Reality”, Lawson (1997) argues that contemporary academic economics is not in a healthy state. His main concern is that mainstream economics neglects ontology and props up what he regards as an epistemic fallacy (pp. 62). He argues that econometric analysis in economics focuses solely on the identification of strictly defined regularities in solely observable events which is at odds with the stratified ontology of realism.

Most of Lawson’s critique comes from the use of econometrics in mainstream economics rather than econometrics itself; it is important to make the distinction between econometric analysis as a practice or a method that observes the empirical, and that of mainstream economics which has adopted deductivism as a doctrine. It is mainly the deductive logic of mainstream economics that is inconsistent with the ontology of critical realism (Lawson 1999; Fleetwood 1999). Following Lawson, Cartwright (1989), appears slightly more favorable towards econometrics but underlines the very strict conditions under which they can be applied. Her main argument is that social laws might exist within limited domains, a concept that she describes as “local realism”. This is similar to the “ceteris paribus” (meaning “all other things constant”) concept in economics which tries to simulate a closed local system. However, the locality in Cartwright’s case comes from the actual characteristics of the system and not the assumptions made to study it. Despite the negativity that Lawson and Cartwright direct toward the use of econometrics, they both accept that descriptive statistics are useful. More specifically, Lawson (1999) argues that producing summary statistics from a body of data that reveal trends or growth rates (using computation tools to graph and tabulate) can be considered as legitimate from a critical realism perspective (pp. 69).

Unlike Lawson and Cartwright, Hoover (1997) and Bache (2003) take a positive stance towards econometrics. They do not agree with Lawson that realism implies the impossibility of econometrics; instead, they argue that econometrics is not about measuring laws, but about observing unobvious regularities. Indeed, they maintain that the existence of such regularities is a fundamental requirement of realism.

Identifying regularities and demi-regularities

Bache asserts that “the extent to which econometrics could be useful in critical realist research is related to the role played by demi-regularities in this research” (2003 pp. 14). These demi-regularities can be understood as the partial event regularities which at first sight indicate “the occasional, but less than universal, actualization of a mechanism or tendency, over a definite region of time-space” (Lawson 1997, pp. 204). Bache also argues that Lawson only admits a role for demi-regularities at two instances in the research process: “First, demi-regularities have a role in the context of discovery. Demi-regularities help focus the research design and contribute to the generation of hypotheses about causal mechanisms. Second, demi-regularities play a role in the generation and assessment of explanations in the analysis phase” (pp. 14). Econometric analysis can potentially expose non-spurious and non-obvious (demi-) regularities. Econometrics could be particularly important here because it

prioritizes the empirical thus allowing for relationships to emerge in the data generating process (see Bache's (2003 pp. 14) discussion of the LSE econometrics approach).

Much like Bache (2003), Downward and Mearman (2002) argue that there are instances in the social world that can be characterized as "quasi-closed". That way they acknowledge that econometrics can play a much more significant role in revealing demi-regularities than the one Lawson stipulates. Hoover (1997 pp.15) also supports the view that, in many ways, econometrics could be regarded as a more sophisticated version of what social scientists already consider to be legitimate statistical tools. From this perspective, Lawson et al are overstating the flaws of econometrics and exaggerating the failure of empirical economics. Hands (1999) pursues this point further, suggesting that Lawson has wrongly interpreted modern neoclassical economics. He justifies this by analyzing the work of Arrow and Hahn (1971), which shows that their argument "is most certainly not the positivist-inspired search for event regularities […] [but] it looks much more like a search for the actual causal mechanisms behind the phenomena" (pp. 177). Hands' counter-explanation of Arrow and Hahn is noteworthy because it illustrates how econometric modeling can be used consistently with the type of transcendental realism that critical realism advocates. A similar example from the information systems economics literature could be drawn from Aral et al (2006) who also retain a critical view in their research on IT investments and the effects on firm-level productivity.

While these authors have been concerned with the specific critique of econometrics (and economic science practices) much of the debate has focused and on other disciplines that use regression analysis in a similar fashion. Ron (2007) examines the possibility of statistical regressions in political science and concludes that it would be thoughtless to ignore the results generated from regression analysis. He also argues that critical realism can help narrow the gap between textbook statistics and the way they are actually practiced. Within the fields of management science/operational research and information systems, Mingers (2000, 2005) discusses the weaknesses of "conventional interpretation of statistics" but also describes how it can be better employed from a critical realism perspective. He argues that overall the realist critique on statistical modeling can be grouped into the following categories: the assumed nature of causation within empiricism; assumptions about closure; the "atheoretical" nature of statistical modeling; the limitations of the null-hypothesis significance test approach; and the lack of forecasting accuracy" (2005, pp. 206). In the next sub-section, we place our use of statistical analysis in the theoretical context of critical realism.

Beyond econometric models: mixed-method designs and critical realism

Despite the extensive critique that econometrics has received from critical realists, there is also substantial support for the use of econometric modeling in social science. Similarly, we favour the use of econometrics which we believe can be consistent with the stratified ontology of critical realism. As a result, we agree with most of its supporters that econometric models have the capacity to reveal unobvious and robust regularities and therefore can be useful for social scientists. However, observations invite explanation capable of making them relevant and insightful. Despite situations of

"quasi-closure", social systems are generally open which usually generates complexity and messiness. For this reason, it is not possible to entirely isolate its components and examine them under controlled conditions. However, these can be explored using intensive methods that provide context and supply evidence on the mechanisms and structures characterising the empirical domain. This combined "stratified" approach offers a good basis for a critical social science.

We are already seeing some evidence of this in practice, for example Downward and Mearman (2002) encourage the use of additional research methods (such as interviews and case studies) that provide context to the econometric analysis and help uncover meaning and the mechanisms behind processes. In the next section, we consider this proposition in more detail and ground our position with evidence from a study of IS innovation adoption in payment systems. Before moving to the practical example however, we will briefly outline our practical framework for this multi-method research.

In their illustrations of combining qualitative and quantitative methods, Tashakkori and Teddlie (1998) distinguish between two basic categories of mixed-method designs: equivalent status versus dominant/less-dominant designs and sequential versus parallel/simultaneous designs. These four approaches can be mixed together leading to different combinations. For example, an equivalent status sequential design is employed when a researcher uses qualitative and quantitative methods on an equal basis to understand the phenomenon under study. In this instance, the methods are employed sequentially, one after the other, in two distinct phases. In a dominant/less-dominant parallel scenario, one methodological approach would be used more than the other (e.g. more qualitative evidence than quantitative) but these would be used at the same time and analyzed simultaneously. These illustrations of different research designs can refer to both data collection and analytical techniques. Creswell (2003) uses an analogous categorization of mixed-method strategies but groups the different designs into decision choices between: types of implementation (sequential vs. non-sequential); priorities among research approaches (qualitative priority vs. quantitative priority vs. equal priority); integration of research (at data collection, analysis, interpretation, or some combination); and theoretical perspectives (explicit versus implicit). Finally, Mingers (2001) distinguishes between sequential, parallel, dominant, multi-methodological, and multi-level types of research design. All the above research frameworks help in organizing the research properly and dealing with the deficiencies of mono-methods. Even though these can be good guides of research conduct leading to a combination of research frameworks or to complex designs which can be accommodated within a program of research rather than a single research project. As with most methodological guides, they represent an ideal and in lived experience things usually develop in unexpected ways that demand researchers to be responsive but remain systematic. As noted above much more research advice is available to those pursuing mono-methods and therefore our aim in the next section is make a contribution to what we hope will be a cumulative body of work providing insights into multi-method practice based upon tales of the field.

A practical example: Value added from payment systems adoption

So far we have argued that mixed-methods are not just advantageous but often deemed necessary in order to provide context and rigor to a particular research domain. In addition, we have built a case justifying critical realism as the underlying philosophy for use of multiple methods in one research study. In this section we provide a practical example to illustrate how a researcher can conduct multi-method research from a critical realism perspective. First, we start by positioning our research study within the ICT and productivity debate and discuss the complexities associated with the adoption of information systems in organizations (specifically the financial services sector). In the second section we describe our research design and provide a series of detailed illustrations to show how the research took place in practice.

The economics of IS

In the economics of information systems literature there have been a number of attempts to understand and measure the effects of ICT on the financial performance of firms. Consequently an active debate was initiated between various scholars on whether investment in IT can result in an increase in productivity and under which circumstances. In 1987, Robert Solow declared that "You can see the computer age everywhere but in the productivity statistics"[3]. His famous quip stimulated generations of research into this topic and over time new evidence has appeared. Leading economists in the field of innovation and productivity growth have given many explanations for the existence of the so-called Solow's productivity paradox (Brynjolfsson 1993; Triplett 1999). The key points in their critique include:

- Incorrect measurement of outputs and inputs
- Discrepancies and lack of timing due to learning and adjustment (it was too soon to tell).
- Redistribution of profits
- Poor management of Information & Communication Technologies

So where does productivity growth come from? By definition productivity doesn't come from working harder. Although this may increase the output, it also increases the input in labour (similarly, using more capital doesn't necessarily increase productivity). Productivity growth comes from working "smarter" (Brynjolfsson and Hitt 1998), this means adopting new technologies and innovative techniques for production. According to economic theory, the most effective way to determine if information technologies have positive effects on productivity growth is by studying broad datasets which contain multiple observations and identify trends in the data. Recent evidence shows that a consensus is beginning to emerge despite the IT failures (Brynjolfsson and Hitt 1995, 1996, 1997; Dewan and Min 1997; Lichtenberg 1995). As a consequence the debate is shifting from whether ICT really boosts productivity toward the analysis of management practices that lead to more efficient use of ICT in organizations. Key to this is the proposition that businesses optimize their investment in ICT

[3] Robert Solow, the New York Times Book Review (July 12, 1987).

when it is combined with other complementary investments such as focused efforts to form distinctive organizational strategies, business process re-design, and the creation of other forms of "organizational capital" (Brynjolfsson and Hitt 1998, Draca et al 2007).

The complex inter-dependencies of financial systems create tensions within and between organizations as multiple accounting criteria result in different definitions of business value for competing profit centres. This presents complications for research on the link between productivity and ICT in this sector. For example, ATMs reduced the number of checks banks process and therefore we can argue that by some measures banking output and productivity decreased. However, the increases in convenience ATMs created go uncounted in conventional productivity metrics, whereas their costs are counted (Brynjolfsson and Hitt 1998). It is only natural, when costs can be easily counted but benefits prove difficult to assess, to misjudge investments in IT, particularly if those benefits take time to be realized.

In the early 1990s, new data were obtained and facilitated a re-evaluation of some of the earlier findings about ICT and productivity. For the first time, scholars had data that enabled them to look at IT investment patterns and productivity of significant numbers of firms instead of focusing on higher level totals such as services industries or the entire economy. This micro-level approach holds a number of advantages. Firm level data provides opportunities to appraise a considerable amount of intangible value created by investments in IT even if this value cannot be observed straight away. Early firm-level research on ICT and productivity argues that an additional unit of IT capital is linked with a considerable increase in revenue each year (Brynjolfsson and Hitt 1995, 1996).

Research on ICT and productivity is entering a new stage. Whilst the initial phase of research tried to capture the relationship between IT investments and productivity growth, recent studies tend to focus on how to leverage IT resources and make them more effective with particular emphasis on business practices. Computerization does not automatically result in productivity growth; however, it is a crucial element that should be combined with other organizational changes in order to increase financial performance. As shown in Graph 1, the scholarly effort that we are involved in builds upon these findings and proposes combining an econometric model with qualitative IS research including case studies, historical narrative, and surveys.

SWIFT adoption and firm performance

The main goal of our study was to understand and estimate the effect of SWIFT adoption on the financial performance of banks. SWIFT, which stands for "Society for Worldwide Interbank Financial Telecommunication", is an international, co-operative organization that provides the proprietary communications network to financial institutions around the world. SWIFT also provides the messaging standards so that member banks can perform financial transactions more efficiently. The motivation for the study emerged after exploratory interviews with people in financial sevices who revealed a number of controversies and helped identify themes such as governance and control of

financial networks, stifling of innovation, as well as the importance of practices and the management of change relating to SWIFT. The official commencement of the study took place in January 2007 when SWIFT provided a complete dataset with all its member institutions providing detailed information regarding the timing and mode of SWIFT adoption. A major operation was then initiated to match these data with firm-level financial information for each bank. The matching, which ended in the summer of the same year, resulted in a significant dataset of 6,848 adopter and non-adopter institutions from 29 countries in Europe and the Americas. During that time interviews were conducted with executives and professionals from the financial industry and among banks that had adopted SWIFT. At the start of the study, the overriding assumption patterning the interview data was that SWIFT itself does not add value in a conventional way that could be traced in the accounting figures of the banks. There was also an assumption that small banks don't benefit from SWIFT adoption except in intangible ways such as enhanced reputation.

Once the quantitative datasets were constructed and made ready to use, an econometric analysis was performed looking at the relationship between SWIFT adoption and various measures of financial performance[4]. Other variables were also used that described total sales and operating costs. In our model specifications we controlled for the size of the banks, their number of employees, and other firm-level characteristics that could eventually influence performance including year and country trends. Overall, our use of quantitative analysis suggested that SWIFT adoption makes a significant difference and revealed very different relationships between diffusion of innovation and bank-level performance. At that point we used insights from both of these methods to craft the focus of the study around the question "How does SWIFT add value, for whom, and when?" We took the findings from our first round of quantitative work and communicated it to domain experts (professional bankers as well as representatives from SWIFT) who disputed the statistical evidence and reverted to the claims made in the first round of interviews asserting that SWIFT is just a neutral pipe which does not add value to the individual adopter. Our domain advisors encouraged us to disentangle our statistical findings further and refine the results. So we made the statistical analysis more specific by splitting the sample into smaller and bigger banks and grouping them into different regions in order to conduct further regressions. Alternative controls were employed to rule out the influence of other factors on the outcome of adoption including firm fixed effects. The positive effect on our performance measures stubbornly remained despite all these efforts and so we set about designing a new phase of research to understand why.

The next stage of the qualitative research consisted of further interviews with account managers and technicians from SWIFT trying to list all the costs and benefits involved from the implementation of SWIFT. A detailed timeline was developed which described all the implementation phases. The aim was to identify the dynamics and interplay of the technology with the business processes involved in the procedure and map these onto our quantitative data. A further qualitative case study was conducted specifically around the issues relating to small banks in order to understand the value generating

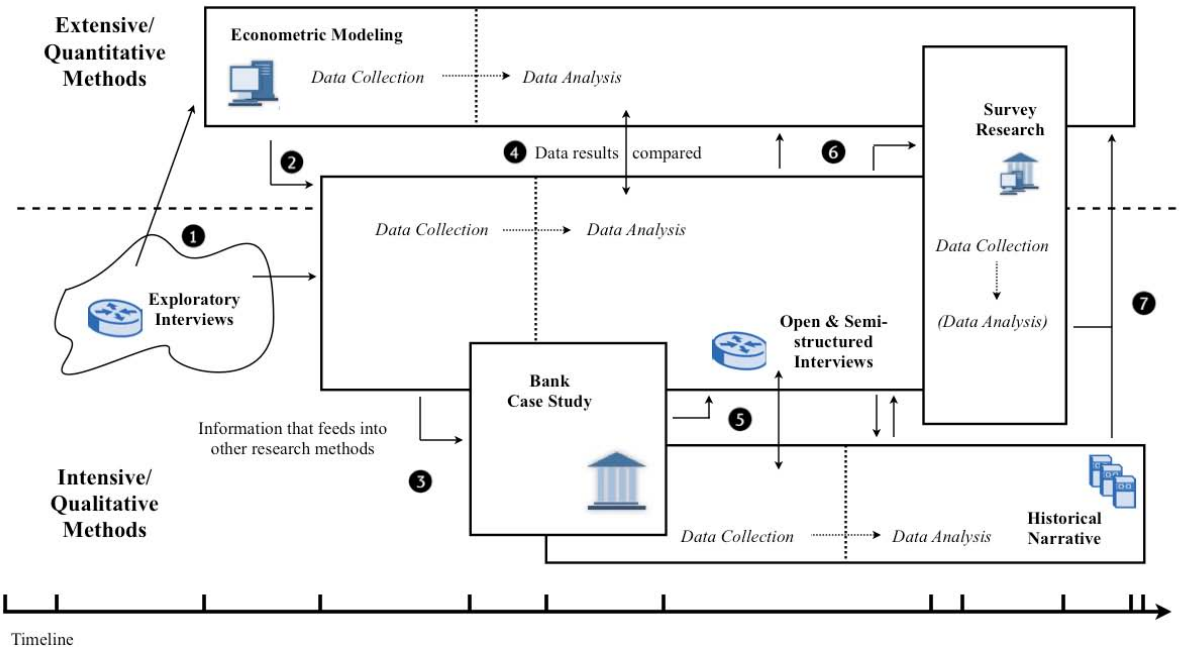
[4] The main variables of interest were: Profit Margins, Return on Assets, and Return on Equity.

mechanism of SWIFT and provide context to those particular econometric results. Our analysis of this data provided evidence to support a counter-claim that small banks achieve tangible benefits and gave us specific examples of how this was realized in practice.

Another major result that emerged from the quantitative analysis identified differences between the way early and late adopters experienced the effects of SWIFT adoption. In our analysis we found that late adopters had an advantage over early adopters in realizing the benefits from SWIFT implementation. Descriptive statistics confirmed that the majority of early adopters were large organizations who were also the founders and initial developers of SWIFT. A thorough historical study was then initiated in order to investigate the origins of SWIFT and the early years of its development. The study, carried out over a 7 month period, consisted of extensive archival work and interviews with retired bankers and senior executives. The results of this research helped us to understand why particular issues dominated our initial interview data (governance, control, stifling innovation) and sector-level discourse at industry conferences. It also revealed a significant part of the political dynamics in the sector and the uneasy relationship between particular financial organizations. The scale of the investment by big banks and their decision to prioritize expansion of the network over dominance of the infrastructure helped to explain why they regarded the cost/benefit for small banks as relatively insignificant.

Using our combined findings also helped us to achieve a better understanding of the network effects taking place at a population level and gave the propositions emerging from our research greater granularity. A richer understanding of the trade-off between private network/limited profit and community utility/business expansion emerged. The compromises over governance recounted in the interviews connected to evidence in the population level results showing that early adopters gained benefit from greater connectivity which enabled them to provide a wider range of services to a diversified customer base. These benefits are compounded when subsequent banks join the network because connectivity increases exponentially. Therefore contrary to claims of some of our interviewees, just joining SWIFT *does* makes a difference. While the effect is small, it achieves significance because it is amplified by the sheer scale of the SWIFT network (more than 8000 users constituting almost the entire banking population of the world).

In the final part of the research (begun in January 2010), we constructed a survey in order to acquire more information on the complementary technologies and business practices that accompany the implementation of SWIFT. This survey will reinforce the findings from our case study in one of the smaller banks by providing evidence from over 400 banks in Europe and the US. This part of the research is not yet completed, nevertheless, it is expected that it will underline the nature and the importance of such complementarities and produce data that can be matched to the original panel dataset.



❶ Exploratory interviews helped identify the research questions and decide on the appropriate methods to use during the course of the study.

❷ Initial results from the econometric analysis gave more information on what to include in our interviews.

❸ Interviews and quantitative analysis also gave us insights into where and how to perform our case study.

❹ The results from the data analysis between the different methods were also compared frequently.

❺ The case study provided more evidence and again we discussed findings with contacts in financial services.

❻ Results from the interviews resulted in another round of more explicit quantitative analysis that gave rise to interesting relationships between the adoption of SWIFT and bank performance.

❼ The historical study informed and helped make sense of data gathered using other research methods

Graph 1. Mixed-method Research Framework

During the course of the study research methods were used in parallel and interchangeably. Qualitative and quantitative methods were used subscribing to the equal priority or equivalent status research approach from Creswell (2003) and Tashakkori and Teddlie (1998). Data collection and analysis from each method provided feedback and context to the results generated from other approaches in a way that mutually informed each other. Graph 1 highlights the dynamic way in which the respective

research methods were used in the study and how each method supported the use of the other during the research process. The arrows show the direction of each research method informing the other during data collection and data analysis phases. Results were also compared between methods resulting in a synthesis of outcomes that gave a greater understanding of findings so far and inspiration for further research. The size of the boxes is also an approximation of the magnitude of each research method and their importance in the study. In addition, their location vertically and horizontally in the graph represents whether the methods were extensive/quantitative methods or intensive/qualitative methods and how soon they were conducted in the research process respectively.

Discussion and Conclusions

Our practical example provides a compelling illustration of how mixed method research can combine qualitative and quantitative approaches under a single research approach. More importantly, however, it highlights the limitations of using only positivist or interpretivist approaches by themselves. More specifically, qualitative research interviews demonstrated weaknesses particularly for topics concerned with infrastructure in which professionals tend to only understand their bounded area of expertise and do not have a sense of larger sector-wide consequences. In parallel, quantitative methods did not help us to understand the themes of governance and innovation that dominated industry discourse. To comprehend these issues further we needed to conduct a historical study including extensive archival work. Furthermore, the statistical analysis alone could not make sense of the trends that we found and we needed to conduct specific case studies to understand them better.

What was striking throughout the research process was the way in which sector experts seemed wholly unmoved by the findings generated by a single research method. The qualitative research only served to reinforce their own assumptions, whereas the quantitative ran so counter to them that they could not accept them. It was only when we conducted further rounds of both qualitative and quantitative research to produce a combination of refined statistical analyses on split samples supported by empirical illustrations from case studies that domain experts became engaged with our findings. Indeed, the insights that this generated were regarded as having considerable business intelligence and we have presented our findings to the Board of SWIFT and central banks.

Mixing methods mutually informed our research design influencing the scope of the study and our approach to analysis. At each stage the insights from one method shed light on the other. If we had not used mixed method, the study may have ground to a halt in the face of criticism from domain advisers who, while experts in their own area, did not have a sense of population-level change over time. At each point important questions were raised that challenged our findings and their assumptions. We found that combining intensive and extensive research methods meant that we kept us asking questions when other approaches might have given up and gave us relevant input that enabled us to work systematically through the difficulties that we came across in each phase of the research.

Achieving recognition among domain professionals and policy makers was greatly facilitated by the combination of research methods. We were able to provide evidence which gave us the confidence to challenge their assumptions and demonstrated to them the value of working with us to find explanations. It is unlikely that a positivistic or an interpretive approach alone could have succeeded in this regard. Critical realism enabled us to recognize the contribution that research methods typically used within different paradigms can make when made to work together sympathetically within a theoretically coherent research design. Mingers articulately justifies critical realism's role a multi-method research process as follows: "no matter how complex a statistical analysis or rich an ethnographic interpretation, this is only the first step – [critical realism] wants to get beneath the surface to understand and explain why things are as they are, to hypothesize the structures and mechanisms that shape observable events" (2004 pp. 100). Based on the stratified ontology of critical realism, qualitative methods are justified as being important in order to dig into the "real" and uncover the mechanisms and structures that cause the events we actually observe and experience into the "empirical" domain. The distinction between transitive and intransitive objects of knowledge (the material and social world), encourages the use of different methods in order to understand their distinctive characteristics. As we have argued earlier, this is of particular importance to IS research which studies the sociomaterial entanglement of technology and society (Orlikowski and Scott 2008).

In our example regularities (or demi-regularities) played an important role. Trends in our quantitative analysis regarding the value added from SWIFT adoption, particularly for smaller firms, showed us where to look "beneath the surface" in order to disclose parts of the mechanism that shape these observable regularities. Unlike empiricism, we did not assume right away that what we observe is a causal effect from the adoption of the specific innovation. We took a critical stance and decided to look into the matter further by employing a case study and additional interviews with professionals knowledgeable in the field. When we revisited our econometric analysis we were more confident of the results we were getting and our research was better informed by incorporating the qualitative results. On the criticism of the implicit assumption of closure (Mingers 2004, 2005) we acknowledge the complexity of the financial sector and the issues involved in estimating economic variables, however, we were also aware that "quasi-closures" can exist (Downward et al 2002, Bach 2003). This became particularly apparent when we broke down our sample to a specific time-span using a more homogenous section of the population data. In this way, we discovered some robust demi-regularities that were persistent across samples. While we were conducting our regression analysis we were also aware that the assumed linear relationship of our variables could be an approximation of their real relationship. Yet, we believed that on average the underlying relationship would be close to the one described by our main specification model. If we had adopted Lawson's approach and disregarded econometrics completely we would never be able to identify these non-obvious partial regularities, and no matter how many interviews we carried out we would never have developed the original line of argument that has emerged from using this approach to study the research phenomenon in our research.

There are, of course, still areas for debate with regard to our findings: for example we recognize that the magnitude of our coefficients describing the value added from SWIFT could be upwardly biased due to unobservable characteristics correlated with the adoption of SWIFT in our sample. However, qualitative methods helped reveal these complementarities and we have incorporated them into our survey to get a richer understanding from a larger sample. This will help isolate the effect of these complementary factors and get a better estimation of the SWIFT effect. Simultaneity (or reverse causality[5]) may also be an issue however the corpus of data built up using qualitative methods has helped us to develop an explanation for size of our coefficients. While there is still further research to be done, the evidence so far reveals the distinctive value that can be realized by dynamically linking multiple methods within a study and supports the call for further work of this kind in the IS community.

Contribution and way forward

In this paper we argue in favor of mixed methods research in IS and propose more extensive use of critical realism as the underlying philosophy for studies that combine qualitative and quantitative methods. We draw upon our research into the economics of IS to show how different methods can be used in unison feeding into each other and providing a diversity of insights from which to develop a deeper understanding of the phenomena under study. Drawing on debates within critical realism, we construct a philosophical basis for our research design. In particular, we highlight the importance of demi-regularities and how these can be identified by quantitative methods such as econometric analysis. We illustrate the way that demi-regularities can inform data-gathering and analysis of qualitative data from interviews, case studies, and historical narratives. We suggest that the systematic insights that have emerged from combining methods in this study would be very difficult to achieve within a single method. Furthermore, we maintain that our experience working with critical realism as a theoretical lens proves that it can draw together a research design and overcome potential philosophical concerns about the incommensurability of research methods from different paradigms. The contribution of this paper is therefore threefold: firstly, we provide additional important motivation for using multiple methods; secondly, using the notion of demi-regularities we develop a theoretically nuanced proposal for using critical realism as the philosophical foundation for mixed methods research in the IS field; and thirdly, we provide a practical example of mixed methods at work in a critical study.

Our paper has some important limitations which could be addressed in further research. Consistent with the exploratory nature of the research, the theoretical developments were partly identified in advance and partly emergent in nature. For example, while the notion of demi-regularities was

[5] Reverse causality exists when one of the independent variables in an equation is jointly or simultaneously determined with the dependent variable. This can cause doubt on whether the positive (or negative) correlation observed is because of the effect of the independent variable onto the dependent or the other way around.

identified in advance we had to ‘work out’ their relationship to qualitative fieldwork design. We had originally planned to explore demi-regularities arising from chronological events (such as a explaining a surge in membership in a particular year) but instead found it more practical to focus more closely on the interplay between themes in the research and statistical patterns within the SWIFT population (e.g. the experience of small banks). Other researchers may have made alternative choices and interpreted the role of demi-regularities in the stratified ontology of critical realism differently leading to other findings. As Mingers (2001) has observed, research, much like the social world, can be messy and researchers often appreciate research situations differently. We recognize that other combinations of multiple research methods could be explored which were not included in our example including: ethnography, participant observation, factor analysis, path analysis and many others.

The IS field has reached an important stage in its development in which the value of both qualitative and quantitative methods have achieved recognition. This coincides with a historical period in which information and communication technologies have become more pervasive creating important relationships between multiple levels of analysis ranging from work practices on the ground to the use of infrastructures by distributed populations. This is likely to change the demand for multi-method research in coming years. Studies have shown that statistical analysis is often favored by senior managers and policy makers (Fox 1992) who prefer less reliable statistical evidence upon which they can base budgets and reports rather than no numerical descriptions at all. The expertise and growing experience in academia with multiple research methods, increasing computational resources, and complex data sets has put us in a better position than ever before to provide nuanced, systematic, domain relevant findings. If qualitative and quantitative research methods are seen as competing methods then this will inhibit our understanding of phenomena. Critical realism can be seen as a powerful middle way of gaining knowledge through intensive and extensive research methods, that when used in conjunction can come closer to achieving a much needed systematic understanding of the relationships, structures and mechanisms constituting the material and social world.

References

Arrow, K. J., & Hahn, F. H. (1971). *General Competitive Analysis*. *San Francisco: Holden-Day*. San Francisco: Holden-Day.

Bache, I. W. (2003). *Critical Realism and Econometrics*. *Working Paper: Central Bank of Norway*, Research Department, Norges Bank (pp. 1-22).

Benbasat, I., & Weber, R. (1996). Research Commentary : Rethinking "Diversity" in Information Systems Research. *Information Systems Research*, *7*(4), 389-400.

Bhaskar, R. (1975). *A Realist Theory of Science [RTS]*. *Leeds: Leeds Books* (first.).

Bhaskar, R. (1978). *The possibility of naturalism*. *Sussex: Harvester Press*.

Bhaskar, R. (1989). *Reclaiming reality*. *London: Verso*.

Bhaskar, R. (1998). Philosophy and Scientific Realism. In M. Archer, R. Bhaskar, A. Collier, T. Lawson, & A. Norrie, *Critical realism: essential readings* (first.). London: Routledge.

Brynjolfsson, E. (1993). The productivity paradox of information technology. *Communications of the ACM*, *36*(12), 66-77.

Brynjolfsson, E., & Hitt, L. M. (1998). Beyond the productivity paradox. *Communications of the ACM*, *41*(8), 49-55.

Brynjolfsson, E., & Hitt, L. M. (1995). Computers as a Factor of Production: The Role of Differences Among Firms. *Economics of Innovation and New Technology*, *3*(3), 183-199.

Brynjolfsson, E., & Hitt, L. (1997). *Computing productivity: Are computers pulling their weight?*, MIT and Wharton working paper.

Brynjolfsson, E., & Hitt, L. M. (1996). Paradox Lost? Firm-Level Evidence on the Returns to Information Systems Spending. *Management Science*, *42*(4), 541-558.

Carlsson, S. A. (n.d.). *Critical Realism : A Way Forward in IS Research*. Unpublished Draft (pp. 1-12).

Cartwright, N. (1989). *Nature's Capacities And Their Measurement*. *Oxford: Clarendon Press*. Oxford: Clarendon Press.

Cherryholmes, C. H. (1992). Notes on Pragmatism and Scientific Realism. *Educational Researcher*, *21*(6), 13-17.

Collier, A. (1994). *Critical Realism*. *London: Verso*.

Creswell, J. W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. *London: Sage* (Second., pp. 1-246).

Denzin, N. K. (1970). *The Research Act in Sociology*. *Chicago, IL.: Aldine*.

Dewan, S., & Min, C. (1997). The Substitution of Information Technology for Other Factors of Production: A Firm Level Analysis. *Management Science*, *43*(12), 1660-1675.

Downward, P., Finch, J. H., & Ramsay, J. (2002). Critical realism, empirical methods and inference: a critical discussion. *Cambridge Journal of Economics*, *26*(4), 481-500.

Downward, P., & Mearman, A. (2002). Critical Realism and Econometrics: Constructive Dialogue with Post-Keynesian Economics. *Metroeconomica*, *53*(4), 391-415.

Downward, P., & Mearman, A. (2006). Retroduction as mixed-methods triangulation in economic research: reorienting economics into social science. *Cambridge Journal of Economics*, *31*(1), 77-99.

Draca, M., Sadun, R., & Van Reenen, J. (2007). Productivity and ICT : A Review of the Evidence. In R. Mansell, C. Avgerou, D. Quah, & R. Silverstone, *The Oxford Handbook of Information and Communication Technologies* (pp. 100-147). Oxford: Oxford University Press.

Feller, J., Finnegan, P., Fitzgerald, B., & Hayes, J. (2008). From Peer Production to Productization: A Study of Socially Enabled Business Exchanges in Open Source Service Networks. *Information Systems Research*, *19*(4), 475-493.

Fleetwood, S. (1999). Situating Critical Realism in Economics. In S. Fleetwood, *Critical Realism in Economics* (first., pp. 127-135). London: Routledge.

Fleetwood, S. (2001). Causal Laws, Functional Relations and Tendencies. *Review of Political Economy*, *13*(2), 201-220.

Fleetwood, S. (2005). Ontology in Organization and Management Studies: A Critical Realist Perspective. *Organization*, *12*(2), 197-222.

Fox, S. (1992). What are we? The constitution of management in higher education. International Studies of Management & Organization, 22(3), 71-93.

Gable, G. (1994). Integrating Case Study and Survey Research Methods: An Example in Information Systems. *European journal of information systems*, *3*(2), 112-126.

Galliers, R. D., & Land, F. F. (1987). Choosing Appropriate Information Systems Research Methodologies. *Communications of the ACM*, *30*(11), 900-902.

Guba, E. G., & Lincoln, Y. S. (1994). Competing Paradigms in Qualitative Research. In N. Denzin & Y. S. Lincoln, *Handbook of Qualitative Research* (1st Ed., pp. 105-117). Thousand Oaks, CA: Sage.

Hands, W. D. (1999). Empirical realism as meta-method: Tony Lawson on neoclassical economics. In S. Fleetwood, *Critical Realism in Economics* (first., pp. 169-186). London: Routledge.

Hoover, K. D. (1997). *Econometrics and Reality*. *Working Paper: UC Davis - Dept. of Economics*, The Working Papers of the Department of Economics, University of California, Davis. (pp. 1-38).

Howe, R. K. (1988). Against the Quantitative-Qualitative Incompatibility Thesis or Dogmas Die Hard. *Educational Researcher*, *17*(8), 10-16.

Hume, D. (1967). *Enquiries Concerning Human Understanding and the Principles of Morals*. *Oxford: Clarendon Press*. Oxford: Clarendon Press.

Jones, M. (2000). Mission impossible? Pluralism and 'multi-paradigm' IS research. *Information Systems Review*, *1*(1), 217-232.

Kaplan, B., & Duchon, D. (1988). Combining qualitative and quantitative methods in information systems research: a case study. *MIS Quarterly*, *12*(4), 571-586.

Kuhn, T. (1970). *The Structure of Scientific Revolutions*. *Chicago, IL.: Chicago University Press*. Chicago, IL.: Chicago University Press.

Landry, M., & Banville, C. (1992). A disciplined methodological pluralism for MIS research. *Accounting, Management and Information Technology*, *2*, 77-97.

Laudan, L. (1984). *Science and Values: An Essay on the Aims of Science and their Role in Scientific Debate*. *Their Role in Scientific Debate, Uruversity of California Press, Berkeley, CA*. Berkeley.

Lawson, T. (1994). A Realist Theory for Economics. In R. Backhouse, *New directions in economic methodology* (first., pp. 257-285). London: Routledge.

Lawson, T. (1997). *Economics and reality*. *London: Routledge*.

Lawson, T. (1999). Developments in economics as realist social theory. In S. Fleetwood, *Critical Realism in Economics* (first., pp. 3-20). London: Routledge.

Layder, D. (1990). *The Realist Image in Social Science*. *New York : St. Martin's Press* (pp. 1-189). New York: St. Martin's Press.

Lee, A. S. (1989). A Scientific Methodology for MIS Case Studies. *MIS Quarterly*, (March), 33-51.

Lee, A. S. (1989). Case Studies as Natural Experiments. *Human Relations*, *42*(2), 117-137.

Lee, A. S. (1991). Integrating Positivist and Interpretive Approaches to Organizational Research. *Organization Science*, *2*(4), 342-365.

Lee, A. S. (1999). Rigor and Relevance in MIS Research: Beyond the Approach of Positivism Alone. *MIS Quarterly*, *23*(1), 29-34.

Lee, A. S., & Baskerville, R. L. (2003). Generalizing Generalizability in Information Systems Research. *Information Systems Research*, *14*(3), 221-243.

Lee, A. S., Liebenau, J., DeGross, J. (1997). *Information systems and qualitative research*. (A. S. Lee, J. Liebenau, & J. DeGross)*London: Chapman Hall*.

Lee, A. S., & Sarker, S. (2008). *A Schema for Relating and Combining Quantitative, Qualitative, Positivist, and Interpretive Research Methods in the Discipline of Information Systems. Working Paper: Unpublished Manuscript*, Unpublished Manuscript (pp. 1-23).

Lichtenberg, F. R. (1995). The Output Contributions of Computer Equipment and Personnel: A Firm-Level Analysis. *Economics of Innovation and New Technology*, *3*(3), 201-217.

Lyytinen, K. (1992). Information systems and critical theory. In M. Alvesson & H. Willmott, *Critical Management Studies* (Vol. management, pp. pp159-180). London: Sage.

Lyytinen, K., & Klein, H. (1985). The critical theory of Jurgen Habermas as a basis for a theory of information systems. In E. Mumford, R. Hirscheim, G. Fitzgerald, & W. T, *Research methods in Information Systems* (Vol. formations, pp. pp219-236). Amsterdam: Elsevier.

Maki, U. (2002). Fact and Fiction in Economics: Models, Realism and Social Construction. (U. Maki)*Cambridge: Cambridge University Press*, 1-397.

Markus, M. L. (1983). Power, Politics, and MIS Implementation. *Communications of the ACM*, *26*(6), 430-444.

Markus, M. L., & Robey, D. (1988). Information Technology and Organizational Change : Causal Structure in Theory and Research. *Management Science*, *34*(5), 583-598.

Meyer, B. D. (1995). Natural and Quasi-Experiments in Economics. *Journal of Business & Economic Statistics*, *13*(2), 151-161.

Miles, M., & Huberman, M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook. Thousand Oaks, CA.: Sage*.

Mingers, J. (2000). The Contribution of Critical Realism as an Underpinning Philosophy for OR/MS and Systems. *The Journal of the Operational Research Society*, *51*(11), 1256.

Mingers, J. (2001). Combining IS Research Methods: Towards a Pluralist Methodology. *Information Systems Research*, *12*(3), 240-259.

Mingers, J. (2003). The paucity of multimethod research: a review of the information systems literature. *Information Systems Journal*, *13*(3), 233-249.

Mingers, J. (2004). Real-izing information systems: critical realism as an underpinning philosophy for information systems. *Information and Organization*, *14*(2), 87-103.

Mingers, J. (2005). A critique of statistical modelling in management science from a critical realist perspective: its role within multimethodology. *Journal of the Operational Research Society*, *57*(2), 202- 219.

Myers, M. (1997). Qualitative Research in Information Systems. *MIS Quarterly*, *21*(2), 241-243.

Nandhakumar, J., & Jones, M. (1997). Too close for comfort? Distance and engagement in interpretive information systems research. *Information Systems Journal*, *7*, 109-131.

Ngwenyama, O. (1991). The critical social theory approach to information systems: problems and challenges. In H. E. Nissen, H. Klein, & R. Hirscheim, *Information systems research: Contemporary approaches* (Vol. emergenttr, pp. pp267-280). Amsterdam: North Holland.

Orlikowski, W.J., & Baroudi, J. (1991). Studying information technology in organizations: research approaches and assumptions. *Information Systems Research*, *2*(1), 1-28.

Orlikowski, W.J., & Scott S.V. (2008). Sociomateriality: challenging the separation of technology, work and organization. *Academy of Management Annals*, 2(1), 433-474.

Patomaki, H., & Wight, C. (2000). After Postpositivism? The Promises of Critical Realism. *International Studies Quarterly*, *44*(2), 213-237.

Pratten, S. (2005). Economics as progress: the LSE approach to econometric modelling and critical realism as programmes for research. *Cambridge Journal of Economics*, *29*(2), 179-205.

Reed, M. (1985). *Redirections in organizational analysis*. *London: Tavistock*.

Robey, D. (1996). Research Commentary: Diversity in Information Systems Research: Threat, Promise, and Responsibility. *Information Systems Research*, *7*(4), 400-408.

Ron, A. (2007). Regression Analysis and the Philosophy of Social Science: A Critical Realist View. *Journal of Critical Realism*, *1*(1).

Rorty, R. (1982). Pragmatism, relativism, and irrationalism. In R. Rorty, *Consequences of pragmatism* (pp. 160-175). Minneapolis: University of Minnesota Press.

Sayer, A. (2000). *Realism and Social Science*. *London: Sage* (First., pp. 1-301).

Smith, M. (2006). Overcoming theory-practice inconsistencies: Critical realism and information systems research. *Information and Organization*, *16*(3), 191-211.

Snowden, B., & Vane, H. (1999). Conversation with Milton Friedman. In *Conversations with Leading Economists: Interpreting Modern Macroeconomists* (pp. 124-144). Cheltenham: Edward Elgar.

Swanson, E. B., & Ramiller, N. C. (1993). Information Systems Research Thematics: Submissions to a New Journal, 1987-1992. *Information Systems Research*, *4*(4), 299-330.

Tashakkori, A., & Teddlie, C. (1998). *Mixed Methodology: Combining Qualitative and Quantitative Approaches*. *London: Sage* (pp. 1-185).

Triplett, J. E. (1999). The Solow Productivity Paradox: What do Computers do to Productivity? *The Canadian Journal of Economics / Revue canadienne d'Economique*, *32*(2), 309.

Walsham, G. (1995). Interpretive case studies in IS research: nature and method. *European journal of information systems*, *4*(2), 74–81. Nature Publishing Group.

Walsham, G. (1995). The Emergence of Interpretivism in IS Research. *Information Systems Research*, *6*(4), 376-394.

Wooldridge, J. M. (2006). *Introductory Econometrics: A Modern Approach* (3rd., pp. 1-890). Thomson, South-Western.