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AN ANALYSIS OF ICT ACTIVITY BEHAVIOR OF GREEK BANKS IN THE ECONOMIC CRISIS

Euripidis N. Loukis
University of Aegean, eloukis@aegean.gr

Spyros Arvanitis
ETH Zurich, arvanitis@kof.ethz.ch

Dionysis Myrtidis
University of the Aegean, dmyrtidis@gmail.com

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Loukis, Euripidis, University of the Aegean, Samos, Greece, eloukis@aegean.gr

Arvanitis, Spyros, ETH Zurich, Zurich, Switzerland, arvanitis@kof.ethz.ch

Myrtidis, Dionysis, University of the Aegean, Samos, Greece, dmyrtidis@gmail.com

Abstract

The influence of the external environment on ICT use, management and exploitation by firms has been widely recognized and researched for long time. However, quite limited research has been conducted on the impact of one of the most serious disruptions that repeatedly occur in firms external environment, the economic crises of various intensities and durations, which cause economic recession and sharp, rapid and strong decrease of the demand for products and services, and have quite negative short- medium- and long-term consequences. Our study contributes to filling this important research gap, by analysing the behaviour of the core 'system-relevant' Greek banks with respect to their ICT activity in the first years 2010-2014 of the severe Greek economic crisis, examining a wide range of 'hard' and 'soft' aspects of their ICT activity concerning important ICT resources and capabilities as well as ICT plans. For this purpose, we have adopted a mixed methodology, including a combination of quantitative and qualitative techniques (interviews with ICT General Directors of the above banks combined with questionnaire filling). It has been concluded that the main priority of core Greek banks in the economic crisis with respect to their ICT activities has been the rationalization of their ICT processes/practices and improvement of their ICT capabilities, especially their ICT strategic alignment capability, to a large extent, followed by the reduction of their ICT-related expenses, mainly for ICT personnel payroll, and for investments in new ICT technological resources (new hardware and software), and the adaptation of their ICT plans to the crisis conditions, both to a moderate to large extent. Our findings enable a better understanding of the impact of economic crisis on important 'hard' and 'soft' aspects of ICT activity, concerning important ICT resources and capabilities, as well as ICT plans, in a highly important and 'information-intensive' sector, which has been historically a heavy and experienced user of ICT. Furthermore, our findings reveal interesting multi-dimensional patterns of ICT behaviour /management (concerning a wide range of both 'hard' and 'soft' aspects of ICT activity) in economic crisis, which might be of wider interest and usefulness to firms for managing ICT in such difficult recession times.

Keywords: ICT Activity, ICT resources, ICT capabilities, ICT plan, economic crisis, economic recession.

1 Introduction

The influence of the external environment on the use, management and exploitation of Information and Communication technologies (ICT) by firms has been widely recognized and researched for long time in information systems (IS) research. The historic and well-established model of ICT utilization and business value generation by firms of Melville et al. (2004), which was developed through exten-

sive review of relevant literature, and became quite influential in subsequent information systems (IS) research, includes firm's external environment as an important factor affecting the use of technological and human ICT resources, as well as their exploitation for the generation of business value; furthermore, it defines specific characteristics of firm's external environment, concerning its industry (such as competition, dynamism and regulation) as well as its country environment (such as economic development, growth rate, education, infrastructures and culture), that affect the use and exploitation of ICT for improving the performance of firm's business processes and finally its organizational performance. Much later, the 'synthetic' firm-level ICT business value model developed by Schryen (2013), based on a review of several previous ones, includes firm's external environment (industry-related factors, such as competition, and also country-related ones, such as legal framework and technological infrastructures) as an important element of it, which influences the development of firm's ICT assets, human ICT resources, as well as ICT management and capabilities, and also their impact on firm's performance. Furthermore, there has been considerable empirical research investigating the effects of various characteristics of firm's external environment, such as industry dynamism, concentration, competition, munificence-growth and complexity, on ICT use, management and exploitation (Melville et al., 2007; Loukis et al., 2008; Xue et al., 2012; Mithas et al., 2013; Chae et al., 2018).

However, such research is missing with respect to one of the most severe disruptions that repeatedly occur in firms' external environment, the economic crises, which cause economic recession and sharp, rapid and strong decrease of the demand for products and services, and have quite negative consequences for firms, both short-term ones (such as reduction of their sales revenue, production activity, employment, procurement), and medium- and long-term ones (such as reduction of investment, leading to technological and competitiveness hysteresis), and for the economy and society in general (Artis et al., 1997; Diebold and Rudebusch, 1999; Keeley and Love, 2010; Knoop, 2010; Frumkin, 2010). Quite limited research has been conducted on the effects of economic crises on the use, management and exploitation of ICT by firms (reviewed in section 2.2), despite the usefulness of this research for gaining a deep understanding of these effects, in order to develop firm-level approaches for reducing them, as well as for recovering after the end of the crisis, and also in order formulate government policies for supporting the firms that have been quite negatively hit by economic crisis with respect to their ICT activity, and are at risk of severe technological hysteresis. This is an important research gap, since economic crises occur repeatedly in market-based economies (Keeley and Love, 2010; Knoop, 2010); therefore, it is necessary to investigate the effects of economic crises on various 'hard' and 'soft' aspects of firms' ICT activity, concerning important ICT resources and capabilities.

Our study makes a contribution in this direction, towards filling the abovementioned important research gap, by analysing the behaviour of the core 'system-relevant' Greek banks with respect to their ICT activity in the first years 2010-2014 of the Greek economic crisis, examining a wide range of 'hard' and 'soft' aspects of their ICT activity that concern important technological and human ICT resources, ICT capabilities, as well as ICT plans. The recent 2007 Global Financial Crisis, in combination with pre-existing weaknesses and imbalances in both the private and the public sector of the economy, gave rise to a severe and long economic crisis in Greece, which has resulted in a big contraction of country's GDP by 25%, increase of unemployment reaching a level of 27% of the total workforce, and also a collapse of investment, generating a big 'investment gap' that is expected to have a negative impact on the competitiveness and growth of the Greek economy in the near future (Provopoulos, 2014; Gourinchas et al., 2016; PricewaterhouseCoopers, 2017; Karamouzis et al., 2017; Karamouzis and Anastasatos, 2019). This economic crisis has hit quite hard the Greek banks, through strong decrease of the deposits (due to reduction of savings as well as massive withdrawals fuelled by fears for exit of Greece from the Eurozone), and at the same time strong increase of the non-performing loans, in combination with significant 'haircut' of government bonds they were holding; while in most of the other Euro-area countries the crises originated in the banking sector and spilled over to private and the public sector, and increased substantially the sovereign debt, in Greece the opposite happened: the crisis originated in the public sector, with the sovereign debt crisis generating a private sector crisis, and both these crises creating a banking crisis, which led to three large-scale

re-capitalizations of the Greek banks amounting to € 64bn in total (Provopoulos, 2014; Bank of Greece, 2018; Hellenic Bank Association, 2019; Karamouzis and Anastasatos, 2019). This resulted in dramatic decrease of the financial resources available for funding their investments and operations, both 'traditional and ICT-related ones. So, it is interesting to analyse the behaviour of the core Greek banks in this economic crisis with respect to ICTs, which constitute a critical infrastructure for the efficient and effective operation of the highly 'information-intensive' banking sector, as well as for its product/service innovations (introduction of new financial products/services); in particular, it is quite interesting to analyse banks' behaviour during the crisis with respect to ICT technological and human resources' investment as well as operating expenses, rationalization/improvement of ICT-related capabilities, and adaptation of pre-existing ICT plans to the new realities that the crisis brought. For this purpose, we have adopted a mixed methodology, including a combination of quantitative and qualitative techniques: interviews with ICT General Directors of the core 'system-relevant' Greek banks combined with questionnaire filling.

We believe that our findings enable a better understanding of crisis-behaviour and crisis-impact in a wide variety of hard and soft aspects of ICT activity, concerning important ICT resources and capabilities, as well as ICT plans, in an 'information-intensive' and quite critical for the whole economy sector, which has been historically a heavy and experienced user of ICT. Furthermore, our findings reveal interesting multi-dimensional patterns of ICT behaviour/management (concerning a wide range of both hard and soft aspects of ICT activity) in economic crisis, which might be of wider interest and usefulness to firms for managing ICT in such difficult recession times.

The paper is structured in five section. In the following section 2 the background of our study is outlined, while our methodology and data are described in section 3. The results are presented in section 4, and finally in section 5 the conclusions are summarized, and future research directions are proposed.

2 Background

2.1 Economic Crises

As mentioned in the introduction, economic crises repeatedly appear in market-based economies, caused either by the fluctuations that economic activity usually exhibits, with periods of expansion followed by periods of contraction, called 'business cycles', or by other events that happen in the economy or the society, such as banking/financial crises, or big changes in the prices of important goods or production materials/inputs (Artis et al., 1997; Diebold and Rudebusch, 1999; Keeley and Love, 2010; Knoop, 2010; Frumkin, 2010). According to Knoop (2010) numerous economic crises of various intensities, durations and geographic scope (local, regional or international) have appeared in the last 100 years, with quite negative consequences for the economy and the society, the most extensively debated one being definitely the 1929 Great Depression in the USA, and the recent 2007 Global Financial Crisis, followed by the first and second oil crisis (1973 and 1979 respectively), the Asian crisis (1997) and the dot-com crisis (2000), as well as the "Big Five" bank crises of Spain (1977), Norway (1987), Finland (1991), Sweden (1991), and Japan (1992) (Reinhart and Rogoff, 2008). The economic crises cause economic recession, and sharp, rapid and strong decrease of products/services demand, and lead to serious reductions in firms' available financial resources (Pearce and Michael, 2006; Latham, 2009; Keeley and Love, 2010), as: i) customers reduce their spending (due to lower income as well as uncertainty for the future), defer unnecessary purchases for the future, become more price-sensitive, and press for lower prices, while business customers proceed to renegotiations of pre-existing contracts; ii) banks during recession periods are more careful and hesitant with their business loans, lending less than in normal periods, as they expect lower performance of firms, and therefore reduced ability to pay back their loans and higher risk; iii) competitive rivalry increases, as competitors strive in order to gain higher share of the decreasing demand, resulting in reductions of prices.

Firms, respond to these big challenges posed by economic crisis primarily by reducing their operating as well as their investment activities and expenses, aiming mainly to survive, and be able to meet their short-time financial obligations despite the abovementioned drastic reduction of their financial resources; on one hand they reduce their production activities, personnel employment (through lay-offs, which increase unemployment, poverty and social exclusion, and give rise to severe social problems and unrest) and salaries, materials procurement (propagating the crisis to suppliers' industries, etc.), and also renegotiate pre-existing contacts with their suppliers of materials and services pressing putting strong pressure for lower prices; on the other hand, they also reduce capital expenses concerning investments in production equipment, ICT, buildings, etc. (which has negative consequences on firms' medium- and long-term competitiveness and performance). These are combined with rationalization actions, aiming to improve efficiency of internal operations, address pre-existing major inefficiencies and problems, and also actions of adaptation to the crisis, such as introduction of new lower cost products and services, or modifications of existing ones offering higher value-for-money (Pearce and Michael, 2006; Latham, 2009; Keeley and Love, 2010; Ahmed, 2014; Burger, 2017).

Latham (2009), based on the core turnaround strategies for managing organizational decline proposed by Hofer (1980), developed a typology of actions for responding to recessions, which includes three main types of actions: cost reduction, assets reduction (divestment of non-core assets) and revenue generation ones. The first two include eliminating some operating costs and assets that are not critical to performance (often characterised as 'fat') and are 'replaceable', which can be acquired again after the end of the crisis if needed, because they are traded in markets, and are not firm-specific, rare and difficult to build/imitate, and at the same time exploiting more efficiently the remaining ones; as typical examples are mentioned employees with skills that can be found in the labour market, without extensive needs for firm-specific training and adaptation to firm's operations and activities, and also assets (e.g. office spaces, warehouses, equipment) that are not absolutely necessary, or are redundant/duplicate, and can be purchased from the market after the end of the crisis. The third one includes generation of new revenue: a) by shifting some of the existing resources of the firm (and without acquiring new resources) to new products and markets that have been affected less by crisis and are more promising and profitable; b) by reacting to the new realities created by the crisis in their core markets through adaptations of their existing products and services or introduction of new ones. In general, the research conducted in the area of organizational decline and turnaround identified two main stages that the turnaround process includes: initially the 'retrenchment actions stage', which includes costs and possibly (in cases of severe decline) assets reduction in combination with relevant rationalization, followed by the 'strategic actions stage', which includes changes or adjustments of how the firm competes in its traditional domains (e.g. new products and services, changes or adjustments in its strategies for gaining competitive advantage), or even move to new domains (Trahms et al., 2013)

However, limited research has been conducted concerning firms' behaviour/response during economic crisis in the area of ICT use, management and exploitation, despite the widely recognized importance of the ICT for the efficient and effective operation of modern firms, as well as for their processes, products/services and business models innovations and transformations (United Nations, 2018). In the following section 2.2 a brief review of this research is provided.

2.2 Economic Crises and ICT

Some research has been conducted concerning the impact of the recent 2007 Global Financial Crisis, as well as the previous crises, on ICT spending, but mainly at country level, or for the whole ICT sector or important segments of it (i.e. specific kinds of technologies or services) (e.g. OECD, 2009; Rojko et al., 2010; OECD, 2010), while quite limited similar research has been conducted at firm level (Leidner et al., 2003). Rojko et al. (2010) analyse the impact of the recent 2007 Global Financial Crisis on ICT spending, based on data from several international organizations. They conclude that this

crisis had negative impact on ICT spending, however it has affected the ICT market selectively, and much less than other sectors, with the extent of the negative impact differing significantly among countries and depending on the economic situation and development stage of each country. The crisis affected ICT spending much less radically than other types of spending, since ICT have become a necessary element of firms' and individuals' everyday life and activity. Furthermore, they conclude that some new ICT segments (such as cloud computing, ICT outsourcing, etc.) that allow cost savings, higher productivity and efficiency have been strengthened during the crisis. Finally, the authors argue that another reason for this decrease of ICT spending might be the extremely fast ICT expansion in the previous three decades (1971-2000), which gave rise to a period of slower sectoral growth, in line with the theories of 'economic super-cycles'. OECD (2009) analyse the impact of the 2007 Global Financial Crisis on ICT employment in its member countries, and conclude that in the first year of it the employment decreased by 6-7% in ICT goods manufacturing, but remained flat in ICT services. Furthermore, some niche ICT industries, such as green ICTs, virtualisation, and cloud computing, exhibited ICT employment increase trends despite the crisis.

At firm level, quite interesting and useful is the research of Leidner et al. (2003), who, based on interviews with twenty Chief Information Officers (CIOs) of large USA firms from various industries, identified four main ICT management approaches during the 2000 dot-com crisis, with respect to ICT planning and adaptation of pre-existing ICT plans to the new conditions and realities of the crisis. These four ICT management approaches differ in two dimensions: the attitude towards the pre-existing ICT plan (retain vs. rethink) and the time horizon (short-term vs. long-term). In particular, the four identified approaches are:

i) Extend the Lifecycle: a long-term approach of retaining the ICT projects that the pre-existing ICT plan includes but extending their implementation time.

ii) Bulletproof the Infrastructure: a long-term management approach of rethinking the ICT projects of the pre-existing ICT plan, and focusing on projects aiming at the development of an ICT infrastructure that allows rapid development and interconnection of new applications.

iii) Clean House: a short-term management approach of rethinking the ICT projects of the pre-existing ICT plan, but focusing on projects having immediate outcomes/benefits and providing direct support of firm's strategy, and cancelling or downsizing the other projects, or at least changing their priorities.

iv) Maintain the Legacy: a short-term approach of retaining the existing legacy systems by undertaking only the absolutely necessary ICT projects for prolonging their life until the end of the crisis.

However, this research on ICT management approaches during recession periods has a very narrow perspective, as it is limited to only one (though important) aspect of ICT management: the ICT planning (definition of the ICT projects to be undertaken by the firm). In this study we extend the above perspective, conducting a multi-dimensional analysis of ICT behaviour/management of the core Greek banks during the economic crisis, examining a wide range of 'hard' and 'soft' aspects of their ICT activity, which concern the most important ICT resources and capabilities (see following section 2.3), as well as ICT plans. This allows the identification of more comprehensive and multi-dimensional approaches to ICT behaviour/management during economic crisis, which concern/involve a wide range of ICT resources and capabilities.

2.3 ICT Resources and Capabilities

Previous IS research has revealed that firms in order to generate business value from the use of ICT should not only acquire 'ICT resources', but also develop 'ICT-related capabilities' as well, defined as firm's "abilities to mobilize and deploy ICT-based resources in combination or co-presence with other resources" (Bharadwaj, 2000). There has been considerable research in the IS domain for identifying the main ICT resources and capabilities, as well as for investigating their impact on various measures of firm's performance. Feeny and Willcocks (1998) identified three general IS-related capabilities that

firms should develop, which concern the definition of an 'IS vision' associated with the general business vision of the firm, the design of IS architecture, and the delivery of IS services; furthermore, they elaborated them into nine more specific IS-related capabilities, which concern IS-related leadership, business system thinking, relationship building, architecture planning, implementing technology, informed buying, contract facilitation, contract monitoring and vendor relationship development. Ravichandran and Lertwongsatien (2005) developed and estimated a model that relates the quality of firm's main ICT resources (ICT infrastructure, ICT human capital (defined as ICT personnel skills and knowledge concerning technologies as well as firm's operation) and IS partnerships (both internal ones, between firm's ICT unit and business units, and external ones, between the ICT unit and the ICT vendors)) at a first layer, with the main IS capabilities (for IS planning, development and operation) at a second layer, the resulting ICT support provided for the main business functions at a third layer and finally the financial performance; they found that all first layer ICT resources have positive effects on the above three main ICT capabilities of the second layer, which have a strong impact on the degree of ICT support of firm's business functions and finally performance. Gu and Jung (2013) investigate empirically the effects of firm's ICT resources (ICT infrastructure, ICT personnel technological skills and business expertise, ICT internal and external relations) on firm's ICT capabilities (for ICT planning, business process change, ICT acquisition, IS development, IS operation and IS users' support), and then the effect of the latter on firm's IS-enabled business processes performance and finally IS-enabled overall performance. All their hypotheses have been supported by the collected data, indicating the importance of ICT resources for the development of ICT capabilities, which affect positively the performance of firm's business processes, as well as its overall performance. Chen et al. (2015) investigate empirically the effects of ICT infrastructure flexibility, ICT integration, ICT business alignment and ICT management (including ICT planning, project management, security control, development, policies and evaluation/control) capabilities on firm's entrepreneurship and innovation; they find that all these capabilities affect positively entrepreneurship behaviour and orientation as well as innovation performance, with the ICT management having the strongest effects. Recently, Aydiner et al. (2019) investigate empirically to what extent the decision-making performance and the business processes performance mediate the effects of the ICT infrastructure capability, the ICT human resource capability and the ICT administration (including ICT planning, strategic alignment, software development, project management and service quality management) capability on firm's performance. They find that decision-making performance and business-process performance play a critical mediating role in the effects of ICT human resource and ICT administration capabilities on firm-performance, but this does not hold for the effect of the ICT infrastructure capability on firm performance. Reviews of the research that has been conducted on ICT resources and capabilities are provided by Liang et al. (2010), Arvanitis et al. (2013) and Aydiner et al. (2019). This research reveals some ICT resources as well as some ICT capabilities, which are the critical elements of ICT exploitation at firm level, therefore a comprehensive analysis of the ICT-related behaviour of a firm during economic crises should examine its behaviour with respect to the main ICT resources and capabilities (e.g. the extent of reduction of operational and investment expenses concerning the main ICT resources, the extent of rationalization concerning improvement of the main ICT capabilities).

3 Method and Data

In order to develop our research model and define the specific variables to be examined for conducting a comprehensive analysis of ICT-related behaviour during the crisis we have been based on the following theoretical foundations:

i) on one hand the main types of response to economic recession identified by previous relevant management science research (briefly reviewed in section 2.1): reductions of operational as well as investment expenses, in combination with rationalization actions for improving efficiency, and also ad-

aptations to the new conditions and realities of the crisis (Pearce and Michael, 2006; Latham, 2009; Keeley and Love, 2010; Ahmed, 2014; Burger, 2017);

ii) on the other hand the main ICT resources and capabilities identified by relevant IS research (see section 2.3) (Feeny and Willcocks, 1998; Bharadwaj, 2000; Ravichandran and Lertwongsatien, 2005; Liang et al., 2010; Gu and Jung, 2013; Arvanitis et al., 2013; Chen et al., 2015; Aydiner et al., 2019);

iii) and also, the four approaches to ICT management during economic recessions concerning ICT plans adaptations identified by Leidner et al. (2003).

Our research model for the analysis of firm-level ICT-related behaviour in the economic crisis is shown in Figure 1: it includes a first general part, followed by three detailed parts focusing on ICT expenses reduction, ICT rationalization (concerning improvements of main ICT capabilities) and ICT plans adaptation respectively.

The first general part aims to assess the extent of reduction due to the crisis of ICT-related activities, ICT-related operational costs and ICT-related investment expenditures, as well as the extent of rationalization/improvement of ICT practices/processes and capabilities, in general; and also, for comparison purposes, to assess the extent of reduction of the overall activities, the overall operational costs and the overall investment expenditures of the bank.

The second part focuses on the detailed assessment of the extent of reduction in various kinds of ICT expenses: a) reduction of ICT investment expenditures, on one hand for ICT technological resources, for the acquisition of new hardware (equipment) and software, and on the other hand for ICT human resources, for the recruitment of new ICT personnel, and for training ICT personnel as well as ICT users; b) reduction of ICT operational expenditures, on one hand for ICT technological resources, through the re-negotiation of contracts with ICT services (e.g. maintenance, support) providers, the replacement of old costly applications with modern software packages from the market and the termination of the use of old costly applications, and on the other hand for ICT human resources, through reduction of ICT personnel payroll (salaries reduction).

The third part of our research model focuses on the detailed assessment of the extent of rationalization of ICT activities, through the improvement of the main ICT-related practices/processes and corresponding capabilities: for ICT planning, for ICT strategic alignment (i.e. interconnection/alignment between ICT plans and overall strategic plans), for ICT project management, for IS operation and support, and for ICT service management (using established standard service management frameworks, such as COBIT, ITIL, etc.).

Finally, the fourth part aims to assess the extent of having made the main kinds of ICT plan adaptation to the crisis identified by Leidner et al. (2003): changes of the content of the ICT plan (future ICT projects), extension of the implementation time of the ICT plan, cancelation or postponement of already planned ICT projects, downsizing of already planned (or even partly realized) ICT projects, change of priorities of already planned ICT projects, priority on ICT projects with immediate outcomes/benefits, and priority on ICT projects aiming at building an ICT infrastructure that allows rapid development and interconnection of new applications. Furthermore, since previous literature on firms' response to economic recession and turnaround (see section 2.1) distinguish two main response directions, cost reduction/rationalization and new revenue generation (e.g. see Latham (2009), Trahms et al. (2013)) we have added two more elements in this fourth part of our research model for assessing to what extent the crisis has been catalyst for new ICT projects aiming at bank's operational costs reduction through processes automation or innovation, and also at the generation of additional revenue through new products and services, respectively.

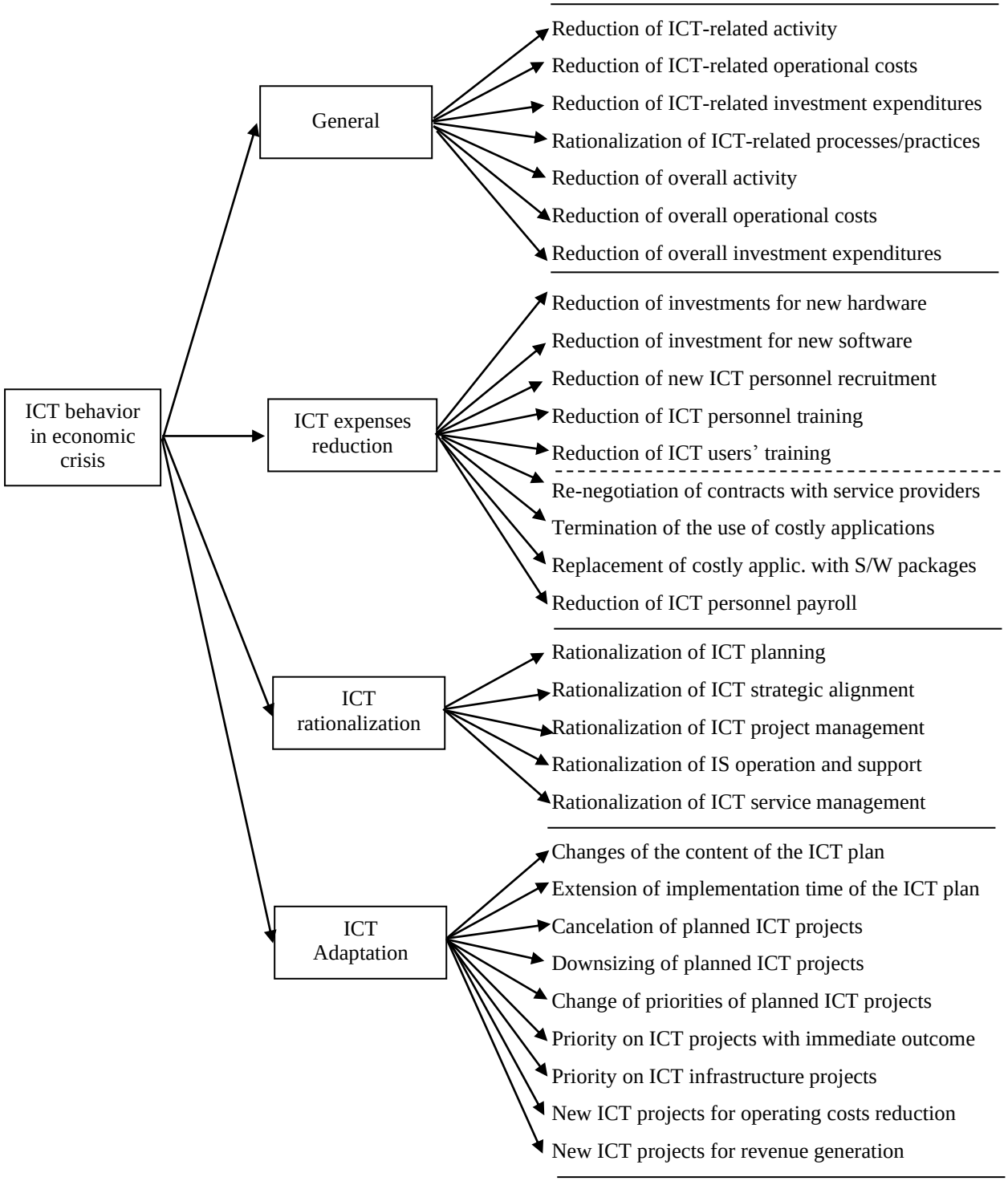

Figure 1. Research Model

We collected data concerning the above 30 variables – responses to the crisis of our research model from the five core 'system-relevant' Greek banks using a mixed methodology, through a combination of quantitative and qualitative techniques: we conducted interviews with the ICT General Directors of the above banks, which included filling a questionnaire concerning the extent of having taken these 30

actions as a response to the crisis (cost reductions, rationalizations/improvements, adaptations), as well as in-depth discussions and clarifications about them. The ICT General Directors are definitely the 'key-informants' for our purposes, as they are the most appropriate persons for providing all these data, because they have a complete knowledge about all the aspects of the ICT operations, investments, practices/processes and plans of their banks, as well as their changes due to the crisis. The research model shown above in Figure 1 was converted into a questionnaire: for each of the right hand (most detailed) 30 elements of our research model a question was developed concerning the extent of having taken the specific action to be answered in an 1-5 Lickert scale. An initial version of the research model and the questionnaire were reviewed by three ICT specialists of Greek banks, who proposed minor modifications of some questions in order to make them more understandable and clear; furthermore, they mentioned two more actions that have been taken by banks in order to reduce their ICT operational expenses as a response to the crisis (termination of the use of old costly applications, replacement of old costly applications with software packages from the market), which should be added to the research model and the questionnaire. Based on all these comments the final version of the questionnaire was prepared.

4 Results

In this section are presented and discussed the results concerning the behaviour of the five Greek core "system-relevant" banks with respect to their ICT activities in Tables 1 to 5. Initially the general ICT-related behaviour, as well as the overall behaviour, during the economic crisis, is shown in Table 1, followed by the detailed behaviour with respect to various types of ICT investment in technological and human ICT resources shown in Table 2. The information in these two tables indicates the extent of the negative effects of the economic crisis, as the banks reacted immediately by contracting activities in almost all domains and levels, particularly in their ICT-domain. This kind of reaction behaviour was characteristic for the first phase of the economic crisis. In later phases, as it became clear that the crisis would last long, the banks began to develop and employ various additional actions against the crisis, aiming primarily at stabilizing the situation and avoid a further erosion of their economic state. We distinguish three main groups of such actions against the crisis: actions aiming at the reduction of ICT-related operational costs, shown in Table 3, actions aiming at the rationalization of their ICT activities and practices, and the improvement of corresponding ICT-related capabilities, shown in Table 4, and actions related to a crisis-induced re-orientation and adaptation of ICT plans, which are shown in Table 5. These three lines of action can be interpreted as strategies of developing and strengthening a bank's resilience in order to survive in a long-lasting economic crisis.

4.1 General behaviour

As we can see in Table 1 the banks reacted to crisis as expected by reducing overall activities due to crisis-induced decreasing demand for financial services. Crisis decreased spending of both individuals and enterprises for consumption and investment and as a consequence the demand for credits, mortgages, etc. However, ICT-related activities were reduced less than the overall activities (average extent of reduction score 2.8 versus 4.2), indicating that banks, being highly 'information-intensive', tried to keep more or less the level of ICT activities that was necessary in order to be able to continue operation even in an overall negative economic environment. This difference as to the negative impact can be traced back to different reactions with respect to operational costs and investment expenditures. ICT-related operational costs were reduced to the same extent as the overall operational costs (average reduction score 5.0 for both), while decrease of ICT-related investment was weaker than the decrease of the overall investment (average reduction score 3.4 versus 4). Obviously, banks had to reduce current operational costs in all activity domains, but wanted to avoid the endangerment of long-run development of their ICT-infrastructure, which heavily depends on investment in new technologies and

technology applications. A glance on the scores of the responses of the individual banks shows a similar crisis behaviour among banks as to operational costs (large decrease!), but significant differences with respect to investment expenditures both overall and in ICT domain (see Table 1, columns 3 to 7). However, from the last row of Table 1 we can see that this important reduction of ICT-related activities, operational and investment expenses was combined with rationalization of ICT-related processes and practices to a large extent (average extent of rationalization score 4.2) in order to improve their efficiency (in Table 4 a more detailed picture is provided on this, showing the extent of rationalization of the main ICT-related processes/practices and improvement of corresponding ICT capabilities). Therefore Table 1 indicates broadly an interesting pattern of ICT behaviour/management during the crisis: large reduction in ICT-related operational costs, but small reduction of ICT-related investments, and at the same time large rationalization/improvement of ICT-related processes and practices. In the following Tables 2 – 5 we can see this pattern of ICT behaviour/management of banks during the crisis in more details.

	Average score	Bank A	Bank B	Bank C	Bank D	Bank E
Reduction of overall activities	4.2	2	5	5	4	5
Reduction of ICT-related activities	2.8	2	4	1	3	4
Reduction of overall operational costs	5.0	5	5	5	5	5
Reduction of ICT-related operational costs	5.0	5	5	5	5	5
Reduction of overall investment expenditures	4.0	1	5	4	5	5
Reduction ICT-related investment expenditure	3.4	1	5	1	5	5
Rationalization of ICT-related processes/practices	4.2	4	4	5	4	4

Table 1. General ICT – related and overall behaviour (1: not at all/5: to a very large extent, for the first, second and last question; 1: large increase /5: large decrease for the other questions)

4.2 ICT Investment Expenditures

In Table 2 we can see that there was a small reduction of the 'hard' investment for new ICT technological resources due to the crisis, which was higher for the software than for the hardware (equipment) investments, and a much smaller reduction of the 'soft' investment for ICT human resources (average reduction score 3.6 versus 3.3), while training of ICT-users was left unchanged. This indicates that the banks, despite the reduced availability of financial resources due to the crisis, did not proceed to large reductions of their 'hard' ICT investment in hardware and software, in order to avoid technological obsolescence of their IS, which might lead to important problems in their operations (e.g. due to lower availability of IS and frequent interruptions), since their main priority was to 'keep the lights on' despite the crisis, as mentioned repeatedly in the interviews; another reason that the interviewees mentioned for not proceeding to large reductions of their hard ICT investment was their interest in experimenting with and exploiting some promising novel ICTs, such as the artificial intelligence, the business analytics and the blockchain, which seem to them as having a high potential for the banking sector. Also, Greek banks reduced even less their 'soft' ICT investment in recruitment of new ICT personnel, and providing training to ICT personnel and ICT users; the main motivation mentioned for this was to keep up with the intensive new knowledge and new technologies developments in the ICT domain, and avoid obsolescence of their 'ICT knowledge capital', which is quite important

also for coping with the increasing competition from 'fintech' firms (that seems to be a major issue for all interviewed ICT General Directors) (see Lee and Shin (2018) for more information on this).

	Average score
acquisition of ICT equipment (hardware)	3.4
acquisition of software	3.8
Average for ICT technological resources investments	3.6
recruitment of new ICT-personnel	3.6
training of ICT personnel	3.4
training of employees using ICT	2.6
Average for ICT human resources investments	3.3
Average for ICT investment	3.4

Table 2. Reduction of investment in ICT technological and human resources (1: large increase /5: large decrease)

4.3 ICT Operational Expenditures

In Table 3 we can see that the main reductions of ICT operational expenditures made by the banks as a response to the crisis were the reduction of ICT personnel payroll, by reducing their salaries, and also the reduction of the prices paid for ICT-related services (e.g. maintenance, support) to external providers, by re-negotiating relevant contracts, both to a large extent (average reduction score 4.0 for both). Furthermore, they proceeded to termination of use of some old costly applications, and replacement of some others with modern software packages from the market, however to a moderate extent (average score 3.0 and 2.6 respectively). In the interviews ICT General Directors emphasized that the banks reacted not only defensively to crisis, with small reductions of ICT investment and larger reductions in ICT personnel payroll, but also offensively as well, by re-negotiating contracts with external ICT-related services providers in order to reduce relevant expenses, and also by rationalizing and improving their ICT-related processes and practices, and increasing their relevant ICT capabilities (see section 4.4 - Table 4), as well as adapting their pre-existing ICT-related plans to the crisis conditions capabilities (see section 4.5 - Table 5). It was mentioned that in a period of severe crisis the banks tried to reduce the ICT-related operating costs of both their ICT technological and human resources, in many domains and at several levels, through both internal actions, as well as external ones (extensive re-negotiations).

	Average score
re-negotiation of contracts with suppliers of ICT-related services provider for prices reductions	4.0
termination of use of costly ICT applications	3.0
replacement of old costly ICT applications with software packages from the market	2.6
Average for ICT operational expenditures for ICT technological resources	2.9
Reduction of ICT personnel payroll	4.0
Average for ICT operational expenditures	3.4

Table 3. Reduction of ICT operational expenditures (1: not at all /5: to a very large extent)

4.4 ICT-related Practices/Processes and Capabilities

The above reductions of ICT-related expenses were combined with extensive ICT-related rationalization actions concerning the main ICT processes, practices and capabilities. As we can see from Table 4

an important category of actions against the crisis referred to the improvement to a large extent of the main ICT-related practices and processes with respect to ICT governance and organizational issues (average improvement score 3.7). Such actions were the rationalization and improvement of the practices/processes for the development of ICT plans, the interconnection and alignment of the ICT plan to the overall strategic plans and goals, the management of ICT projects, the operation and support of IS, and the ICT service management through increased use of internationally established frameworks for this purpose (e.g., ITIL, COBIT). All these ICT practices/processes were improved to a large extent, with the exception of the ICT project management ones that were improved to a moderate extent, leading to enhancements of relevant banks' ICT capabilities; this, according to the interviewees, is quite beneficial not only for coping with this crisis, but also for banks' future performance as well, given their increasing reliance on ICTs (both the 'traditional ones, as well as the novel emerging ones, such as the artificial intelligence, the business analytics and the blockchain) and the strong competition from ICT-based fintech firms.

	Average score
Improvement of the ICT plan (defining the future short- and medium-term ICT projects) development practices/processes	3.8
Improvement of practices/processes for interconnection and alignment of ICT plan to overall strategic plans and goals	4.0
Improvement of practices/processes for management of ICT projects	3.2
Improvement of practices/processes of operation and support of information systems (ICT operations)	3.8
Improvement of practices/processes of ICT services management using established standard service management frameworks, such as COBIT, ITIL, etc.	3.8
Average for all ICT-related practices/processes' improvement	3.7

Table 4. Improvement of ICT-related practices/processes (1: not at all /5: to a very large extent)

4.5 ICT Plan Adaptation

Beyond the reduction of ICT operational and investment expenses, and the rationalization-improvement of ICT practices/processes and increase of relevant ICT capabilities, described in the previous sections 4.2 - 4.4, Greek banks have made adaptations of their pre-existing ICT plans to the new crisis conditions, on average to a moderate to large extent (average score 3.4). As we can see from Table 5 they mainly changed to a large extent the content of their ICT plans and the priorities of the already planned ICT projects, placing high priorities on ICT projects with immediate outcomes/benefits, and ICT projects that enable reduction of the operational costs of bank activities through processes automation or innovation, and also to a lower extent on projects that enable the generation of additional revenues for the bank through new products and services. Secondarily, to a moderate extent they started new projects aiming at building an infrastructure that allows rapid development and inter-connection of new applications; and also only to a small to moderate extent they made extensions of the implementation time of the pre-existing ICT plan, cancellation, postponement or downsizing of already planned ICT projects.

	Average score
Changes of the content of the ICT plan (future ICT projects)	3.8
Extension of the implementation time of the ICT plan	2.6
Cancelation or postponement of already planned ICT projects	2.6
Downsizing of already planned (or even partly realized) ICT projects	2.8

Change of priorities of already planned ICT projects	3.6
Priority on ICT projects with immediate outcomes/benefits	4.2
Priority on ICT projects aiming at building an infrastructure that allows rapid development and interconnection of new applications	3.2
New ICT projects for bank's operational costs reduction through processes automation or innovation	4.4
New ICT projects for the generation of additional revenue through new products and services	3.4
Average for all ICT plan adaptations	3.4

Table 5. Adaptations of ICT plans (1: not at all /5: to a very large extent)

Therefore, the Greek banks with respect to their ICT plans seem to have adopted during the crisis mainly the 'Clean House' approach proposed by Leidner et al. (2003): a 'rethink' approach, having a rather short-term perspective, oriented towards supporting two of the three main strategies for responding to economic recessions proposed by Latham (2009): predominantly the 'cost reduction' strategy and secondarily the 'revenue generation' strategy.

5 Conclusions

In the previous sections of this paper we analysed the behaviour of the core 'system-relevant' Greek banks with respect to their ICT activity in the first years 2010-2014 of the severe Greek economic crisis. For this purpose, we developed a multi-dimensional analysis framework, based on theoretical foundations from previous research on firm-level strategies for responding to economic recession (and on organizational decline and turnaround in general), as well as on ICT resources and capabilities. This research framework allowed us to examine the behaviour/response of Greek banks in the crisis with respect to a wide of 'hard' and 'soft' aspects of their ICT activity, concerning their main ICT resources as well as ICT capabilities, along three main directions: ICT expenses reduction, ICT rationalization – capabilities improvement and ICT plans modification-adaptation to the crisis. These constitute three main strategies against the crisis: ICT cost-reducing strategy, ICT rationalization and capabilities-improving strategy and ICT plans-modifying strategy.

It has been concluded that the strategy that was used to a large extent is the ICT rationalization and capabilities improvement strategy, while the other two strategies have been used to a lower extent. Obviously, the banks concentrated their effort in improving their ICT capabilities and increasing the efficiency of their ICT activities as the most important measure against the crisis. Presumably, they consider capabilities as an important precondition for achieving good results also when employing the other two strategies. In particular, they placed great emphasis on the improvement of their processes, practices and capabilities mainly for developing ICT plans, interconnecting and aligning them to the overall strategic plans and goals, operating and supporting their IS, and managing the quality levels of the ICT services offered to the ICT users. At the same time important priorities were also the reduction of investments in new ICT hardware (equipment), ICT personnel payroll, and expenses for external ICT services (e.g. maintenance, support), as well as new ICT projects that enable bank's operational costs reduction through processes automation or innovation and offer immediate benefits.

Our findings enable a better understanding of the impact of economic crisis on important 'hard' and 'soft' aspects of ICT activity, concerning important ICT resources and capabilities, as well as ICT plans, in a highly important and 'information-intensive' sector, which has been historically a heavy and experienced user of ICT. Furthermore, our findings reveal interesting an interesting pattern of ICT behaviour/management in economic crisis, which is based mainly on ICT activities rationalization, and to a lower extent on ICT cost reduction, and ICT plans adaptation to the crisis, that might be of wider interest and usefulness to firms (especially of 'information – intensive' sectors) for managing

ICT in such difficult recession times. However, further similar research is required in other sectoral contexts (probably in less 'information-intensive' ones) as well as other national contexts (experiencing economic crises of various levels of severity), and examining a wider range of 'hard' and 'soft' aspects of ICT activity (more ICT resources and capabilities) during crisis, based on larger numbers of firms; also, it is necessary to investigate the internal and external determinants of firms' ICT-related behaviour in economic crises (i.e. the characteristics of firms, as well as their external environment, that affect this behaviour).

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