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ICT-related Behavior of Greek Banks in the Economic Crisis

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ABSTRACT
This article analyzes the ICT-related behavior of the five 'system-relevant' Greek banks in the first years 2010–2014 of the Greek economic crisis. We conclude that besides the standard immediate reaction to the crisis by reducing ICT-related expenses, the Greek banks in a later phase of the economic crisis proceeded to a substantial rationalization of their ICT processes/practices and improvement of their ICT capabilities, as well as the adaptation of their ICT plans to the crisis conditions.

KEYWORDS
Economic crisis; economic recession; ICT resources; ICT capabilities; ICT plan

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 a long time in information systems (IS) research (Melville et al., 2004; Schryen, 2013). However, such research is missing for the most severe disruptions that repeatedly occur in firms' external environment, the economic crises, which lead to a reduction of overall activities, and consequently to severe negative effects for employment, production, and investment (Keeley & Love, 2010; Knoop, 2010). The particular motivation for this study is the investigation of the impact of economic crises on ICT activities at the firm level. More research in this direction would provide a deeper understanding of these effects, also for developing strategies for reducing them as well as for recovering from them after the end of the crisis. Moreover, such research would help to formulate government policies for supporting the firms that have been severely hit by an economic crisis with respect to their ICT activities.

Our study makes a contribution toward filling the abovementioned important research gap by analyzing the behavior of five 'system-relevant' Greek banks[1] with respect to their ICT activities in the first years 2010–2014 of the Greek economic crisis. To this end, this study examines a wide range of 'hard' (referring to ICT hardware and software) and 'soft' (referring, e.g., to ICT-related skills) aspects of their ICT activity, which concerns important technological and human ICT resources, ICT capabilities, as well as ICT plans. For this purpose, we developed a multi-dimensional analysis framework (described in section 3), which allows the identification of a wide range of both negative and also possibly positive effects of the crisis on ICT activity. Our analysis framework has strong theoretical foundations based on previous management science research about the firm-level impact and management of recessions as well as previous IS domain research about ICT resources and capabilities. It takes into consideration not only investment and operating expenditures for ICT (technological and human) resources but also measures for ICT rationalization and improvement of ICT-related capabilities, measures for optimization of the use of ICT resources, and measures for adaptation of preexisting ICT plans to the new realities that the crisis brought. Our study constitutes one of the first attempts to investigate the response of large 'information-intensive' organizations with respect to ICT use and management to major external shocks.

In our study, we have adopted a mixed methodology, which includes a combination of quantitative and qualitative techniques: questionnaire filling by the ICT General Directors of the above banks followed by in-depth discussions with them.

Our findings are interesting and useful to IS researchers as well as practitioners as they enable a better understanding of crisis behavior and crisis impact with respect to a wide variety of aspects of ICT activity, namely important ICT resources and capabilities, as well as ICT plans, in the particularly 'information-intensive' banking sector, which has been historically a heavy and

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experienced user of ICT. Furthermore, our findings reveal interesting multi-dimensional patterns of ICT behavior/management in an economic crisis, which might be of wider interest and usefulness to firms for managing ICT in such difficult recession times.

The article is structured in six sections. The following section offers an overview of the economic crisis in Greece focusing on the banking sector. In the next section, the conceptual background of our study is outlined, followed by a methodology and data description section. Then, the results are presented, and in the final section, the conclusions are summarized, the implications for research and practice are discussed, and future research directions are proposed.

Economic crisis and Greek banks

The recent 2007 Global Financial Crisis, in combination with preexisting 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. It 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. The crisis generated 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 (Gourinchas et al., 2016; Karamouzis & Anastasatos, 2019; Karamouzis et al., 2017; Pricewaterhouse Coopers, 2017; Provopoulos, 2014).

This economic crisis has hit quite hard the Greek banks, first, through a strong decrease of the deposits due to reduction of savings as well as massive withdrawals fueled by fears for the exit of Greece from the Eurozone, second, through the strong increase of the non-performing loans, and, third, through the significant 'haircut' of government bonds they were holding in their portfolios. While in most of the other Euro-area countries the crises have originated in the banking sector and spilled over to the private and the public sector, increasing substantially the sovereign debt, in Greece the opposite happened. The crisis that originated in the public sector led to a crisis of the non-banking private sector. The combination of disruption in both the public and the private sector generated a banking crisis, which was followed by three large-scale re-capitalizations of the Greek banks amounting to € 64bn in total (Bank of Greece, 2018; Hellenic Bank Association, 2019; Karamouzis & Anastasatos, 2019; Provopoulos, 2014). This resulted in a dramatic decrease in the financial resources available for financing investments and operations, both the 'traditional' and the ICT-related ones.

Conceptual background

General theoretical foundations

The historic and widely cited and used model of ICT utilization and business value generation by firms of Melville et al. (2004), which has become a theoretical 'workhorse' for subsequent IS research, includes firms' external environment as an important factor affecting the use of technological and human ICT resources by the firm as well as their exploitation for the generation of business value. Much later, the 'synthetic' firm-level ICT business value model developed by Schryen (2013) considers firms' external environment (referring, e.g., to market competition, legal framework, and technological infrastructures at country level) as important constituents, which influence the development of firm's ICT assets, human ICT resources, ICT capabilities, and ICT management, as well as 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, and complexity) on ICT use, ICT management, and ICT exploitation (Chae et al., 2018; Loukis et al., 2008; Melville et al., 2007; Mithas et al., 2013; Xue et al., 2012).

Economic crises

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 (Allen, 2016; Artis et al., 1997; Diebold & Rudebusch, 1999; Frumkin, 2010; Keeley & Love, 2010; Knoop, 2010). According to Knoop (2010) numerous economic crises of various intensities, durations, and varying 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 is definitely the 1929 Great Depression in the USA, followed by the recent 2007 Global Financial Crisis, 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).

There has been a considerable research stream in management sciences that investigates recessions' firm-level impact as well as management strategies. This research has concluded that economic crises cause

sharp, rapid, and strong decrease of the demand for most products/services, which leads to serious reductions in firms' available financial resources (Keeley & Love, 2010; Latham, 2009; Lee et al., 2015; Pearce & Michael, 2006). This is caused, first, by consumers that 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. Second, business customers also contribute to the downward trend by proceeding to renegotiations of the conditions of preexisting contracts for lower prices. Third, banks become during recession periods 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. Fourth, rivalry among market participants increases as competitors try to obtain a larger share of the decreasing demand, resulting in reductions in prices.

Firms respond to these big challenges posed by economic crisis primarily by reducing their operational as well as their investment activities and expenses, aiming mainly at surviving and remaining able to meet their short-term financial obligations despite the drastic reduction of their financial resources (Burger et al., 2017; Keeley & Love, 2010; Lai et al., 2016; Latham, 2009; Pearce & Michael, 2006; Wickramasinghe & Perera, 2012). In particular, on one hand, they reduce production activities, personnel employment (through lay-offs, which increase unemployment and give rise to severe social problems and unrest), salaries and benefits, material procurement (thus, propagating the crisis to suppliers' industries, etc.), and renegotiate preexisting contacts with their suppliers putting strong pressure for lower prices. On the other hand, they reduce expenditures concerning investments in production equipment, ICT, buildings, etc., which has negative consequences on firms' medium- and long-term competitiveness and performance. These are often combined with optimization and rationalization actions, aiming at improving the efficiency of internal operations, addressing preexisting inefficiencies and problems, and also performing actions of adaptation to the crisis, such as the introduction of new lower-cost products and services, or modifications of existing ones offering higher value-for-money.

Latham (2009), based on the core turnaround strategies for managing organizational decline proposed by Hofer (1980), developed a typology of actions taken by firms in order to respond to recessions, which includes three main types of actions: cost reduction, asset reduction (divestment of non-core assets) and revenue generation.

The first two are of 'defensive' nature and include, first, the elimination of some operating costs and assets that are not critical to performance (often characterized as 'fat') and are 'replaceable.' Such assets 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. At the same time, firms try to exploit more efficiently the remaining resources and optimize their use. As typical examples of easily replaceable assets are employees with skills that can be easily found in the labor market without extensive needs for firm-specific training and adaptation to firm's operations and activities, further, 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.

However, the third type of actions is 'offensive' aiming at the generation of new revenue: (a) by shifting some of the existing resources of the firm to new products and markets that have been less affected by crisis and are more promising and profitable; and (b) by reacting to the new realities created by the crisis in their core markets through adaptations of existing products/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 a 'retrenchment actions stage,' which includes cost and possibly asset reduction in combination with optimization and rationalization actions, followed by a '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 about firms' behavior/response during economic crisis concerning ICT use, management, and exploitation, despite the widely recognized and continuously increasing importance of the ICT for the efficient and effective operation of modern firms as well as for their renewal, innovation, and transformation (United Nations, 2017). In the following section, a brief review of this research is provided.

Economic crises and ICT

Some research has been conducted concerning the impact of the recent 2007 Global Financial Crisis (as well as of some previous crises) on ICT spending, mainly at country-level, or on the revenue of the ICT sector or important segments of this sector (e.g., OECD, 2009,

2010; Rojko et al., 2010). Only quite limited similar research has been conducted at the firm-level. (Leidner et al., 2003).

Rojko et al. (2010) analyze the impact of the recent 2007 Global Financial Crisis at the country-level as well as worldwide on ICT spending based on data from several international organizations. They conclude that this crisis had a negative impact on ICT spending of most countries as well as worldwide; however, it has affected the ICT market selectively. The extent of the negative impact differed significantly among countries and depended on the particular economic situation and the particular development stage of each country. However, the crisis affected ICT spending much less radical than other types of spending, since ICT have become a necessary element of firms' and individuals' everyday activity. Furthermore, these authors conclude that some new ICT segments (such as cloud computing, ICT outsourcing, etc.) enabling cost savings as well as productivity and efficiency improvements have been strengthened during the crisis. Finally, the authors argue that another reason for this decrease in 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) analyzes 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 equipment manufacturing, but remained flat in ICT services. Furthermore, some niche ICT industries, such as green ICT, virtualization, and cloud computing, exhibited ICT-employment increase trends despite the crisis.

At firm-level, quite interesting is the research of Leidner et al. (2003), who, based on interviews with 20 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 concerning the adaptation of preexisting ICT plans to the new conditions and realities of the crisis. These four ICT management approaches differ in two dimensions: the attitude toward the preexisting ICT plan (retain vs. rethink) and the time horizon (short-term vs. long-term). However, this research on ICT management approaches during recession periods has a narrow perspective, as it is limited to only one (though important) aspect of ICT management: the ICT planning (i.e. definition of the ICT projects to be undertaken by the firm). In this study we extend the above perspective: we analyze ICT-related behavior/management of the core Greek banks during the economic crisis with respect to a wider range of 'hard' and 'soft' aspects of their ICT activity concerning their main ICT resources and capabilities (see following section 3.4) as well as their ICT plans. This wider perspective allows, on one hand, a broader understanding of the impact of the economic crisis on ICT activity, and, on the other hand, the identification of more comprehensive and multi-dimensional approaches to ICT behavior/management during the economic crisis, which concerns/involves a wider range of ICT resources and capabilities.

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 the firm's performance.

Feeny and Willcocks (1998) identified three general IS-related capabilities that firms should develop, which concern the definition of a strategic 'IS vision' associated with the general business vision/strategy of the firm, the design of IS architecture, and the delivery of IS services. Furthermore, they elaborated these general IS-related capabilities into nine more specific ones, which concern IS-related leadership, business system thinking, relationship building, architecture planning, technological implementation, 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 operations) and IS collaborations (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 three main ICT capabilities of the second layer, which themselves have a strong impact on the degree of ICT support of the firm's business functions and finally performance.

Gu and Jung (2013) investigated 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 a firm's IS-enabled business process 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) investigated 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 a firm's entrepreneurship and innovation. They find that all these capabilities affect positively entrepreneurship behavior and orientation as well as innovation performance, with ICT management having the strongest effects.

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). The above research reveals the main ICT resources as well as ICT capabilities, which are the critical elements for the effective exploitation of ICT by firms and the generation of business value. Therefore, an analysis of the ICT-related behavior of a firm during economic crises should examine its behavior with respect to these 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/improvement of the main ICT capabilities, etc.).

Method and data

In order to develop and specify our research model of ICT-related behavior during the crisis, we used the following theoretical foundations.

First, our model takes into consideration the main types of firms' response to economic recession identified by previous relevant management science research (briefly reviewed in the previous section): reductions of operational as well as investment expenses (i.e. 'defensive' reactions), however in combination with optimization in the use of resources, rationalization for improving efficiency, and also adaptation to the new conditions and realities of the crisis (i.e. 'offensive' actions) (Burger et al., 2017; Keeley & Love, 2010; Latham, 2009; Pearce & Michael, 2006; Trahms et al., 2013)

Second, our model also considers the main ICT resources and capabilities identified by relevant IS research (see the previous section) (Arvanitis et al., 2013; Aydiner et al., 2019; Bharadwaj, 2000; Chen et al., 2015; Feeny & Willcocks, 1998; Gu & Jung, 2013; Liang et al., 2010; Ravichandran & Lertwongsatien, 2005). Since previous research on firms' response to recession has identified both 'defensive' expenses reduction-oriented actions and also more 'offensive' rationalization-/optimization-oriented ones, we examine these concepts with respect to ICT resources and capabilities, i.e. we investigate the extent not only the reduction of expenses for ICT resources but also optimization of the use of ICT resources as well as rationalization of ICT processes/practices for improving the main ICT capabilities.

Finally, we utilize the four approaches to ICT management during economic recessions concerning ICT plan adaptation identified by Leidner et al. (2003).

Our research model for the analysis of firm-level ICT-related behavior in the economic crisis, which is based on the above theoretical foundations, is shown in Figure 1: it includes four components assessing, respectively, the extent of (a) reduction of different categories of ICT-related expenses for ICT technological and human resources, (b) optimization of the use of ICT resources, (c) rationalization of ICT processes and practices leading to improvements of main ICT capabilities, and (d) adaptation of ICT plans to the crisis conditions.

The first component of our research model focuses on the assessment of the extent of reduction in various kinds of ICT-related operational and investment expenditures. These are expenditures for ICT technological resources (for the acquisition of new ICT hardware as well as ICT software), expenditures for ICT human resources (for the recruitment of new ICT personnel and for training ICT personnel as well as ICT users), and operational expenditures for the ICT-personnel payroll.

The second component refers to the optimization of the use of ICT resources through the re-negotiation of contracts with ICT service providers (e.g., maintenance, support) concerning, e.g., reductions in services' unit prices, through the termination or reduction of the use of old costly applications as well as through the replacement of such old costly applications with new applications or modern software packages from the market.

The third component of our research model focuses on the assessment of the extent of rationalization of ICT activities through the improvement of the main ICT-

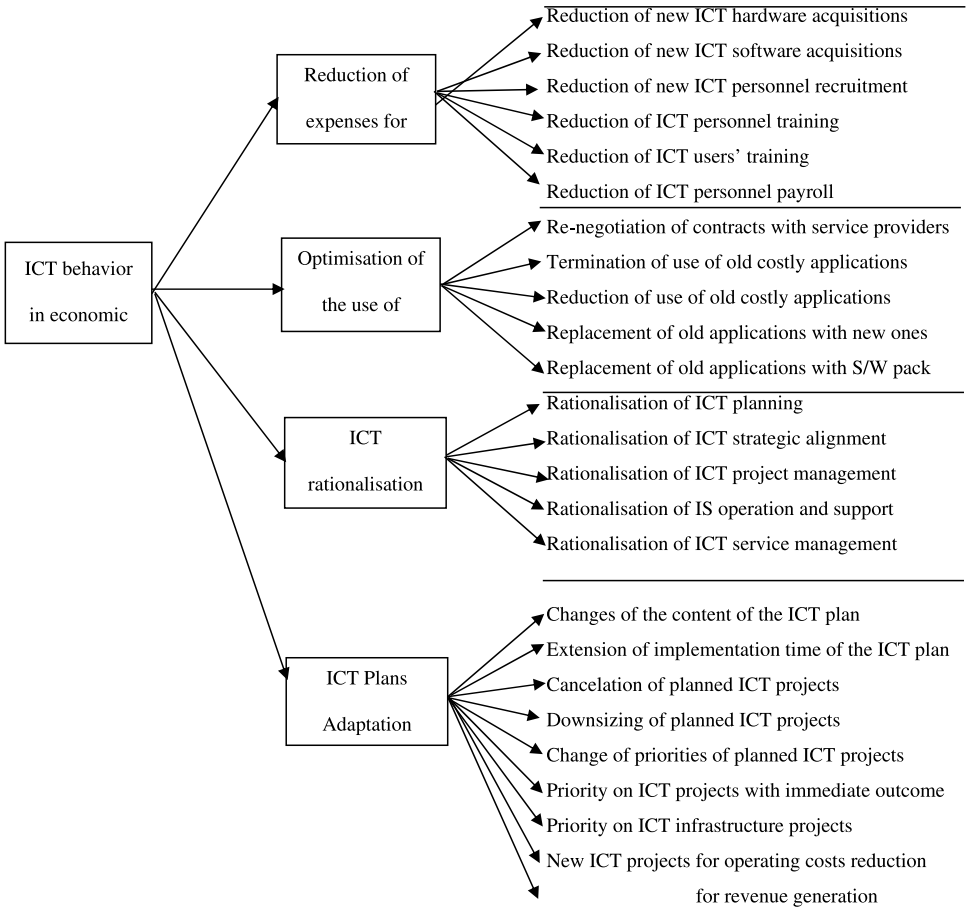

Figure 1. Research model.

related processes, practices, and ICT capabilities: for ICT planning, ICT strategic alignment (i.e. interconnection/alignment between ICT plans and overall strategic plans), ICT project management, IS operations and support, and ICT service management.

Finally, the fourth component aims at assessing the extent of having done the main kinds of ICT-plan adaptations to the crisis identified by Leidner et al. (2003): changes of the content of the ICT plan (concerning future ICT projects), extension of the implementation time of the ICT plan, cancelation 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 distinguishes two main response directions, which concern not only cost reduction/rationalization but also new revenue generation (e.g., see Latham, 2009; Trahms et al., 2013), we have added two more elements in this fourth component of our research model for assessing to what extent the crisis has been the catalyst for new ICT projects aiming at (a) a bank's operational cost reduction through process automation or innovation; and (b) generation of additional revenue through new products and services.

Our study contains also a general part that aims at assessing the extent of reduction due to the crisis of ICT-related activities in general, ICT-related operational expenses and ICT-related investment expenditures, and also, for comparison purposes, the extent of reduction of the overall activities of the bank, the overall operational costs, and the overall investment expenditures. This part of our study, which we present at the beginning, helps us to gain an overall picture of the immediate negative effects of the crisis on the banks' ICT activities and expenses and compare them with the effects of the crisis on banks' overall activities and expenses and then follows the more detailed part of our study that aims at assessing the effects of the crisis on the detailed aspects of ICT activity of the abovementioned four components of our research model (Figure 1).

We collected data from five 'system-relevant' Greek banks[2] concerning the 31 variables of our study, i.e. the 6 variables of the general part of our study and the 25 variables of the detailed part of it based on the research model in Figure 1. The research model shown in Figure 1 was converted into a questionnaire. For each of the 25 right-hand elements in Figure 1 a question was developed referring to the extent of having taken the specific action to be measured on a 5-point Likert scale. An initial version of the questionnaire has been reviewed by three ICT specialists of Greek banks, who proposed modifications of some questions in order to make them more understandable and also some additional questions. Based on their comments, the final version of the questionnaire was prepared.

We use a mixed methodology through a combination of quantitative and qualitative techniques. Interviews were conducted with the ICT General Directors of the five banks, who filled our questionnaire, followed by an in-depth discussion about the answers to the questions in order to provide further clarifications and explanations 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.

Results

Introductory remarks

In this section, we present and discuss the behavior with respect to ICT activities of the five Greek 'system-relevant' banks in the economic crisis, i.e. their response to the crisis concerning the 31 important aspects of ICT activity described in section 4. The assessments of the banks about the consequences of the economic crisis on their ICT-related activities, ICT-related operational expenses, as well as ICT-related investment expenses, are presented in Table 1. In addition, in the same Table, we present for comparison purposes their assessments concerning the consequences of the crisis on their overall activities as well as their overall operational and investment expenses and then follows the discussion of the main results of our study structured according to the research model presented in section 4. The in-depth discussions with the ICT General Directors of the banks allowed us to distinguish between immediate 'defensive' negative responses to the crisis (cost cuts) and more 'offensive' resiliency-oriented measures against the crisis taken at a later point of time.

Table 2 indicates the extent of the immediate ICT-related negative effects of the economic crisis, as the banks reacted immediately by contracting activities and expenses in the ICT domain. This kind of reaction behavior was characteristic of the first phase of the economic crisis. In later stages, as it became clear that the crisis would last long, the banks began to develop and employ various more sophisticated measures against the crisis, aiming primarily at stabilizing the situation and avoiding a further erosion of their economic state. We distinguish three main groups of such actions: measures aiming at the optimization of the use of ICT-related resources (see Table 3), rationalization measures aiming at the improvement of important ICT-related practices/processes and capabilities (see Table 4), and measures related to a crisis-induced re-orientation and adaptation of ICT plans (see Table 5). These three lines of action can be interpreted as strategies of developing and strengthening the bank's resilience in order to survive in a long-lasting economic crisis.

Overall behavior

The results in Table 1 show that the five banks reacted to the crisis as expected by reducing overall activities due to crisis-induced decreasing demand for financial services. In the in-depth discussions it was mentioned that the crisis decreased spending of both individuals and enterprises for consumption and investment, and as a consequence, the demand for credits, mortgages, etc. At the same time, many firms due to the reductions in their sales revenue could not repay their loans, resulting in an increase of non-performing loans, reducing the availability of capital for performing banking activities. An additional severe problem of Greek banks referred to the presence of a high volume of Greek state bonds in their balance sheets that lost most of their value at the

Table 1. Effect of the crisis on bank activities, operational costs, and investment expenditures: overall versus ICT-related ones.

Crisis effect	Average score	Bank A	Bank B	Bank C	Bank D	Bank E
Crisis impact on overall activities	4.2	2	5	5	4	5
Crisis impact on ICT-related activities	2.8	2	4	1	3	4
Crisis impact on overall operational expenses	5.0	5	5	5	5	5
Crisis impact on ICT-related operational expenses	5.0	5	5	5	5	5
Crisis impact on overall investment expenses	4.0	1	5	4	5	5
Crisis impact on ICT-related investment expenses	3.4	1	5	1	5	5

For the first two questions 1: no impact; 5: very large negative impact – for the other questions 1: large increase; 5: large decrease.

beginning of the crisis. All these were mentioned as major reasons for this large reduction of banks' activities in the crisis.

However, ICT-related activities were reduced less than the overall activities (average extent of reduction score 2.8, i.e. reduction to a moderate extent, versus 4.2, i.e. reduction to a large extent), since 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 investment expenditures. ICT-related operational costs were reduced to the same extent as the overall operational costs (average reduction score 5.0 for both, i.e. very large decrease). In the in-depth discussions, the ICT General Directors mentioned that there were similar very large reductions in both the ICT-related and the overall operational expenses, mainly through reductions of salaries as well as voluntary redundancies. However, the decrease of ICT-related investment was weaker than the decrease in the overall investment (average reduction score of 3.4 versus 4). 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.

Furthermore, in the interviews was also mentioned that the crisis necessitated some new ICT investments, not only for reducing the operational costs through automation or transformation of some tasks but also for meeting the higher requirements for financial risk management, non-performing loan management, as well as regulatory compliance posed by the crisis. Also, some of the banks mentioned that during the crisis proceeded to the acquisition of smaller and weaker banks. This necessitated ICT investments for the integration of their heterogeneous IS and the consolidation of their data centers. Finally, some of the banks emphasized that the crisis was a driver for ICT projects aiming to address preexisting problems, weaknesses, and deficiencies in their ICT infrastructures (especially concerning the Internet and mobile banking services provided to their customers), which became now unavoidable in order to survive in the conditions of the crisis. All these activities contributed significantly to having lower levels of reduction of the ICT-related investment during the crisis in comparison with the overall investment.

A glance at the scores of the responses of the individual banks (see Table 1, columns 3 to 7) shows a similar crisis behavior among banks as to operational costs (large decrease), but significant differences with respect to investment expenditures both overall and in ICT domain. The banks B, C, and E show quite similar behavior, but there is also some behavior heterogeneity: bank A (the largest Greek bank) and bank C (before the capital restocking by the state in 2012 the largest only private Greek bank) even reported a large increase of ICT-related investment.

Reduction of expenses for ICT-related resources

Table 2 shows the average extent of reduction of the main kinds of operational and investment expenses for ICT-related resources (technological and human ones). There was a small reduction of investment for new ICT technological resources due to the crisis, which was higher for the software than for the hardware (equipment) investment. Also, there was a small reduction of investment for ICT human resource recruitment and training, while training of ICT users was left unchanged. Therefore, in total Greek banks reduced only to a small extent their expenses for ICT resources.

In the in-depth discussions, the ICT General Directors stressed 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 as well as 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. Another reason that (some of) the interviewees mentioned for not proceeding to large reductions of their 'hard' ICT investment was their interest in experimenting with (at least at the level of pilots) and exploiting some promising novel ICT, 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 the recruitment of new ICT personnel and in providing training to ICT personnel and ICT

Table 2. Effect of the crisis on the use of various ICT-related resources.

Crisis effect	Average score
Reduction of acquisition of ICT equipment (hardware)	3.4
Reduction of acquisition of software	3.8
Reduction of recruitment of new ICT personnel	3.6
Reduction of training of ICTpersonnel	3.4
Reduction of training of employees using ICT	2.6
Reduction of ICT-personnel payroll	4.0
Average score	*3.5*

1: large increase; 5: large decrease.

users, in order to keep up with the intensive new knowledge and new technology developments in the ICT domain. This is quite important also for coping with the increasing competition from 'fintech' firms, which seems to be a major issue for all interviewed ICT General Directors (see Lee and Shin (2018) for more information on this). However, the compensation of ICT personnel was reduced somewhat stronger than other expenditures. This finding is a hint that the costs of the maintenance of the ICT employment have been counterbalanced by the reduction of employee compensation.

Optimization of the use of ICT resources

Table 3 presents the average extent of performing various kinds of optimizations in the use of ICT resources. The single optimization measure that has been performed to the largest extent has been the renegotiation of contracts with the providers of ICT-related services, such as maintenance and support, in order to reduce their unit prices, reducing at the same time too strict requirements for quick failures' recovery. Further, optimizations with respect to too extensive application portfolios were performed to a moderate to large extent, mainly replacements of old costly applications by new ones developed using new technologies. In the in-depth discussions with the ICT General Directors it was mentioned that since the banks have been an old and 'historic' user of ICT, they have large numbers of old equipment and software applications, which are costly to support and maintain. For this reason, they proceeded to the replacement of some of their old and costly applications by new ones that were developed using modern tools and languages, but only to a limited extent based on software packages from the market. The main reason for this was that because of the specificities and the complexity of banking sector activities and processes there was a limited availability in the market of appropriate software packages for supporting them. This replacement of old and costly applications reduced significantly the maintenance and support costs and made easier their interconnection with other applications as well as the modification and enrichment of their functionality for meeting new needs.

Table 3. Measures against the crisis: optimization of the use of ICT-related resources.

Reaction to crisis led to:	Average score
Re-negotiation of contracts with suppliers of ICT-related equipment and ICT-related services aiming at the reduction of supply prices	4.0
Termination of use of some costly ICT applications	3.0
Reduction of access and use of some costly ICT applications	2.2
Replacement of old ICT applications by new ones based on new technologies	3.4
Replacement of old applications by external acquired software packages	2.6
Average score of all five single measures	*3.0*

1: not at all; 5: to a very large extent.

ICT-related practices/processes and capability rationalization

Table 4 demonstrates that an important category of actions against the crisis referred to the rationalization/improvement to a large extent of the main ICT-related practices and processes with respect to ICT governance and organization (with an average rationalization score of 3.7), and therefore the increase of relevant ICT-related capabilities.

In particular, the main emphasis has been placed on making large rationalizations and improvements in the practices and processes that usually followed for the generation of the ICT plan and its stronger interconnection with overall strategic plans. These measures aimed at strengthening 'ICT strategic alignment,' which has been widely recognized in the previous IS research as critical for generating business value from the use of ICT (Chan & Reich, 2007; Wu et al., 2015). In the in-depth discussions, it was mentioned that there have been some weaknesses in the past concerning the rational development of ICT plans, the selection and the priorities of the ICT projects included in them, and their interconnection with a bank's strategic priorities. Some of the banks also mentioned that for the purpose of improvement of these processes they have set up and strengthened the role of ICT Steering Committees, in which participate besides the ICT General Director all General Directors managing the banking activities. The interaction among them seems to be very useful for ensuring that the ICT plans focus on projects that contribute significantly not only to the promotion of the strategic orientations and

Table 4. Measures against the crisis: rationalization of practices/processes for improving ICT-related capabilities.

Reaction to crisis led to:	Average score
Improvement of the generation process of ICT plan (defining future short- and medium-term ICT projects)	3.8
Improvement of practices/processes for interconnection and alignment of ICT plan to overall strategic plans and goals	4.0
Rationalization and improvement of the processes of (internal or external) realization and administration of ICT projects	3.2
Rationalization and improvement of the processes of operation and support of information systems (ICT operations)	3.8
Improvement of methods of ICT service management	3.8
Average score of all five single measures	*3.7*

1: not at all; 5: to a very large extent.

priorities of the bank but also to experimentation with and introduction of new technologies (such as business intelligence and analytics, artificial intelligence, etc.) in important bank activities such as credit rating and risk management.

Further, the emphasis has been placed on achieving rationalization and improvement in the practices and processes that usually followed for the operation and support of IS as well as for the ICT service management. To this end, the banks increased the use of existing methods/standards of ICT service management (e.g., ITIL, COBIT), while some of them proceeded to obtaining relevant certifications.

According to the results in Table 4, with the only exception to the rationalization/improvement of the processes of realization and administration of ICT projects (used to a moderate extent), all other four types of ICT rationalization actions that are examined in this study were employed to a large extent, leading to an enhancement of ICT-related capabilities. The average of ICT rationalization scores in Table 4 is 3.7, which is the highest score among all examined groups of crisis response actions. According to the interviewees, ICT capability enhancement is quite beneficial not only for coping with this crisis but also for banks' future performance as well, given their increasing reliance on ICTs and the strong competition from ICT-based fintech firms.

ICT-plan adaptation and new ICT projects

Another important group of actions taken by Greek banks against the crisis was adaptations of their preexisting ICT plans to the new crisis conditions to a moderate to large extent (with an average score of 3.4, i.e. moderate to large extent; see Table 5). The main actions of this category that were undertaken to a large extent were: placing high priorities on ICT projects with immediate outcomes/benefits, changes of the content of ICT plans, and changes in the priorities of the already planned ICT projects. Further, new ICT projects were promoted to a large extent that enabled the reduction of the operational costs through process automation or innovation, and to a lower extent, projects that enabled the generation of additional revenues for the bank through new products and services. In the in-depth discussions, it was mentioned that the crisis was a driver for new ICT projects aiming not only at reducing operational costs through automation but also at support some activities that had become of critical importance for the survival of the banks in the crisis, such as management of non-performing loans, financial risk management, credit rating, processing of loan applications, anti-fraud initiatives, etc. A further category of new ICT projects was necessary for meeting the extensive requirements for regulatory compliance, which had become even stricter during the crisis. To a smaller extent were also promoted new ICT projects that supported new products and services that had to be offered to customers in order to meet new needs generated by the crisis (such as new types of accounts or investments) or for supporting extensions to new market segments (such as farming businesses and contract farming mentioned by two of the banks).

From the above it can be concluded that 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, with a rather short-term perspective, oriented toward 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.

Table 5. Measures against the crisis: adaptation of the ICT plans.

Reaction to crisis led to:	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 of ICT projects with immediate outcomes	4.2
Priority of ICT projects aiming at an infrastructure that allows rapid development and interconnection of new applications	3.2
New ICT projects for bank's operational costs reduction through process automation or innovation	4.4
New ICT projects for the generation of additional revenue through new products and services	3.4
Average of all nine single measures	*3.4*

1: not at all; 5: to a very large extent.

Concluding remarks and implications for research and practice

In the previous sections of this article, we analyzed the behavior of the five 'system-relevant' Greek banks with respect to their ICT activities in the first years 2010–2014 of the severe Greek economic crisis. For this purpose, we developed a multi-dimensional analysis framework, based on and combining theoretical foundations from previous management science research about firm-level impact and management of recessions, and also from previous IS domain research about ICT resources and capabilities. This analysis framework allowed us to perform a multi-dimensional analysis with a wide perspective of the behavior/response of

Greek banks in the crisis with respect to their main ICT resources and ICT capabilities as well as ICT plans.

From our analysis, we distinguished *negative* effects of the crisis on the ICT-related investment and operational expenses, and on the use of several ICT-related resources, which are the consequence of immediate 'defensive' actions taken by the banks against the crisis. However, these reductions of ICT expenses were not dramatic, they were, especially for the ICT investment expenditures, small to moderate. In the qualitative in-depth discussions with the ICT General Directors of the banks were identified a number of reasons for not having a dramatic reduction in ICT investment by the Greek banks during the crisis. One important reason for this was the 'information-intensive' nature of banks' activities, which require continuous ICT support with high availability and minimal interruptions. This necessitates some ICT investments for the renewal (or at least the upgrade) of equipment. Additional reasons for some ICT investment despite the crisis were the necessity to address preexisting problems and inefficiencies in order to reduce operational costs, but also to cope with increasing default risks of customers' obligations, increasing competition for the declining market, and higher compliance requirements. For larger firms, additional investment in ICT would be necessary for the IS integration of acquired smaller firms that could not survive alone.

At the same time, from our analysis, we distinguished also *positive* effects of the crisis on ICT activities. Beyond these 'defensive' ICT expense cuts, some more sophisticated 'offensive' actions in ICT domain were introduced in a later phase, oriented toward ICT rationalization, optimization, and adaptation to the crisis, in order to stabilize the situation and allow a recovery. In this sense, we assume that these three groups of actions presented in this article constitute three main strategies (or action plans) against the crisis: ICT resource optimizing strategy, rationalization-induced ICT capabilities-improving strategy, and ICT plan-modifying/adapting strategy. Among them, the strategy that was used to a large extent refers to the improvement of ICT-related capabilities (average score 3.7 – see Table 4), followed by the ICT plans adaptation strategy that was employed to a moderate to large extent (average score 3.4 – see Table 5), and then the ICT resource optimization strategy that was employed to a moderate extent (average score 3.0 – see Table 3). Obviously, the banks concentrated their effort in applying measures leading to an improvement of ICT processes and capabilities as the most important action against the crisis. Presumably, they consider the improvement of ICT processes and capabilities as an important precondition for achieving good results also when employing the other two strategies.

Our study has interesting implications for research and practice. With respect to research, it contributes useful new knowledge to the IS research domain, especially to its research stream investigating the impact of a firm's external environment on ICT use and management, concerning the impact of economic crises/recessions that constitute the most severe disruptions that repeatedly occur in firms' external environment. Also, it contributes new knowledge to the management science research stream that investigates the impact and management of recessions at the firm level, concerning the impact as well as the management of recessions in the area of ICT use and management. Furthermore, our analysis framework can be quite useful for future research in the above domains.

With respect to practice, our findings enable a better understanding of the impact of the economic crisis on important ICT resources and capabilities as well as ICT plans in the highly important and 'information-intensive' banking sector. Also, our findings reveal an interesting resiliency-oriented pattern of ICT behavior and management during the economic crisis, which is based mainly on rationalization of ICT activities and to a lower extent on ICT expense reduction, that might be of wider interest and usefulness to firms (especially of 'information – intensive' sectors) for managing ICT in such difficult recession times. They indicate that firms' management should not resort exclusively to dramatic cuts of their expenses for ICT technological and resources during economic crises, but should also proceed to rationalizations and improvements of their ICT-related processes and practices, in order to increase their efficiency and effectiveness, aiming to increase their ICT capabilities.

The main limitation of our study is that it has been based on data collected from a single country (experiencing a severe economic crisis) and sector (highly information-intensive, relying heavily on ICTs), so its results might have been influenced by this specific national and sectoral context. Therefore, similar research is required in other sectoral contexts (e.g., in less 'information-intensive' sectors, with smaller size firms, having less experience in ICT use) and other national contexts (experiencing economic crises of various levels of severity, with different levels of economic development), and examining a wider range of 'hard' and 'soft' aspects of ICT activity during the crisis, based on larger numbers of firms. Another interesting direction of research would be to investigate the internal and external determinants of firms' ICT-related behavior in economic crises (i.e. the characteristics of firms as well as their external environment that affect this behavior).

Notes

1. For the definition of the 'system-relevant' or 'systemic' banks of Greece (meant as large banks, having significant impact on the whole system of the national economy, whose failure might pose large scale systemic risks on the economy) see Bank of Greece (2018) and Hellenic Bank Association (2019).
2. The five banks we have taken into consideration in this study are the largest Greek banks and at the same time the most 'system relevant' ones, according to Bank of Greece (2018), since they have a large impact on the whole Greek economy, and their failure might pose high systemic risks to it and lead to extensive destabilization.

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