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Conference Paper

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27th European Regional Conference of the International Telecommunications Society (ITS): "The Evolution of the North-South Telecommunications Divide: The Role for Europe", Cambridge, United Kingdom, 7th-9th September, 2016

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Serrano Calle, Silvia; Pérez Martínez, Jorge; Frías Barroso, Zoraida (2016) : Spanish Public Policies towards the Promotion of Cloud Computing and Digital Services for SMEs, 27th European Regional Conference of the International Telecommunications Society (ITS): "The Evolution of the North-South Telecommunications Divide: The Role for Europe", Cambridge, United Kingdom, 7th-9th September, 2016, International Telecommunications Society (ITS), Calgary

This Version is available at:

<http://hdl.handle.net/10419/148703>

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Spanish Public Policies towards the Promotion of Cloud Computing and Digital Services for SMEs

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Keywords

Digital Economy, Cloud Computing, SME, Public Policy

JEL Codes

H76, L88, O14

Abstract

The paper focuses on the first public programs in Spain to support the introduction of cloud computing services for small and medium-sized enterprises (SMEs) and micro-SMEs, and facilitating the digital transformation of SMEs, stimulating e-commerce and encouraging competitiveness. The paper analyses how the programs that the Spanish Government launched in 2015 transcend technology and impact over the digital ecosystem, with influences over supply and demand. The paper identifies the main drivers of SMEs providing cloud services and ICT solutions and other key elements that help to understand the eligible portfolio of cloud solutions and authorised providers that will contribute to the digital transformation of Spanish SMEs and micro-SMEs.

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1. Introduction

Advanced technologies and their adoption are reshaping traditional businesses. The use of cloud services is expanding and creating new ways to benefit business processes. These changes are impacting people and businesses around the world. Small and medium-sized enterprises (SMEs) have different requirements and need to act strategically to prepare their enterprises for the challenging new environment that is continuously evolving. There are several key factors influencing the cloud usage by SMEs, such as ease of use and convenience, security, privacy, or cost reduction (Gupta et al., 2013). Concerns on security, reliability, costs, or privacy are relevant for the adoption of digital services.

Cloud services are recognized as facilitating speed-to-market, supporting rapid innovation with reasonable costs for companies, for example, with a more efficient cost control. They are a suitable solution for varying demand and different workloads. Cloud computing is highlighted as one of the top technology's investment in the next five years, following Digital marketing, E-commerce, Customer experience management and Business analytics (Gartner, 2014).

The new paradigm in business due to the emergence of cloud computing and other digital services has created a gap on the early adoption of these services between enterprises. While large enterprises have been early adopters of cloud computing, on the contrary, SMEs and micro-SMEs are still thinking about the usefulness of these solutions and considering the benefits and inconveniences of their incorporation. This is a common situation in most countries.

SMEs play a relevant role in the economy of most developed countries. Though public programs to promote digital solutions could be a suitable help welcomed by SMEs, in a liberalized and competitive market, state aid to promote digital adoption by SMEs should be very carefully designed and, at the same time, adequate to achieve desired results. Under this strategy, competition policy and its instruments need to be not only well designed, but implemented and followed, too.

The European Parliament has recently published a resolution on unleashing the potential of cloud computing in Europe, approving the European Commission (EC) strategy to develop a coherent approach to cloud services in order to achieve the strategic goals. The resolution highlights the cloud computing services in its various forms as a significant advancement in information and communication technologies (ICT), with benefits for the users such as lower costs, ubiquitous access, convenience, reliability, scalability and security (European Parliament, 2013).

The Spanish Government, concerned about the digital development and transformation of the enterprises and the promotion of e-commerce, has recently launched a pioneering public initiative in the European Union (EU) to support the digital transformation of SMEs with regard to the adoption of cloud computing and other related services. The first phase of these programs started in August 2015.

Based on the help of the analysis of the information gathered about the Spanish Government's programs and the preliminary results of these programs, this paper explores the research question: Which portfolio solutions of digital services are the best candidates to benefit SMEs from participating in public programs?

In the paper we test the argument that the design of the programs and their implementation have conditioned and configured the supply and the demand of the digital services provided and demanded by SMEs. We will describe both ongoing Supply- and Demand-side Programs under the Spanish digital initiative for SMEs and we will analyse the first results already accomplished, with especial detail on the Demand-side Program.

Section 2 describes public policies to promote the use of digital and cloud computing services by SMEs. Section 3 presents different types of cloud computing services and the definition of a broad portfolio of cloud computing services for SMEs in Spain gathered in the programs under study. Section 4 shows the analysis and characterization of Spanish SMEs' behaviour as a result of the first phase on the Supply- and Demand-side Programs.

The paper concludes with several patterns identified on the still developing portfolio of cloud computing and digital services for SMEs and open some research questions for further analysis. The changes that are taking place in the demand- and supply-side, and the different degree of success and acceptance for the eligible portfolio solutions of digital services solutions to benefit SMEs and micro-SMEs in Spain.

2. Public Policies to promote the use of cloud services by SMEs

Governments and policy makers are concerned about economic growth and social welfare. The digital economy is a complex structure that evolves with innovations and allow new services and agents to reach end-users. From the 80s, the European Commission started to work on a digital strategy for European countries. Since then, public policies have focused on different aspects like infrastructure, the promotion of the use of standards or digital interoperability. The Digital Single Market Strategy as part of the Digital Agenda for Europe (European Commission, 2010a)

has defined a set of priorities in critical questions to advance in the digitalisation of the industry and of European enterprises. In this context, new policies and public investments could be understood as a response to a concern that national enterprises need to adapt to new technological and global competitive challenges.

In the EU there is a political concern on innovation, digital adoption and competitive challenges from the United States, China, and beyond. Recent researches by the EC have shown that, even though only 13% of the EU's SMEs were active in markets outside the EU in 2009, these enterprises showed greater employment growth and innovation than non-exporters (European Commission, 2010b).

A few years ago the EC started a new strategy to unleash the potential of cloud computing in Europe, strengthening the digital transformation of European enterprises to boost productivity, growth and jobs creation (European Commission, 2012). Big companies have always received a special attention, but SMEs and micro-SMEs have not started receiving it till very recently. In the EU, SMEs are the backbone of Europe's economy, representing 99% of all business activity in the EU and providing the majority of all new jobs. Around 85% of new jobs have been created by SMEs in the past five years (Eurostat, 2016).

Cloud services started long ago, but the positive effects have not reached all sort of companies yet. The ability of cloud services to drive business agility is increasing at all levels due to several factors: Migrating into the cloud is easier. Security measures used by cloud vendors are increasing and ensuring trust in the use of cloud computing services by businesses. The economic returns are positive. Business competitiveness improves and open new opportunities for enterprises. Some studies have shown there is a lack of knowledge on its economic effects as they are expected to foster productivity and economic growth (Candel Haug et al., 2015). The EC have suggested that the implementation of new actions enabling and facilitating faster adoption of cloud computing throughout all sectors of the economy could result in additional 45 billion euros of direct spend on cloud computing in the EU in 2020, as well as several million of jobs (European Commission, 2012).

A close review to the literature shows many studies have been conducted on the adoption of cloud services, especially regarding large companies, and the advantages and disadvantages of their use, such as security, privacy, reliability, or cost reduction. Gupta et al., (2013) have done a comparison of empirical studies on the usage and adoption of cloud computing by SMEs, most of them revealed the convenience and the importance of ease of use, and the acceptance and high expectations of SMEs from the adoption of cloud computing.

IT cloud services market and the definition of the different cloud services have evolved over time (IDC, 2015). According to the National Institute of Standards and Technology (NIST, 2012), *Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*

A very basic classification of cloud computing services, attending the ownership and control of the infrastructures is:

Public Cloud. The vendors host the infrastructures at their own premises and/or operate and control the computing infrastructure hosted, which is shared among several unrelated customers.

Private Cloud. In this model, resources are dedicated to a particular company and they are not shared with other organizations.

Hybrid Cloud. Combines both, private and public clouds. There can be dedicated or on-demand hosted private cloud services.

IT industry is moving from traditionally packaged software –i.e. as per number of licenses-models to cloud models. Attending the three main different service models, cloud services can be classified as (NIST, 2012):

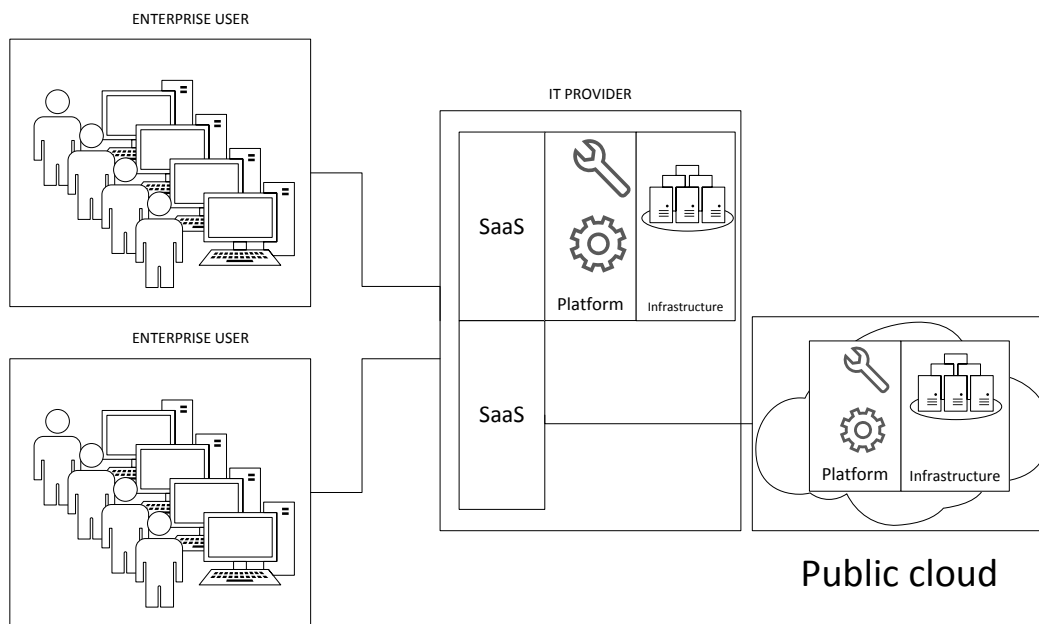
Software as a Service (SaaS). The capability provided to the enterprise is to use the provider's applications running on a private or public cloud infrastructure. The users do not control the underlying cloud infrastructure, though users can have access to specific applications and configuration settings.

Platform as a Service (PaaS). The capability provided to the enterprise is using infrastructure customized or created relying on resources the providers support. The enterprise does not control the underlying cloud infrastructure but have control over the deployed applications and hosting configurations.

Infrastructure as a Service (IaaS). The capability provided to the enterprise is to deliver the provisions for processing, storage, networks, and other resources running on a private or public cloud infrastructure. The users do not manage the underlying cloud infrastructure but they have control over operating systems, storage, applications, and selected networking components.

The three models are based on shared services and standards. Infrastructures are shared among multiple user groups when dealing with IaaS. For SaaS or PaaS, software and APIs are shared among multiple enterprises or private groups. PaaS have emerged as key elements on the new IT paradigm. SaaS is currently expanding among enterprises as virtual client computing is increasing. Figure 1 shows the different models of cloud services being used by SMEs.

Figure 1. Cloud Service Models for SMEs



Cloud computing means a change in IT services technical architectures and in business models. Some of the features a service should meet to be considered cloud are (IDC, 2015):

- Computing resource sharing. Multitenancy
- Elastic pricing: “pay-as-you-go” concept
- Elastic resource scaling
- Self-service. Access through Web services or APIs
- Turnkey services
- Published service interface and APIs

The industry is being transformed from both, the supply-side and the demand-side. The multi-dimensions of the market and the rapid evolution of the IT cloud markets make it difficult to define boundaries or establish a complete catalogue of business models (Marston et al., 2011).

The growth and development of the digital economy is based on the connectivity. Cloud services benefit from this connectivity and have the potential to redefine global trade due to many technology improvements and other innovations. Among other advantages, cloud services can reduce production costs and help SMEs to reach new markets thanks to e-commerce.

The general perception is that Governments have usually prioritised big enterprises that have long been considered of national importance, especially when those companies could become “international champions” in their fields. SMEs and micro-SMEs on the contrary, have not received so much economic and social importance in terms of national strategy. The new policy environment is evolving and policy makers have started promoting digital and cloud computing services for SMEs. Digital economy is expanding and reaches all sectors and activities. The EC has recently conducted several studies that point out the increase in economic terms (jobs creation and productivity) of those SMEs that have started their digital transformation and the need to extend this digitalisation to include all parts of the manufacturing value chain (European Commission, 2015a).

The aim of these new public policies is to help SMEs better understand the changes that lie ahead and provide them with solutions that can help them be more competitive and confront global challenges. The digitalisation of SMEs depends on a number of factors, it is different depending on the sector of activity and in the type of company.

There are many technology initiatives that can benefit SMEs. Cloud computing has been identified as a driver for digital transformation of enterprises and is a unique opportunity to increase SMEs’ competitiveness. Other areas identified are Internet of Things, Artificial Intelligence, Big Data, Smart cities or Cybersecurity.

Additional benefits associated with public goods, like the protection of the environment, could be achieved with the adoption of cloud computing services by SMEs. Moving from on-site facilities to cloud data centres usually saves energy and it is beneficial for the environment.

These changes are not without their challenges. There are challenges on cloud services adoption, as the European Parliament highlighted in the Resolution of 10 December 2013. Concerns on privacy, security, data protection or job disruption are on the table, but also technical aspects, as higher demand for bandwidth and availability of high-speed broadband, ensured performance of cloud services, standardisation, processing capacity or scaling of additional storage.

3. The Spanish digital strategy to support SMEs digital transformation. Programs.

SMEs and Micro-SMEs have a high impact on the economy and employment in Spain. In 2015 SMEs were responsible for around 62% of the employment (Ministerio de Empleo y Seguridad Social, 2016). By size, most of the companies in Spain are SMEs or micro-SMEs, around 99%. In 2015 in Spain, 54.1% of the companies were Micro-SMEs and 45.8% SMEs. Companies with 1-9 employees accounted for 40%, those with 10-49 employees were around 5% and SMEs with 50-249 employees represented 0.8% of the companies (INE, 2016).

In August 2015, the Spanish Government launched two pioneering public programs to support the digital transformation of SMEs through the adoption of cloud computing and other digital services.

The programs are part of the Spanish digital strategy to support SMEs and Electronic Commerce, as it has been defined in the Spanish Digital Agenda (Ministerio de Industria, Energía y Turismo, 2013). The programs have been designed to increase the demand of cloud solutions for Spanish SMEs and micro-SMEs, recognizing SMEs' strategic importance for Spain's growth. The Government's aim with this new strategy is to help SMEs reallocate technology costs while creating new opportunities for SMEs to increase their commercial activity and confront global challenges¹.

Among other results, the programs try to provide new ways for customers to consume services or goods provided by SMEs and their internationalization. In 2013, there were more than 3.18 Million SMEs and micro-SMEs (Ministerio de Industria, Energía y Turismo, 2015). By activity most of them work in the commercial area 24%, followed by building sector 13%, and industry 6%. The 57% left account for other services.

According to a report published by the Spanish National Observatory for Telecommunications and the Information Society (ONTSI, 2012), SMEs still do not know well the benefits of adopting cloud solutions. Only 9.8% of the Spanish SMEs surveyed in 2012 had implemented cloud solutions.

The eligible enterprises to participate in the new Spanish initiative are SMEs and micro-SMEs (defined as those with one or none employee) that should satisfy several requirements. Those requirements are part of the public policy design that have defined a digital ecosystem of

¹ Actions 3 and 7 of "Plan de TIC en PYME y comercio electrónico de la Agenda Digital para España", detailed information about the agenda, and the program itself can be found at: <http://www.agendadigital.gob.es>

solutions. Among the requirements, the eligible SMEs should have less than 250 employees and their annual sales should not exceed 50 million euros.

The Spanish programs represent an innovative approach for IT public policies. These new programs have been designed taking into account the influence of public policies over supply and demand. In addition, the policy has also addressed the preferences of the SMEs.

The public policy is based in two main different public initiatives launched at the same time (last quarter 2015). Both are currently on progress. These initiatives could be a test platform for the new public policies that other European Governments can follow in the near future in order to promote cross-EU cooperation among SMEs, leading innovation and adding value and profit to the European digital economy.

The first program has been defined as the *Supply-side Program for the promotion of cloud computing services' adoption by SMEs and micro-SMEs* (Supply-side Program). It is intended for Spanish technological SMEs, which are the only sort of enterprises that can participate in this program. It started in August 2015 (BOE, 2015a). The Supply-side Program aims at the development of applications for cloud and digital services.

Table 1. Budget by Region. Supply-side Program for the promotion of cloud computing services' adoption by SMEs

REGION	MAXIMUM BUDGET (€)
ANDALUCÍA	5.004.538,40
ARAGÓN	262.040,40
ASTURIAS	415.523,00
CANTABRIA	306.805,00
CASTILLA - LA MANCHA	1.562.540,00
CASTILLA Y LEÓN	1.129.164,40
CATALUÑA	1.454.418,60
COMUNIDAD VALENCIANA	3.573.207,40
EXTREMADURA	1.045.716,20
GALICIA	3.657.736,20
ISLAS BALEARES	213.893,80
ISLAS CANARIAS	2.578.984,20
LA RIOJA	80.431,60
MADRID	1.128.226,60
MURCIA	1.641.840,40
NAVARRA	214.972,20
PAÍS VASCO	729.961,60

The objective of the program is the design of new software solutions, Software as a Service (SaaS), and the development of tools to facilitate the migration of software that is currently being used by SMEs, to the cloud in the SaaS model, but with the particularity that all these new developments and solutions are to be used by SMEs and micro-SMEs.

The amount of the aid that eligible SMEs can receive varies from 20% up to 50% of their proposal (indirect taxes are excluded of public aid) with a minimum of €12,500 and a maximum aid of €60,000. The total budget for this public initiative is nearly 25 Million euros. This is an action co-financed with European Regional Development Fund (ERDF) support², initiative 2014-2020 (European Commission, 2015b).

The budget has been distributed among the 17 Spanish regions as shows Table 1. The distribution of the budget has taken into account the different needs and characteristics of the SMEs in each region and the ERDF requirements to strengthen economic and social cohesion among regions.

The beneficiaries of the aids must implement 100% of the cost of the eligible budget allocated, including indirect taxes applicable. Monitoring the performance of the program will be conducted by the authorities that may require related information to the providers.

The second program, defined as the *Demand-side Program for the promotion of cloud computing services' adoption by SMEs and micro-SMEs* (Demand-side Program), has been divided in two phases:

The first phase of the program started in August 2015, and consisted in a public tender to certify the providers and to select the eligible cloud solutions that SMEs and micro-SMEs can select in the second phase (BOE, 2015b). Enterprises have participated with a single or several cloud proposals of services for the SMEs. There were ten categories of cloud solutions described in Table 3. For each of those categories the enterprises could make their own proposal, with the restriction of only one proposal per category. More than 300 specific proposals of cloud services were registered, most of them, those that complied with the technical requirements, were part of the final catalogue of solutions at the end of the first phase of this program. Each solution and its corresponding certified provider will deliver it to the Spanish SMEs after the second phase of the announcement will take place.

² Programs Co-financed by the European Regional Development Fund (Smart growth' ERDF 2014-20 Operational Programme). The main objectives, funding priorities and expected Impacts: http://ec.europa.eu/regional_policy/en/atlas/programmes/2014-2020/spain/2014es16rfop001

The second phase of the Demand-side Program started in May 2016. The Spanish public program of incentives for SMEs at this stage consists in a cloud service funding, up to 50% of the total cost of the cloud services that certified companies, those selected in the first phase of the Demand-side Program, will provide to the eligible SMEs and micro-SMEs participating in the second phase of the Demand-side Program. The public aid is for nine months. Among the catalogue of solutions and certified providers, SMEs can choose the solutions that better fit their needs.

The total budget of the program is around 40 million euros. The amount per recipient varies from €625 up to €15,000. The public aid is around 20 - 50% of the SME's budget. The action is co-financed with ERDF support, initiative 2014-2020 (European Commission, 2015b). The budget has been distributed among the 17 Spanish regions as shows Table 2. The distribution of the budget varies to meet ERDF requirements to strengthen economic and social cohesion among regions.

Table 2. Budget by Region. Demand Program for the promotion of cloud computing adoption by SMEs

REGION	MAXIMUM BUDGET (€)
ANDALUCÍA	14.934.027
ARAGÓN	327.551
ASTURIAS	519.404
CANTABRIA	383.506
CASTILLA - LA MANCHA	1.953.175
CASTILLA Y LEÓN	1.411.456
CATALUÑA	1.818.023
CEUTA	35.823
COMUNIDAD VALENCIANA	4.466.509
EXTREMADURA	1.307.145
GALICIA	4.572.170
ISLAS BALEARES	267.367
ISLAS CANARIAS	3.223.730
LA RIOJA	100.540
MELILLA	35.823
MADRID	1.410.283
MURCIA	2.052.301
NAVARRA	268.715
PAÍS VASCO	912.452

The portfolio of cloud services, or catalogue, consists in 10 different solutions shown in Table 3. It is organized in groups or categories by functionality.

In the call for tenders for suppliers' certification, enterprises participating in phase one could only make one proposal, but could do it in more than one category, up to ten. There has not been set a maximum or minimum price by category. But the call for tenders has established that all cloud services must be provided in a safe environment, complying with current legislation and the recommendations of the EU.

Table 3. Technical services catalogue and reference number. Services' Classification

Reference number	Technical Service	Brief Description	Classification
1	Virtual User Desktop	To cover basic needs of SMEs users	SaaS
2	Economic Management	To cover SMEs' basic needs of accounting and billing	SaaS
3	Enterprise Relationship Management (ERM)	Meeting critical needs for managing an SME business through an ERM.	SaaS
4	Customer Relationship Management (CRM)	Meeting the basic needs of an SME for the relationship with its customers through a system of Customer Relationship Management (CRM).	SaaS
5	Point of Sale	Facilitating sales management using virtual terminals. Point of Sale (POS)	
6	Internet (Web &/or Marketing online)	Increasing the online presence of SMEs.	SaaS
7	E-commerce	Providing an online channel for Internet sales	SaaS
8	Infrastructure as a Service (IaaS)	Covering SMEs' basic infrastructure requirements.	IaaS
9	Platform as a Service (PaaS)	Providing capabilities and infrastructure for the development and implementation of software applications in basic SMEs platforms.	PaaS
10	Virtual Call Centre	Providing capabilities of an automated PBX equipped with call center and routing capabilities	SaaS

Providers can differentiate their offers, both by price and functionality as part of their sales strategy. Approved suppliers and their solutions are published on the website of the Spanish public institution Red.es³. With the catalogue of technical services and a basic description of requirements all technical proposals should fulfil, enterprises have done their proposals to participate in the first phase. For the 10 categories, a total of 318 proposals have been considered to be included in the final catalogue. Those solutions can be provided by certified providers. There are 105 certified providers, each one has its own technical proposal for the different sort of services. A close examination of the proposals and the companies that will provide those cloud computing services follows in section 4.

Within this program SMEs can benefit in certain cases in a double way. Firstly, because SMEs are the beneficiaries of the solutions under these public proposals. Secondly, because there are

³ Information about the Programs at: <http://subetealanube.gob.es/>

SMEs working on cloud solutions that can provide or collaborate with big companies in the digital ecosystem to provide cloud computing and other solutions under this public initiative. Our hypothesis is that as a consequence of the market structure many of the SMEs participating in the Supply-side Program for the promotion of cloud computing services' adoption by SMEs and micro-SMEs will be very close, not only in geographical terms, to other SMEs participating in the second phase of the Demand-side Program and will also be authorised providers. It is possible that those SMEs may have already offered IT services to other SMEs, and have a better understanding of SMEs digital needs. On the other side, big corporations with PaaS solutions may have serious difficulties to get in touch with micro-SMEs and smaller SMEs, due to the lack of capillarity.

The evaluation criteria to allocate the public aids to the SMEs and micro-SMEs participating in the second phase of the Demand-side Program is a difficult task, provided the huge demand and the limitation of the public aids.

The criteria is based on three points: The IT solutions the SME already has, accounting for 40%. The economic impact and the competitiveness gains for the SME, based on its IT savings as a result of cloud computing services adoption (35%) and the third criteria will be the SME commitment with this public program (25%).

Each beneficiary may select as many categories as they wish, indicating also which of the approved suppliers they choose. SMEs and micro-SMEs may select as many additional subscriptions in the same category as desired, but with a sole supplier.

The recipient must execute 100% of the cost of the eligible budget allocated including indirect taxes applicable. The performance of the program might be monitored by the public authorities, who may require related information to the providers.

The execution period and justification of projects should not exceed 15 months. In this period the certified providers must deliver the nine-months service and submit justification. In this process the beneficiaries are not allowed to switch suppliers. After completing the nine months of the cloud services, providers shall issue an invoice in which they will apply for a discount equivalent to the subsidy. Paid the invoice, the supplier shall provide the justification at the competent public body (Red.es) that will pay the share of the public aid.

4. Results

I. First stage of the Demand-side Public Program

The analysis of the first phase of the Spanish program for SMEs and micro-SMEs digital transformation have shown the influence of public policies over supply. We have analysed the public data about certified providers participating in the first stage of the Demand-side Program. In order to understand their preferences we have also examined the data provided regarding if they were participating in one or more -up to ten- different categories (Table 3), if they were delivering services alone or as a joint venture, or considering their geographical location.

To analyse public policy measurements and their impact on technology adoption by SMEs and the impact on the digital ecosystem, in the paper we have used the model of digital and cloud services in Figure 1, and the services' classification as SaaS, IaaS and PaaS (Table 3). The analysis has been conducted based on a global ecosystem model of cloud computing providers.

Focusing on the Demand-side Program for the promotion of cloud computing services' adoption by SMEs and micro-SMEs, the definition of a broad portfolio of cloud computing services for SMEs in Spain for up to 10 different categories of digital services have shown the preferences for providers of cloud services and ICT solutions. The final approved proposals have varied depending on the sort of cloud service as shown in Table 4.

Table 4. Distribution of approved proposals for each cloud computing service category

Reference number	Technical Service	Number of approved proposals	Classification	% of approved proposals (per service category)
1	Virtual User Desktop	38	SaaS	80.20 %
2	Economic Management	31		
3	Enterprise Relationship Management (ERM)	45		
4	Customer Relationship Management (CRM)	37		
5	Point of Sale	16		
6	Internet (Web &/or Marketing online)	35		
7	E-commerce	38		
10	Virtual Call Centre	26		
8	Infrastructure as a Service	51	IaaS	16.04 %
9	Platform as a Service	12	PaaS	3.80 %

SaaS is the most demanded type of cloud service with around 80% of the approved proposals. For IaaS (service category nº8), the total amount of approved proposals is only around 16. There are 51 approved proposals, what means different 51 approved providers, as the program only

allows each provider to propose a single proposal per service category. On the other side, for PaaS (nº 9), there has been a few proposals, 3.8% of the total, only 12 out of 318 total approved proposals.

Under SaaS classification, ERM (nº3) has received the maximum number of approved proposals and providers, 45. Followed by Virtual User Desktop (nº1), and E-commerce (nº7), both with the same number of approved proposals, 38. For CRM (nº4) there are 37 approved proposals.

One of the results observed analysing the companies that have participated with their proposals at the first phase of the Demand-side Program, is the confirmation of our hypotheses about the role of large companies and their absence in the participation of the first phase of the Demand-side Program as eligible providers. It highlights that large companies with good experience providing cloud services worldwide like Amazon, IBM, Microsoft, or Google to name a few, did not apply for their services to be certified. These multinationals have already been working on the needs of the SMEs for a long time and help SMEs around the world to improve their business experience with their cloud services. On the contrary, other enterprises, mainly SMEs, have participated as eligible providers with their own solutions. However, a detailed technical analysis of all certified services leads us to think these providers use in turn public cloud services of big corporations. This is grounded on the lack of capillarity of their sales force, since they provide very flexible and global services.

Figure 2. Degree of bundling. IT Certified Providers vs. Amount of portfolio services offered



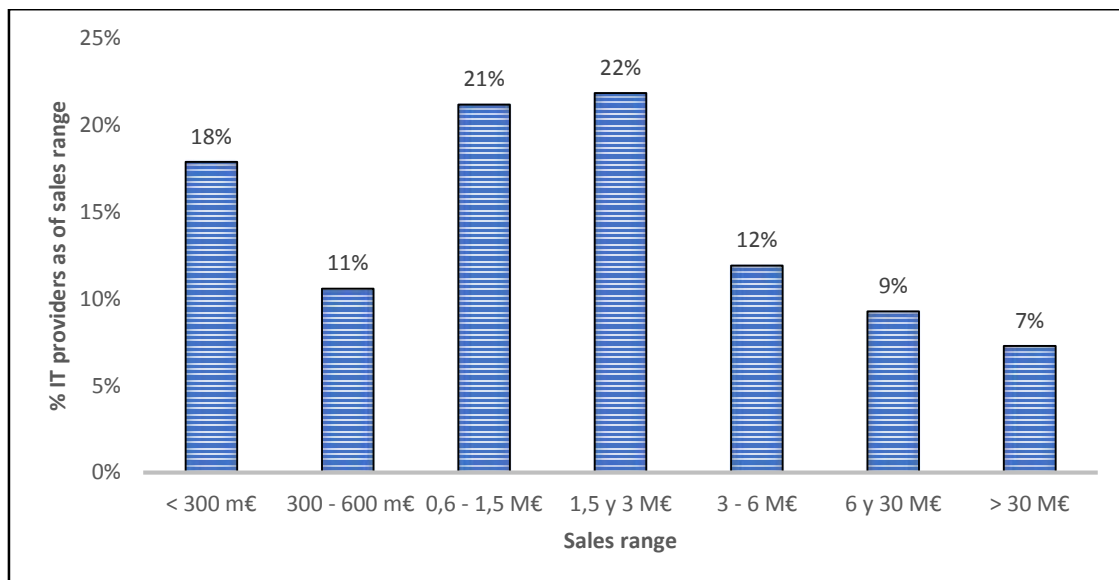
This is reflected in what we can call the “degree of bundling”. Figure 2 shows the number of certified IT providers as of amount of serviced offered. Most of the providers (31) offer one sole kind of service out of the ten existing in the call for tenders. Actually, the number of providers

decrease along with the amount of services (the degree of bundling), what reveals the absence of big global players, since large dominant platforms can provide virtually all services described in the call for tenders.

In addition, this analysis suggests that many of the certified IT providers are market niche players, which develop within in a specific service as e-commerce or enterprise resource planning (ERP).

The behaviour of the certified providers participating in the Demand-side Program, as Figure 3 shows, is being affected by the conditions specified in the Demand-side Program. SMEs with a turnover lower than 1 million euros have participated as part of an interim joint venture to comply with the program specifications. 75% of the approved providers are SMEs with a turnover of less than 5 million euros.

Figure 3. Number of applications as of providers' turnover Demand-side Program



Figures 4 and 5 show the number of applications of standalone providers vs. joint ventures. This is a good example of how the conditions established in the call for tenders have forced providers to find alliances and strategies in order to achieve the annual turnover required in order to be authorised as certified providers. That was one of the requirements.

Figure 4. Number of applications as of providers' turnover. Standalone providers vs. Joint ventures

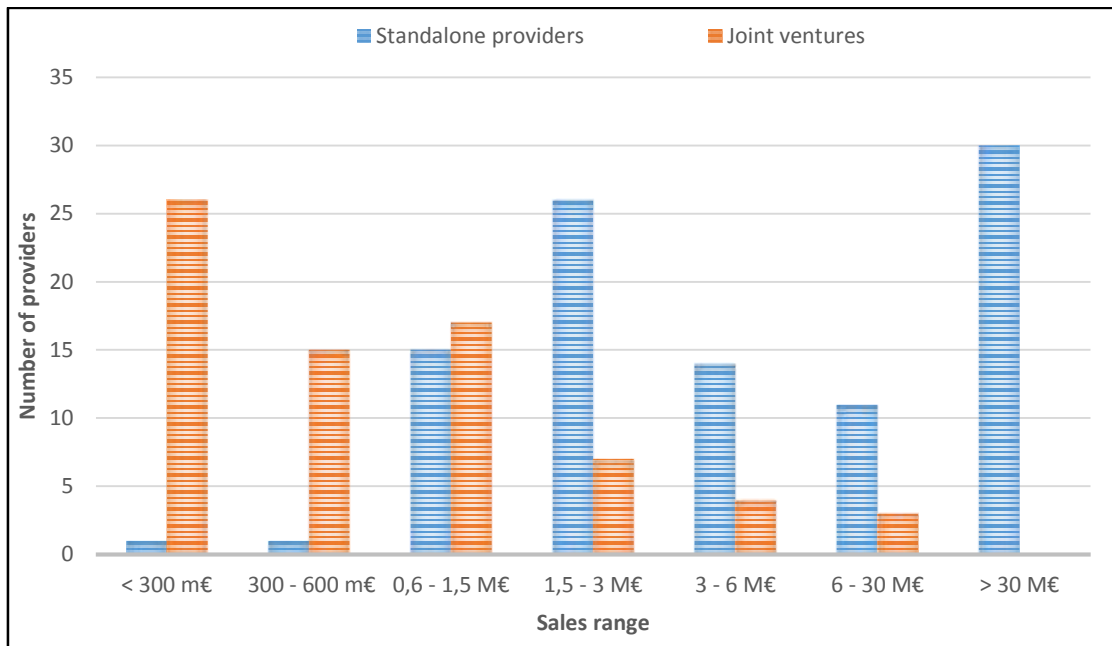
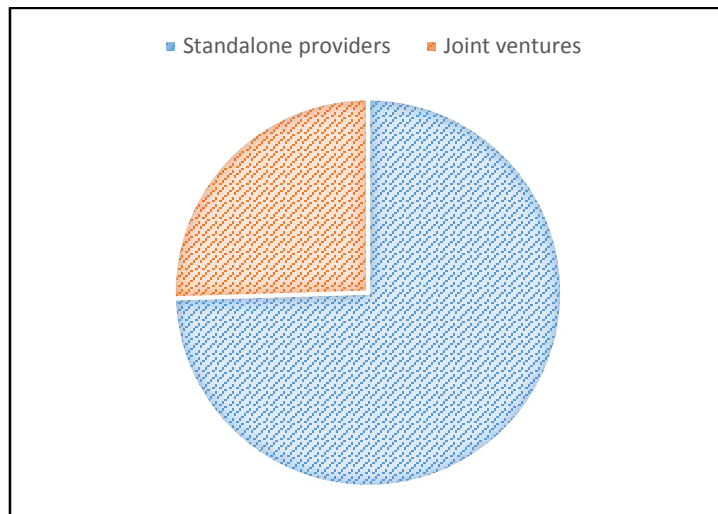


Figure 4 show the same data, but discerning between standalone providers and providers belonging to a joint venture. The number of standalone providers increases along with the turnover, while for joint ventures, it decreases. This is a clear example of how the conditions settled in the call for tenders have influenced the certified services, in this case, forcing alliances among IT providers whose turnover was below 1 Million euros⁴. However, this has been the main driver for joint ventures to be created, but not the only one, since there are a few IT providers whose turnover exceeds € 1M taking part in joint ventures. As we will describe below, geographical location has been another explanatory variable of this phenomenon.

Overall 105 enterprises have been approved as certified providers at the end of phase 1. Out of them, 27 belong to one of the 14 joint ventures that have been certified. The relevance of joint ventures is shown in Figure 5, as joint ventures accounted for a quarter of total certified providers.

⁴ Note that there are some standalone providers whose turnover do not reach the € 1M threshold established in the call for tenders. This is because the public data available, from the Spanish Trade Registry date from 2014.

Figure 5. Certified providers by type



Given the relevance of joint ventures, we have conducted a deeper analysis on their structure. On the one hand, Table 5 shows the number of providers belonging to a joint venture. Most of the joint ventures comprise only two providers, while there are only three of them which aggregate five providers.

Table 5. Certified Joint Ventures. Distribution by size

Joint venture's size	N. Enterprises
2	14
3	8
4	2
5	3

This confirms the turnover criteria as the main driver for joint venture building. Should other factors be relevant, one would expect very different results. For instance, if, given there are 10 service categories, offering a wider portfolio of services had been relevant, joint ventures with a larger number of enterprises would have probably emerged.

On the other hand, a geographical location analysis of the SMEs taking part in one same joint venture show interesting results. Out of the 27 joint ventures, fourteen of them have all their members located in the same region. This means geographical location is another relevant explanatory variable for building a joint venture.

Figure 6. Geographical distribution of providers vs. % of Funds by geographical location

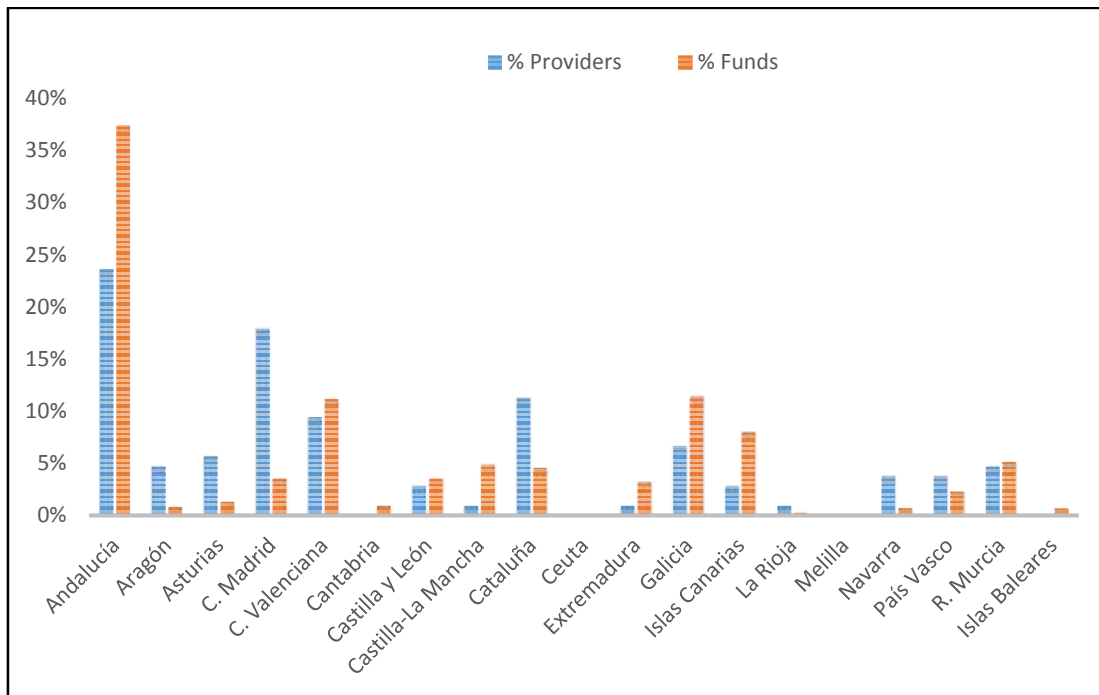


Figure 6 shows the share of funds allocated to each region, on the hand, and the share of certified providers, on the other. The allocation of funds, as it was described in section 3, is calculated, inter alia, according regions' wealth. As one could expect, the higher percentage of funds are located to bigger and less developed regions, as Andalucía, while providers are mainly located in Madrid and Barcelona (Cataluña). Nonetheless, a relevant share of providers is located in big regions irrespective of their wealth, as Andalucía or C. Valenciana. The correlation coefficient between share of funds and share of certified providers is 0.7525. This linkage also suggests that the regionalization of funds, as complying with the ERFD, has greatly influenced the results of the first stage of the Demand-side Program and reinforces the theory on the capillarity-driven demand, as follows.

The linkage between share of funds and share of certified provider theoretically should not be relevant, as for the allocation of funds is considered the location of the SMEs requiring the cloud services, not that of the provider. For instance, if a SME residing in Andalucía adopt a cloud service of a provider in Madrid, that subsidy would account for Andalucía. Following that argument, a high correlation between geographical fund allocation (and thus potential customers) and location of IT providers would only make sense if market players expect in turn a high correlation between the location of providers and customers (the SME adopting the service).

In addition, shall the location be relevant, with providers and adopters being in the same areas, we forecast a fierce competition in the Demand-side Program in places like Madrid and Cataluña, where the ratio of providers largely exceeds that of allocated funds.

II. The Supply-side Program and the virtuous cycle theory

The analysis of the enterprises (SMEs and micro-SMEs) participating in the Demand-side Program Phase I and those participating in the Supply-side Program for the promotion of cloud computing adoption by SMEs and micro-SMEs have shown some interesting and positive retro alimentation.

Participation of SMEs in the Supply-side Program can be considered very successful. The allocated budget, 40 million euros, has been exceeded. More than 600 proposals have been received.

Table 6 shows there is a huge number of IT providers (standalone or in a joint venture) that have participated in both public programs: in the first phase of the Demand-side Program, for their cloud services to be certified, and in the Supply-side Program to be eligible for state aids to generate such services. It is especially relevant that out for the 79 standalone certified providers, 17 have apply to the supply-side contest, while all joint ventures have at least one IT provider taking part in said supply-side contest.

Table 6. Participation of standalone SMEs and joint ventures Demand-side P. Phase I vs. Supply-side P.

	Standalone providers	Joint ventures	Total
Providers present at the Supply-side contest	17	27	44
Providers not present at the Supply-side contest	62	0	62

On the one hand, this should not be surprising. First, to apply to the supply-side program the size of the IT provider must be below 250 employees and the turnover cannot exceed 50 Million euros. This clearly explains why joint ventures –which have been built driven to comply with the financial capacity required for IT providers to be certified for the demand-side program- are more likely to be at the supply-side program than standalone providers.

On the other hand, a second reading is more striking: a relevant part of certified services of the demand-side program to be eligible for SMEs might be under development. And it makes sense. They are mainly local players which, in the absence of demand –or a demand public policy program-, will not generate such services probably because they do not compete with big global players, but their customers are located very close to them in the pre-cloud ecosystem.

The second phase of the Demand-side Program is ongoing. Around 5400 SMEs and micro-SMEs have requested their participation in this public program, requesting public aids over 65 million euros, nearly three times the total budget for this public initiative, which is nearly 25 Million euros.

5. Conclusions and future work

In this paper we have described the last two public policy programs that the Government of Spain has developed for the promotion of cloud computing services by Spanish SMEs and micro-SMEs. The aims of this public policy are to help creating a virtuous circle between the technological development of SMEs (aids for cloud computing solutions development), and SMEs and micro-SMEs of all sectors of economic activity (aids to cloud solutions adoption by SMEs and micro-SMEs), especially for those SMEs and micro-SMEs located in less developed geographical areas. The instrument used to achieve these goal has been the development of the two programs analyzed in our investigation, the Supply-side Program and the Demand-side Program. Both are still ongoing, and can be considered a great success, given the number of aid applications received.

At this moment, few data on the Supply-side Program is available, but our analysis on the purpose and practical implementation of the program, allows us to conclude that IT SMEs in less developed regions in Spain have an excellent opportunity to develop technological solutions with significant public support (public aids). In the future they could sell those services in the market or even sell their solutions to other enterprises, like big service providers of cloud computing worldwide.

The Demand-side Program, which is the one with most public data available and on which we could carry out a more detailed analysis, had a first phase of certification of providers with their cloud solutions' proposals. Any company currently providing cloud computing services in Spain, with a turnover over one million euros could apply. They had to offer a unique solution (performance, price and technical procedure for implementing it) for one or more categories

(one IAAS, one PAAS and eight SAAS categories). With all the homologated solutions, a catalogue of cloud computing services has been developed. SaaS solutions, as our results have shown, are the main portfolio solutions of digital services to be the best candidates to benefit SMEs from participating in the public programs. SMEs participating in the second phase of the Demand-side Program, still on-going, will request public aids and make their selection among those services and certified providers.

The overall conclusion of our analysis is that, although from the standpoint of public policy, the program has been very successful as the applications for aid have exceeded the available funds, even in the most disadvantaged regions, the variability of the benefits of the offered solutions in the catalogue, show that, beyond the possible deficiencies in the program design, there is a huge immaturity of the technical solutions, business models and marketing channels in the cloud computing services market targeted at SMEs. On the other hand, the enormous difference between the potential companies receiving aid and the ones which have finally requested them, shows the great lack of knowledge by SMEs about their advantages. This is a huge problem for the competitiveness of SMEs but a great opportunity for those SMEs – both technological and user ones - that adopt them in the first place "early adopters".

Other significant results of our analysis are:

Major global platforms of cloud computing (Microsoft Azure, Google...) have not submitted their services to certification in order to participate in the Demand-side Program, while there have been a high number of local enterprises, specialized in providing IT services in regional environments, submitting. It seems that these global platforms do not have the commercial flexibility and sufficient capillarity to reach SMEs, which is the intention of this aid program.

In the first phase of the Demand-side Program, there have been a number of small suppliers, in particular 27 joint ventures, apparently motivated by the need to reach the solvency request in the Program to be approved as a supplier, that have taken advantage of the amount of the aids allocated in other regions where they have no presence, or to increase the number of categories of services offered to SMEs. Indeed, most of the companies that have participated in the 27 joint ventures did not reach the threshold of annual turnover. In addition, there are joint ventures formed by companies based in different Spanish regions and some joint ventures which have been formed by companies in the same region are specialized in some solutions of the catalogue. However, our research has also revealed that most of these joint ventures have among its members at least one company that has participated in the Supply-side Program.

A significant number of companies specialized in providing some of the services listed in the portfolio of solutions - particularly those related to e-commerce or business management - , are participating simultaneously in both programs, Demand-side Program and Supply-side Program.

These results lead us to propose the following working hypothesis to be confirmed as the program develops:

First. It is possible that many of the technical solutions in the catalogue are in an early stage of development and therefore need operational third-party services. That means that large platforms absent in the first phase of the Demand-Side Program, but that are large global competitors in public cloud services at all levels (SaaS, PaaS and IaaS) will play a key role in the provision of services through local suppliers, i.e. IT SMEs. Consequently, we predict a process of "local public clouds" creation, fathered by the approved suppliers, to replace the "pre-cloud" products that their customers were using so far. In the process, local suppliers (IT SMEs) can create SaaS services using third-party PaaS and/or IaaS services, or integrating SaaS solution. This last option could be the case of many of the SMEs participating in the Demand-side Program with a SaaS proposal.

Second. All indicators show that the programs have created a virtuous circle at a regional level with significant benefits for both, demand and supply in the market.

We will have to wait until the detailed results of the second phase of the Demand-side Program is published to test these hypotheses.

The analysis of the cloud computing and digital services program for SMEs in Spain has raised some questions that should be addressed in future studies:

The cloud computing business models developed are highly influenced by the public policy. One sole technical offer was admitted for each category in the portfolio. How did providers choose between the different possible technical solutions to certify? Are pricing schemes related to the fact that subsidies last 9 months?

Regarding cost structure. Cloud computing services are billed on a pay-per-use basis. Which metrics are taken into account to measure the use? How important is time and how important are other measures of other computing-related resources? Is the flat rate concept against cloud computing essence?

The analysis of the Spanish public programs to promote cloud computing and digital services for SMEs and micro-SMEs have shown that there is a clear need and demand of digital services by

the enterprises. Deeper insight into the role played by public policies in the promotion and adoption of digital technologies and services may shed new light on the internationalization of SMEs and market integration in the EU.

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