ΙΔΡΥΜΑ ΟΙΚΟΝΟΜΙΚΩΝ & ΒΙΟΜΗΧΑΝΙΚΩΝ ΕΡΕΥΝΩΝ
FOUNDATION FOR ECONOMIC & INDUSTRIAL RESEARCH

Cloud Computing: A Driver for Greek Economy Competitiveness

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Contents

List of Figures

List of Tables

Executive Summary

Introduction

Greece needs a new model of development, where exports and private investment are the key growth drivers. Improvement of the competitiveness of the Greek products and services is a crucial success factor for this transition. This implies that the Greek entrepreneurs should focus their efforts on cutting costs and increasing the value added of their products and services, while the State should minimise the administrative burden it imposes on the economy. The upcoming cloud computing (CC) paradigm shift is a technological event that holds great potential to assist these efforts.

Cloud computing is becoming a popular element of the IT landscape. Hundreds of millions of users rely on remote data centres and browser-based applications in order to exchange and store mail messages, photographs, videos and other types of content. Cloud computing has the potential to become the upcoming technology event that will once more transform the way our society functions, which includes the economy's production techniques and the state-business interface. The aim of this study is to assess the importance of the early adoption of cloud computing for the competitiveness of the Greek economy.

- **Cloud Computing (CC) substantially reduces IT spending, boosts productivity and creates new opportunities for business development.**
- **Over the next decade CC can save almost € 5 billion of expenditure for Greek businesses and the public sector under baseline assumptions of adoption.**
- **Increased scalability and reduced barriers to entry due to CC adoption add € 5 billion of income to the Greek economy in the next 10 years.**
- **Combined with the spill-over effects from increased intermediate demand and household income, the overall cloud dividend over the next decade can exceed € 16 billion.**
- **Up to 38,000 new jobs can be created by 2020 to produce the additional output in the Greek economy directly or indirectly derived from CC adoption.**
- **Speed of adoption is crucial. If Greece achieves 5-year transition to the cloud, while its competitors follow a 10-year transition path, the cloud dividend can reach € 21 billion with substantial employment gains over the medium term.**
- **In contrast, if technophobia and indolence prevail, the cloud dividend will extend to about € 5 billion with very little (if any) employment gains during the very difficult 6-7 years that lie ahead of us.**

Assessment of the Macroeconomic Environment in Greece

A fundamental problem of the Greek economy is that it has suffered from persistent loss of competitiveness and high fiscal deficits over the last three decades. The main characteristic of this period is the large expansion of the state, with employment in general government almost doubling since 1980s. Bearing in mind that almost 70% of state budget spending involves wage, pension payments and social benefits and accounting for the large "shadow" economic activity and the ineffective tax collection mechanisms, resulting in high tax evasion, it is not surprising that Greece's fiscal deficits are historically higher than the EU average.

Greece should aim for knowledge-based innovative entrepreneurship.

The fundamental causes of Greece's economic crisis – which help us understand its inefficiencies - can be summarised into 4 groups:

I. Fiscal Derailment

II. Loss of structural competitiveness

III. Poor achievements in the main competiveness drivers of a knowledge based economy

IV. Distortionary growth model

Under the current macroeconomic circumstances, the Greek economy should quickly adjust to the new growth model, focused on boosting investment and enhancing export activity. Apart from the fiscal consolidation process currently underway, the key parameter for a new cycle of sustainable growth is improvement of the competitiveness of the Greek products and services. This process demands the enhancement of the adoption capabilities of the Greek economy to the broader technological, economic, social and geopolitical changes. It involves improving its ability to produce, acquire and use knowledge. Competitiveness in developed economies is not only about the relative costs and prices, but depends also on the technological content, diversification and quality of the products and services.

In the Greek ICT ecosystem the conditions for cloud computing adoption are more than encouraging, as CC may find fertile ground due to the significant presence of SMEs.

Greece should aim for knowledge-based innovative entrepreneurship. To this extent, investment in technology diffusion in all aspects of the production process, and especially in the public sector, could significantly strengthen competition, increase the quality of offered services, boost exports and narrow the economy's long-run competitiveness deficits.

Cloud Computing and the Local Ecosystem

Cloud computing can have a prominent future in Greece. The current crisis has made the adoption of this cost-effective and innovative technology even more important for the country's private and public sectors. The adoption of the CC model reduces the cost of hardware and software, without reducing the quality of the provided service, which is particularly significant for new business ventures.

Overall, the trend towards the distribution and decentralisation of IT resources is, at the same time, confronted with the need for consolidated and efficient use of IT resources. This results in transition to cloud services, which satisfy several emerging issues such as:

- Increasing demand for storage and computing power at each data centre
- Many and scattered data centres with underutilisation of their resources
- Increasing maintenance costs of data centres

In the Greek ICT ecosystem the conditions for cloud computing adoption are more than encouraging, as CC may find fertile ground due to the significant presence of SMEs. The introduction of cloud computing depends on technical factors such as the technological level of the ICT sector and its capability to quickly incorporate cloud solutions in its product portfolio. It also depends on external conditions such as the economic climate. In this respect, the timing is right for the adoption of cloud computing as the need for cost reduction is more evident than ever. On the other hand, companies that have already invested significant amounts in IT infrastructure in the past need a satisfactory return on investment before deciding to reorganise their IT resources. A gradual shift to CC with the adoption of piloting applications seems the most plausible path for CC deployment in Greece in the near future.

The overall cloud dividend for the Greek economy in the 2010-2020 period under baseline adoption scenario exceeds € 16 billion.

The Impact of Cloud Computing on the Competitiveness of the Greek Economy

Cloud computing can bring substantial gains to the Greek economy. By consolidating IT spending on equipment, expertise and power, cloud computing can generate savings amounting to € 4.8 billion over the next decade. Through increased scalability and reduced barriers to entry in new markets, cloud computing raises income in the economy further by € 5 billion. Taking into account the spill-over effects from the boost in economic activity, the overall cloud dividend for the Greek economy in the 2010-2020 period under the baseline adoption scenario exceeds € 16 billion. In addition, there will be close to 38,000 jobs by the end of the decade, created as a result of Cloud Computing adoption.

Close to 38,000 jobs are expected to be created by the end of the decade as a result of Cloud Computing adoptions.

In order to achieve these benefits, however, Greek businesses (and the public sector as a facilitator) should adopt cloud computing at least as fast as the country's major competitors in the global markets. If Greece achieves a 5-year transition to the cloud, while its competitors follow a 10-year transition path, the cloud dividend can reach € 21 billion with substantial employment gains over the medium term. In contrast, if technophobia and indolence prevail, the competitive position of Greece will continue to slide down and the cloud dividend will only extend to about € 5 billion with very little (if any) employment gains during the difficult 6-7 years that lie ahead of us.

Policy Recommendations

Policy recommendations for a faster diffusion of Cloud Computing (CC) cannot be seen in isolation from a broader review of the policies that support the diffusion of new technologies into the Greek socioeconomic system. Recommendations for CC should hence be incorporated into a more general framework for supporting Information Society and ICTs diffusion in Greece. Such policies, provided they are well designed and targeted, can speed up the diffusion of Information Society in Greece, thus supporting CC adoption as well. Some priorities that could support the diffusion of ICTs and specifically CC, are reported, both at the business level (CC providers) and at the level of public policies supporting ICTs.

Firms have to develop promotion campaigns on the uses of cloud computing and cloud applications in order to communicate the benefits.

Recommendations at the IT business level

The State should invest in large datacentres, which will form a new centralised computing infrastructure for the Greek government that will support all areas of the public sector.

Priority 1: Raise CC Awareness. As people are not yet familiar with the concept of CC, even if they are already using some hybrid CC services, firms have to develop promotion campaigns on the uses of cloud computing and cloud applications, in order to communicate the benefits to private consumers and especially to firms.

Priority 2: Diminish concerns of hesitant IT users. CC providers should monitor international trends and security updates on cloud technologies. Business friendly rules for the treatment and movement of cloud data should also be introduced along with the exact clarification of the contractual relationships and the secure communication with external providers. Customisation of solutions also helps in that direction. Due to the different size and operation level of Greek firms, larger firms may need to develop their own internal clouds (private clouds), while smaller firms could move to clouds from external service providers (public clouds). Customisation allows users to exploit cloud features that could be developed internally based on their specific needs and purposes, while outsourcing other functions to cloud providers.

Priority 3: Support the development of e-skills. Bridging the digital gap between the rather small part of the population and firms that adopt rapidly new technologies and the larger part that still holds back is of paramount importance for the Greek economy. Training of all University students on IT and Business skills through Private Edu Cloud, support of the usage of the latest ICT tools through the Digital School Initiative and free IT skills training to the disadvantaged are some best practices that can be used.

Priority 4: Achieve critical mass of infrastructure and services. Investments in broadband infrastructure should be enhanced while digital content and services based on advanced infrastructure should be expanded. Cloud computing provides a tool for testing and implementing new IT applications, at a lower business risk level.

At the level of public policies for ICTs

Priority 1: Develop Advanced Broadband Infrastructures. The State should invest in large datacentres (G-Data Centres / G-Cloud), which will form a new centralised computing infrastructure for the Greek government that will support all areas of the public sector. A centralised cloud system would be a more efficient IT solution compared to multiple small-to-medium Information Systems scattered around various public agencies with redundant computing power that is left unutilised. Specific areas of interest would be the health sector, the social security system and the management of public finances (i.e. tax collection mechanisms) where significant fiscal benefits could be yielded.

The quality of delivery of education & training in all areas should be improved.

Priority 2: Improve ICT skills. Everyone must have equal chances of developing the necessary capabilities to actively participate and benefit from the Knowledge Economy. There is a need to improve the quality of delivery of education & training in all areas, including distance learning, as well as to enhance the learning experience. Digital School should be expanded, activities relating to life-long training processes and educational & vocational training opportunities should be explored, along with the development of common and widely acceptable standards of certification of ICT training programs.

Priority 3: Diffuse the use of ICTs in the public sector. Advanced e-government services may function as an additional motivation for citizens and firms to adopt ICTs in order to deal with the Public Sector. As the problem of digital illiteracy is more widespread in the Public sector, training courses with the help of IT experts, designed for all layers of civil servants, are necessary. Effective promotion of ICTs could also involve pilot implementation of cloud applications that will be developed once and will be available for all public entities. Compulsory use of ICT applications by the public servants for specific functions, despite initial problems, could also enforce their wide-spread use.

1 | Introduction

The Greek economy was growing at an impressive rate in the years before the outburst of the global economic crisis. Its model of growth, however, was not sustainable, relying excessively on domestic consumption, which in turn was largely fuelled by credit expansion and -unrealistically- low interest rates. With public debt escalating and government deficit out of control, the Greek State was bailed out in May 2010 as a measure of last resort to avoid debt moratorium. The government is currently implementing an Economic Adjustment Programme, which includes austerity measures and a number of important structural reforms.

Greece needs a new model of development, where exports and private investment are the key growth drivers.

The Economic Adjustment Programme is probably insufficient to ensure timely return on a path of convergence to the European technology frontier. Greece needs a new model of development, where exports and private investment are the key growth drivers. Improvement of the competitiveness of the Greek products and services is a crucial success factor for this transition. This implies that Greek entrepreneurs should focus their efforts on cutting costs and increasing the value added of their products and services, while the State should minimise the administrative burden it imposes on the economy. The upcoming cloud computing (CC) paradigm shift is a technological event that holds great potential to assist these efforts.

Cloud computing is already with us. Hundreds of millions of users rely on remote data centres and browser-based applications in order to exchange and store mail messages, photographs, videos and other types of content. Microsoft's Windows Live Hotmail, Google's Gmail, Facebook, YouTube, Dropbox and many other web-based CC services have become household brand names, allowing its users to do things that were unfathomable a few years back. Cloud computing has the potential to become the upcoming technology event that will once more transform the way our society functions, which includes the economy's production techniques and the state-business interface. CC will significantly reduce the overall cost of computing, which implies that the countries that will embrace this technology change early enough will a acquire competitiveness edge over its rivals. Given the current adverse economic conditions in the country, Greece does not have the luxury to stay out of the new technology wave.

Countries that will embrace cloud computing technology early enough will acquire a competitiveness edge over its rivals.

The aim of this study is to assess the importance of the early adoption of cloud computing for the competitiveness of the Greek economy. The following chapter presents the new paradigm of cloud computing and outline the capabilities of the Greek ICT ecosystem to support the transition from client/server to cloud computing. The need for fundamental change in the Greek model of development is stressed in Chapter 2. The impact of adopting CC on the competitiveness of the Greek economy is outlined in Chapter 4. The report concludes with some policy recommendations.

2 | Assessment of the Macroeconomic Environment in Greece

The overall macroeconomic environment of a country indicates not only the fundamental economic parameters of its economy, but also the inefficiencies of a given growth model and possible growth opportunities and prospects that may lie ahead. The Greek economy is experiencing a transition period, from a consumer-centred to an export-oriented growth model, while, at the same time, trying to implement a rigorous fiscal consolidation program. In this economic context and under a changing macroeconomic environment, it would be interesting to investigate whether there are growth opportunities for a new technological paradigm: the introduction and diffusion of cloud computing could more efficiently support Greece in tackling some of its structural weaknesses.

2.1 How did we get here: Reasons for the country's competitive inefficiencies

The fundamental problem of the Greek economy lies in the area of persistent loss of competitiveness and high fiscal deficits over the last three decades.

The fundamental problem of the Greek economy lies in the area of persistent loss of competitiveness and high fiscal deficits over the last three decades. The main characteristic of this period is the large expansion of the state, with employment in general government almost doubling since 1980s. Bearing in mind that almost 70% of state budget spending involves wage, pension payments and social benefits and accounting for the large "shadow" economic activity and the ineffective tax collection mechanisms, resulting in high tax evasion, it is not surprising that Greece's fiscal deficits are historically higher than the EU average. Therefore, the fundamental causes of Greece's economic crisis - which help us in understanding its inefficiencies - can be summarised into 4 groups:

I. Fiscal Derailment
II. Loss of structural competitiveness
III. Poor achievements in the main competiveness drivers of a knowledge based economy
IV. Distortionary growth model

In the following sections, we explain in more detail these factors in order to understand how they have shaped the macro and micro environment in Greece.

2.1.1 Fiscal Derailment

On the **expenditure front**, data show that Greece underperformed Eurozone average until 2007, with general government spending amounting to c. 45% of GDP on average (for the period 1995-2007), versus 48.3% of GDP in the Eurozone area. After the outburst of the financial crisis in 2007, public spending increased as a percentage of GDP, both in Greece and the Eurozone area, due to the various stimuli packages aimed at supporting the financial and banking sectors. The sharp increase in public spending from 2007 onwards (from 47% of GDP in 2007 to 53% of GDP in 2009) is a clear indication of the fiscal derailment that occurred during the last years mainly attributable to the increase in public sector hirings and compensations. However, since Greece's public expenditure (as a % of GDP) does not largely exceed that of the Eurozone average, the attention should be drawn to the allocation and effectiveness of this public spending. Social indices, like the poverty line, reveal that living conditions of the population do not seem to be improving accordingly. The fact that public spending has failed to improve living conditions of the population is mainly attributed to the extensive mismanagement of funds, low efficiency records, increasing corruption and bureaucracy.

The fiscal derailment that occurred during the last years is mainly attributable to the increase in public sector hirings and compensations.

Furthermore, the public sector enjoyed a comparative advantage in terms of income earnings versus the private sector. OECD 2007[1] findings have shown that c. 24% of total employees in the economy are employed in the public sector, while the OECD average lies in the area of 20%. At the same time, c. 33% of total compensation of employees in the economy belongs to government employees (vs. a 22% OECD average). Compensation of civil servants in Greece was therefore relatively high. More importantly though, the country was facing one of the highest disparities between the number of public servants (as a % of the total workforce) and their compensation as a percentage of the total compensation. In other words, relatively few where being paid relatively high. To this extent, it should be noted that the average spending on public sector wages increased by 100% during the last decade, while the employment in the public sector climbed over 10%.

In addition, the structure of the social security system was not viable. Before the 2010 reform, the pension replacement rate in Greece was 96% (vs. 59% OECD average) implying that pensioners in Greece were essentially receiving as pension almost the entire 5 best-year average wage of their last decade as employees. This system resulted to pension payments accounting to c. 12% of GDP in 2009 (vs. 11% Eurozone average) and was projected to increase rapidly, leading to a collapse of the overall social security system.

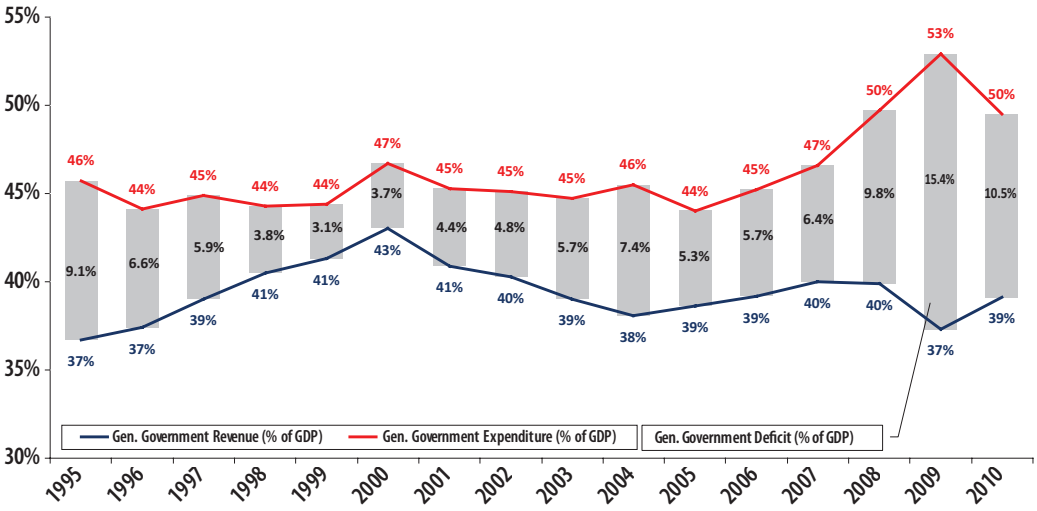
On the **revenue side**, the most important intrinsic characteristic of the Greek economy can be narrowed down to the problem of high tax evasion. The inefficiency of the tax collection mechanisms (regarding both direct and indirect taxation) and the inertia of public administration to tackle this problem resulted to public revenues consistently lagging behind budget targets, while being significantly lower than Eurozone average. For the period 1995-2009, general government revenue attributed to c. 39% of GDP on average in Greece (vs. 46% of GDP in EZ-17). Moreover, an OECD index measuring the efficiency of VAT collection mechanism[2] (2006) indicates that tax authorities in Greece collect almost 50% VAT revenues of what they could potentially have collected (vs. 70% efficiency rate of OECD average). Finally, the size of the "shadow" economy remains relatively high in Greece compared to other OECD

The most important intrinsic characteristic of the Greek economy can be narrowed down to the problem of high tax evasion.

[1] *Greece at a Glance, Policies for a Sustainable Recovery, OECD, March 2010*
[2] *Tax efficiency is calculated as the ratio of the effective (potential) revenue from value added taxes on private consumption and statutory rates.*

economies; based on recent published research it is estimated to be around 25% of GDP for 2008-2009, compared to 12% of GDP in OECD (unweighted average over 21 OECD countries)[3].

Figure 2.1: General government expenditure / revenue / balance (% of GDP)



Source: Ministry of Finance, State Budget 2011

Competition is hindered by various restrictions, regulations and barriers in Greece.

As a result of the aforementioned budget components, fiscal deficits widened, especially during 2007-2009. General government deficit increased from 6.4% of GDP in 2007 to 15.4% of GDP in 2009, while in the rest of the Eurozone the trend was also upward but much milder. Looking at historical data, it can easily be inferred that the Greek public administration is a deficit generating mechanism, with a tendency to overshoot expenditures and underestimate revenues (Figure 2.1).

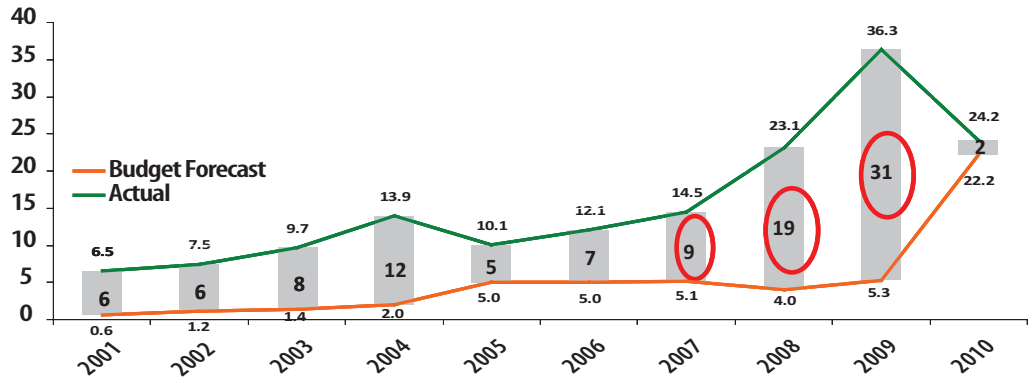
In addition to the above, and given the lack of efficient monitoring and control mechanisms for the achievement of objectives set in state budgets, the performance of Greek governments in meeting fiscal targets has been disappointing. The necessary fiscal adjustment measures taken by government authorities in order to narrow the fiscal gap could have been much lower, had there been a credible control mechanism of implementing and monitoring state budget. In fact, during the first year of the implementation of the fiscal adjustment program for Greece, which was followed by close monitoring of the objectives of the program, the deviation between budget estimates and actual data observed regarding the fiscal deficit significantly narrowed to only EUR 2bn (or 1.4% of GDP). This clearly indicates that strict monitoring of state budget implementation could result to a significant decline in fiscal deviations. (Figure 2.2)

Apart from the high fiscal deficits and chronic mismanagement of public finances, Greece also suffers from large structural losses in competitiveness. Competition is hindered by various restrictions, regulations and barriers in Greece. Due to the overregulated market framework and the numerous restrictions in the products / service markets, the labour market, entrepreneurship and investments, the average profit margin in the non-tradable goods & services sector is 15% higher than the relevant Eurozone margin, while in the labour market the margin is 10% higher versus the Eurozone average. In terms of relative unit labour cost, Greece has lost competitiveness following the trend of other European periphery countries.

[3] *Schneider, F.: The Size of the Shadow Economy in 21 OECD Countries Using MIMIC and Currency Demand Approach" (2009).*

More specifically, during the period 2000-2010, the unit labour cost in Greece relative to the rest of 35 industrial economies increased by 21%[4].

Figure 2.2: General Government Deficit (in EUR bn)

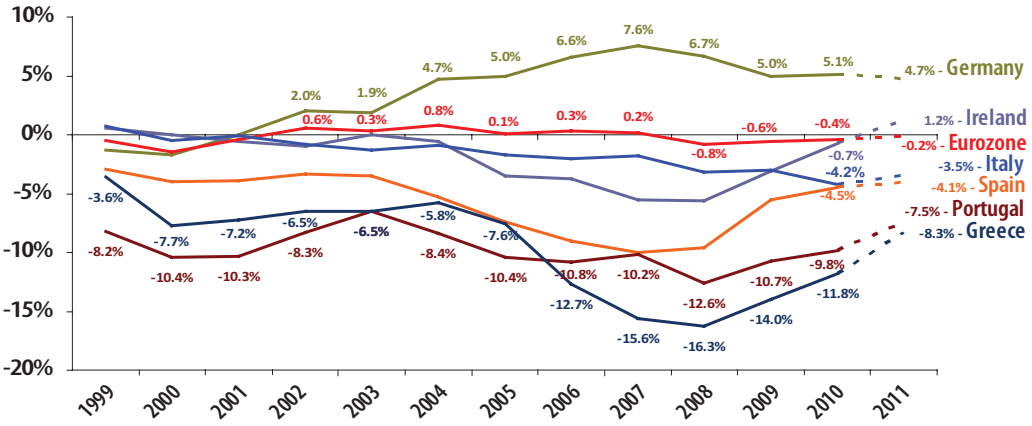


Source: Ministry of Finance, State Budget 2011

2.1.2 Loss of Structural Competitiveness

Another indicator of the loss of competitiveness is the performance of the Current Account Balance. For more than a decade, Greece has been experiencing deficit in its current account, essentially indicating deficits in its external trade balance (i.e. imports exceeding exports) and capital flows. Greece's Current Account Deficits (CAD) lie over 5% of GDP from 2000 onwards, while in 2006 reached 13% of GDP and climbed to 16.3% of GDP in 2008 (Figure 2.3).

Figure 2.3: Current Account Balance (% of GDP)



Source: Eurostat

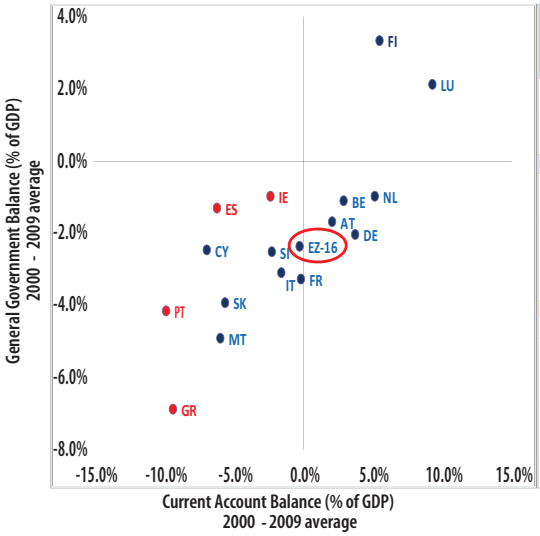
On the other hand it should be noted that looking into the data of other Eurozone countries, it can easily be inferred that almost all Southern European economies bore Current Account Deficits, while many countries of the north (such as Germany) enjoyed Current Account Surpluses. This evidence clearly shows a specific trend in the Eurozone, implying that the deficits of the south were funding the surpluses of the north, while the Eurozone as whole has a balanced current account.

[4] *It is however broadly in line with the performance of other countries in the European periphery (Ireland: 36%, Italy: 26%, Spain: 20%, Portugal: 13%, Eurozone-17: 28%)*

2.1.3 Poor achievements in the main competiveness drivers

The macroeconomic disparities among the Eurozone economies, along with the fiscal expansion that accelerated after the outburst of the global financial crisis have placed many European economies in the centre of investors' attention. Investors are now focusing on the structural imbalances and the leverage of sovereign economies. Greece and other European periphery economies face the problem of long-run twin deficits, implying both a mismanagement of public finances and losses of competitiveness (Figure 2.4). As a consequence of the deterioration of structural competitiveness, Greece ranks very low in various international competitiveness indices[5], effectively indicating the loss of credibility by international investors towards the country and their restrain from doing business in Greece.

Figure 2.4: Macroeconomic imbalances among the Eurozone economies



Country	Current Account Balance (% of GDP) 2000-2009 average	General Government Balance (% of GDP) 2000-2009 average
Luxembourg (LU)	9.3%	2.1%
Cyprus (CY)	-6.9%	-2.5%
Ireland (IE)	-2.3%	-1.0%
Greece (GR)	-9.3%	-6.9%
Portugal (PT)	-9.8%	-4.2%
Spain (ES)	-6.2%	-1.3%
Netherlands (NL)	5.2%	-1.0%
Italy (IT)	-1.5%	-3.1%
Malta (MT)	-5.9%	-4.9%
Eurozone-16	-0.2%	-2.4%
Austria (AT)	2.1%	-1.7%
France (FR)	-0.1%	-3.3%
Belgium (BE)	2.9%	-1.1%
Germany (DE)	3.8%	-2.1%
Finland (FI)	5.5%	3.3%
Slovakia (SK)	-5.6%	-3.9%
Slovenia (SI)	-2.2%	-2.5%

Source: Eurostat

The high growth rates of the 1995-2008 period could have supported the implementation of more contractual fiscal policies, instead of the expansionary policies that were actually implemented. But the main problem was the lack of intention in resolving some of the chronic structural weaknesses of the Greek economy. This inertia combined with the reduction of international liquidity due to the global financial crisis, exacerbated the problem of fiscal imbalances in the country, thus leading to the fiscal derailment of the period 2007-2009.

Hence, by 2009 Greece was a country in a structural fatigue with the crisis only highlighting its systemic weaknesses. A productive system with many micro and small firms and few large competitors with global presence inhibits efforts of internationalisation. At the same time this structure is preventing penetration of innovation and ICT in the domestic production system. Furthermore, too many barriers of entry exist in many product markets and distortions that do not allow firms and public sector to operate efficiently. The state itself is also too large and unable to support the private sector effectively.

[5] *IMD World Competitiveness Yearbook: 56th position in 2011 (out of 59 countries) - 37th position in 2004, World Economic Forum: 90th position in 2011- 2012 report (out of 142 countries) - 35th in 2004, Doing Business Report (World Bank): 100th position among 183 countries in Doing Business 2012 Report - 80th position in 2006*

In terms of innovation, Greece is characterised by a transfer of knowledge and innovations from abroad, exports of low value-added, R&D funding mainly from EU funds, poor cooperation between universities and firms, while most businesses focus solely on internal markets. Thus, the Greek productive system in a globalised environment is currently under pressure on two fronts: a) low cost global producers, but not necessarily unskilled or of low quality and b) "superior producers" with products / services of advanced quality with significant technological and productive capacities.

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As a result Greece is lagging behind compared to other developed countries in key structural and competitiveness indicators, as reflected in both the increasing current account deficit and the deterioration of the trade balance. The whole productive system of Greece is distortionary on the supply side: production is introverted, oriented towards domestic consumption rather than towards exports, which include goods and services of relatively low or average standard and technological intensity, with innovative goods and services accounting for a small ratio of the total and only a very limited number of branded Greek products in the world market. Furthermore, entrepreneurship in Greece faces numerous obstacles that hinder economic activity and affect its structural competitiveness. Some of them are presented next:

1. Time consuming and costly procedures for starting a business

While there has been an improvement, the current procedures and regulations governing the initiation of a new company are still discouraging new entrepreneurs from going into business. According to World Bank's ***Doing Business 2012*** report the number of procedures to start a business in Greece today is 10 (15 days in 2011) and it takes 10 days to complete the whole process (19 days in 2011). These changes represent significant improvement compared to the previous period, despite the fact that OECD average procedures are 5. However, still the cost of these procedures (as % of income per capita) is very high (20.1% compared to an OECD average of 4.7%) while the paid-in Minimum Capital amounts to 22.8 % of income per capita (compared to an OECD average of 14.1%)[6]. Furthermore, planning permits are hard to get due to the restrictions on land use, while environmental impact approvals are also suffering from significant delays. The latter is caused mainly by a) the number of agencies jointly responsible; b) the lack of specialised staff in the public administration departments and c) the number of visits which the interested party needs to make in order to push his dossier forward[7] .

Procedures and regulations governing the initiation of a new company are still discouraging new entrepreneurs from going into business.

2. Labour market rigidities

Labour markets in Greece are exposed to various rigidities. Limited flexibility in terms of part time employment, binding and inflexible collective agreement framework and low employment participation of youth and female, are some of the problems observed in Greece. Furthermore, the bureaucracy involved in recruiting / firing people is also disappointingly extensive. There is a need to repeatedly give government departments the same information (i.e. the need to report new recruitments) with complicated staff recruitment procedures[8] , when simple database IT applications and connectivity could boost effectiveness.

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[6] *See for details, Doing Business 2012 report, www.doingbusiness.org .*

[7] *New legislation for the environmental permits is also underway, which presumably will improve effectiveness.*

[8] *The National Insurance Fund requires companies to keep a special register of newly recruited staff. This means that the following procedure has to be applied for every new employee: 1.report recruitment to the Manpower Employment Organisation within 8 days; 2. enter new employees in the special register of newly recruited staff, as soon as they have been recruited and before they start work; 3. file a list of employees with the Labour Inspectorate for each new employee within 15 days*

3. Difficulties in exporting

The procedures for bidding in public procurement tenders are complicated.

In cross-border transportation, the cost of clearing goods through customs can be as much as 3-5% of the value of the goods, making imported goods expensive. Also, the procedures for exporting goods from Greece are time-consuming and costly. According to the 2012 World Bank ***Doing Business*** report, it takes 20 days, five documents and 1,153 USD to export a consignment from Greece and, as a result, Greece ranks 84th (out of 183 countries) in the world in this category.

4. Complicated public procurement procedures

The procedures for bidding in public procurement tenders are complicated. The relative legislative and regulatory framework is fragmented and includes excessive demands in terms of supporting documentation. This discourages bidding, due to high cost, and, because of the few bidders, there is little real competition in public procurement auctions. Furthermore, bureaucracy is vast as numerous proofs have to be resubmitted for every competition (i.e. proof of registration of business, proof of no outstanding insurance contributions, proof that the business is not bankrupt, etc.), while e-procurement solutions are hardly used by the Public Administration.

Direct and indirect taxation change almost each year, thus not allowing for long term business planning.

At the same time, there is a lack of technical specifications from the single procurement programme agencies and, as a result, a lack of transparency in the terms of competitions, giving rise to numerous objections and appeals by bidders. As far as competition procedures are concerned, there is a lack of electronic support and this reduces competitiveness and results in a small number of bidders, higher costs and longer procedures.

5. Complex and unstable tax regulation

The Tax regulation is complex, allowing for subjective interpretation of its application. This leads to corruption as taxpayers often resort to bribery in their dealings with the tax authorities. Furthermore, tax legislation needs to clarify which company expenses are tax-deductible. The confusion surrounding tax-deductible expenses gives rise to accounting differences during tax audits and the assessment of tax surcharges. In addition, frequent changes to what is already a complicated tax system discourage young entrepreneurs and deter foreign investors and strong Greek "players" in the business world from making long-term plans and investments. Direct and indirect taxation change almost each year, new tax rates are implemented thus not allowing for a long term business planning.

The Greek economy relies mostly on companies that successfully incorporate technology and innovation produced elsewhere, rather than opting for primary R&D and endogenous production of innovations.

6. Poor research / innovation

According to the ***Innovation Union Scoreboard 2010***, Greece belongs to the group of moderate innovators (below average performance). R&D expenditures in Greece stand at a very low level - only 0.58% of GDP, below 1/3 of the European average, while the private sector accounts for less than 30% of that amount. Most of the funding comes from European funds while financing innovation through venture capital or even the usual banking sector schemes is scarce. Some innovation input indicators seem positive (high % of tertiary education graduates, doctoral graduates, public funding for R&D, etc), but the output indicators are low (licenses, patent etc.). The Greek economy relies mostly on companies that successfully incorporate technology and innovation produced elsewhere, rather than opting for primary R&D and endogenous production of innovations.

Greek firms appear to only use embedded innovation in equipment developed abroad. Some effort for non-R&D innovation is evident, but the majority of Greek firms are experiencing difficulties in meeting the requirements of the international competitive environment. That is why, with few exceptions, they focus primarily on domestic demand.

The type of entrepreneurship that has emerged is mainly oriented towards end consumer products and not generation of knowledge/ innovation.

Links between academia and industry are weak, therefore not leading to incentives for the commercial exploitation of innovations. Transferring research results - usually to industry/ production - involves high investment costs and harbours a major risk of failure. One reason could be that the institutional framework for intellectual property needs to be modernised.

7. Old fashioned institutional set up in education and ambiguous attitude towards entrepreneurship

Primary and secondary education system in Greece does not promote creativity. The education system is memory-based and does not encourage critical thinking[9]. Instead it promotes the pursuit of grades and may therefore hinder the development of talents. This feature of the education system does not allow pupils to cultivate what are considered as the fundamental aspects of entrepreneurship (i.e. creativity, out-of-the-box thinking, risk taking etc In higher education, one can find a limited number of courses on entrepreneurship and most of them focus on specific and "narrow" aspects, such as starting up and running a business. Furthermore, life-long learning practices have only recently become part of the Government agenda. As a result, Greek businesses are inflexible when it comes to adapting to market changes and human capital's qualifications gradually become out-dated compared with those of their European counterparts.

In terms of entrepreneurship per se, a "quick and easy profit" culture has emerged through the years. Overtime, the "self-made" quickly evolving businessman was promoted as the ultimate model of success. This kind of entrepreneurship was mainly oriented towards end consumer products and not generation of knowledge/innovation. Many new ventures were supported under Community funding on a quantity and not a quality base, while taking advantage of the partisan/corporative nature of public administration and the frequent lack of meritocracy. On the other hand, this "quick success" culture subsequently stigmatises the entrepreneur that fails: fear of failure is prevalent and constitutes a significant obstacle in initiating a new entrepreneurial venture.

Fear of failure is prevalent and constitutes a significant obstacle in initiating a new venture.

Furthermore, the "demonisation" of entrepreneurship (profit) and the limited promotion of successful businesspeople (success stories) also distort the entrepreneurial culture. The coexistence of corruption at all levels of society and economy and the intense presence of the State facilitates the establishment of nepotism and "easy wealth". The latter, in combination to specific historical characteristics of Greece, have nurtured a distorted image of what entrepreneurship really is, collectively treating entrepreneurs as *a priori* speculators and holding them responsible for social/economic problems.

These characteristics can be identified as local, cultural features that play a significant role in shaping people's opinion and therefore, attitude. Recognising the importance of mentality on the development of entrepreneurship, the ***Global Entrepreneurship Monitor*** (GEM)[10] mo-

[9] *OECD, Strong Performers and Successful Reformers in Education, Education Policy Advice for Greece, 2011*

[10] *Since 1997, the GEM research program has sought to address the complex phenomenon of entrepreneurship by collecting relevant harmonised data on an annual basis. The Global Entrepreneurship Monitor (GEM) is a not-for-profit academic research consortium that has as its goal making high quality information on global entrepreneurial activity readily available to as wide an audience as possible. GEM is the largest single study of entrepreneurial activity in the world. Initiated in 1999 with 10 countries, GEM 2010 conducted research in 59 economies all over the world. Greece has been participating in GEM through IOBE/FEIR for the past eight years. More information and reports: http://www.gemconsortium.org/*

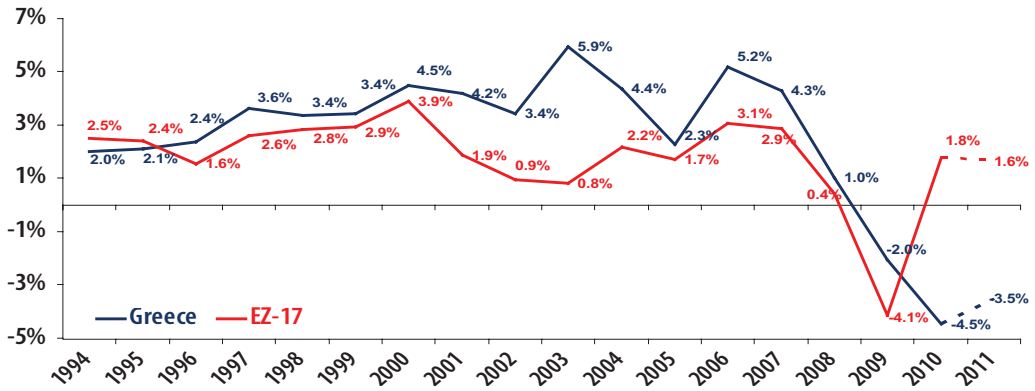
nitors relevant local perceptions, in order to assess the characteristics of entrepreneurship in each country. As far as Greece is concerned, the country has been the global "champion" regarding the fear of failure, as a determining factor of launching a start-up (more than half of early-stage entrepreneurs admit to be hindered by such a fear, 1st in rank among GEM countries). This "non-forgiving failure" culture may stem from the minor promotion of successful business stories from the media (34.5% the lowest percentage among GEM countries).

2.1.4 Distortionary Growth Model

The excessive dependence on domestic consumption was largely fuelled by credit expansion and low interest rates.

The fundamental imbalance of the Greek economic growth model is clearly depicted on the structure of the GDP (from the demand side). While it is true that the average growth rate achieved by Greece in the last decade exceeded the Eurozone average by c. 1.3% on average (Figure 2.5), the growth dynamics were mainly consumption driven. In a small economy like Greece, this is not a sustainable pattern for a long-run period, without the necessary adjustments taken on the supply side of the economy. Data for the 2000-2010 indicate that Greece on average was consuming 91% of GDP (Table 2.1), which is the largest share observed in the Eurozone[11] . The excessive dependence on domestic consumption was largely fuelled by credit expansion and low interest rates. In addition, the Greek economy had the lowest share of exports in its GDP as compared to other Eurozone members, exporting only 22% of GDP on average during 2000 -2010.

Figure 2.5: Real GDP (annual level | year-on-year % change)



These parameters constitute the structural and chronic weaknesses of the Greek economy that effectively led to the economic crisis. It is these factors, along with the continuous revisions of the statistical data that affected the credibility of Greek policy makers towards financial market participants, that came to the policy frontline in 2010. But other exogenous factors have also affected the current escalation of problems. The global international financial crisis after the collapse of Lehman Brothers (autumn 2008) changed the reaction of investors towards the prospects of the Greek economy. Investors gradually changed the way of accounting for risk premia and started focusing on the sustainability of public finances of sovereign states. Consequently, a process of re-evaluating country risk commenced, with Greece coming on the spotlight of international investment community due to the reasons described above.

[11] *70% of total consumption was attributed to private consumption and the rest 20% was public consumption*

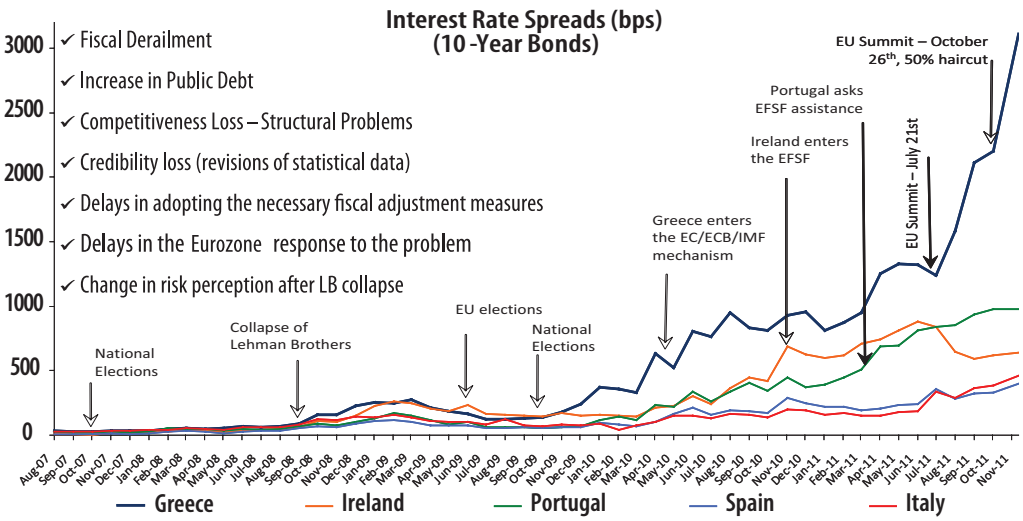
Table 2.1: EZ-17 GDP Structure (Demand side) (2000-2010 avg)

	Final Consumption (% of GDV)	Investements (% of GDV)	Exports (% of GDV)	Imports (% of GDV)
Eurozone - 17	77.8%	20.8%	38.3%	36.8%
Belgium	75.0%	21.3%	79.1%	75.4%
Germany	77.3%	18%	40.5%	35.9%
Esthonia	73.4%	30.5%	73.6%	77.9%
Iraland	64.2%	22.4%	88.9%	75.2%
Greece	90.7%	20.8%	22.1%	33.6%
Spain	76.3%	27.5%	26.6%	30.4%
France	80.5%	19.9%	26.6%	27.0%
Italy	79.2%	20.8%	26.5%	26.5%
Cyprus	83.9%	19.5%	47.9%	51.3%
Luxembourg	52.2%	20.9%	159.2%	132.3%
Malta	84.7%	18.6%	83.5%	86.8%
Netherlands	72.9%	19.9%	70.2%	62.9%
Austria	73.1%	22.8%	52.7%	48.5%
Portugal	84.9%	23.8%	29.4%	38.1%
Slovenia	74.0%	26.8%	60.3%	61.1%
Slovakia	76.9%	26.3%	77.0%	80.3%
Finland	73.8%	20.5%	41.9%	36.1%
Sweden	74.8%	18.2%	48.2%	41.2%
United Kingdom	86.0%	16.7%	27.3%	29.9%

Source: Eurostat

A clear indication of the shift in attitudes of financial markets participants towards Greece is the evolution of borrowing costs as measured by the spreads of Greek Government Bonds and the German Bunds (Figure 2.6).

Figure 2.6: Spreads of government bonds vs. German Bunds



Source: Financial Times (Last updated: July 13, 2011)

Gradually, the additive impact of all the above mentioned factors marked a continuous upward trend, skyrocketing spreads above 800bps, thus making the cost of funding public debt unsustainable and forcing the government to enter the newly (at that point) established EU/IMF/ECB support mechanism in May 2010.

2.2 Current standings: economic activity under the Economic Adjustment Program

Since May 2010, Greece is implementing a very ambitious fiscal adjustment program, aimed at reducing the budget deficit to below the 3% of GDP threshold by 2014. The main characteristic of the program is that it is front loaded, meaning that the main bulk of the fiscal adjustment is scheduled to occur during the first two years. Furthermore, the program addresses all economic imbalances of the Greek economy, including reforms in the fiscal sector, the social security system, the deregulation in goods/services/labour markets and the stability of the financial sector.

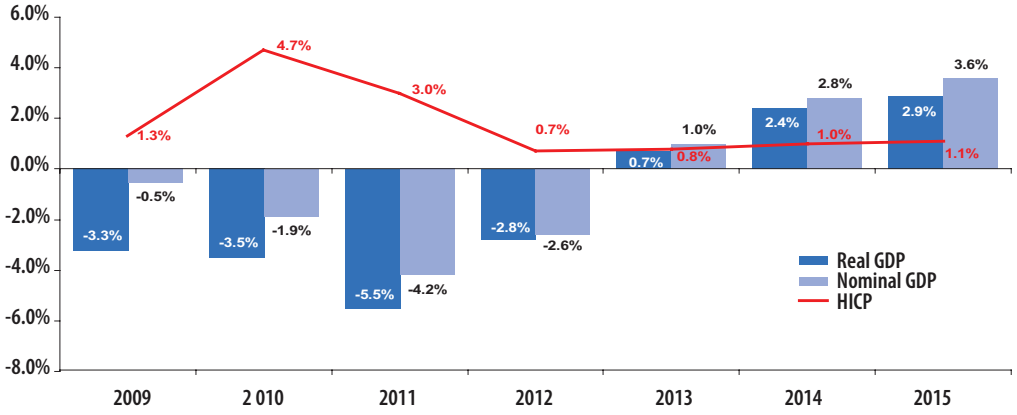
The financing of the economic adjustment program for Greece consists of bilateral loans between Greece and the Eurozone member states, as well as funds from the IMF, in order for the country to be able to finance its obligations to bondholders and service its debt, since financial markets effectively excluded the participation of Greece from long-term bond auctions. The main assumptions of the baseline macroeconomic scenario of the Economic Adjustment Program for Greece are presented in Table 2.2 and Figure 2.7. The Greek economy is projected to contract by c. 5.5% in 2011, following 2 years of recession, while in 2012 the decrease in GDP is estimated to subside, only to return to marginally positive territory in 2013. It is important to note that nominal growth rate is expected to lie above 2% from 2014 onwards, implying that the inflation rate will hover around 1%. The growth driver for the economy's expansion in the upcoming period will rely on exports, which are estimated to grow at an average annual rate of 6.4% in the period 2011-2015. Investment activity is also forecasted to positively contribute to the economic rebound, while consumption growth is estimated to lie at significantly low levels (as compared to previous years).

Table 2.2: Baseline Macroeconomic Scenario

% y-o-y change	2009	2010	2011	2012	2013	2014	2015
GDP	-3.3	-3.5	-5.5	-2.8	0.7	2.4	2.9
Private Consumption	-1.3	-3.6	-6.2	-4.3	-0.9	0.6	0.7
Public Consumption	4.8	-7.2	-8.5	-9.0	-7.0	-4.0	-1.0
Gross Fixed Capital Formation	-15.2	-15.0	-15.9	-3.6	6.3	8.6	8.4
Imports of goods & services	-20.2	-7.2	-6.2	-3.2	0.6	2.7	3.0
Exports of goods & services	-19.5	4.2	4.8	6.5	6.5	7.0	7.0
HICP (%)	1.3	4.7	3.0	0.7	0.8	1.0	1.1
Unemployment Rate (%)	8.9	11.7	15.7	17.5	17.5	16.9	16.3
Current Account Balance (% of GDP)	-11.1	-12.2	-9.9	-7.8	-6.8	-5.8	-4.5
Primary Balance (% of GDP)	-10.5	-5.0	-1.8 to -2.3	0.0	2.4	5.0	
General Government Budget Balance (% of GDP)	-15.8	-10.6	-8.5 to -9.0	-7.0	-5.3	-2.9	-1.1
General Government Debt (% of GDP)	129.0	144.9	162.8	181.4	181.3	173.5	

Sources: The Economic Adjustment Programme for Greece – 5th Review (Draft) , Directorate-General for Economic and Financial Affairs, European Commission, Occasional Papers 82, October 2011 Medium-Term Fiscal Strategy Framework 2012-2015, Ministry of Finance, June 2011. Note that the debt projections do not take into consideration the latest EU decisions regarding the sustainability of Geek public debt and the application of a 50% haircut.

Figure 2.7: Growth Rate (annual percentage change)



Sources: The Economic Adjustment Programme for Greece – 5th Review (Draft) , Directorate-General for Economic and Fi-nancial Affairs, European Commission, Occasional Papers 82, October 2011 Medium-Term Fiscal Strategy Framework 2012-2015, Ministry of Finance, June 2011.

A boost in export oriented economic activity and implementation of structural reforms, as well as effective and rigorous deregulation of product / services / labour markets will contribute to the enhancement of the economy's competitiveness going forward, with the deficit in the Current Account Balance gradually decreasing to c. 5% of GDP by 2015. With regards to the fiscal consolidation effort, the key parameter is the creation of primary surpluses, which will enable the economic authorities to start repaying interest expenditures from own public resources and essentially signal the government's capability in servicing its public debt.

A boost in export oriented economic activity and implementation of structural reforms, as well as effective and rigorous deregulation of product / services / labour markets will contribute to the enhancement of the economy's competitiveness going forward.

2.3 Growth potential – Opportunities for the ICT sector

The adoption of the growth-enhancing structural reforms will facilitate the return of the Greek economy to potential growth by improving the supply-side conditions of the economy and the increasing internal competition and external competitiveness, also contributing to the credibility of the consolidation process. A concise outlook of the potential gains from market and institutional reforms is provided in Table 2.4.

Table 2.4: Potential gains from market & institutional reforms

Reforms	Gains
Approaching the EU average administrative burden.	2% - 3% of GDP
De-regulating "closed" professions.	2% of GDP
10% reduction in the costs of business services achieved through the liberalisation of regulated professions.	0.5% reduction in overall prices
Enhancing market competition by eliminating restrictions.	2% of GDP
Business environment reforms	Increase by 30 places in the World Bank's Doing Business Index (from 100th place in 2012 to 70th).
Improvement of Greece's education performance by 45 points(3.5%) in OECD's PISA tables	1% of GDP

2.3.1 Opportunities for the ICT sector

Given these macroeconomic developments, Greece urgently needs a new growth model, in which exports and private investment will fuel economic development.

Given these macroeconomic developments, Greece urgently needs a new growth model, in which exports and private investment will fuel economic development. Improvement of the competitiveness of the Greek products and services is a crucial success factor for this transition. This implies that the Greek entrepreneurs should focus on cost-cutting activities and increasing the value added of their products. The State should also minimise administrative burden imposed on the economy. Investing on new technology, promoting the ICT sector, and ultimately converging to the European technological frontier, could significantly contribute to the rebalancing of the Greek economy, as technological improvement boosts competitiveness and incorporates large economies of scale. Furthermore, modernising the public administration through the promotion of e-governance and IT systems could contribute substantially to the overall fiscal adjustment effort, by reducing bureaucracy, administrative costs and increasing effectiveness.

According to theoretical research[12], the contribution of the ICT sector to economic growth is mainly derived through these three sources:

1) the value-added of production activity in related sectors,
2) the utilisation of ICT services as resources in the production activity of other sectors in the economy,
3) the multiplier effect from the impact of ICT on the total factor productivity (multifactor productivity).

Especially with regards to the impact of ICT sector on labour productivity, the benefits stem from:

1) the changes in the level of ICT services used by a labour unit,
2) the effect of using ICT services on the rest of capital resources,
3) the improvement in the quality of labour outcome due to the use of ICT services,
4) the combined outcome of the above factors on total productivity.

As far as the public sector is concerned, statistical data show that the overall productivity and the effectiveness of state entities and organisations substantially improved due to the introduction of ICT services.

On a business level, empirical research has indicated that the existence of increasing returns in the use of ICT services[13], while investing in ICT has also resulted to a significant containment in cost growth by 0.7 percentage points on an annual level[14] .

As far as the public sector is concerned, statistical data[15] show that the overall productivity and the effectiveness of state entities and organisations substantially improved due to the introduction of ICT services. Furthermore, the promotion of ICT services in the organisational structure of the public sector services has significant externalities in the private sector of the economy, mainly reflected in the time duration and cost containment required to perform a given transaction. These private sector externalities are attributed to the expansion of e-government applications, the drastic decline of bureaucratic procedures and the reduction of associated corruption levels.

In particular, the reduction of the public deficit should come primarily from thoroughly designed policies, which constitute specialised interventions to specific problems, rather than

[12] *Jalava, J., Pohjola, M, (2005) - "ICT as a Source of Output and Productivity Growth in Finland", Helsinki Center of Economic Research, Discussion Paper No. 52*
[13] *Hempell T., (2005) - "What's Spurious? What's Real? Measuring the Productivity Impacts of ICT at the Firm Level", Empirical Economics, 30(2), pp. 427-64 . Hempell estimates a product elasticity with regards to the ICT capital investment close to 0.06, implying that every monetary unit spent on ICT investment returns 1.96 units.*
[14] *Crepon, B. and Heckel, T., (2002) – "Computerization in France: An Evaluation based on Individual Company Data", Review of Income and Wealth, no 1, pp. 1-22*
[15] *Telstra, (2009) – "The Government Productivity Report" – Empirical research for the Australian public sector.*

across-the-board actions[16]. The fundamental weaknesses of public administration result to revenue losses waste in government spending, inefficient allocation of resources, as well as malfunctioning of the private sector (due to extensive bureaucracy and high administrative costs). Some indicative examples of such problems are the following:

In the **health sector**:

- Widespread financial mismanagement of healthcare institutions (e.g. procurement of health equipment, pharmaceuticals).
- Low efficiency indicators of healthcare institutions (i.e. high operating costs in relation to the level of services offered).

In the **public finances sector** and the **tax collection mechanism** the inability to:

- Tackle the problems of tax evasion and tax avoidance.
- Incorporate "shadow" economic activity.
- Collect receivables.
- Control the operating cost of government entities.
- Timely monitor / control the state budget execution, detect any divergence from annual targets and proceed to corrective / adjustment measures.

The benefits from promoting the adoption of web based technologies in the public sector lie on providing effective solutions to the weaknesses of public administration.

In the **social security sector** the inability to:

- Address the problem of social security contribution evasion.
- Tackle the problem illegal labour employment.
- Address the problem of excessive drug prescriptions.

The use of modern technological tools and methodologies, the utilisation of IT systems and the potential of e-government capabilities can significantly contribute to addressing the structural weaknesses of public sector administration, as the ICT applications incorporate some essential characteristics targeted at increasing efficiency, such as: i) the ability to determine and measure the various dimensions of each issue, ii) the ability to perform quantitative analysis and assessment of alternative solutions, iii) the ability to supervise and monitor the implementation of actions taken, iv) the utilisation of tools that guarantee long-run effectiveness.

The benefits from promoting the adoption of web based technologies in the public sector (such as e-government), lie on providing effective solutions to the aforementioned weaknesses of public administration, ensuring a high return-to-cost ratio and being widely accepted by all the parties involved (businesses, public sector, society). The major benefits of adopting web based government applications are the following:

- Effective use of IT systems in crucial sectors of public administration, aiming at increasing efficiency (e.g. tax collection mechanism), lowering operating cost and limiting mismanagement of resources (e.g. social security, healthcare).
- Boost of labour productivity and optimization of Human Resource management in the public sector.
- Mobilisation of the private sector in order to implement and technically support such solutions, thus revamping relevant industry sectors and contributing to the

[16] *During 2010, the measures adopted to meet the fiscal targets focused on increasing taxation (mainly indirect), reducing labour cost (wage cuts) in the public sector and curtailing the Public Investment Program. The across-the-board actions may have an immediate fiscal effect and present a satisfactory performance in the short-run, but do not address the long-term structural problems of the Greek economy, which is characterised by low competitiveness*

reverse of the trends of the overall economic activity.

- The effective implementation of e-government structural reforms will also gain public opinion support, as they will contribute to the modernisation of public administration, boost transparency and improve the services provided by the state.

Some indicative examples of e-government projects that could enhance the overall effectiveness of the public sector administration are the following[17] :

- **Supervision and settlement of social security expenditures (e-prescription)**: This initiative refers to the centralised supervision and settlement of all spending in the healthcare sector (drugs, hospitalisation and diagnostic tests) that is funded by the public Social Security Funds. The proposed business model to be implemented will cover all the procedures, from the initial registration and the execution of prescriptions, until the repayment of suppliers of healthcare consumables and the calculation of the rebates to pharmaceutical suppliers, envisaged in the current legislative framework. E-health cloud applications can support this reform. The total potential spending to be monitored with this application exceeds 7 billion EUR per annum, while the savings from the implementation of such a system is roughly estimated to range between 700 million EUR and 1billion EUR per annum, without needing any form of prior public investment spending.
- **Reform of the accounting and financial management system in public hospitals**: This initiative aims at enhancing financial supervision and cut of spending by setting specific operational targets. The proposed solution includes the transition to cloud applications, specialised technical support (auditing, accounting) and the actions required for collecting, processing, recording, analysing and assessing financial data of hospitals. The technological reform of the accounting and financial management of public hospitals is estimated to save at least 5% of relevant public spending, excluding the benefits from combating corruption and mismanagement of resources.
- **Implementation of an integrated healthcare electronic procurement model**: This initiative concerns the recording of procurement needs, the determination of aggregate demand, the execution of procurement processes, the combination of alternative procurement methods, the physical and financial processing of orders, etc. Centralised procurement management, implementation of methods aiming at enhancing transparency and competition, utilisation of economies of scale in managing inventories (logistics techniques) and the use of smart risk management / business intelligence system to supervise this process are estimated to save spending by over 15% - 20% of current levels.
- **Adoption of e-invoicing and e-payment applications in the transactions with the public administration**: This initiative refers to the implementation of an across-the-board action in order to gradually promote the use of:
  - e-invoicing in the transactions of public institutions with suppliers of goods and services,
  - e-payment for the above mentioned transactions,
  - e-payment for fees and other obligations by individuals and businesses to the State.

Such an initiative could provide substantial direct and indirect savings from: i) eliminating paper invoices, ii) limiting errors, iii) reducing the processing and recording costs, iv) re-strict-

[17] *These proposals were drafted by a special in-house IOBE workshop*

ing the administrative burden in the transactions of individuals and business with the State. Additionally, the proposed initiative will contribute to the:

- enhancement of transparency,
- promotion of relevant culture of "doing business" in the private sector, thus creating significant prospects for the affiliated service branches,
- improvement of tax supervision and reduction of "shadow" economy.

The quantitative benefits, in terms of spending savings, from the reduction of administrative cost are estimated at tens of millions of euros per annum.

- **Electronic supervision of spending of all pubic sector entities (state budget execution).**
- **Implementation of a unified wage and remuneration system in the wider public sector and electronic settlement of the wage payments.**
- **Electronic registry of all public property.**
- **Electronic system to cross-check and examine the sourcing of individuals' assets and funds, in order to trace all taxable assets.**
- **Electronic system to combat social security contribution evasion (business intelligence system that combines data from social security and tax systems).**

In all of the above, the new technological paradigm of cloud applications can reduce both the initial capital investment requirements, but also the operating costs, after the transition. With fiscal consolidation process underway and only limited public financial resources, implementing these reforms is facilitated by using cloud application rather than the traditional IT legacy.

The new technological paradigm of cloud applications can reduce both the initial capital investment requirements, but also the operating costs.

2.4 Conclusions

Under the current macroeconomic circumstances, the Greek economy should quickly adjust to the new growth model, focused on boosting investment and enhancing export activity. Apart from the fiscal consolidation process currently underway, the key parameter for a new cycle of sustainable growth is improvement of the international competitiveness of the Greek products and services. This process demands enhancement of the adoption capabilities of the Greek economy to the broader technological, economic, social and geopolitical changes. It involves improving its ability to produce, acquire and use knowledge. Competitiveness in developed economies is not only about the relative costs and prices, but is also dependent on the technological content, diversification and quality of the products and services.

Greece should aim at knowledge-based innovative entrepreneurship. To this extent, investment in technology diffusion in all aspects of the production process, and especially in the public sector activity, could significantly strengthen competition.

Greece should aim at knowledge-based innovative entrepreneurship. To this extent, investment in technology diffusion in all aspects of the production process, and especially in the public sector activity, could significantly strengthen competition, increase the quality of offered services, boost exports and narrow the economy's long-run competitiveness deficits.

It should be noted that initial investments on ICT systems do not have immediate, short-run returns, as a period of operational adjustment is required in order for the systems to be fully effective. Therefore, the promotion of ICT services will rather have a medium / long – term impact on the economy. Nevertheless, historical experience shows that other economies that have also faced severe fiscal crises and serious competitiveness problems in the past, have opted to invest on technological improvement and address the structural imbalances of the economy (e.g. Scandinavian countries, Israel).

Another indication of the importance of investing in the ICT sector as a deterministic factor affecting the overall competitiveness of the economy, is the fact that relevant metrics are included in the composite indices evaluating the economy's structural competitiveness, as these benchmarks are measured by international organisations, such as the World Economic Forum (WEF). Greece, in the WEF's ***Global Competitiveness Report 2011- 2012***, ranks 47th out of 142 countries in the "technological readiness" index[18] (improving its 2009 position of 71st place among 133 countries, due to the initiatives taken by the government to promote e-government applications), thus indicating that there is still room for improvement in order to reach the average of innovation-driven economies and the European standards.

[18] *WEF- 'The Global Competitiveness Report 2011-2012'. According to the WEF, the technological readiness pillar measures the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with specific emphasis on its capacity to fully leverage ICTs in daily activities and production processes for increased efficiency and competitiveness. The aggregate index is consists of the following sub-indices: 'Availability of latest technologies', 'Firm-level technology absorption', 'Laws relating to ICT', 'FDI and technology transfer', 'Mobile telephone subscriptions per 100 population', 'Internet users per 100 population', 'Broadband Internet subscribers per 100 persons', 'Personal com-puters per 100 persons.*

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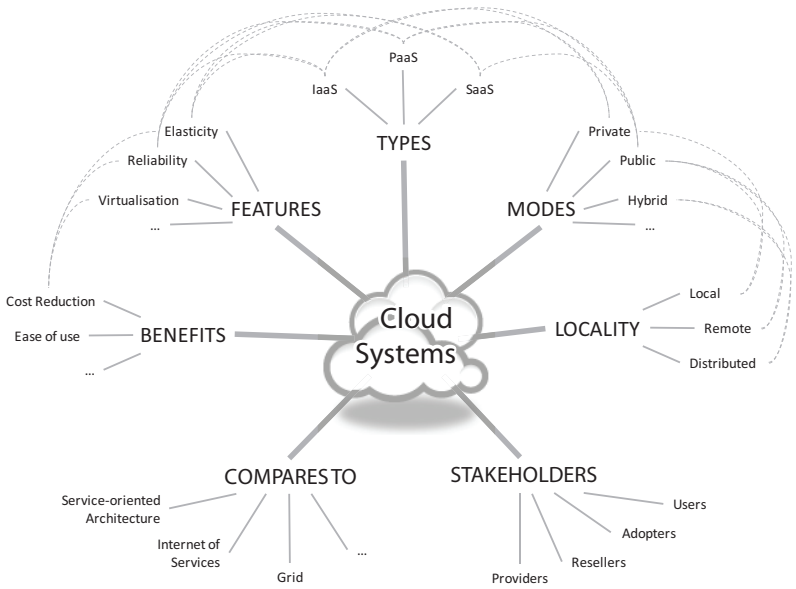
3 | Cloud Computing and the Local ICT Ecosystem

3.1 The new paradigm of Cloud computing

3.1.1 Introduction

Cloud computing can be defined as a computing in which dynamically scalable and often virtualised resources are provided as a service over the Internet. Cloud computing has become a significant technology trend, and many experts expect that it will reshape information technology (IT) processes and the IT marketplace. With cloud computing technology, users can select among a variety of devices, including PCs, laptops, smartphones, and PDAs in order to access programs, storage, and application-development platforms over the Internet, via services offered by cloud computing providers. Some of the advantages of cloud computing technology include cost savings, high availability, and easy scalability, along with more effective peak management.

Figure 3.1: View on the aspects forming a cloud system



Source: Expert Group Report: The future of cloud computing

Cloud computing has become a significant technology trend, and many experts expect that it will reshape information technology (IT) processes and marketplace.

In its broadest form, we can define a "cloud" as an elastic execution environment of resources involving multiple stakeholders and providing a metered service at multiple granularities for a specified level of quality (of service). Cloud Computing results from the convergence of Grid Computing, Utility Computing and Software-as-a-service (SaaS), and essentially represents the increasing trend towards the external deployment of IT resources, such as computational power, storage or business applications, and obtaining them as services. It has the potential to disruptively change the X-as-a-Service products and markets.

3.1.2 Technologies

Cloud computing takes the technology, services and applications that are similar to the Internet and turns them into a self-service utility. The use of the word "cloud" makes reference to two essential concepts:

- ***Abstraction***: Cloud computing abstracts the details of system implementation from users and developers. Applications run on physical systems that aren't specified, data is stored in locations that are unknown, administration of systems is outsourced to others, and access by users is ubiquitous.
- ***Virtualisation***: Cloud computing virtualises systems by pooling and sharing resources. Systems and storage can be provisioned as needed from a centralised infrastructure, costs are assessed on a pay-as-you-go basis, multi-tenancy can be achieved, and resources are scalable seamless to the function of the applications.

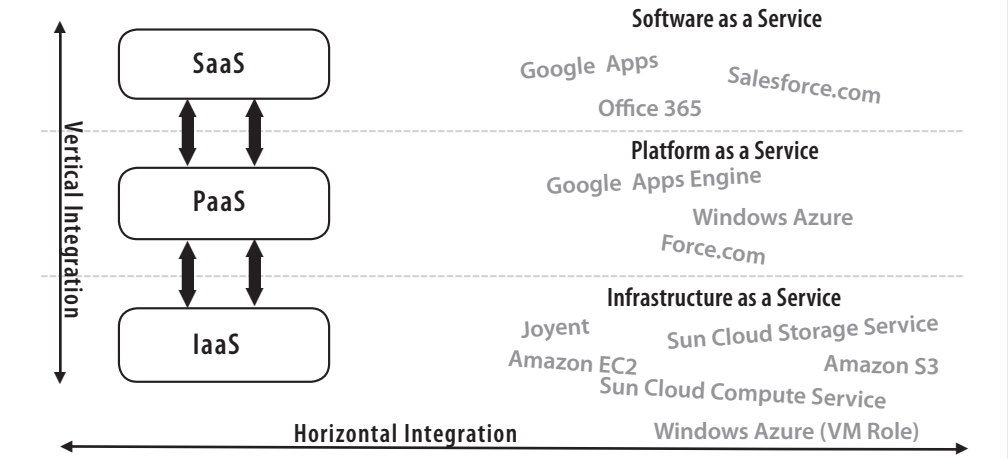
The Three Layers of Cloud Computing

The usual classification of cloud computing technologies includes three basic categories or layers (Figure 3.2). These layers support each other, and the relationships between them (and the way each of the layers operates) remain relatively stable. These three layers are:

1. Hardware virtualisation
2. Data storage and database management
3. Applications and application development environments

Hardware Virtualisation refers to the abstraction of physical computer resources so that many different computers or application servers appear to be available to run different application systems even though there may be a much smaller number of physical servers in the environment. The term virtual machine (VM) refers to a software implementation of a computer or application server that executes programs like a real physical machine, but that server is tapping the resources across a pool of virtualised servers in order to maximise efficiency. As a result, hardware virtualisation enables firms to optimise the use of physical computer resources and improve system administration. In the cloud computing world, this layer is also referred to as Infrastructure-as-a-service (IaaS). The most famous examples are Amazon S3, SQL Azure, Amazon EC2, Zimory, Elastic hosts.

Figure 3.2: The three layers of cloud computing



Source: Katerina Stanoevska-Slabeva, Thomas Wozniak, Santi Ristol, Grid and Cloud computing, A business perspective on technology and applications

Platform Virtualisation refers to the abstraction of the Platform in addition to the Hardware. In these cases, a series of Platform-related tasks are handled automatically, like patching of the system to the latest update, or load-balancing the web requests to two or more VMs with the same application hosted, or detecting a non-functioning VM & failing-over to brand new VM with a fresh installation of the application. This Platform abstraction provides the benefit of elevating the application developer from the need to handle any IT-related issues, and focus his/her complete attention on software development and data manipulation. PaaS typically offers application services (building blocks for application creation) such as hosting, team collaboration, web service integration and marshalling, database integration, security, scalability, storage, persistence, state management, application versioning and application instrumentation. PaaS also exposes Application Programming Interfaces (APIs) to control the behaviour of a server hosting engine which executes and replicates the execution according to user requests (e.g. access rate).

Applications and application development environments can leverage hardware virtualisation and data storage and database management capabilities in a cloud computing environment. Application systems to support different business operations can be hosted on virtual machines that are scaled up or scaled down hour by hour and as needed to meet changing business user demands. In this environment, new copies of a given application system can be created instantly and put into operation as needed. In cloud computing, this layer is referred to as Software-as-a-service (SaaS). SaaS is software that is owned, delivered and managed remotely by one or more providers and that is offered in a pay-per-use manner. SaaS is the most visible layer of Cloud Computing for end-users, because it is about the actual software applications that are accessed and used. Examples in this type of services are Google Docs, Salesforce CRM, SAP Business by Design.

Most of the firms and the public sector have as a fundamental priority their privacy and the safety of their documents. Cloud gives the solution to the problem by offering the private model option.

3.1.3 Classification of Clouds

Similar to P/I/SaaS, clouds may be hosted and employed in different ways, depending on the business model of the provider. We can distinguish between the following deployment types:

Private cloud: Most of the firms and the public sector have as a fundamental priority their privacy and the safety of their documents. Cloud gives the solution to the problem by offering the private model option. The private cloud operates dedicatedly for a single organisation. Functionalities are not directly exposed to the customer, though in some cases services with cloud enhanced features may be offered - from the customer point of view this is similar to (Cloud) Software as a Service. The most common example is eBay.

Public cloud: Providing the user with the actual capability to exploit the cloud features for his / her own purposes also allows other firms to outsource their services to such cloud providers, thus reducing costs and effort to build up their own infrastructure. This model refers to the case that services are available to the general public (firms, governments, individuals). According to this type of deployment, the cloud is depicted in its traditional mainstream sense - "anyone can have access". In this cloud model the dominant players are Amazon, Google Apps, Windows Azure.

Hybrid cloud: This is a type of cloud that uses a combination of two or more clouds (public, private or community). Hybrid cloud is also called hybrid delivery. There are not many hybrid clouds actually in use today, though early initiatives by IBM, Juniper and others have already introduced base technologies for their realisation.

Community cloud: Typically cloud systems are restricted to the local infrastructure, i.e. providers of public clouds offer their own infrastructure to customers. Community clouds can either aggregate public clouds or dedicated resource infrastructures. Community Clouds as such are still just a vision, though there are already indicators for such development, for example, through Zimory and RightScale, two companies that allow firms to design, deploy, manage and automate business critical applications on the cloud through an integrated cloud management software.

3.1. 4 International Trends

The emergence of Web 2.0 represented a shift from "high-touch, high-margin, high-commitment" provisioning of service to "low-touch, low-margin, low-commitment" self-service. It was a shift that allowed new upcoming trends that are shaping the technology today, one of which is Cloud Computing. For example, in Web 1.0, accepting credit card payments from strangers required a contractual arrangement with a payment processing service such as VeriSign or Authorize.net; the arrangement was part of a larger business relationship, making it very difficult for an individual or a very small business to accept credit cards online. With the emergence of PayPal, however, any individual can accept credit card payments with no contract, no long-term commitment, and only modest pay-as-you-go transaction fees which is the main feature of cloud computing.

The emergence of Web 2.0 represented a shift from "high-touch, high-margin, high-commitment" provisioning of service to "low-touch, low-margin, low-commitment" self-service. It was a shift that allowed new upcoming trends that are shaping the technology today, one of which is Cloud Computing.

The level of "touch" (customer support and relationship management) provided by these services are either non-existent or minimal, but the fact that the services are now within reach of individuals seems to make this less important. Similarly, individuals' Web pages can now use Google AdSense to realise revenue from ads, rather than setting up a relationship with an ad placement company, such as DoubleClick (now acquired by Google). Those ads can provide the business model for Web 2.0 applications as well. Individuals can distribute Web content using Amazon CloudFront rather than establishing a relationship with a content distribution network such as Akamai. AmazonWeb Services capitalised on this insight in 2006 by providing pay-as-you-go computing with no contract: all the customers need is a credit card. A second innovation was selling hardware-level virtual machine cycles, allowing customers to choose their own software stack without disrupting each other while sharing the same hardware and thereby lowering costs further.

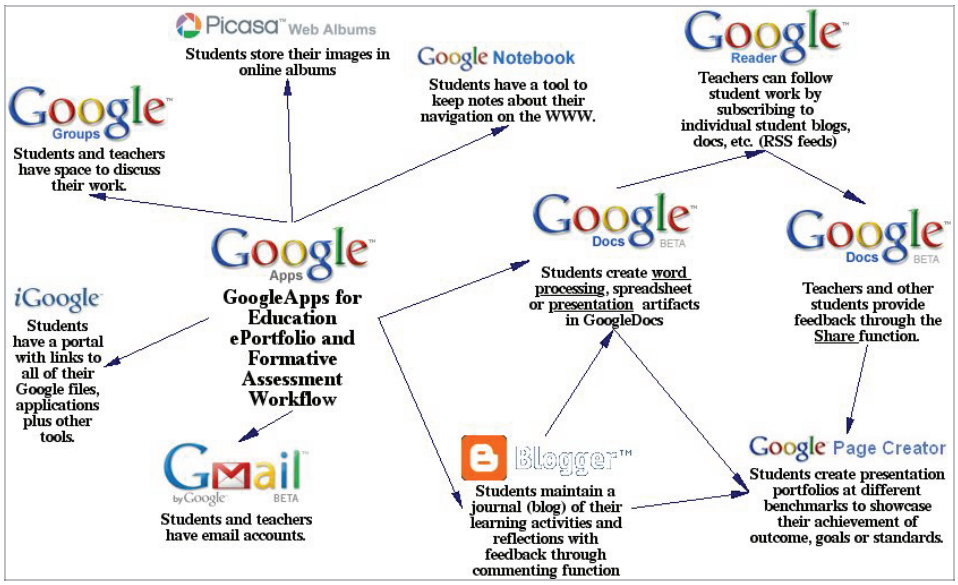
3.1.5 International case studies

All the major global firms in the field have already developed products / services to promote cloud computing. The cases presented here illustrate the dynamic of the Cloud and its general impact on the firms' productivity. The choice of the firms presented here is based on their global influence on market trends, popularity and social utility.

Case study 1: Google

Various Google cloud applications, such as Gmail, iGoogle, Blogger, Picasa and Google Reader already enjoy a great number of users. Laptops, smartphones and tablets participate in the cloud process with applications and data saved in Google's servers, instead of the PC's hard drive or the organisation's server. Google maintains updated copies of various data across multiple servers in multiple locations so that scheduled maintenance breaks won't be required. Furthermore, data will be safe and principally will have a backup.

Figure 3.3: Cloud services provided by Google with an example of their use in Education



Case Study 2: Amazon

Amazon provides the Elastic Compute Cloud (Amazon EC2). It is a web service that provides resizable computing capacity in the cloud. The EC2 is designed to make web-scale computing easier for developers. It is clearly a virtual computing environment that allows you to use web services with a variety of operating systems. This type of cloud offers almost all the common amenities that a cloud should provide. First of all, it is a typical elastic cloud in the sense that it enables the user to decrease or increase capacity within minutes. In the same way, an application can automatically scale itself up and down depending on its needs. Furthermore, the user's instances are completely controlled. The access to each instance is feasible and the user has the possibility to interact through any machine.

As for flexibility, Amazon EC2 gives to the user choice of multiple instance types, software packages and operating systems. EC2 allows the user to select a combination of memory, CPU, and instance storage that are produced from different firms.

Reliability and security are two more features of Amazon's cloud. It offers a highly reliable environment where replacement instances can be rapidly commissioned. The service runs within Amazon's network infrastructure and datacentres.

The characteristic that differentiates this cloud from the others is that EC2 includes web service interfaces to configure firewall settings that control network access to and between groups of instances. Last but not least, this is an inexpensive cloud, benefiting from Amazon's scale.

Case Study 3: Microsoft

The cloud services provided by Microsoft include all aspects of cloud computing.

- A SaaS offering through public & commercial services.
- A PaaS flavor through Windows Azure, for hosting software.
- An IaaS part, again through Windows Azure.

The Microsoft SaaS offering has two distinct parts: the consumer cloud services and the com-

mercial cloud services. The first one includes many popular services like the Bing search engine, the Hotmail email service, the MSN portal, the Xbox Live service and many others, with millions subscribers each, hosted on Microsoft's datacentre facilities globally. The latter includes the Office 365 suite of applications and other commercial services, like Outlook online, SharePoint online, Lync Online, CRM Online and others.

Figure 3.4: Microsoft Cloud Services

Windows Azure (PaaS) is divided in three major categories: the hosting & storage called Windows Azure, the SQL Azure - a relational database as a service- and, the AppFabric building blocks for cloud applications. Windows Azure offers developers a Windows Server 2008 environment to host their solutions. Thus, any application that can run on a typical on premise Windows Server 2008 environment, can also run on Windows Azure, making it possible to see hosted solutions built in the .NET stack (C#, VB.NET, F# etc), Java, PHP, Python, Ruby or even older frameworks like Visual C++, VB6, Delphi, Powerbuilder etc. The Windows Azure Fabric Controller exposes APIs to scale programmatically as needed and takes over many other tasks like load balancing, patching, health monitoring & restore etc. Apart from hosting, Windows Azure offers services for storage, IpSec tunnelling, data cashing through a content delivery network, and failover or geo-location-based load balancing.

SQL Azure offers a fully-functional relational database as a service providing features like data synchronisation with on-premise or other cloud databases, SQL Server reporting services, backup & restore etc.

AppFabric provides services as "building blocks" for application development like user authentication with popular providers (hotmail, yahoo, facebook etc), fast caching between hosted services and instances, enterprise service bus, workflow and Biztalk-type transformations.

Case Study 4: Apple

Apple's participation in the cloud is primarily aimed at facilitating the users of its "i-devices", such as iphone and ipad. Following iTools in 2000, Mac in 2002, and MobileMe in 2008, iCloud is the latest brand of Apple cloud computing services. Music, photos, calendars, documents and apps are stored in Apple's iCloud. All data are pushed wirelessly and automatically to all available devices. This offers benefits to the users as the cloud is both cost and time effective.

The motto of the company is: "iCloud does it all for you", which means that syncing and management are not required. Moreover, iCloud allows its users to download any new app from any suitable device. Apple's iCLoud is particularly strong in the digital music segment. The characteristic that makes the vital difference for the iCloud is that an iOS device is needed.

3.2 The ICT ecosystem's readiness for cloud adoption

3.2.1 Introduction

The Greek ICT sector now consists of more than 1,700 firms, 85% of which have ICT as their core activity.

The Greek ICT sector was showing a strong growth in the years before the crisis, as there was a strong uptake of new technologies. The booming broadband penetration is a characteristic example of this trend. Currently Greece might be a moderate innovator but it is picking up momentum very fast as its performance is improving rapidly.

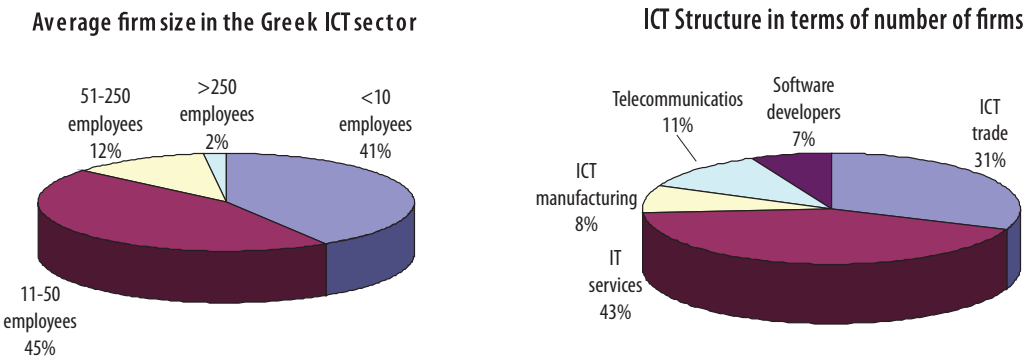
The ICT sector now consists of more than 1,700 firms, 85% of which have ICT as their core activity and the rest have ICT as a peripheral activity[19]. The sector is "under-aged" – 88.3% of the ICT firms has been established in the last 15 years, while 1 in 3 firms in the sector has been established after 2001. The majority of the firms are established in Attica (79.4%) whilst only 9.3% of them are located in Thessaloniki and 11.3% in the rest of Greece. However it is important to note that during the last decade there has been an increase in the birth of IT firms outside Attica.

In terms of size by number of employees, the majority of the ICT firms are small or medium sized as 41% of the sector's companies employ up to 10 persons and another 45% have between 11 and 50 employees. Only 12% of the ICT firms consist of 50 to 250 persons and a very small minority (2%) has over 250 persons (Figure 3.4). Regarding the breakdown per activity, 43% of the ICT firms is dealing with IT services, 31% with retail trade (ICT equipment), 11% with telecommunications, 8% with ICT manufacturing and 7% with software development. Recent research has estimated the ICT sector's contribution to the GDP to be around 3.3% of GDP comes from ICT firms in 2007[20].

[19] *These firms operate under the legal status of LTD or S.A.. This means that these are the firms that are required to publish their balance sheets. Firms that do not publish balance sheets (sole proprietorships or other small personal firms) are not included in this set of companies. Taking into consideration all such firms (even small retail shops), then the total amount of ICT firms is almost 20.000 firms (data from Eurostat, Structural Business Statistics, 2007 latest available).*

[20] *Study of the Information and Communication Technologies Sectors in Greece, and the use of ICT in important sectors of economic activity in Greece: Current situation and future trends. IOBE 2008, funded by the Observatory for the Greek IS*

Figure 3.5: Structure of Greek ICT Sector



Source: Study of the ICT sector in Greece: Current Situation and Future Trends, IOBE 2007, funded by the Observatory for the Greek IS.

The main ICT clusters in Greece are in Athens, Patras, Thessaloniki, Iraklio and Ioannina. There are several attractive publicly funded projects throughout Greece in the fields of defence, public transport, broadband networks, and e-government.

3.2.2 Cloud computing - The supply side[21]

Integrators will have to change their model of revenue creation, as their cash inflows will be based on subscriptions rather than product purchases and user licenses.

Multinationals but also independent Greek ICT firms seem willing to incorporate cloud solutions in their product portfolio as they are developing the proper expertise, supported by the global providers. At this stage, firms adopt and offer cloud solutions in different scale, as this depends on their potential as well as on their client demands. Many local IT firms offer IaaS, SaaS and Paas services while others offer only 1 or 2 of them depending on demand. In many cases, in order to help their clients obtain a smoother transition, they offer a combination of on premise and cloud solutions. To provide customised cloud development model for each customer, the Greek IT firms take into consideration the following 5 factors:

1. The entrepreneurship model that each firm follows and their actual needs
2. The economic benefits that would arise from the pay-as- you go system instead of investing in infrastructure and software
3. The TCO index (Total Cost of Ownership) that is derived from the cost of investment in the traditional and the new model
4. The capability of the staff to support and accept the new model
5. The need of the firm for quick and easy access to the system away from its premises.

One basic consequence of CC diffusion will be the fact that integrators will have to change their model of revenue creation, as their cash inflows will be based on subscriptions rather than product purchases and user licenses. The pricing model that is used is Pay-as–you-go/ Pay-as-you-grow. According to this, a firm pays only for the resources that it uses through the cloud. This pricing option is extremely flexible, involves no up-front costs and no long term-commitment. The length of the subscription varies from 1 month to 1 year depending on the supplier.

[21] *By the term supply side we refer to a) the cloud hosting services providers and firms b) integrators and c) retailers, usually box movers.*

Integrators may lose revenues from installation costs and software licenses, but on the other hand they may benefit from the added value of new services. Integrators can add more value to cloud than to on-premise applications, so their long term revenues can become significantly larger than the currently adopted business model. The subscription format of revenues is more effective as it secures a continuous flow of income with high profit margins. Another important benefit that minimises suppliers' cost is that most work can be done remotely.

Summarising, the benefits for the IT sector due to cloud computing are the following:

1. Continuous income flow
2. Optimised geographical spread as they do not need to work in the same area as their clients
3. Capability to provide high quality products without initial investment
4. Their clients are not burdened with maintenance costs
5. Larger profit margins

There will be a need to possess high quality knowledge in order to market the new servicers offered.

There are also significant spill-over effects. Cloud computing is expected to have a significant impact on ICT-related jobs. It is expected to increase demand by cloud computing service providers for ICT specialists, change the need for ICT specialists in firms that are using cloud computing and increase the applications development potential of ICT and non-ICT specialists as a result of readier access to advanced ICT services. Apart from the very large cloud computing providers with very diverse portfolios, an increasing number of cloud computing specialists are providing cloud computing services from smaller outlets.

3.2.3 The transition to the cloud

For a smooth transition into the cloud, a well-trained pool of experts is essential. Integrators need to possess high quality knowledge in order to market the new servicers offered. Their role is crucial as they have to provide to their clients not only the cloud services, but accompanying training, operational support and technological knowledge if required. Obviously consulting services will play a major role in the transition process.

Overall, the big advantage of this transition consists in respecting the integrators' desires to maintain control while allowing them to scale beyond the restrictions of their infrastructure and provide enhanced capabilities to customers and users. At the same time, however, such an arrangement implies that the platform owners have to share part of the income, as well as having to rely on other providers. On the other hand, providers will benefit from the additional capabilities and infrastructure size, as well as from reduced management overhead, in the same way the customers benefit from exploiting a public cloud.

The supply side's role is crucial for the functioning and success of cloud computing. There are, however, reservations on the readiness and willingness of the remaining supply channel to support the transition. The reasoning behind these reservations is that the cloud makes the relationship between cloud hosting services and consumers more direct, reducing the need for intermediary integrators. In the same line of argument traditional local "box movers" seem also to be under threat.

To cope with these reservations, certain cloud hosting services are trying to boost the role of integrators in the delivery channel, supporting their contribution to the transition into cloud. The cooperation between cloud hosting services and integrators is essential. Together

Microsoft has been training globally a network of more than 600,000 partners in more than 200 countries for the transition to the cloud.

they can cooperate on product bundling, productivity training and promotion. A prominent example is Microsoft which has been training globally large network of partners - 600,000 entities in more than 200 countries who support millions of firms - for the transition to the cloud. In Greece, more than 60 companies focus on the creation of cloud solutions. Cloud computing creates new roles - the supply sector must learn to adopt and discover even more roles in order to survive. One example is that of Cloud Services Architect whose role is to decide which services and applications should be transferred into cloud and when. Furthermore, cloud suppliers can add value to the original cloud applications and acquire intellectual property rights. Those integrators that will make the required investments, will not only survive, but thrive if they are innovative, which is the crucial factor for business development in the cloud.

3.2.4 Readiness to achieving transition

Private sector (non ICT sectors)

Every firm regardless of its size and the level of technological adoption can be a potential user of Cloud technologies. A key advantage of cloud computing is lower cost, as well as direct availability of service and easy access from any device. Security, customisation and integration can be delivered through the cloud at the same level of quality as through local private resources. However, a firm already operating with an expensive data centre will not easily adopt cloud services. In that case, depreciation, maturation and gradual transition may be required. Applications such as ERP, for example, require advanced readiness level. In contrast, others such as mail services, office communication services, backup, storage and recovery services seem to be already in a mature state to join the "cloud".

Public sector

A large private cloud that covers all the IT needs of the Public Sector would significantly reduce the current IT expenditure and simultaneously remove barriers that are currently inhibiting growth.

The implementation of cloud computing solutions in the Public Sector should be considered as a unique opportunity, especially for the Greek State that is undergoing a major fiscal consolidation. In particular, a large private cloud that covers all the IT needs of the Public Sector would significantly reduce the current IT expenditure and simultaneously remove barriers that are currently inhibiting growth. However, such a solution requires sizable initial investment in Data Centres. An alternative that is worth considering would be to opt for public cloud solutions by companies with relevant experience that can provide specific functions and fulfil strict security standards.

Policy makers in the public sector have already begun to comprehend the significant economic and social benefits of cloud computing. Both the new strategy of digital convergence and projects like "Kallikrates" underscore service consolidation and virtualisation, facilitating the creation of the needed cloud computing infrastructure.

3.2.5 Risks, complexities and obstacles

Economy and flexibility are two of the major factors for the transition of Data Centres to the Cloud. However, there are important security issues that should be handled, related to the transition of critical applications and sensitive data to public or shared Cloud environments. An efficient handling of security issues in cloud computing platforms is not simple and concerns that have been raised are indeed relevant and have a ground.

Cloud technology needs to be explained further as there is little understanding of how to best

apply it. There is still scarcity of best practices for the commercial application of cloud computing. The requirements for Cloud Computing in firms are different compared to eScience and ready-made concepts and technologies cannot be directly transferred to industry. Firms have higher security and reliability requirements. It is important to keep in mind that the size of cloud computing's cost savings depend on the complexity of the service outsourced to the "cloud", privacy and security requirements, and whether the service is critical for the client's core activities.

Cloud technology needs to be explained further as there is little understanding of how to best apply it.

While trying to reduce the complexity of cloud computing for clients, cloud computing providers also face the complexities of coping with new technologies such as distributed computing, parallel programming and virtualisation. This fact increases the skills required of ICT specialists working for cloud computing providers and may increase skill shortages for cloud computing applications.

The adoption of Cloud Computing from Greek firms is still at an early stage of development. There are still considerable obstacles that need to be overcome. On one hand, there are technical obstacles such as:

- Lack of Know-how
- Security risks, associated with data transfer in particular
- Costly and complex integration with existing IT infrastructure
- Complexity of Cloud Technology
- Doubts in the reliability of Cloud Technology

On the other hand, there are also a few non-technical obstacles such as:

- Lack of clarity on the legal aspects related to the liability of the involved players
- Low awareness for Cloud Technology in general
- Counter-party risk and matching difficulties
- Legal constraints with respect to processes that cannot be performed outside the firm
- Internal and legal regulations that do not allow some processes to run in parallel on the same machine or to run in parallel with processes from other firms.

The adoption of Cloud Computing from Greek firms is still at an early stage of development.

These obstacles are real and should be addressed by CC providers in order to support CC diffusion.

3.3 Conclusions

Cloud computing can have a prominent future in Greece. The current crisis has made the adoption of this cost-effective and innovative technology even more important for both the private and the public sector. The adoption of the CC model reduces the cost of hardware and software, without reducing the quality of the provided service, which is particularly important for new business ventures.

In the Greek ICT ecosystem the conditions for cloud computing adoption are more than encouraging, as CC may find fertile ground due to the significant presence of SMEs.

Overall, there is a trend towards distribution and decentralisation of IT resources that at the same time is confronted with the need for consolidated and efficient use of IT resources. This results in transition to cloud services, which satisfy several emerging issues such as:

- Increasing demand for storage and computing power at each data centre
- Many and scattered data centres with underutilisation of their resources
- Increasing maintenance costs of data centres

In the Greek ICT ecosystem the conditions for cloud computing adoption are more than encouraging, as CC may find fertile ground due to the significant presence of SMEs. The introduction of cloud computing depends on technical factors such as the technological level of the ICT sector and its capability of quickly adopting the cloud. It also depends on external conditions such as the economic climate. In this respect the timing is right for the adoption of cloud computing as the need for cost reduction is more evident than ever. On the other hand, companies that have already invested significant amounts in IT infrastructure in the past need a satisfactory return on investment before deciding on a re-organisation of their IT resources. A gradual shift to CC with the adoption of piloting applications seems the most plausible path for CC deployment in Greece in the near future.

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4 | The Impact of Cloud Computing on the Competitiveness of the Greek Economy

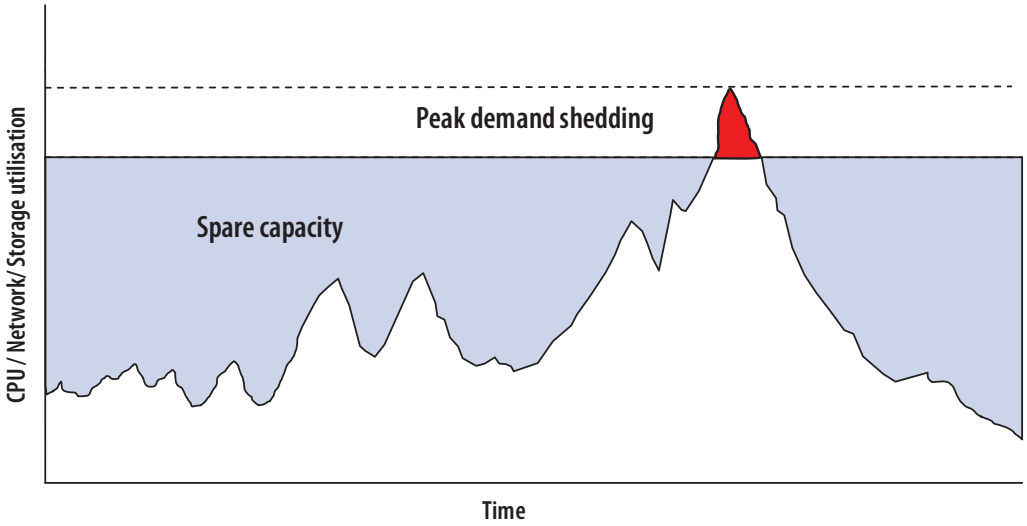
4.1 Introduction

Cloud Computing (CC) holds the potential for significant cost reduction and major productivity boost.

Cloud Computing (CC) holds the potential for significant cost reduction and a major productivity boost. The key to understanding the source of this potential lies in the way cloud computing changes the utilisation pattern of computing resources.

The decision on how much computing capacity a workstation or a server should have faces a trade-off between spare capacity and probability of overload (Figure 4.1). Higher computing capacity lowers the risk of unsatisfied demand or outages, but increases the amount of capacity that remains idle most of the time. It has been estimated that in the client-server computing model, the average server utilisation rate ranges between 5 to 10 percent, [1] which implies that 90-95% of this computing resource remains idle for most of the time.

Figure 4.1: Utilisation schedule of computing resource (illustration)



Cloud computing offers significant economies of scale on the supply side.

Both spare capacity and outages have opportunity cost. This cost increases with the variability of the flow of user instructions. Cloud computing alleviates the effects of variability in computing demand flow, coming from various sources, by aggregating instructions across users (Text box 4.1). Re-dispatching them to idle computing resources, cloud computing reduces the discrepancy between computing demand flow and computing capacity, achieving significant improvement in overall resource utilisation.

Text box 4.1: Sources of computing variability

Five sources of variability significantly smoothed out with cloud computing:

1. **Time-of-day patterns:** The vast majority of IT users perform business tasks during the day and leisure tasks at evenings. Meanwhile, the computing resources are utilised differently during work and play. By pooling enterprise and consumer services and/or workloads from different time zones on the same virtualised server, cloud computing reduces substantially the intraday variability of demand.
2. **Industry-specific variability:** Different industries are exposed to different predictable and unpredictable demand shocks. Retail has high demand prior to festivities, tourism has a summer peak and public services experience surge of demand at or near deadlines. Unpredictable major events have heterogeneous effects on the various industries. For example, the 2010 Iceland volcano eruption severely disrupted air traffic, but had little direct effect on most domestic activities. By pooling computing use across industries, cloud computing reduces this source of variability.
3. **Multiresource variability:** The optimal mix of computing resources (CPU, network or storage) differs across users. However, most users (individuals and SMEs in particular) do not have either the resources or the expertise to purchase highly customised solutions. Through aggregation, cloud computing reduces the spare capacity coming from discrepancy in user profiles and bundle solutions.
4. **Uncertain growth patterns:** A company expecting high growth of its sales may end up with excess capacity of computing resources. In contrast, the long lead times for bringing IT capacity online may prevent a company from realising fully its potential. By pooling resources across fast-runners and slow-starters, cloud computing improves companies' scalability and reduces the demand variability from this type of heterogeneity.
5. **Randomness:** Apart from day-cycles, seasonality and industry shocks, the fluctuation in the demand for computing resources contains certain degree of pure randomness. A celebrated result in statistics is that aggregation reduces uncorrelated randomness, which is one more channel through which cloud computing improves the utilisation of computing resources.

Source: Microsoft, The Economics of the Cloud, November 2010

In addition to the benefits of demand-side aggregation, cloud computing also offers significant economies of scale on the supply side. Large CC providers can acquire significant buying power through heightened infrastructure homogeneity. They can also spread the fixed costs for security and variability and IT expertise over larger demand pool, which brings down their average cost. They can also take advantage of the variation in power costs across different regions of a country or across countries by allocating data centres and servers accordingly.

As long as there is competition for the provision of cloud services, the significant improvement in computing resource utilisation and the supply-side economies of scale will translate into reduced computing spending for the IT users. Moreover, improved resource utilisation will enable the enterprises to tap potential demand that would otherwise remain unsatisfied.

The supply-side economies of scale will translate into reduced computing spending for the IT users, while improved resource utilisation will enable the enterprises to tap potential demand that would otherwise remain unsatisfied.

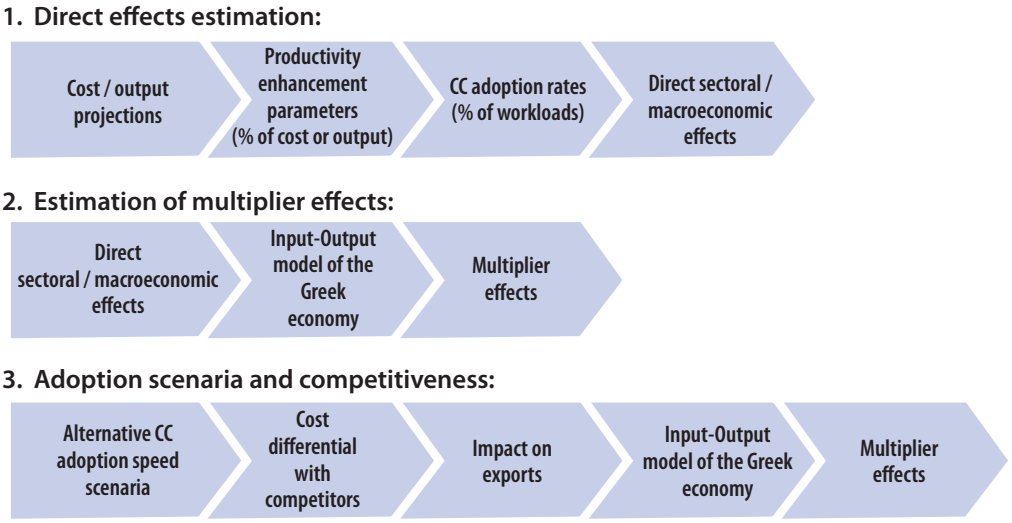
In addition, lower equipment cost will make it easier to start up new SMEs, thus making it possible for many more ideas to materialise and translate into increased economic activity. Improved productivity and higher output in particular sectors will lead to multiplier effects for the economy overall, as there will be higher demand for intermediate goods going into the production of this new output, while the households will have more income to spend.

In this study, we attempt to quantify these benefits for the Greek economy over the next decade. Section 4.2 contains a description of the methodology that we followed. In Section 4.3 we present the impact of cloud computing under baseline assumptions with regards to the speed and extent of CC adoption. The impact from promptness / sluggishness in CC adoption is quantified in Section 4.4. The chapter concludes with a summary of the results.

4.2 Methodology overview

To quantify the benefits of cloud computing, we followed a three-step procedure (Figure 4.2).

Figure 4.2: Estimation procedure

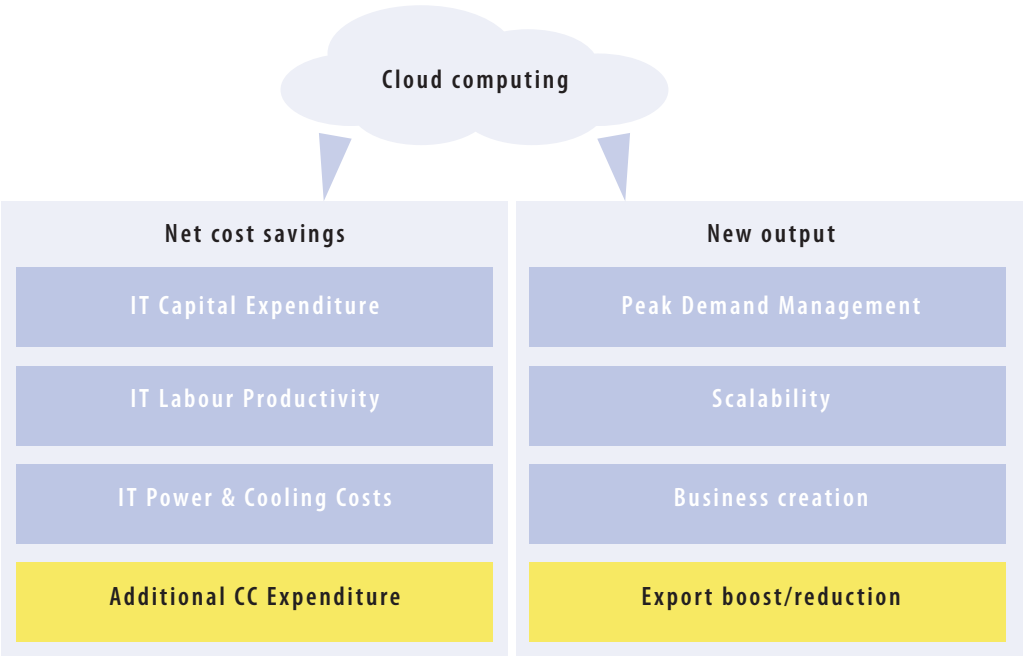


First, assuming a particular speed and extent of cloud computing adoption per sector of the Greek economy and using IOBE's macroeconomic forecast over the next decade, we quantified CC's direct economic benefits in terms of net cost savings and new output generated. Next, we estimated the multiplier (indirect and induced) effects from CC adoption, using an Input-Output model for the Greek economy. Finally, we estimated the overall impact on the Greek economy from adopting CC faster or slower than the country's main competitors, through quantifying the impact on the country's exports from the cost differential that would result from different CC adoption speeds.

4.2.1 Direct effects

In this study, we quantified the direct economic benefits from adopting CC computing in terms of net reduction in IT cost and additional activity from capturing incremental demand (Figure 4.3).

Figure 4.3: Direct benefits from cloud computing



Net cost savings

Total IT capital expenditure can be reduced by 17% to 40%, depending on the adopted cloud computing model .

With public cloud computing the user does not need to buy servers and storage, which takes up significant share of the users' IT capital expenditure. Even in private and hybrid cloud solutions, the user can achieve significant cost savings from hardware and software consolidation, standardised application frameworks and reduced maintenance of hardware and facilities. The total IT capital expenditure can be reduced by 17% to 40%, depending on the adopted cloud computing model (Table 4.1).

In addition, cloud computing consolidates IT labour resources. With fewer or no servers to maintain and applications to install, the IT experts can be redeployed within the company or in the wider economy to perform more productive activities, such as application development. CC can reduce a company's IT labour cost by 19% - 31% on average, depending on the cloud model that it adopts (Table 4.1). Given the shortage of IT skills and the increasing demand for IT services, the IT labour cost reduction translates into increased productivity, rather than redundancies.

Table 4.1: Net cost savings from CC adoption

Action	Private	Hybrid	Public	Cost item
CAPEX reduction	17%	31%	40%	IT CAPEX budget
Productivity gains	19%	24%	31%	IT labour costs
Power and cooling cost savings	44%	61%	79%	IT power and cooling budget
New expenditure on cloud services	0%	6%	13%	IT budget

Source: Centre for Economics and Business Research, The Cloud Dividend: Part One, December 2010

Furthermore, the CC users can significantly reduce their energy bill, as CC eliminates the need to power and cool servers and data centres. It is estimated that between 44% and 79% of the IT power and cooling budget can be eliminated by adopting a cloud computing model (Table 4.1).

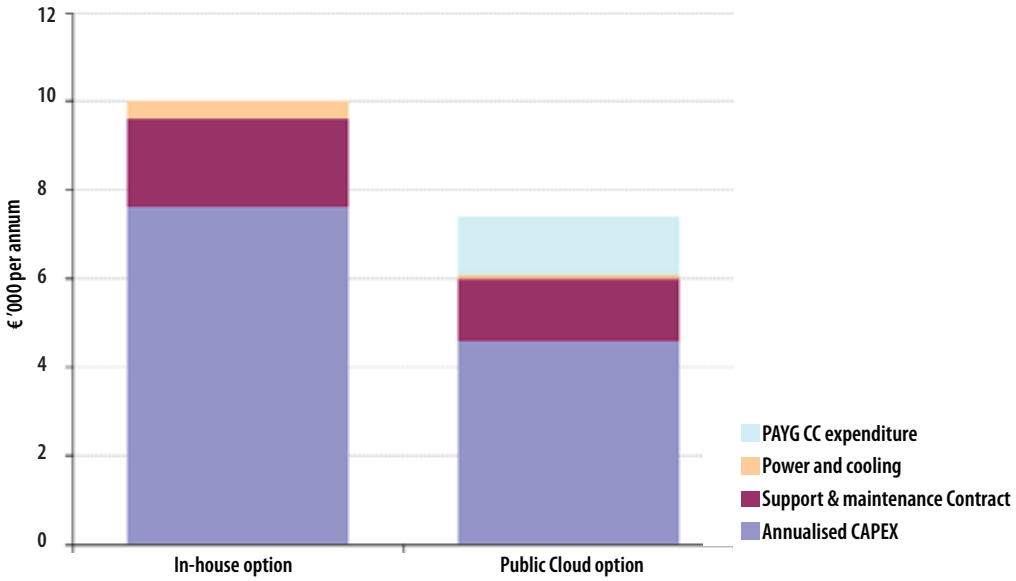
By adopting cloud computing the users replace capital and operating expenditure with on demand pay-as-you-go services. While under the private CC model, little (if any) operating expenditure on CC services is outsourced to third parties, under the hybrid and public CC models, it is estimated that on average 6% and 13% respectively of the users' IT budget will be spent on outsourced CC services. Given the overall savings that CC achieves and the strong competition in the provision of CC services that has already emerged, it is safe to say that the net impact from CC on the users' bottom-line will be strongly positive.

By adopting cloud computing the users replace capital and operating expenditure with on demand pay-as-you-go services.

We can illustrate these savings with a couple of examples. Take a medium-sized business with 10 employees. Let us assume that such a business needs 10 high-end computers and 3 servers (e-mail, files storage and sharing). For this equipment it is reasonable to expect that the company would pay about €18,000. In addition, the cost of its application software could well reach €2,000, which would give us a total capital expenditure (CAPEX) of €20,000. Given the high rate of computer equipment turnover, this equipment will have to be changed in about 3 years, which implies that the annualised equipment cost amounts to €7,620 (under the assumption that the company faces 7% cost of capital).

In addition, given the average pattern of IT spending of Greek enterprises, which, according to the latest IDC data, represents as little as 22% of their total IT budget on services, the company would have a support and a maintenance agreement with an IT provider of about €2,000. Meanwhile, out of its energy bill, about €400 would be paid to power and cool its computer equipment. This would give a total annual IT budget of slightly more than €10,000.

Figure 4.4: Cost savings example: Medium-sized business with 10 employees



In-house scenario assumptions:

- 10 high-end computers: € 6,000 CAPEX
- 3 servers (email, file storage and sharing): €12,000 CAPEX
- Application software: € 2,000 CAPEX
- Total CAPEX: € 20,000 over 3 years
- Annualised CAPEX (@7% cost of capital): € 7,620 per annum
- Support and maintenance agreement: € 8,000 per annum
- Power & Cooling: € 650 per annum

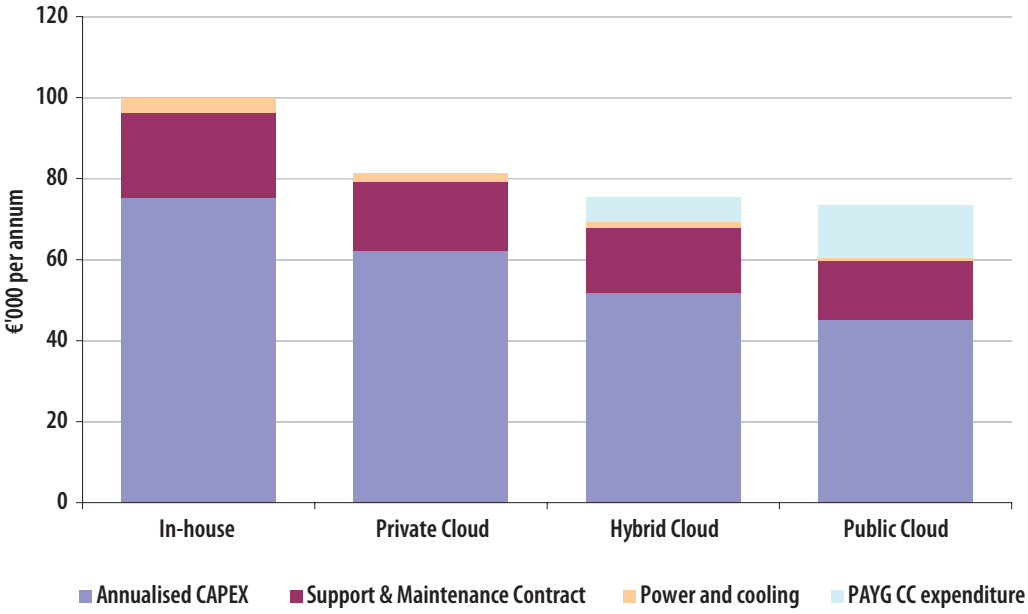
Public Cloud scenario assumptions:

- 40% reduction of CAPEX
- 31% savings on support & maintenance
- 79% reduction of power & cooling costs
- New expenditure on cloud services: 13% of pre-cloud IT budget

If this company shifts all its IT workload to the public cloud, its annual CAPEX would drop to approximately €4,500. Similarly, given the labour productivity enhancement from CC, under a competitive IT market the support and maintenance agreement could drop to about €1,300, while its IT related energy bill would drop to less than €100. The company would need to pay about €1,300 for the provision of cloud computing services on a pay-as-you-go basis, under the assumptions used in this study. Overall the company can save more than €2,600 by moving to the cloud, which represents about 26% of its annual IT budget. (Figure 4.4)

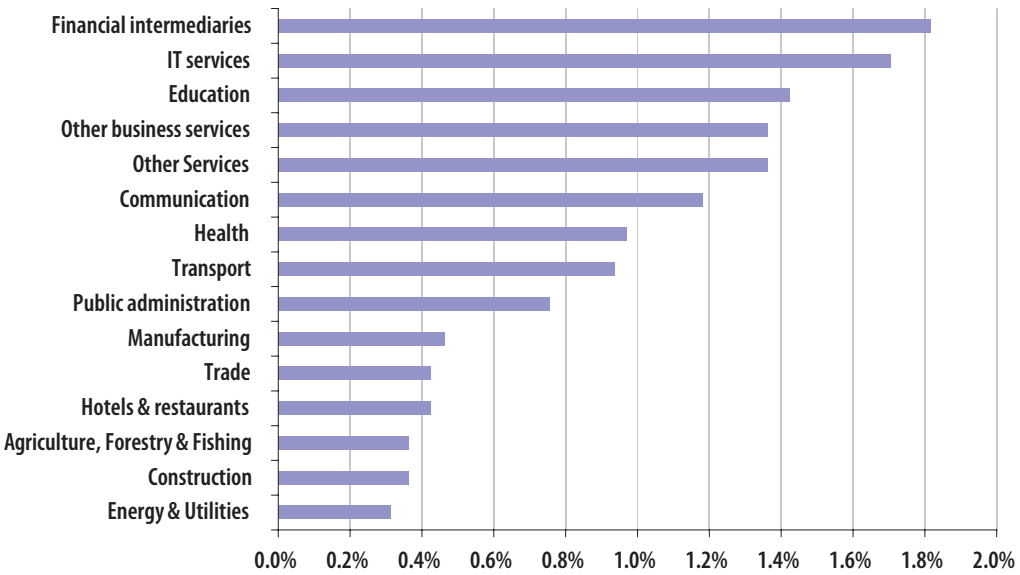
The overall cost savings are expected to be largest under a public cloud solution, but legal or other issues might turn an IT user to private or hybrid solutions. However, substantial cost savings are to be expected under those solutions as well. Take for example a public sector agency with €100,000 annual IT budget. Under CEBR's cost savings estimates that we use for our study, such an agency would save from €18,600 to €26,500 out of its IT budget, depending on the adopted cloud solution (Figure 4.5).

Figure 4.5 Cost savings example: Public sector agency with €100,000 IT budget



To estimate the IT spending savings in the Greek economy overall, we projected the total IT budget and its constituents (capital expenditure, labour cost and energy spending) over the next decade. Due to lack of reliable and/or publicly available data on IT spending per sector in Greece, we opted for parameters from the international literature, which we scaled down for Greece in order to obtain IDC's estimate of the overall Greek IT market size in turnover for our base year (€2.9 billion for 2010). The estimates are presented in Figure 4.6 and Table 4.7 (in Appendix).

Figure 4.6: IT expenditure as percentage of turnover



Source: [4], IDC Black Book and IOBE calculations

Business development

Cloud computing allows the users to be more responsive to demand fluctuations. By shifting IT fixed cost to the cloud, the companies are in a better position to trace the demand curve of their products through time by adjusting their on-demand spending on CC services. The effective management of seasonal peaks and other sharp upturns of demand enables the CC users to tap incremental output that otherwise would have been lost due to overload of their IT systems.

IT scalability can be a source of productivity improvement for large enterprises in sectors that are experiencing rapid technological improvements.

Table 4.2: Additional output due to adoption of cloud computing (% of annual output)

Sector	Peak demand	Scalability and time-to-market	
		SMEs	Large Ent.
Agriculture, Forestry & Fishing	0.07%	0.13%	-
Energy & Utilities	0.07%	0.14%	-
Manufacturing	0.15%	0.20%	-
Construction	0.05%	0.10%	-
Distribution, Retail & Hotels	0.06%	0.27%	0.10%
Transport & Communication	0.07%	0.20%	0.20%
Finance & Business Services	0.11%	0.28%	0.10%
Government, Education & Health	0.04%	0.17%	-
Other Services	0.05%	0.20%	-

Source: Centre for Economics and Business Research, The Cloud Dividend: Part One, December 2010

It has been estimated that with the improved management of peak demand, a company in the finance & business services that has adopted CC can tap on average 0.11% more output, while in manufacturing this potential reaches 0.15% of annual output (Table 4.2). In addition, the more flexible cost structure that comes with cloud computing will enable users to reduce time-to-market and enter new markets. The potential additional demand that can be captured this way is particularly high for SMEs, for which IT capital expenditure can be a significant showstopper. The potential gain in output ranges from 0.10% in construction to 0.28% in finance & business services. IT scalability can also be a source of productivity improvement for large enterprises in sectors that are experiencing rapid technological improvements, such as communication, finance & business services and trade (Table 4.2).

Figure 4.7: Incremental SMEs in Greece due to CC adoption

Source: Etro, F. (2009), 'The Economic Impact of Cloud Computing on Business Creation, Employment and Output in Europe,' Review of Business and Economics, 2009(2): 179-208

The reduction in fixed IT costs significantly reduces the barriers for new businesses to enter markets.

Furthermore, the reduction in fixed IT costs significantly reduces the barriers for new businesses to enter markets. Etro (2009), using his endogenous market structure model, estimated that at least 3,491 new SMEs will be created in Greece over the medium run as a result of adopting cloud computing, out of which most companies (1,498) are expected to emerge in the Trade sector (Figure 4.7). In addition, the influx of new companies will put pressure on the existing companies to improve their productivity. In such a way, cloud computing is expected to significantly change both industry structure and productivity over the next five to ten years.

4.2. 2 Adoption rate assumptions

We modelled the penetration of cloud computing, using Verhulst-Pearl-Lotka's celebrated law of population growth (Text box 4.2). The key advantage of this approach is that it captures considerably better the product life-cycle dynamics, compared with linear or exponential models of growth. In our case, the variable that grows according to the Verhulst-Pearl-Lotka's law is the cloud computing adoption rate, defined as the percentage of IT workloads (amount of user requests for the usage of CPU, memory, storage and network resources per unit of time) that are executed through cloud solutions.

Text box 4.2: Verhulst-Pearl-Lotka's law of population growth

Inspired by a seminal text on population growth by the celebrated British 18th century economist Thomas Malthus, the Belgian mathematician Pierre Francois Verhulst came up with what came to be known as the logistic function:

$$P_t = \frac{KP_0 e^{rt}}{K + P_0\left(e^{rt} - 1\right)}, \quad \lim_{t\to\infty} P_t = K$$

where P_t is the population size at time t, P_0 is the initial population size, K is the population limit, determined by the carrying capacity of the environment and r is a parameter that determines the rate of growth of the population.

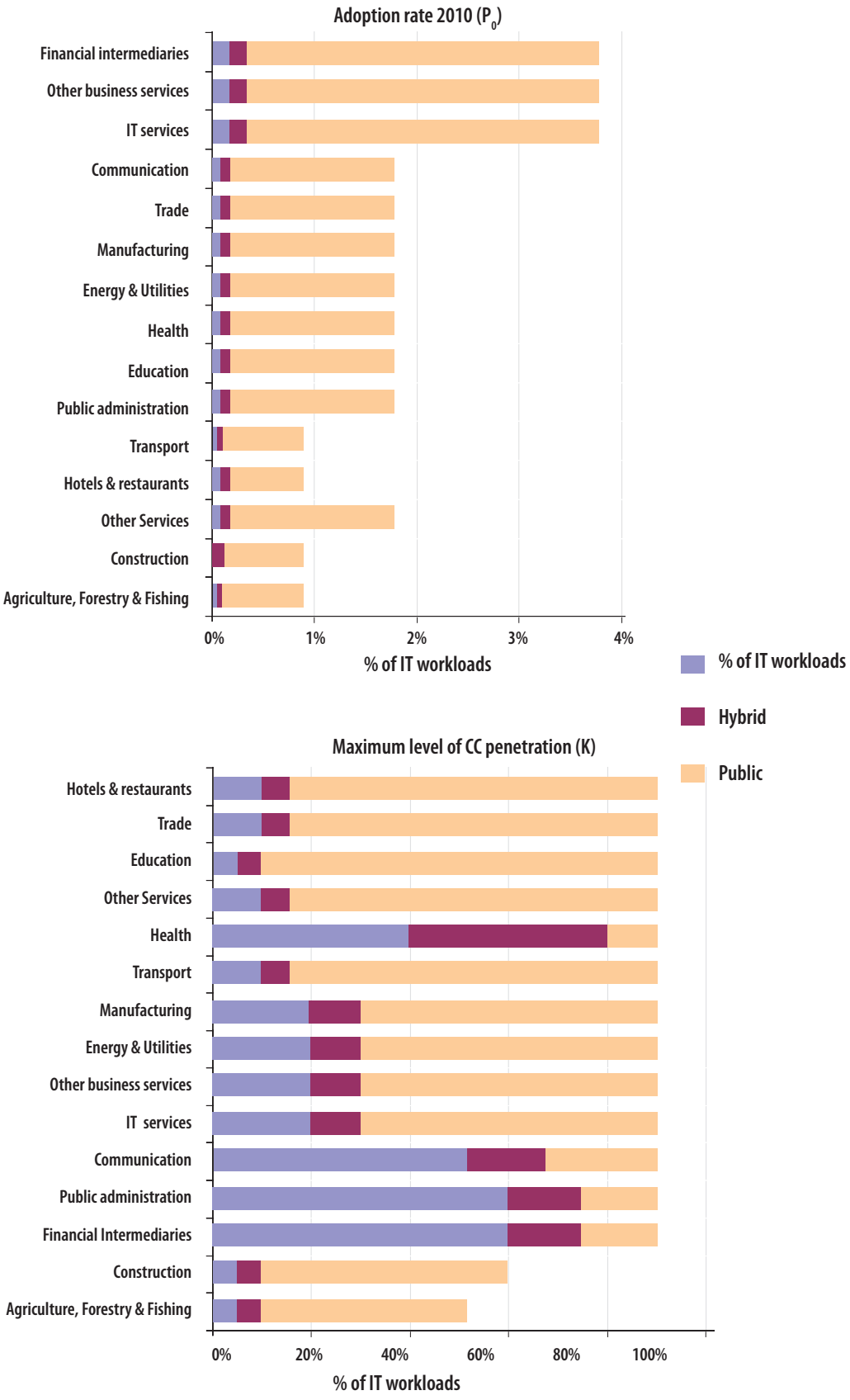
The logistic function was popularised in the 1920s by the US biophysicist Alfred J. Lotka as a Law of Population Growth. Since then it has found applications in wide range of fields, including artificial neural networks, economics, chemistry, mathematical psychology, sociology, political science and statistics.

In the estimation of the Cloud Computing adoption rates (in terms of % of IT workloads shifted to the cloud) over the next decade, P_0 represents the level of cloud computing penetration in 2010, K refers to the maximum level of CC penetration, while r is a speed of adjustment parameter that varies across the three adoption scenaria.

We set the cloud computing adoption rate for 2010 at the rather conservative rate of 2% (Figure 4.8 and Table 4.6 in the appendix). For comparison, the average adoption rate in five large European countries (UK, Germany, France, Italy and Spain) for which data was available was substantially higher (6.6%).[2]

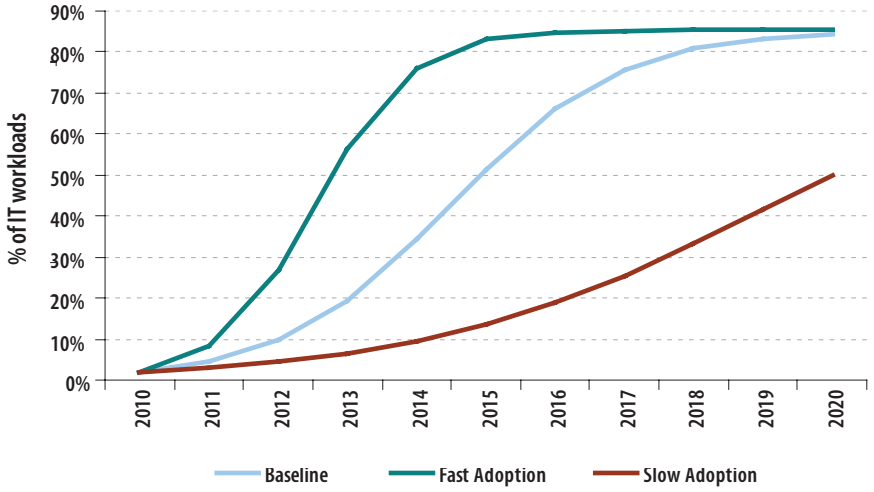
We assumed further that cloud computing's potential uptake in most sectors can reach 90% of IT workloads. The maximum penetration rate was set at less than 100% as some resources will have to be kept at clients' premises even under the CC model, while local backup of very critical data will most probably continue to be performed even under the most ambitious penetration scenario.

Figure 4.8: Adoption rate assumptions



We set the maximum uptake for the two sectors with lowest IT sophistication - Construction and Agriculture, forestry & fishing - at 60% and 50% respectively. In sectors with heightened concern over data security (Financial intermediation, Public administration, Communication) we assumed that the private cloud model prevails. We assumed strong penetration of the hybrid model in the Health sector, where sensitive data needs to flow across the boundaries of a single legal entity (healthcare funds, hospitals, diagnostic centres, labouratories, doctor offices, etc.).

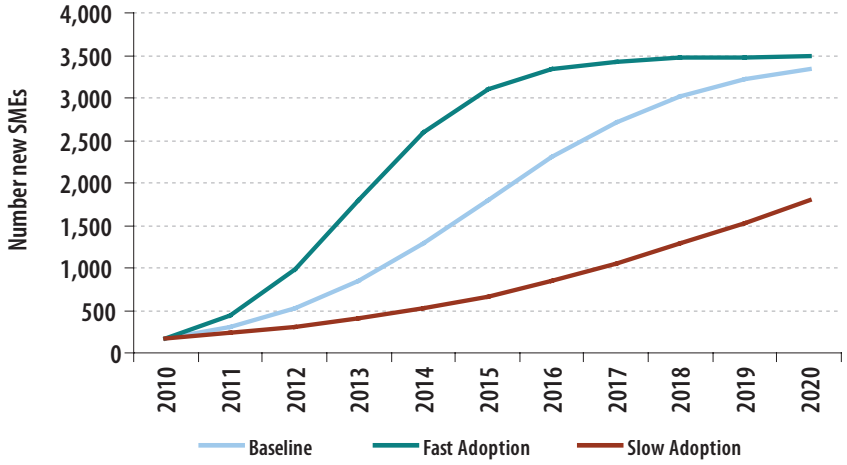
Figure 4.9: Cloud computing adoption rate assumptions per scenario



For the baseline scenario, we assumed that the CC adoption rate approaches its maximum towards the end of the decade (Figure 4.9). Under the fast adoption scenario, the maximum adoption rates are approached within five years. In contrast, in the slow adoption scenario, we assume that the adoption rate towards the end of the decade does not exceed the baseline adoption for 2015 (approx. 50% of IT workloads).

We took a similar approach for modelling the business creation opportunities that come with reduced barriers to create small and medium-sized enterprises (SMEs). As carrying capacity for the number of new SMEs due to CC adoption, we used Etro's estimates (Figure 4.7), reflecting conservative adoption rate scenaria.[3] The speed of adjustment parameters was determined, using the same rationale as in the adoption rate projections.

Figure 4.10: Number of newly created SMEs due to CC adoption



4.2.3 Effects on competitiveness

If Greek businesses do not adopt cloud computing as fast as their key trade competitors, the relative price of their products will deteriorate.

In the two alternative scenaria we also took into account the impact that different speeds of adoption between Greece and its trading partners would have on Greek exporters' competitiveness. If Greek businesses do not adopt cloud computing as fast as their key trade competitors, the relative price of their products will deteriorate. In contrast, if the adoption of CC in Greece is faster, local businesses will gain competitive advantage.

We modelled Greek exports as a function of EU imports (as proxy for the potential global demand for the Greek exports) and the price of Greek exports (in terms of non-domestic output price index or where not available domestic output deflators) relative to the cost of production in EU27 (measured in terms of domestic output deflators). We estimated the parameters of this function in order to single out the elasticity of Greek exports with respect to their relative price vis-à-vis their EU competitors. For sectors where the estimation did not generate statistically meaningful results, we assumed unit price elasticity.

Assuming that Greece's key competitors follow a 10-year path of CC adoption, the cost savings in the fast adoption scenario will translate in a drop of the relative price of Greek exports. The reverse applies in the case of slow adoption - lower cost savings imply a loss of price competitiveness. The impact from the boost / loss of price competitiveness on exports was quantified, using the elasticities presented in Table 4.3.

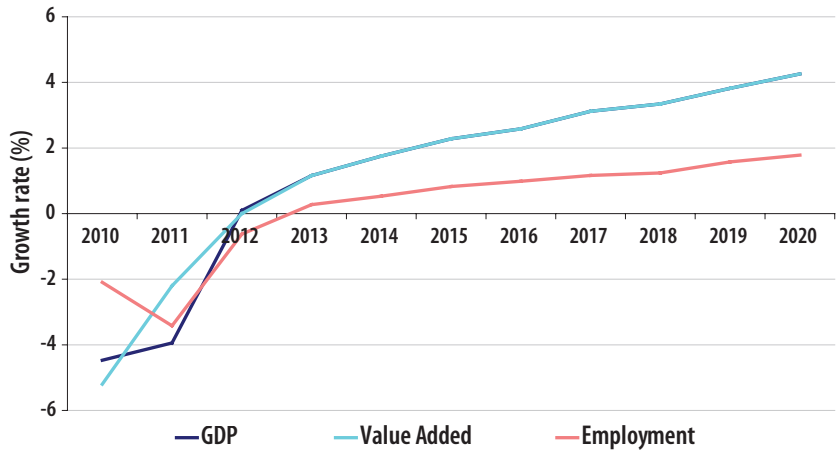
Table 4.3: Relative price elasticity of Greek exports

Sector	Elasticity
Agriculture, Forestry & Fishing	-0.71
Energy & Utilities	-1.00
Manufacturing	-1.57
Construction	-1.00
Trade	-1.00
Hotels & restaurants	-1.03
Transport	-1.48
Communication	-2.29
Financial intermediaries	-5.54
IT services	-1.00
Other business services	-5.68
Public administration	-4.71
Education	-1.00
Health	-1.00
Other Services	-1.00

4.2.4 Macroeconomic projections

In order to project the cost savings from CC adoption, we estimated the future course of ex-ante IT cost (i.e. IT cost without cloud computing) over the next decade. Using IOBE's June 2011 Macroeconomic Scenario (Figure 4.11), we projected each sector's output and the ex-ante IT cost, assuming that without CC adoption the IT budget would hold a constant share of overall product value (Table 4.8 in the Appendix).

Figure 4.11: Economic activity projections



Source: IOBE, June 2011

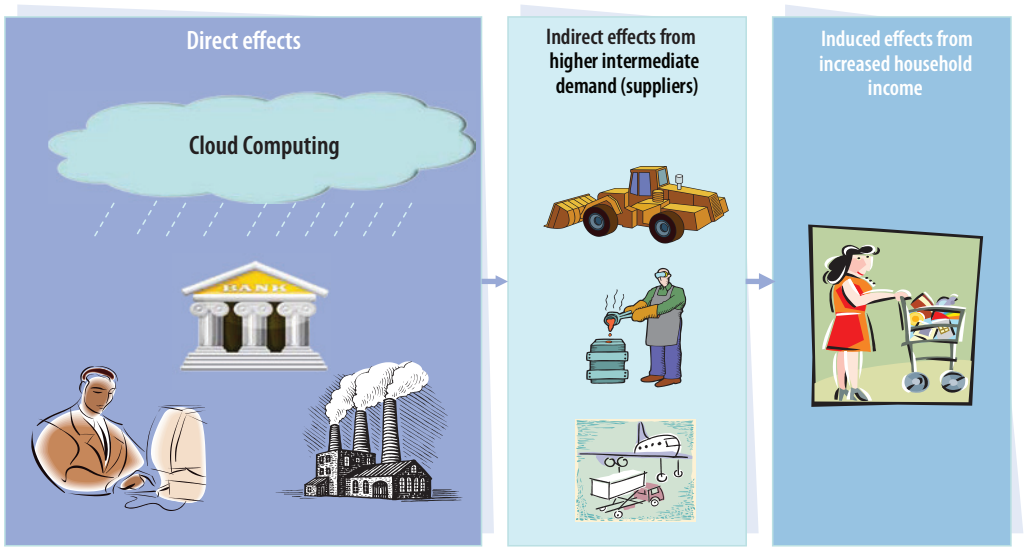
4.2.5 Multiplier effects

The benefits of cloud computing for the economy overall are even larger due to the linkages that exist across the various sectors in the economy.

Cloud computing generates direct economic benefits to its users in terms of net cost savings and enhanced business opportunities. The benefits for the economy overall are even larger due to the linkages that exist across the various sectors in the economy (Figure 4.12). The existence of these linkages implies that a shock in one sector of the economy leads to effects that spill over to the other sectors. The final outcome in terms of economic variables such as GDP, employment, etc., is often a multiple of the direct effect from the initial shock.

The additional output that a travel agency will capture, for example, due to improved scalability at booking season, will bring more tourists to the country, boosting the economic activity of airline companies, taxi drivers, hotels, restaurants, museums, etc., which in turn will create further boost of demand for intermediate consumption. Meanwhile, the increased economic activity will generate value added, part of which will be distributed as labour income, and employment, giving a boost to consumption spending.

Figure 4.12: Direct, indirect and induced effects



We quantified the multiplier effects using a 15 sector input-output model (Text box 4.3), aggregating Eurostat's 58-sector IO tables of the Greek economy. The key purpose of the input-output model is precisely to take into account the sector inter-dependencies that exist in the economy, in order to assess the full impact from a positive or negative shock.

The building block of the Input-Output model is the Input-Output table (Table 4.4 in appendix), prepared by the statistical agency of each country, which is also used in the preparation of national accounts data. The Input-Output table measures the inputs that a branch requires from other branches in the domestic economy in order to produce its output, which in turn is consumed as input by other branches in the economy, by the households or by the government, is invested in capital stock or is exported abroad. The difference between a branch's output and its intermediate consumption is Gross Value Added (GVA), which represents the resources left to a sector's enterprises to pay wages, cover depreciation expenses, pay taxes and retain as net after tax earnings. Adding the amounts collected in the form of taxation on products (such as VAT and excise taxes) to GVA results in the Gross Domestic Product, which is also equal to the sum of Final Consumption (household and government), Investment and Exports net of Imports.

The additional output due to CC was modelled as a positive shock to final demand. The cost savings from the adoption of CC were taken into account in the model as productivity improvements, reducing the input coefficients of the Greek sectors for IT services (IT labour cost savings, net of additional CC expenditure), Manufacturing (IT capital expenditure savings) and Energy (IT power and cooling cost savings) over time. The impact on imports was controlled for, using import component ratios, estimated using the input-output tables.

Text box 4.3: Leontief's Input-Output model

The input-output model was developed by the Russian-American economist Wassily Leontief in the 1930s. Leontief restated general equilibrium economic analysis in such a way so as to make computation feasible and applied it to practical issues, for which he was awarded the Nobel Memorial Prize in Economic Sciences in 1973.

Key assumptions of the input-output model:

- Constant returns to scale
- Fixed relations of inputs (no factor substitution)
- Sufficient excess capacity to accommodate final demand shocks

The input-output methodology forms an essential building block of the complex multisector computable general equilibrium models that have been developed since then and remains very popular tool for performing impact assessment studies.

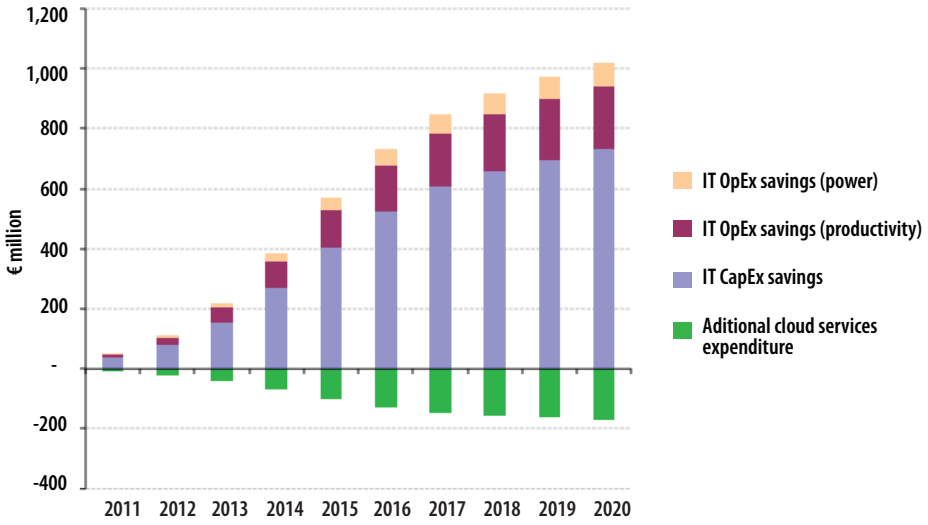
4.3 Estimation results for the baseline scenario

4.3.1 Net cost savings

Overall, Cloud Computing saves € 4.8 billion in IT expenditure over the next decade (baseline scenario).

As already mentioned (Figure 4.3), the adoption of Cloud Computing reduces capital expenditure, allows for more optimal use of the IT labour resources and lowers the energy bill due to reduced power and cooling needs, yet involves additional expenditure on cloud services. Overall, under the baseline scenario, Cloud Computing saves € 4.8 billion in IT expenditure over the next decade (2011-20)[22]. The potential annual net cost saving can exceed € 850 million, achieved under the baseline scenario towards the end of the decade (Figure 4.13).

Figure 4.13: Net cost savings in the Greek economy from the adoption of Cloud Computing



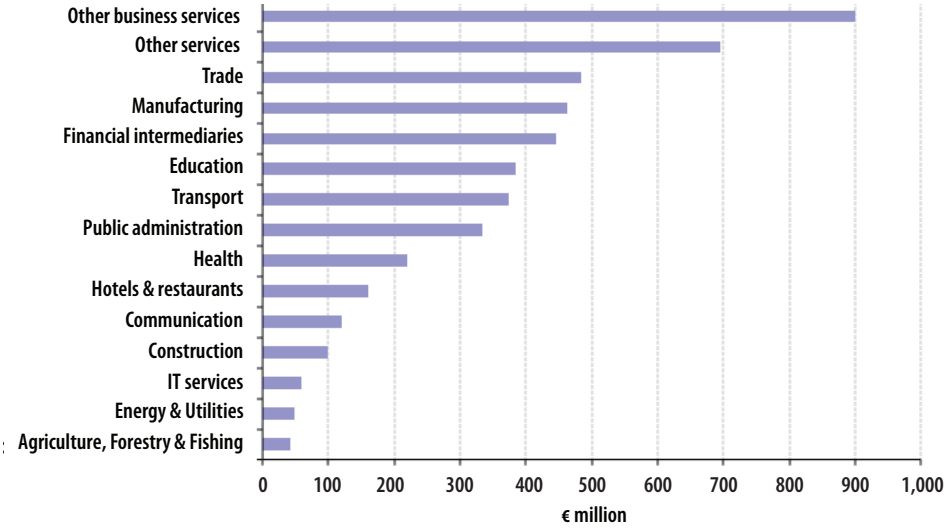
More than 70% of the gross cost savings come from reduced IT capital expenditure, which reflects the pattern of IT spending of the Greek enterprises. IT labour cost savings take up about one fifth of the gross cost savings, while the remaining savings (7.4%) are attributed to energy costs.

The largest cost reduction (€ 900 million over the next decade) is observed in Other business services sector, which includes various professional and scientific activities, such as accounting, advertising, consultancy, legal services, real estate, etc. (Figure 4.14). The Other services-category, which includes various activities aimed at non-business customers, such as entertainment, recreation, etc., is expected to present significant cost reduction (€ 694 million).

The cost savings in Financial intermediaries may seem low, compared to the other sectors, given that banks have large IT budgets. This is due to the assumption that businesses in this sector will opt primarily for private cloud solutions, due to the concern of loss of control over sensitive client data.

[22] *All values in this and the following sections are expressed in real terms (2010 prices)*

Figure 4.14: Net cost savings per sector, 2011-2020



The net cost savings in sectors that are predominantly state-owned (Public administration, Health Education) exceed € 900 million.

The net cost savings in sectors that are predominantly state-owned (Public administration, Health and Education) exceed € 900 million. This highlights the potential of cloud computing to contribute to the fiscal consolidation effort.

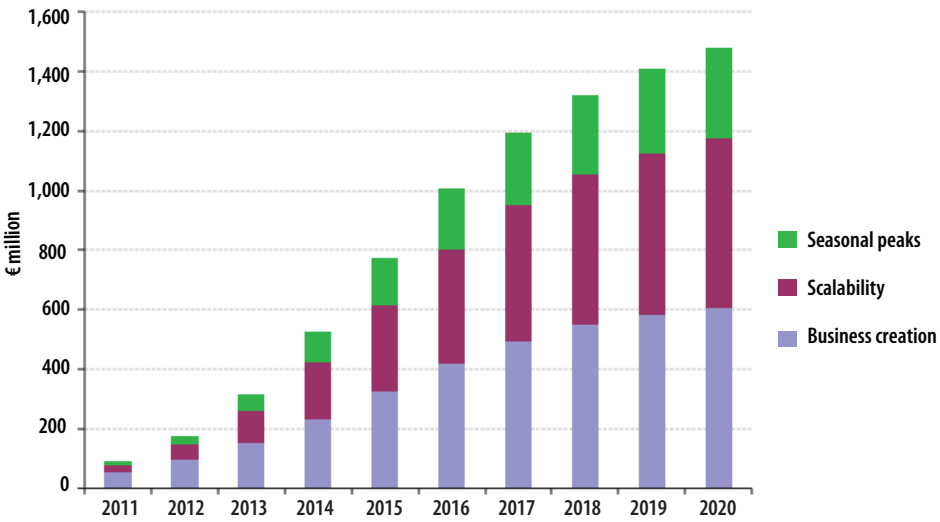
4.3.2 New supply

The value of the incremental output that can be captured through the adoption of cloud computing over the next decade amounts to nearly € 8.3 billion. This translates to additional € 5.1 billion gross value added for the Greek economy. The annual impact on output from the fullest possible adoption of CC approaches € 1.5 billion (corresponding to about € 900 million of GVA per annum).

Shorter time-to-market and improved productivity are responsible for about 42% of this output gain (Figure 4.15). Business creation due to reduced barriers for new SME takes up 38% of this effect, while peak demand management is responsible for the remaining 20%.

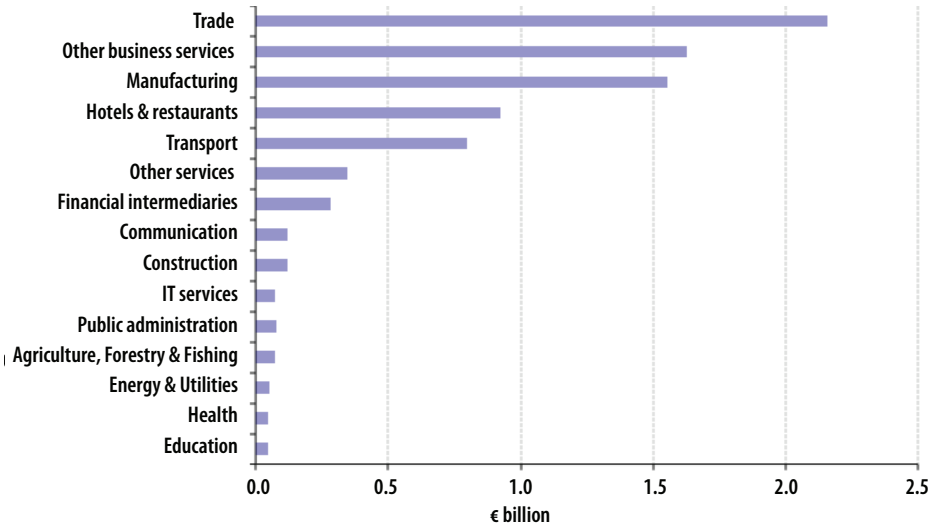
The value of the incremental output that can be captured through the adoption of cloud computing over the next decade amounts to nearly € 8.3 billion.

Figure 4.15: New output due to CC adoption



Highest output gains - to the volume of € 2.2 billion – are expected in the Trade sector (Figure 4.16), which receives by far the largest number of new SMEs. Significant gains are also registered in Other business and Manufacturing.

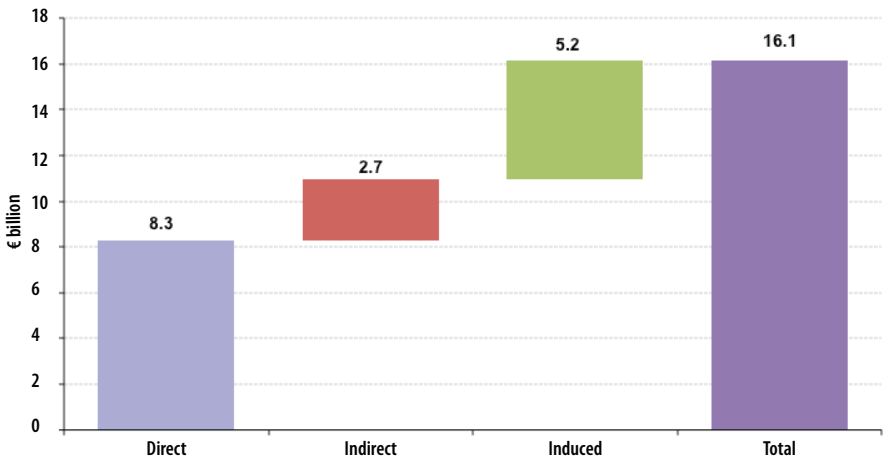
Figure 4.16: New output (direct effect) per sector, 2011-2020



4.3.3 Multiplier effects

The direct effect of € 8.3 billion additional output translates to € 16.1 billion boost of production for the Greek economy over the next decade, if we take into account the inter-sector dependencies in the Greek economy (Figure 4.17).

Figure 4.17: Incremental output (total effect) due to CC, 2011-2020

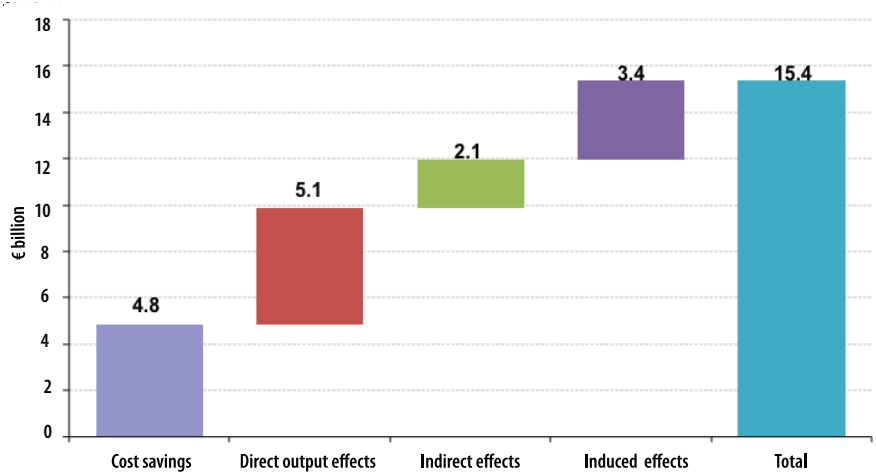


Out of the almost € 8 billion spill-over (indirect + induced) effect on output, two thirds correspond to higher activity due to increased household income (induced effect) and the remaining one third comes from secondary effect on the demand for inputs (indirect effect).

The overall effect on Gross Value Added from cloud computing over the next period amounts to € 15.4 billion.

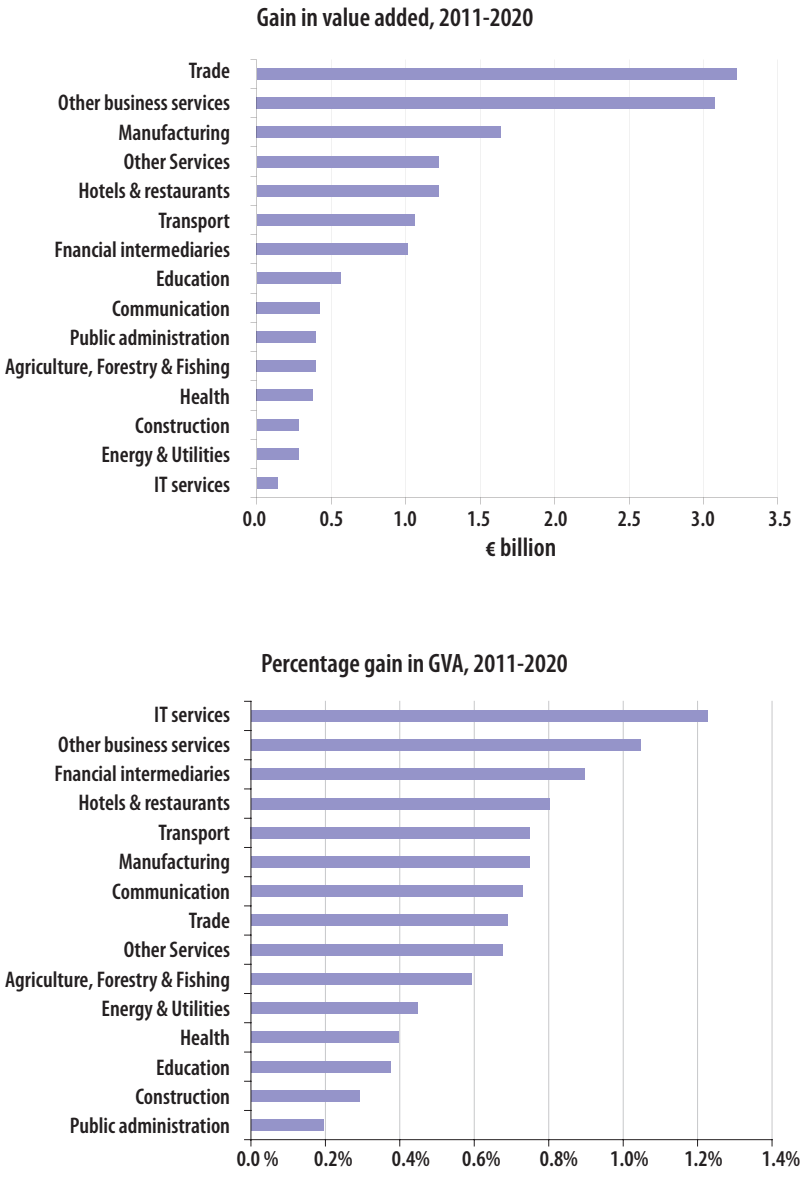
The overall gain to the economy in terms of wages, dividends, retained corporate earnings, etc. is measured by Gross Value Added, which equals output minus intermediate consumption. The increased economic activity enables the businesses to generate incremental Gross Value Added. In addition, the reduced production cost from cloud computing also boosts corporate and household income. The overall effect on GVA from cloud computing over the next period amounts to € 15.4 billion (Figure 4.18). The spill-over (indirect and induced) effects take up € 5.5 billion of this amount. As a result of CC adoption, the Gross Value Added of the Greek economy in 2020 is higher by € 2.7 billion or 1.1%.

Figure 4.18: Incremental GVA due to CC, 2011-2020



The largest income gains (€ 3.2 billion) over the next decade occur in the Trade sector (Figure 4.19), closely followed by the "Other business services" category (€ 3.1 billion). Controlling for the size of each sector, the largest gains occur in IT services (1.2%), followed by Other business Services (1.0%) and Financial intermediaries (0.9%).

Figure 4.19: Incremental GVA due to CC per sector, 2011-2020

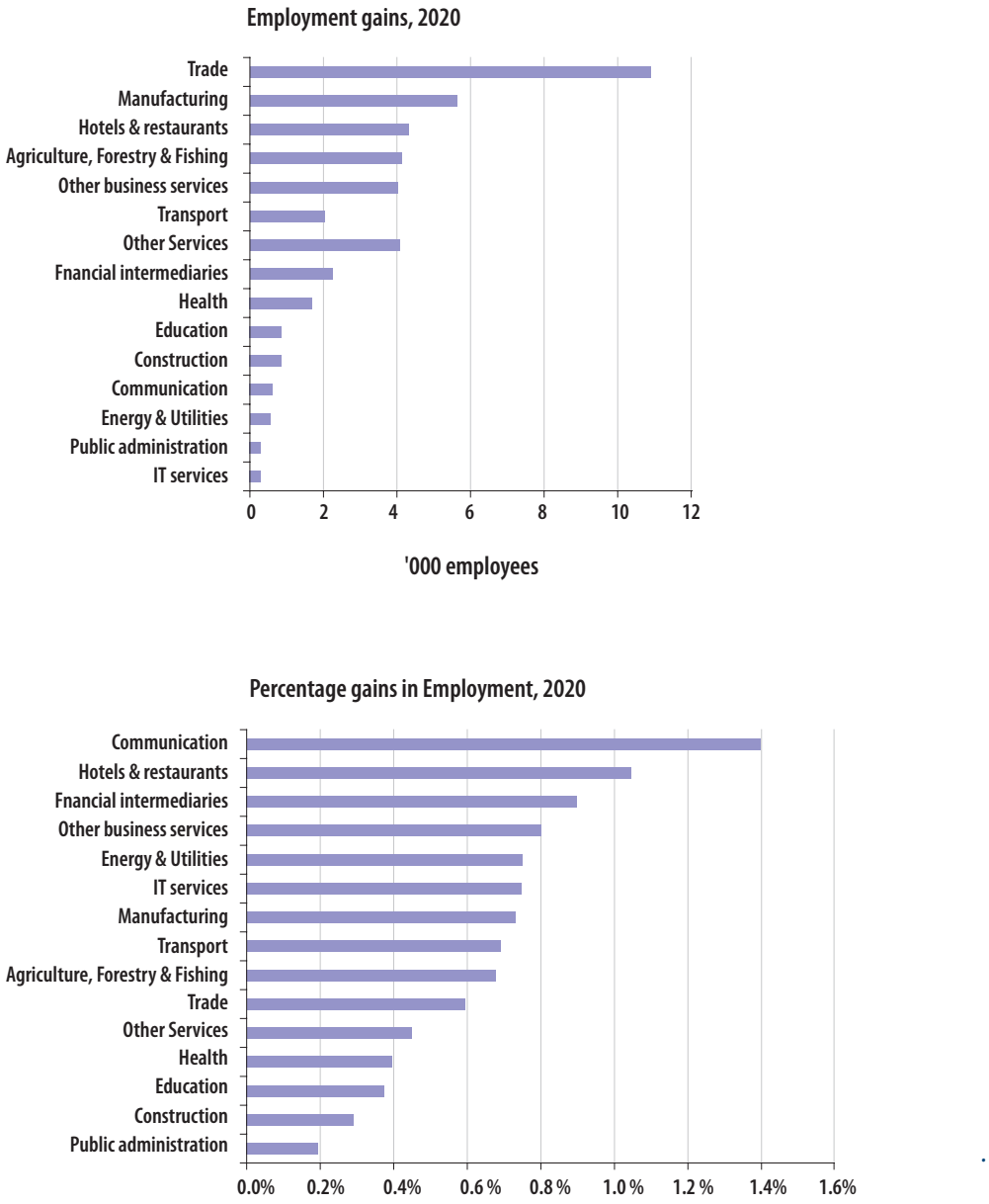


Given the additional output that is generated due to the adoption of cloud computing, in 2020 employment is higher by more than 37,900 jobs.

In order to generate more output, the Greek economy will need more labour employed to produce it. Given the additional output that is generated due to the adoption of cloud computing, in 2020 employment is higher by more than 37,900 jobs. The largest employment gains (about 10,900 jobs) occur in Trade (by far the most populous sector of the Greek economy), followed by Manufacturing with 5,600 jobs (Figure 4.20). The variation in employment gains across the sectors is not so pronounced if we control for the size of each sector. The Communications sector employs about 1.4% more people in 2020 due to CC, followed by

Hotels & Restaurants at 1.3% and Financial Intermediaries at 1.2%, while IT services come sixth with 1.1%.

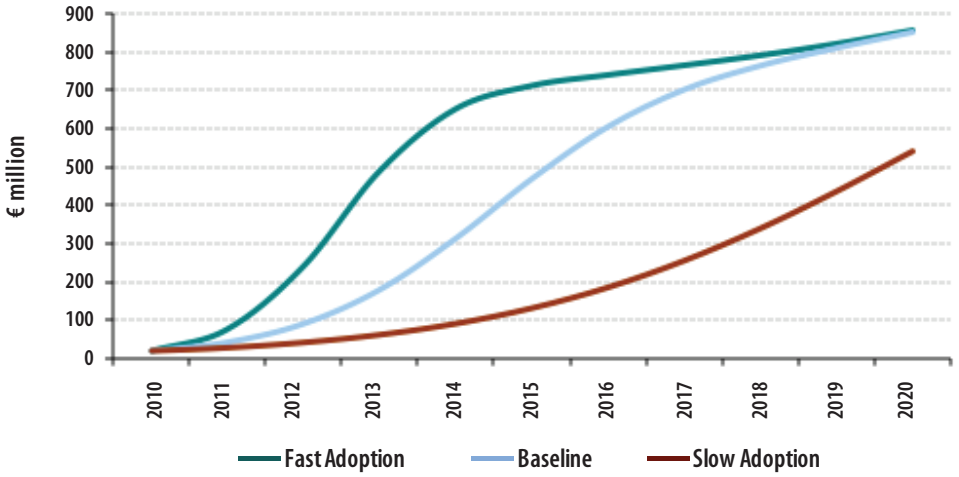
Figure 4.20: Incremental employment per sector due to CC, 2020



4.4 Adoption scenaria and the competitiveness of the Greek Economy

The extent of the gains presented so far depends crucially on the speed with which the Greek businesses and the public sector will adopt cloud computing solutions. Under the fast adoption scenario, the net cost savings from IT over the next decade increase to € 6.1 billion, higher by 27% compared with the baseline scenario.

Figure 4.21: Net cost savings per adoption scenario

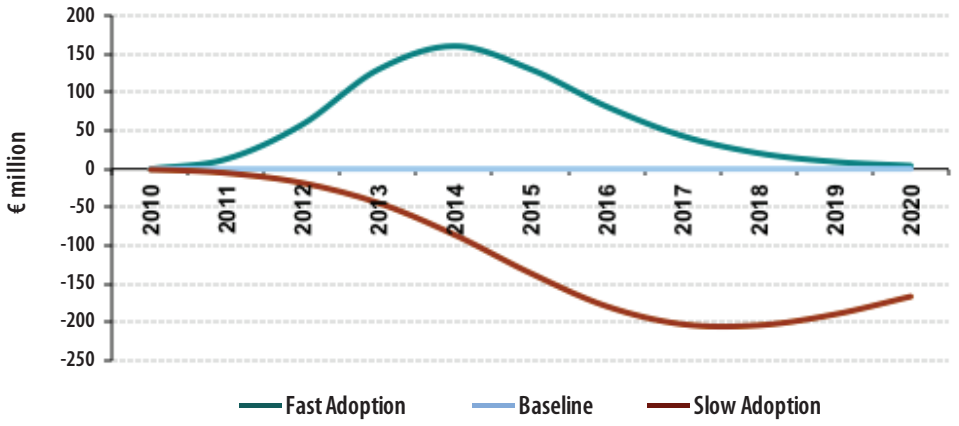


The difference in the economic impact between the three scenaria is compounded by the fact that faster / slower adoption in Greece, compared to the rest of the world, implies competitiveness gain / loss.

In contrast, under the slow adoption scenario, the net cost savings are limited to € 2.1 billion, lower than the baseline scenario by more than a half (-56%). The difference in net cost savings over the next decade between fast and slow adoption extends to € 2.7 billion.

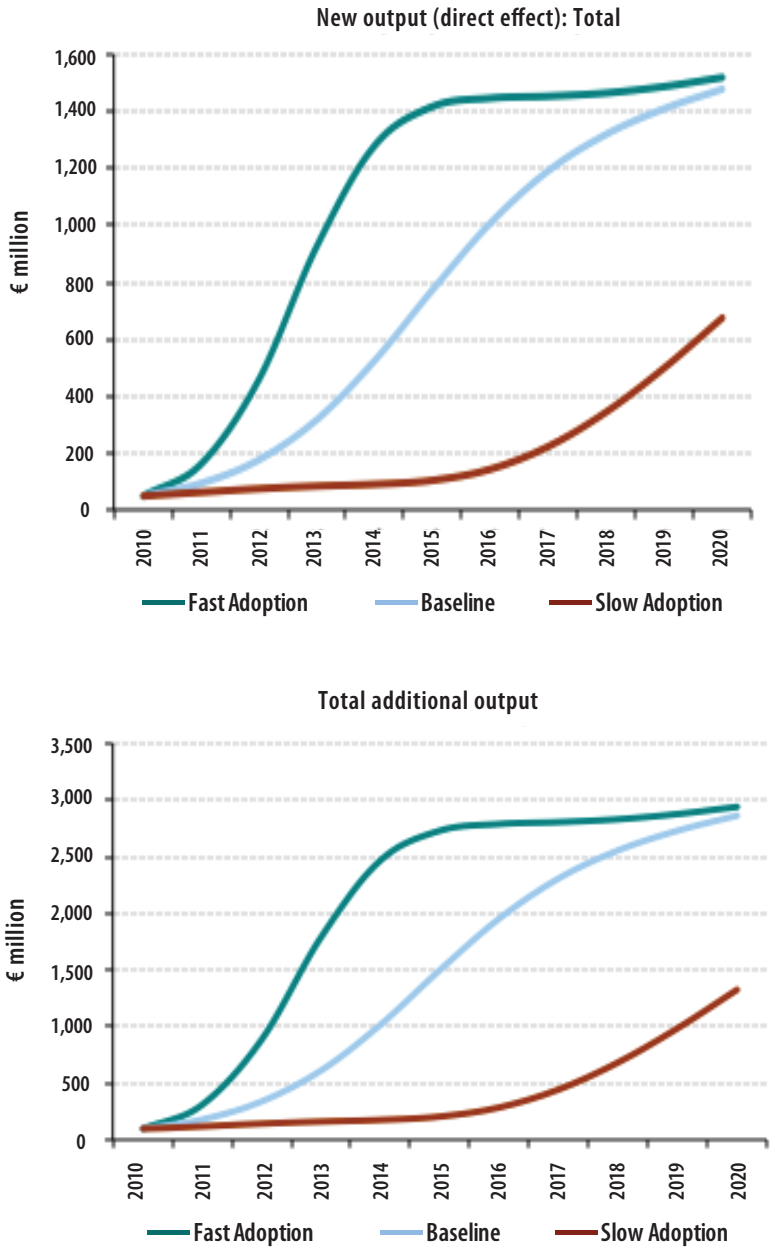
The difference in the economic impact between the three scenaria is compounded by the fact that faster / slower adoption in Greece, compared to the rest of the world, implies competitiveness gain / loss. Taking this effect into account, under the fast scenario the additional boost to output due to incremental exports reaches € 650 million over the next decade (Figure 4.22). In contrast, slow adoption is associated with dampening of Greek exports by almost € 1.2 billion.

Figure 4.22: Effect of different adoption speeds on Greek exports



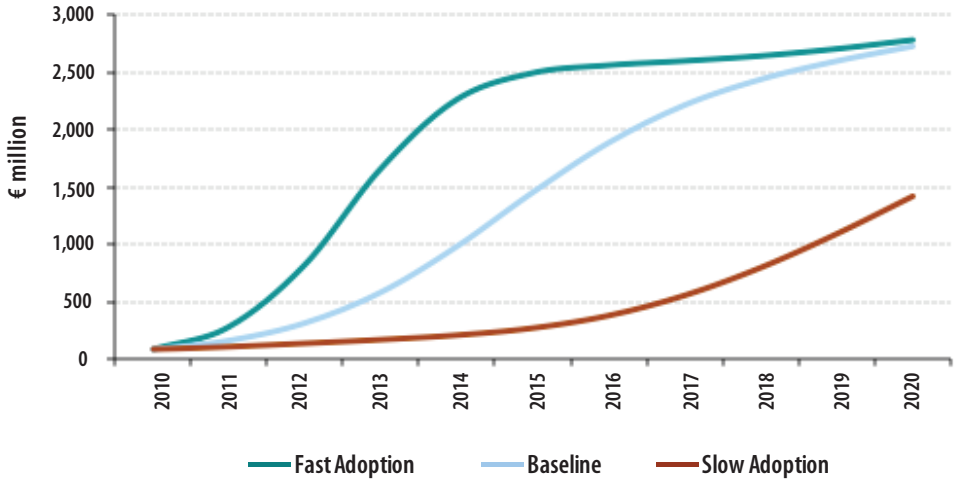
As a result of the competitiveness effect, under the fast adoption scenario the full potential output gain is fully realised already by mid 2010s (Figure 4.23). In contrast, the loss of competitiveness from sluggishness in adoption wipes out almost completely the output gains from improved scalability and productivity until later in the decade, when adoption by Greece's competitors has reached its upper bound, while in Greece it has just started to pick up.

Figure 4.23: Direct and overall incremental output per adoption scenario



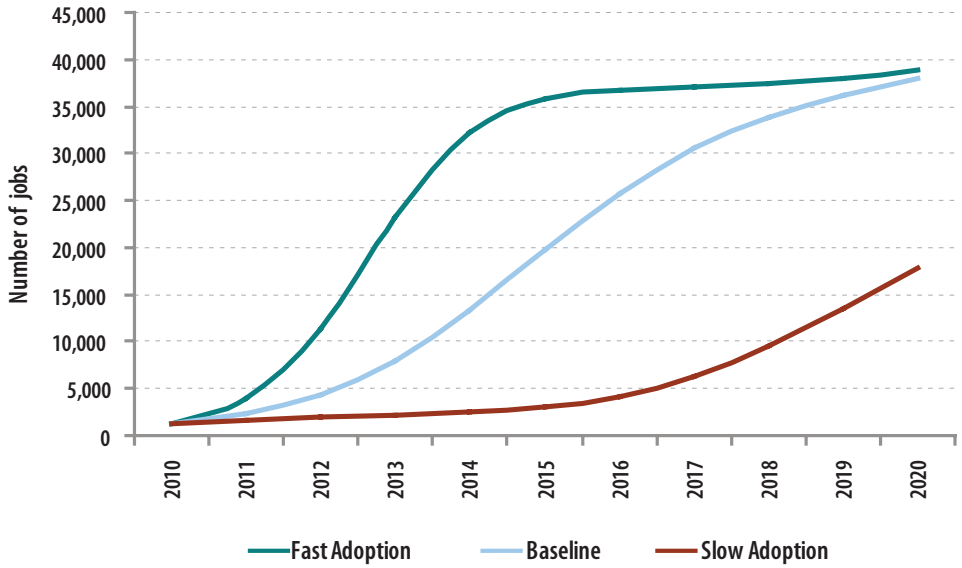
The additional income in the economy from the adoption of cloud computing over the next decade under the fast adoption scenario reaches almost € 21 billion (Figure 4.24). Compared with the baseline scenario, GVA is higher by € 5.5 billion or 36%.

Figure 4.24: Incremental Gross Value Added per adoption scenario



In contrast, under the slow adoption scenario the impact of CC on the income generated by the Greek economy is limited to € 5.1 billion, by € 10.2 billion lower than the baseline scenario and by almost € 16 billion lower compared with the fast adoption scenario.

Figure 4.25: Employment gains per adoption scenario



The speed of adoption has significant impact on jobs as well. Under fast adoption the gains in employment materialise within the next five years, providing relief at very difficult times for the Greek economy (Figure 4.25). In contrast, substantial employment gains under the slow adoption scenario will not occur until much later in the decade (2018-2020), when the Greek economy is expected to have recovered substantially from the current economic crisis.

4.5 Conclusions

Cloud computing can bring substantial gains to the Greek economy. By consolidating IT spending on equipment, expertise and power, cloud computing can bring savings to the amount of € 4.8 billion over the next decade. Through increased scalability and reduced barriers to entry into new markets, cloud computing raises the income in the economy further by € 5 billion. Taking into account the spill-over effects from the boost in economic activity, the overall cloud dividend for the Greek economy in the 2010-2020 period under baseline adoption scenario exceeds € 16 billion. In addition, by the end of the decade, close to 38,000 jobs will be created as a result of Cloud Computing adoption.

In order to achieve these benefits, however, Greek businesses (and the public sector as a facilitator) should adopt cloud computing at least as fast as the country's major competitors in the global markets. If Greece achieves 5-year transition to the cloud, while its competitors follow a 10-year transition path, the cloud dividend can reach € 21 billion with substantial employment gains over the medium term. In contrast, if technophobia and indolence prevail, the competitive position of Greece will continue to deteriorate and the cloud dividend will only extend to about € 5 billion with very little (if any) employment gains during the very difficult 6-7 years that lie ahead of us.

4.6 Bibliography

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[3] Etro, F. (2009), *"The Economic Impact of Cloud Computing on Business Creation, Employment and Output in Europe"*, Review of Business and Economics, 2009(2): 179-208

[4] Gartner, *IT Key Metrics Data: 2011 Summary Report*, January 2011

5 | Policy Recommendations

Policy recommendations for a faster diffusion and adoption of Cloud Computing (CC) cannot be proposed in isolation from a broader review of the policies that support the overall diffusion of new technologies into the Greek socioeconomic system. Recommendations for CC should hence be incorporated into a more general framework for the support of Information Society and ICTs diffusion in Greece. Indeed, in a country with a satisfactory adoption rate, but yet a low level of ICT adoption - with the exception of mobile phones - the attention should be drawn on the necessity of promoting new technologies, rather than on the exact type of technologies to be diffused. The latter may involve only a limited audience, despite the fact that the benefits of each type of technology can and should be communicated. Hence, the paradigm of CC should be embedded in an over-all policy discussion about the need to promote ICTs.

The role of the State is crucial in removing obstacles or improving the specific regulatory framework.

Business strategies of ICT firms, along with public policies supporting the Information Society, not only influence the demand directly or indirectly, but at the same time they shape the environment in which ICT firms operate. Such policies, provided they are well designed and targeted, can speed up the diffusion of Information Society in Greece, and thus support the CC adoption as well.

In this section we try to propose some ideas that could support the diffusion of ICTs and CC, by leveraging both private and public resources. Yet it should not be ignored that due to the limited public funds, it would be more likely to expect action from the private sector (the supply side), rather than the State. Nevertheless the role of the State is crucial in removing obstacles or improving the specific regulatory framework: the State does not necessarily need to spend extensive resources in enforcing a technology but create the conditions for the diffusion of the best alternatives. We therefore make some policy recommendations as suggested priorities, at two levels of analysis: a) at the business level (the level of CC providers) and b) at the level of public policy supporting ICTs. More specifically:

Recommendations at the IT business level

Priority 1: Raise CC Awareness

Raising awareness is maybe the first priority concerning cloud policy actions, effectively affecting the supply side. People are not yet familiar with the concept of CC, even if they are already using some hybrid CC services. Firms have to develop promotion campaigns on the uses of cloud computing and cloud applications in order to communicate the benefits to private consumers and especially to firms. Nevertheless a common level of understanding between potential customers and the IT sector regarding the direct and indirect benefits of cloud services seems to be more than necessary.

Raising awareness is maybe the first priority concerning cloud policy actions.

Priority 2: Diminish concerns of hesitant IT users

Another important priority is the mitigation of concerns of hesitant users regarding the adoption of cloud computing services. First of all, CC providers should monitor international trends and security updates on cloud technologies. In addition to monitoring, business

friendly rules for the treatment and movement of cloud data should also be introduced. In this line of argument, the exact clarification of the contractual relationships and the secure communication with external providers seems to play a crucial role. In other words, the higher the degree of clarification on cloud processes, the higher the potential of safer internet use.

IT firms should have a leading role in supporting the development of relevant e-skills.

Customisation of solutions also works in the direction of attracting hesitant users. Due to the different size and operation level of Greek firms, the type of clouds developed at a firm level may vary. Larger firms may need to develop their own internal clouds (private clouds), while smaller firms could move to clouds from external service providers (public clouds). Customisation allows users to exploit cloud features that could be developed internally based on their specific needs and purposes, while at the same time it allows the outsourcing of other functions to cloud providers.

Furthermore, cloud adoption rates may be improved through a free-of-charge testing period. This will allow firms to understand the basic principles of the proposed solutions and improve their decision making.

Priority 3: Support the development of e-skills

A third policy priority is the support of the development of e-skills through training programs. The digital gap between the rather small part of the population and firms that adopt rapidly new technologies and the larger part that still holds back, must be bridged. Although the State's contribution in such a priority is crucial, IT firms should have a leading role in supporting the development of such skills. Microsoft's initiatives in this direction could be used as a best practice. Microsoft supports K12 (primary and secondary school students) and University Students and Teachers in advancing their e-skills. Training of all University students on IT and Business skills through Private Edu Cloud, support of the usage of the latest ICT tools of K12 Students through the Digital School Initiative and free IT skills training to the disadvantaged of society, are some of the actions that Microsoft is currently implementing.

Priority 4: Achieve critical mass of infrastructure and services

IT firms should also put a lot of effort in the development of a critical mass of infrastructure and services in ICTs. In particular, investments in broadband infrastructures, with priority on open access, should be enhanced while digital content and services based on the advanced infrastructures should be expanded. Moreover, software developers need to focus on new attractive applications which can be provided at a reasonable cost. Cloud Computing provides an interesting tool for testing and implementing new IT applications, at a lower business risk. Finally, the production of digital content and relevant software in collaboration with content providers (publications, radio-television firms etc) that maximise benefits from the ICTs, remains a key foundation for cloud technology uptake and usage.

The public sector should invest in large datacentres which will form a new centralised computing infrastructure for the Greek government that will support all services.

At the level of public policy for ICTs

Priority 1: Develop Advanced Broadband Infrastructures

Due to the increasing concerns on both the current level of public broadband infrastructures and on the efficient use of those already developed, the State policies should aim at boosting investment on advanced broadband infrastructure and increasing efficiency. In particular, the public sector should invest in large datacentres (G-Data Centres / G-Cloud) which will form a new centralised computing infrastructure for the Greek government that will support all areas of public sector services (fiscal management, tax collection mechanisms, Regional Development, eGovernment, Social Security & Health, Education, Research and Technology

etc). Specifically, a large private cloud that would include wide areas of public sector could create economies of scale and maybe remove technically some of the barriers that currently are impeding functions of the State. A centralised cloud system could be a more efficient IT solution compared to multiple small-to-medium Information Systems scattered around various public agencies and having redundant computing power that cannot be utilised. Furthermore, it should be underlined that the technological modernisation of the public sector with the introduction and use of ICTs and CC applications in areas special interest, such as the health sector, the social security system and the management of public finances (i.e. tax collection mechanisms) could yield significant fiscal benefits, reduce "red tape" and add to the overall rationalisation of wider public sector.

Priority 2: Improve ICT skills

Bridging the digital gap between users and non users (individuals and firms) is a crucial priority and challenge for all current policies at a European level. Therefore, emphasis should be given on the development of ICT skills. Everyone must have equal chances in developing the necessary capabilities and knowledge in order to actively participate and fully benefit from the Knowledge Economy. Additional efforts for education and training are required. Otherwise, Greece could face the probability of lagging behind in developments regarding the Information Society, which could further hamper its competitiveness.

The need to enforce ICT courses at all levels of education seems a necessary condition for the creation of an advanced and highly skilled human capital in the country. These skills will help labour force participants claim better paid jobs, as well as contribute to the technological improvement of the medium-sized Greek firms. However, the introduction of computer science as a school course, is not adequate enough; the partial transformation of the overall educational procedure is also required. This means that the teachers should adopt the practical use of computer science in their courses and support the educational procedure by exploiting the existing tools (need for educational software). There is a need to improve the quality of delivery of education & training in all areas, including distance learning, as well as to enhance the learning experience. The Digital School should be expanded, while activities relating to lifelong training processes - both formal and informal -, as well as educational & vocational training opportunities could also be explored. Finally, the development of common and widely acceptable standards of certification of ICT training programs should be promoted.

The use of ICTs in the Public Administration can improve its efficiency and significantly contribute in limiting corruption and bureaucracy.

Priority 3: Diffuse the use of ICTs in the public sector

The use of ICTs in the Public Administration can improve its efficiency, and significantly contribute in limiting corruption and bureaucracy. Advanced e-government services may function as an additional motivation for citizens and firms to adopt ICTs in order to deal with the Public Sector. Nevertheless, it should be underlined that the problem of digital illiteracy is maybe more widespread in the Public sector. Therefore, target-specific strategies should be employed for public sector employees. Training courses with the help of IT experts, designed for all levels of civil servants, are necessary. Effective promotion of ICTs could also involve pilot implementation of cloud applications. These applications will be developed once and will be made available for all public entities since they can be customised to fit the needs and business environment of each institution (e.g. eProtocol, Website standards, Digital Signatures etc). Finally, it should be mentioned that past experience has shown that a stricter approach may accelerate the diffusion process. Compulsory use of ICT applications by the civil servants for specific functions, despite initial inertia, could enforce their widespread use.

6 | Appendix

Table 4.4: Input-Output table

<table>
<tr><td>Branches / Variables</td><td>Industry</td><td>---</td><td>Other services</td><td rowspan="6">Final consumption</td><td rowspan="6">Investment</td><td rowspan="6">Exports</td><td rowspan="6">Total output</td></tr>
<tr><td>Industry</td><td colspan="3" rowspan="5">Intermediate Consumption</td></tr>
<tr><td>…</td></tr>
<tr><td>Other services</td></tr>
<tr><td>Imports</td></tr>
<tr><td>Product taxation</td></tr>
<tr><td>Corporate taxation</td><td colspan="3" rowspan="4">Gross Value Added</td></tr>
<tr><td>Wages</td></tr>
<tr><td>Depreciation</td></tr>
<tr><td>Operating surplus</td></tr>
<tr><td></td><td colspan="3">Total output</td></tr>
</table>

Table 4.5: Small and medium enterprises per sector

Sector	Share of SMEs in Turnover	Share of SMEs in Employ-ment	Employees in SMEs (No.)	Number of SMEs	Employees per SME
Agriculture, Forestry & Fishing	100%	100%	519,500	513,792	1.0
Energy & Utilities	16%	28%	5,663	732	7.7
Manufacturing	53%	79%	322,806	95,164	3.4
Construction	90%	94%	287,282	108,803	2.6
Trade	87%	90%	888,923	305,616	2.9
Hotels & restaurants	93%	96%	286,483	104,376	2.7
Transport	73%	79%	154,705	71,017	2.2
Communication	7%	14%	5.581	616	9.1
Financial intermediaries	11%	11%	12,373	3,953	3.1
IT services	63%	81%	18,877	6,506	2.9
Other business services	81%	82%	277,570	142,849	1.9
Public administration	3%	3%	13,095	1,581	8.3
Education	6%	6%	20,758	5,650	3.7
Health	9%	9%	19,143	4,609	4.2
Other Services	77%	77%	145,904	48,883	3.0

Table 4.6: Adoption rate assumptions

Adoption rate (% of IT workload)	2010				Carrying capacity			
	Private	Hybrid	Public	Overall	Private	Hybrid	Public	Overall
Agriculture, Forestry & Fishing	1%	1%	1%	3%	5%	5%	40%	50%
Energy & Utilities	3%	3%	2%	8%	20%	10%	60%	90%
Manufacturing	3%	3%	2%	8%	20%	10%	60%	90%
Construction	1%	1%	1%	3%	5%	5%	50%	60%
Trade	3%	3%	2%	8%	10%	5%	75%	90%
Hotels & restaurants	1%	2%	2%	5%	10%	5%	75%	90%
Transport	1%	2%	2%	5%	5%	5%	80%	90%
Communication	3%	3%	2%	8%	50%	15%	25%	90%
Financial intermediaries	5%	4%	2%	11%	60%	10%	20%	90%
IT services	5%	3%	2%	10%	20%	10%	60%	90%
Other business services	5%	3%	2%	10%	20%	10%	60%	90%
Public administration	3%	2%	1%	6%	60%	10%	20%	90%
Education	3%	2%	1%	6%	5%	5%	80%	90%
Health	3%	2%	1%	6%	40%	40%	10%	90%
Other Services	2%	2%	1%	5%	10%	5%	75%	90%
Average	3%	2%	2%	7%	23%	10%	53%	85%

Table 4.7: IT cost breakdown

Sector	CAPEX%	Labour%	Power%
Agriculture, Forestry & Fishing	47%	49%	4.0%
Energy & Utilities	47%	49%	4.0%
Manufacturing	33%	63%	4.0%
Construction	47%	49%	4.0%
Trade	47%	49%	4.0%
Hotels & restaurants	47%	49%	4.0%
Transport	33%	63%	4.0%
Communication	33%	63%	4.0%
Financial intermediaries	19%	77%	4.0%
IT services	19%	77%	4.0%
Other business services	33%	77%	4.0%
Public administration	33%	63%	4.0%
Education	33%	63%	4.0%
Health	33%	63%	4.0%
Other Services	33%	63%	4.0%

Source: Gartner 2011, CEBR 2010, IOBE

Table 4.8: Estimated ex-ante IT cost

Sectors	2010	2011	2012	2013	2014	2015	2020
Agriculture, Forestry & Fishing	41	40	40	40	41	42	49
Energy & Utilities	29	28	28	28	29	29	35
Manufacturing	270	264	264	267	272	278	329
Construction	83	81	81	82	83	85	101
Trade	271	265	265	268	273	279	330
Hotels & restaurants	97	95	95	96	97	100	118
Transport	222	217	217	219	223	228	270
Communication	79	77	77	78	80	82	96
Financial intermediaries	284	278	278	281	286	292	346
IT services	33	32	32	33	33	34	40
Other business services	504	493	493	499	508	519	615
Public administration	223	218	218	220	224	229	271
Education	212	207	207	210	213	218	258
Health	147	144	144	145	148	151	179
Other Services	389	381	381	385	392	401	475
Total	2,883	2,819	2,819	2,852	2,902	2,968	3,513