

SMEs in the cloud: The impact of cloud adoption on economic growth and development

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The current economic crisis in Europe generated the need for new models of development, with Small-Medium Enterprises (SMEs) being a key solution and a growth driver. This could be achieved by the promotion of technological innovation, as for example by the means of the cloud computing business model.

Cloud computing is a rapidly evolving computational model and has the potential to become the upcoming technology event that will transform the economy's production techniques.

This work highlights the importance of the cloud computing adoption by the SMEs and its impact on the competitiveness of a state's economy. It also explores the economic benefits of the new business model like cost reduction, creation of job positions and entrepreneurship promotion, while it addresses the associated risks and concerns of adopting or migrating to the cloud. Evidence from the European area is provided and the case of Greece is considered as an example.

Keywords

Cloud computing, Economic crisis, Economic growth, Market competitiveness, SMEs

1. Introduction

It is evidence that the recent economic crisis has an impact on the European area, expressed not only in terms of banking and national debt but also in terms of a growth and competitiveness crisis. All member states of the Eurozone are facing the recession in the real economy and they are seeking for solutions in order to build more competitive and more efficient European economies. A very promising solution key is to invest on the Small and Medium Enterprises (SMEs), improve their business environment and reveal their full potentials in global market and economy [1].

SMEs are the backbone of economy breeding industrial development [2] and their strategic importance derives from their contribution to economic growth and job creation, based mainly on their flexibility regarding the adoption of new working patterns and new business practices. Despite the fact that no clear, or unique, definition of the term SMEs exists, the benefits of growth in this business sector are

significant, in each country. Indeed, the term SME is defined either in terms of the number of employees in the company (usually up to 250), or in terms of ownership and management. Their contribution to development and economy growth indicates that appropriate actions should be initiated and supported to help them adopt new technologies and improve their efficiency. Moreover, the use of Information and Communication Technology (ICT) is widely seen as critical for the competitiveness of SMEs in the emerging global market, since businesses must be able to process data and use information effectively. This, in turn, enables them to substantially gain competitive advantage, thus adding significant value, in terms of productivity increase and performance improvements. The growth of the Internet has provided even more opportunities, especially for the small to medium-sized businesses, enabling them to sell their products and services to a potential global market, making global trading available for almost all enterprises.

Therefore, the establishment of an appropriate environment in which SMEs will be able to grow is critical for the development and expansion of businesses. ICTs play an increasingly important role in their growth. However and as a consequence of the recession, a vast number of SMEs may be too small to be able to employ a dedicated Information Technology (IT) expert [3, 4] or may lack resources and expertise in terms of management of new technologies [5].

This kind of problems can be adequately faced by an innovative ICT business model, the cloud computing, a state-of-the-art technological approach. Cloud computing is expected to assist the European market to be more efficient and productive by generating new jobs and enhancing economic growth. Europe's economic recovery will very probably be boosted by business investments in cloud computing [6]. An increasing number of SMES are thinking of migrating to the cloud, or have already done so. Cloud is an attractive option for many SMEs, particularly in the current global economic crisis, due to its characteristics, mainly the flexible cost and the scalability [7].

The rest of the paper is structured as follows: In Section 2 the cloud computing business model is introduced. Section 3 is devoted to the exploitation of the economic benefits that derive by the adoption of the cloud, providing evidence from Europe and suggesting solutions to developing economies facing the recession. In Section 4 the risks and threats by the adoption of the cloud are presented and, finally, Section 5 concludes.

2. The Cloud Computing Business Model

Cloud computing is a type of computing that relies on sharing computing resources rather than having local servers or personal to handle. The term "cloud" denotes "the Internet", therefore cloud computing refers to a type of Internet-based computing model, where different services - such as servers, storage and applications - are delivered to an organization's computers and devices through the Internet. In simple terms, cloud computing can be defined as the set of hardware, networks, storage, services and interfaces combined to deliver aspects of computing as a service based on user demand [8]. It can also be perceived as the procedure of storing and accessing data and applications over the Internet, instead of the user's computer hard drive [9]. A more precise and formal definition can be found in *National Institute of Standards and Technology (NIST)* [10].

From a technical perspective, the structure of the cloud is composed of five essential characteristics, three service models, and four deployment models [11], introduced below.

2.1 Essential characteristics

- *On-demand self-service.* A consumer can unilaterally ask for the provision of computing capabilities as needed, such as server time and network storage, automatically, without requiring human interaction, or intervention of the service provider.
- *Broad network access.* Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
- *Resource pooling.* The provider's computing resources (storage, processing, memory, and network bandwidth) are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources, dynamically assigned and reassigned according to the consumer's demand.
- *Rapid elasticity.* Capabilities can be elastically and automatically provisioned and released, to scale rapidly outward and inward commensurate with demand.
- *Measured service.* Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service [11].

2.2 Service Models

- *Software as a Service (SaaS).* The capability to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser, or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities.
- *Platform as a Service (PaaS).* The capability to deploy onto the cloud infrastructure languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure but has control over the deployed applications and possibly configuration settings for the application-hosting environment.
- *Infrastructure as a Service (IaaS).* The capability to process, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components [11].

2.3 Deployment Models

- *Private cloud.* The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.
- *Community cloud.* The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned,

managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

- *Public cloud*. The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.
- *Hybrid cloud*. The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds) [11].

The above are graphically illustrated in Figure 1:



Figure 1 Cloud Computing Models

3. Economic Benefits of cloud computing to Business and SMEs

3.1 Benefits

The cloud computing business model can be used not only as a powerful technological tool but also as a business advantage, like the Internet once was, when it was first adopted by SMEs. In addition to all operational benefits this computational model offers, it can also provide a higher concentrated competitive advantage than ever before [12].

From a less technology-oriented perspective, SMEs need to respond to the changing market conditions and demanding customer wills, based on different cost models than the traditional [13]. The most efficient and low-risk way to enter new market segments and promote business development is to use the upcoming technology of cloud computing, combined with its supported services, thus obtaining important benefits and advantages.

Cost-saving benefits are among the most important economic advantages to ICT consumers, as well as to businesses. Outsourcing services and resources can make data more accessible to end users, in terms of mobility and usage. Furthermore, moving all the necessary data and IT applications into the cloud reduces server and storage costs, software maintenance expenditures, as well as network and hardware expenses within an enterprise. This, consequently, offers low start-up costs, a “pay-as-you-go” cost structure and an environment for rapid innovation. Cloud computing adoption can eliminate internal operations and support costs, as well as cooling, power and other energy needs of a firm, resulting in a total IT cost budget reduction. The cloud is gaining popularity among businesses, since it promises new

development opportunities and job creation. It introduces a new business model that promotes entrepreneurship and competitiveness, therefore assisting companies in satisfying their business goals, sooner and easier than before, through elastic provisioning of IT, free from additional costs, together with reduced fixed costs of entry to new markets, spanning worldwide. Thus, SMEs can reach the maximum potential business development benefit from cloud computing as they have new revenue opportunities and improved profitability. New enterprises are expected to be created and the existing to be developed, leading at the same time to the creation of job positions, resulting to multiplier benefits and growth of the society's economy and social surplus.

Evidence from European countries that have already used cloud computing supports the above analysis. These countries have found a way to encourage innovation and entrepreneurship, while outweighing perceived risks and possible financial constraints. Findings indicate that the cloud computing business model should be also adopted by less developed countries, in order to boost growth and development [14].

3.2 Evidence from Europe

The cloud computing paradigm has gained enormous momentum across European countries during the last few years, mostly because of their need to adopt a new business model to drive their competitiveness and economic growth forward [15].

According to the Centre for Economics and Business Research Ltd (Cebr), some of Europe's most important economies, such as the French, the German, the Italian, the Spanish and the English, are expected to enjoy significant economic development from the early use of cloud computing, at an expected level of €763 billion over a period of six years, from year 2010 to 2015 or, expressed in terms of *Gross domestic product (GDP)*:

- a 1.50% of total GDP for France,
- a 1.59% of total GDP for Germany,
- a 1.76% of total GDP for Italy,
- a 1.84% of total GDP for Spain and
- a 1.26% of total GDP for the UK.

The above economies have already achieved quite high average rates of cloud adoption, which are likely to raise even more as, for example, from 31% to 48% for France and from the surprising rate of 37% to 51% for Spain. Thus, a gradual shift to cloud computing is observed across these economies and especially at some particular industry sectors of each country, usually depending on the characteristics of each individual economy. In Germany, the strongest of the five economies, the banking, financial and business services sectors are the ones that bring the greatest output from the cloud computing adoption, due to the fact that they do not only save a big amount of capital expenditures but they also create many new business positions. The rest of the considered countries are expected to develop more the distribution, retail and hotel sectors [16].

The substantial economic benefits derived from the adoption of this new business model for all the countries are provided in Table 1 and they are graphically illustrated in Figure 2.

Table 1: The economic benefits due to cloud adoption of each country over the period 2010-2015.

Country	France	Germany	Italy	Spain	UK
Cumulative Economic Benefit (CEB) in billions	€162.8	€221.2	€150.8	€110.6	€118.0
Contribution to benefits in 2015	23%	22.4%	23.3%	22.8%	25.4%

Contribution to GDP	1.50%	1.59%	1.76%	1.84%	1.26%
Net Cost Savings/ CEB (in billions)	16.2% (€26.3)	17.1% (€37.7)	18.9% (€28.5)	19.9% (€22.0)	22.2% (€26.2)
Business Development Benefits (in billions)	15.1% (€24.6)	14.8% (€32.6)	15.9% (€24.0)	15.3% (€16.9)	25.0% (€29.6)
Business Creation Benefits (in billions)	31.6% (€51.4)	31.4% (€69.5)	28.7% (€43.3)	28.0% (€30.9)	17.0% (€20.0)

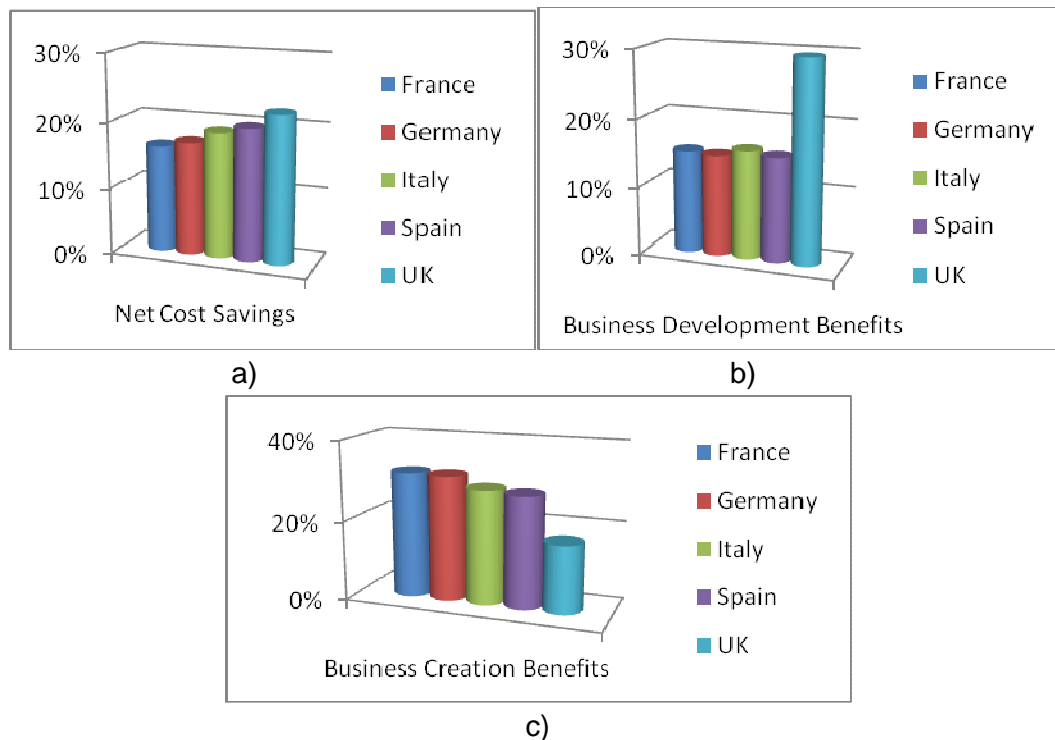


Figure 2: Percentage contribution of a) Net Cost Savings, b) Business Development Benefits, c) Business Creation Benefits of cloud adoption to total economic benefits of each country over the period 2010-2015.

The lowest cumulative cost savings deriving by the cloud are expected to be met in France, constituting the 16.2% of its aggregate cloud share, whereas the UK is the country with the highest percentage contribution that amounts 22.2% of its cumulative cloud dividend. The UK shows a strong performance on business development, as a result of the high productivity of English SMEs. On the contrary, the rest of the countries do not differ significantly from each other, as the enterprises located there have shown a low productive performance.

The cumulative business creation benefits in France and Germany are likely to exceed the level of 31% of their total cloud gain, whereas Italy and Spain have also a significant percentage contribution, estimated at about 28%. These results are fully justified by the large number of SMEs which are expected to be created or expanded. However, the UK is supposed to be a poor performer on business creation, due to the lack of new SMEs and job positions [16].

Despite the European economic crisis, the above predictions show that the diffusion of cloud computing can be critical for boosting the economic growth of a country and create a competitive environment for the SMEs to develop themselves and achieve economic success, contributing to the economic development by enhancing their productive performance [15].

As a result, many new job positions and SMEs are expected to be created in many different industrial sectors in all the aforementioned countries, as shown in Table 2.

Table 2: Creation of new jobs and new business start-ups by 2015 (thousands)

Country	New jobs	New SMEs
United Kingdom	289	35
Germany	789	39
France	469	48
Italy	456	81
Spain	393	55

3.3 Developing Countries - The Case of Greece

Based on the expected benefits of cloud computing across Europe, the adoption of the cloud is very likely to contribute substantially to the developing countries. The case of Greece is a characteristic example. The country's economy is expected to be more efficient and productive, through the generation of jobs and the enhancement of economic development [15].

Cloud computing can affect the Greek economic environment in terms of both the governmental organizations and the SMEs of the private sector. They both constitute the key driver of investment and development [17] and this new business model can be an important macroeconomic factor to support the Greek economic growth, since there is already a significant number of established SMEs [14], ready to adopt the new technology. The majority of Greek companies make use of ICT, 43% of them provide IT services, whereas the rest of them have different activities, such as retail trade, telecommunications, manufacturing and software development. Depending on the cloud computing model (private, hybrid, public), a significant increase of potential IT cost savings is expected, because of the reduction of the overall IT capital expenditures by 17% up to 40%. Although the introduction of the cloud computing is really encouraged by their needs to reduce costs and add value to their services, adoption has not yet gained substantial popularity among the Greek firms, due to technical and non-technical difficulties [18]. According to IOBE's macroeconomic study, savings in Greece as a result of cloud computing adoption can reach € 4.8 billion over the decade, between years 2010 to 2020. The expected annual net cost savings are estimated to be more than € 850 millions (Figure 3).

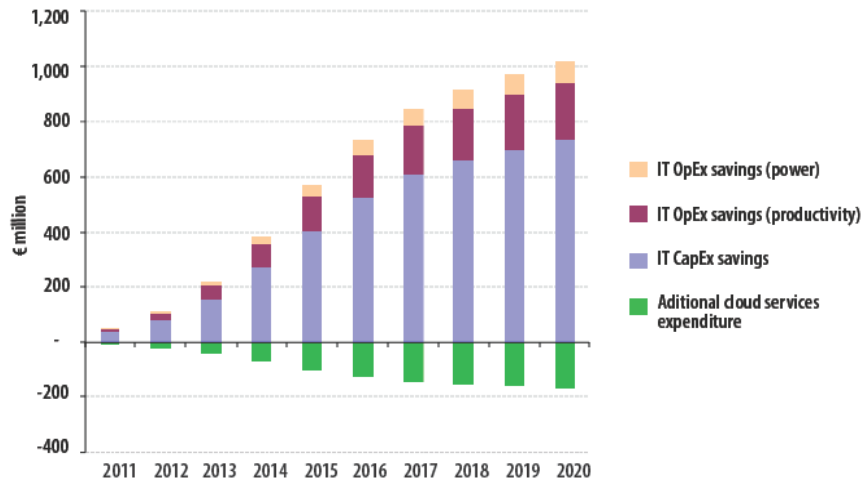


Figure 3: Contributions of the individual categories of savings to net cost savings from the adoption of cloud computing in Greece, over the period from 2010 to 2020. (Source: IOBE)

IT capital expenditure (IT CapEx) savings are expected to contribute at a level of more than 70% of the gross cost savings over this decade. About 20% of them will derive from the reduced IT operational expenses (IT OpEx) related to labor cost and productivity, whereas the rest (7.4%) will be the result of energy cost savings.

Moreover, cloud computing adoption from the Greek SMEs offers all the other significant economic benefits mentioned above, such as new business development and creation. More specifically, it is predicted that the value of these benefits may be almost € 8.3 billion, adding an extra € 5.1 billion Gross Value Added (GVA) for Greece from 2010 to 2020, while the annual estimated economic impact on output is € 1.5 billion [14].

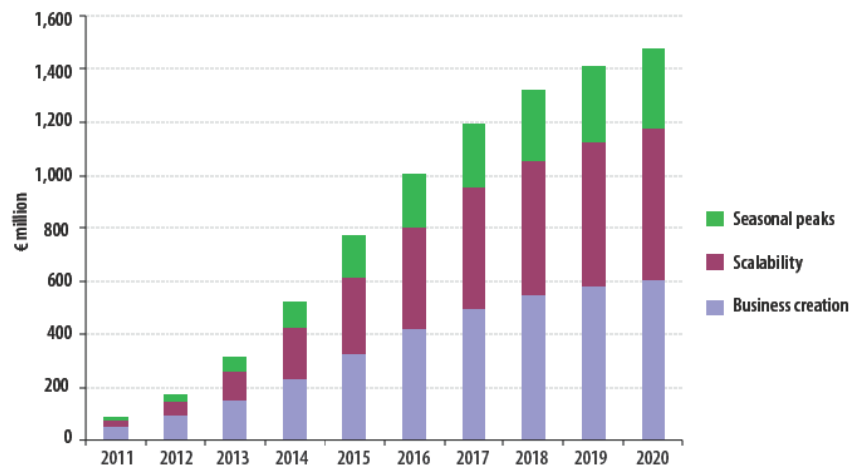


Figure 4: Contributions of the business development (Seasonal peaks, Scalability) and creation benefits of cloud computing adoption in the Greek economy over the period from 2010 to 2020. (Source: IOBE' study)

As observed in Figure 4, about 42% of the economic Greek profit comes from increased scalability or the expansion of business and the entry to new markets. Additionally to the direct benefits, indirect and induced economic activity are expected as well, having multiplier impacts on the Greek economy [18]. The most important of these effects are the elevated intermediate demand and the household income, amounting at almost € 8 billion, with an additional € 5.5 billion GVA, which, combined with the business development and creation benefits, can give a total of € 16 billion of output gain. The total impact on the Greek GVA

exclusively due to cloud computing adoption over the considered period of 10 years can reach a level € 15.4 billion (Figure 5). The Trade Sector is expected to contribute the most, as nearly 11.000 new positions are likely to be created out of the total of almost 38.000 new jobs, then the other business services sector comes, followed by the Manufacturing sector.

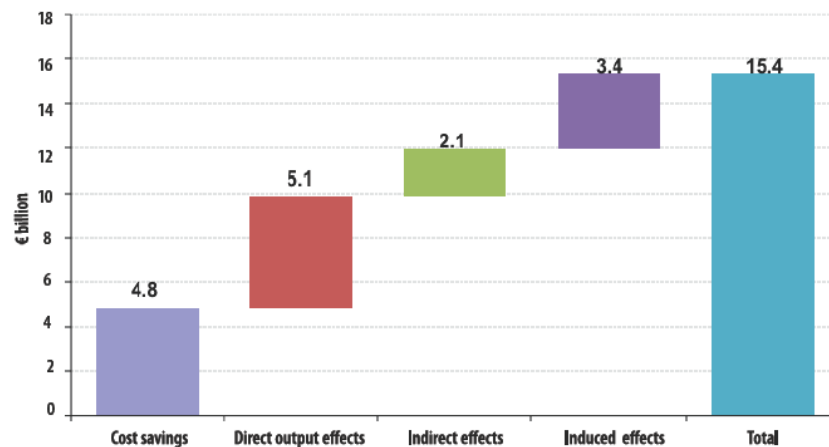


Figure 5: Contributions of the individual categories of economic benefits of cloud computing adoption to the total Greek GVA over the period from 2011 to 2020. (Source: IOBE' study)

Concluding, it is really important that the Greek SMEs incorporate cloud-based solutions, so that they can equally compete with their key trade partners [15]. The faster they adopt the new business model of cloud the higher their expected cost savings and the better the relative price of their services will become.

4. Risks and Threats

Although cloud computing one of the most advancing solutions for SMEs to enhance their IT resources it is important to recognize the risks and threats that exist, in order to prevent several issues that may rise as a result of the implementation of the cloud. SMEs that proceed with adopting cloud computing services allow providers to access their data and applications. Because of the cloud construction and functionality as a shared resource, security is definitely of particular concern. SMEs feel threatened when providers access their confidential data and their intellectual property. They have to grapple with the decision of what data to move to cloud and when, knowing that vendors can utilize their machines [19].

Despite the numerous benefits of the cloud, employees are concerned about the changes that the adoption of cloud computing can bring. They are cautious about this new business technology model and worry about the possibility of losing their job or being unsuitable for managing the cloud [2].

Investing in cloud computing seems to be safe and profitable during the difficult days of recession, nevertheless all investments have risk, even the safe ones. There is always the possibility that an investment in cloud computing will fall through and the adoption of the cloud will not meet the initially set financial goals for growth and competitiveness.

Some industry observers say that the rapid growth of cloud computing is threatened by the lack of standards. This restricts implementation by limiting interoperability among different cloud platforms *“Interoperability between offerings and the portability of services from one provider to another is very important to the customer to*

maximize the expected [return on investment] from cloud computing,” explained IBM vice president for software standards Angel Luis Diaz [20].

Due to the increasing number of SMEs that empower their tasks to cloud providers, the complex nature of consumer demands and cloud computing immaturity, Service Level Agreement (SLA) between consumers and providers is vital [21]. SMEs migrate their corporate data to the cloud, so it is significant to be confident that they obtain an overall performance, availability and quality of the cloud provider's services [19].

5. Conclusions

Cloud computing is an innovative business model to assist economies overcoming recession and economic crisis, by helping Small and Medium Enterprises, the backbone of economy, to grow and be more competitive and efficient. They can change their business model and benefit from the adoption of the cloud computing model, due to its flexible cost and scalability. As a result, they will have a competitive advantage and gain access to new markets and build improved customer relationships. There are plenty of economic benefits arising from the usage of cloud computing, the most important of which are the cost savings, the business development and the business creation. This is supported by evidence from a number of European countries that have already adopted this new business model to drive their development and economic growth forward. The majority of them are expected to have substantial gains to their economies from the early use of cloud computing, while encouraging at the same time innovation and entrepreneurship. These are the reasons why a gradual shift to cloud computing performed in countries that suffer most by recession, like the case of Greece, is expected as well to be more efficient and productive.

Despite its many benefits, cloud computing also has some risks. Businesses, particularly the smaller ones must be aware of these issues before adopting the cloud. Security challenges, lack of standards, financial failure of the investment in the cloud are some of the risks that SMEs must take into consideration. With cloud computing adoption being in its early stages the risks are unavoidable, so it is important for SMEs to find ways to maximize the benefits and minimize the related risks.

Abbreviations

Abbreviation	Explanation
SMEs	Small and Medium Enterprises
ICT	Information and Communication Technology
IT	Information Technology

NIST	<i>National Institute of Standards and Technology</i>
SaaS	Software as a Service
PaaS	Platform as a Service
IaaS	Infrastructure as a Service
Cebr	Centre for Economics and Business Research Ltd
GDP	<i>Gross domestic product</i>
CEB	Cumulative Economic Benefit
CapEx	Capital Expenditure
OpEx	Operational Expenses
GVA	Gross Value Added

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