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ON THE ROLE OF PUBLIC POLICIES SUPPORTING FREE/OPEN SOURCE SOFTWARE. AN EUROPEAN PERSPECTIVE

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On the role of public policies supporting Free/Open Source Software. An European perspective.

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Abstract

Governments' interest in Free/Open Source (F/OS) software is steadily increasing. Several policies aimed at supporting Free/Open Source (F/OS) software have been taken or are currently under discussion all around the world. In this paper, we review the basic (economic) rationales for such policy interventions and we present some summary statistics on policies taken within the European countries. We claim that in order to evaluate correctly the consequences of such interventions one has to consider both the role and the administrative level at which such decision are taken as well as the typology of software which is involved. Moreover, we argue that the level playing field cannot be taken for granted in software markets. Therefore, non-intrusive public policies that currently prevail at the European level in terms, for instance, of the promotion of open standards or in terms of campaigns aimed at informing IT decision–makers, are likely to be welfare enhancing.

JEL codes: O38, L51, L63

Keywords: Free/open source software, public policies, software market

1. INTRODUCTION

Governments' interest in Free/Open Source (F/OS) software is steadily increasing. In Europe, this interest has become visible in the Lisbon Strategy and in the corresponding eEurope Action Plan[1] aimed at making the European Union the most competitive and dynamic knowledge-based economy by 2010. A way to achieve this goal is through the promotion of "the use of [Open Source software] in the public sector and eGovernment best practices" (IDABC, 2006).

Public polices in support of F/OS software take many forms, they may have different targets and they may occur at various administrative levels; for these reasons, it is of crucial interest to understand motivations and effects of governments' interventions in the software markets.

The paper is structured in three parts: in the first part (Section 2), we provide a general analytical framework; as mentioned, public interventions may occur at different administrative levels (i.e. from municipalities to national or supra-national level) and they may have different motivations. These complexities have not received enough attention in the previous analyses on public interventions towards F/OS; the aim of this section is to offer a possible taxonomy for governmental polices in the software market and to discuss the many rationales for intervention but also the counterarguments that often have been put forward. In Section 3, we give a short look at the data and we apply the proposed taxonomy to represent the main public initiatives in Europe; thanks to this simple empirical exercise based on data largely obtained by the IDABC program, we are able to derive some interesting considerations on the motivations and the characteristics of governments interventions implemented all across the EU. Section 4 concludes by bridging the theoretical discussion with the empirical analysis. We claim that, if one considers that the largest share of the software market is represented by self-developed or customized products, the existing literature has placed too much emphasis on packaged software and arguments against public support of F/OS might be improperly grounded. Moreover, we believe that the level playing field cannot be taken for granted in software markets. Therefore, non-intrusive public policies that currently prevail at the European

[1] Further details are available at: http://europa.eu.int/information_society/eeurope/2005/index_en.htm.

level in terms, for instance, of the promotion of open standards or in terms of campaigns aimed at informing IT decision–makers, are likely to be welfare enhancing.

2. A GENERAL FRAMEWORK

It seems to be useful to start our analysis by providing a general framework for discriminating the large heterogeneity of public interventions in the software market. In particular, we claim that, in order to judge correctly rationales, motivations and consequences of public interventions, it is important to distinguish between the various roles played by policy makers and the various categories of software involved. We argue that many existing contributions, both in the scholarly and in the practitioners' debate, have not clearly taken into account these distinctions.

Public administrations, institutions and governments play a double role in the software industry. On the one side, being big spenders for software licenses and software development, their adoption/use decisions represent a significant share of the demand thus having a major impact on market equilibrium. On the other side, by acting as legislators and regulators, governments do in various ways determine the evolution of the market; for instance, it is quite evident that the legislation towards intellectual property rights, either based on strong patent protection as in the US or on weaker copyright legislations as it is within the EU, has a major influence on the functioning of the market and the diverging experiences on the two sides of the Atlantic stand as a clear example of this role. Similarly, as we discuss later in the paper, governments frequently intervene mandating the adoption of open standards/interfaces; these policies are usually aimed at promoting compatibility and interoperability between different software platforms, thus creating a level playing field between different competitors; this kind of intervention clearly affects the efficiency of the market and therefore suggests a regulatory intention of the proponents.[2]

[2] For an example at the transnational level see the European Interoperability Framework for pan-European eGovernment services, mandating a series of policies, standards and guidelines aimed at "facilitating […] the interoperability of services and systems between public administrations, as well as between administrations and the public" (http://europa.eu.int/idabc/en/document/2319/5644). For an application at the national level the reader may refer to the Dutch manual on open standards and open source software

Obviously, it is often difficult to disentangle interventions of public authorities as adopters/users from those motivated on regulatory scopes; being large users, the decision to adopt a certain software package taken by public bodies affects the dynamic evolution of the industry and the equilibrium outcome, thus having regulatory consequences on the overall functioning of the market.

Irrespectively of the role played by a public administration, interventions may produce different consequences depending on the nature of the product involved. Software is not a commodity and the industry is extremely heterogeneous; indeed, the vast majority of software is either self-developed or custom while packaged software represents a minor share of the market.[3] The structure, the players and the dynamics of mass-market and custom segments of the software industry are very different as well as different are likely to be the effects induced by the various public interventions.

In Table 1 we provide four examples of interventions distinguishing among different roles of public administrations and different typologies of software: three of these interventions are directly related to the promotion of F/OS, while the fourth refers to the well–known Microsoft European antitrust case. This last example relates to the F/OS world since, as a consequence of the antitrust action, Microsoft has recently announced its decision to allow access to some parts of the source code of its operating system.[4]

(OSOSS) in the procurement process, encouraging the adoption of open standards in the public sector (http://www.ososs.nl).

[3] According to Bessen (2002), packaged software has never accounted for more than a third of software expenses.

[4] See, for instance, Microsoft's Jan. 25, 2006 press release available at http://www.microsoft.com/presspass/press/2006/jan06/01-25EUSourceCodePR.mspx and the comments of Neelie Kroes (European Union's antitrust chief), stating that documentation enabling interoperability, rather than mere code disclosure, is at issue in order to meet EU's requirements (http://today.reuters.com/business/newsArticle.aspx?type=technology&storyID=nL26331447).

	Adoption/development	Market regulation
Custom	August 2005: the French Ministry of Foreign Affairs starts developing an open source architecture in order to integrate its computing system.[5]	October 2004: the Belgian administration published its white book concerning the use of open standards and open specifications for public sector purchased software.[6]
Packaged	September 2004: the Education Council of Castilla - La Mancha signed an agreement with Sun Microsystems to distribute Star Office 6.0 to the region's schools.[7]	EU's 2004 antitrust decision: Microsoft is required to disclose complete and accurate interface documentation which would allow non-Microsoft work group servers to achieve full interoperability with Windows PCs and servers. This will enable rival vendors to develop products that can compete on a level playing field in the work group server operating system market.[8]

Table 1. Examples of public interventions supporting F/OS or regulating the market[9]

Rationales for intervention: review of the literature

The literature on F/OS software in public administrations is quite substantial. Supporters of F/OS software have mainly focused on adoption of such technologies in the public sector and have based their arguments on technical, cost–efficiency or political–idealistic grounds. Regulatory scopes and therefore those rationales based on the consequences of F/OS public adoption on the overall functioning of the market have been receiving a much more limited attention by this stream of research.

Conversely, most of the critical voices in this debate have warned against detrimental consequences of both direct support/intervention and adoption of F/OS by public administrations on market performance.

In what follows, we briefly summarize the debate on F/OS software in the public sector; we devote the first subsection to provide a general overview of the most frequent motivations that have been proposed to justify public support towards open source. In the

[5] http://europa.eu.int/idabc/en/document/4549/469.
[6] http://europa.eu.int/idabc/en/document/3336/469.
[7] http://europa.eu.int/idabc/en/document/1766/469.
[8] http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/382&format=HTML&aged=1&language=EN&guiLanguage=en.
[9] For a brief but comprehensive review of various national initiatives and policies on open source software see the links provided by the IDABC Open Source Observatory at http://europa.eu.int/idabc/en/document/1677/471.

second subsection we look at the issue from a more critical viewpoint and we present the (often) skeptical view held by some economists and closed source practitioners.

Why supporting F/OS?

Advocates of the F/OS movement put forward several rationales for public policies in the software market. Leaving aside pure idealistic–philosophical motives,[10] governments should support F/OS because of its intrinsic superiority with respect to closed source software. F/OS is considered to outperform proprietary software in terms of, for instance, higher reliability, security, flexibility and maintainability of the code.[11] These superior features stem both from the organizational mode of F/OS which is characterized by the presence of a community of developers that continuously reviews the source code and fixes possible bugs, as well as from the fact that the availability of the source code makes it possible for the user to adapt the software to her/his own personal needs and to check every possible defect. Cost-efficiency is a second common rationale for policy interventions which is especially important for those public administrations that are pressured by budget concerns. The public sector would benefit from F/OS because of a number of reasons: net savings due to the reduced or non–existing licensing fees, the opportunity of freely contracting with software developers for subsequent code maintenance/upgrade without being locked into the relationship with the initial provider, or the possibility of profiting from economies of reuse/collaborative development.[12] Similarly, a further beneficial effect would follow from a more efficient employment of public resources that would be shifted from sterile license costs towards more productive human capital investments.

With the broader perspective of the overall software industry, F/OS advocates also stress the importance and benefits of public intervention. Open source licenses guarantee the

[10] A notable example of this kind of motivations can be found in the programs and activities of the Free Software Foundation, aimed at affirming the primacy of freedom ideals in the development and diffusion of software.

[11] For a comprehensive survey on this topic see Wheeler (2005).

[12] Reuse economies are savings due to recycling previously developed code as a basis for a new project; collaborative development economies are strategies of mutualization consisting in partnerships for joint development by the public sector, motivated by the needs of pooling efforts and sharing costs in building, maintaining and upgrading large software projects of common interest. See Schmitz and Castiaux (2002) for an assessment applied to FO/S software.

availability of the source code and the same legal rights as those of the original developer to every individual who is interested in a certain software product. This wide availability of the "updated state–of–art", within an industry characterized by cumulative generation of knowledge, is perceived to be of crucial importance to spur innovation. In this respect, Varian and Shapiro (2003) argue that, being typically based on open interfaces, F/OS encourages third–party innovation in terms of development of, for instance, adds–on and complementary products.[13] Similarly, Benkler (2002) considers self–organization in the distributed peer production model more efficient in "acquiring and processing information about human capital available to contribute to information production projects" than traditional institutions, such as markets and hierarchies. Henkel & von Hippel (2004) push this argument further, claiming that "user innovation", a fundamental trait in F/OS software development, is welfare enhancing.

From the national perspective, those countries, whose software industry is lagging behind or is not competitive in the international markets, may consider public support to F/OS a viable way to cultivate a domestic software industry, therefore reducing their dependency from foreign suppliers; this rationale for public intervention seems to be ranked particularly high in the agenda of both emerging[14] and developed[15] countries. Varian and Shapiro (2003) sponsor this opinion and emphasize that the GNU/Linux operating system is "an open platform on which commercial or open source applications can be built, thereby spurring the development of a robust domestic industry".[16]

Another common motivation for intervening in support of the F/OS movement is the stimulus of competition in the software market; this motive seems particularly relevant for those segments of the market characterized by the presence of dominant firms such as

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[13] Bessen (2002) holds a similar view.

[14] Support to domestic software industry lies at the core of the IT national policies of India and China. See, for instance, the remarks of the Indian President, A.P.J. Abdul Kalam, on the future challenges of information technology for developing countries (http://news.com.com/2100-1016-1011255.htmlnews.com.com/2100-1016-1011255.html) or the speech of the Ministry of Science and Technology at the 2004 International Conference on Strategies for Building Software Industries in Developing Countries (http://www.iipi.org/Conferences/Hawaii_SW_Conference/Li%20Paper.pdf).

[15] This occurs both at the national as well as at the local levels. See the statement by the Finnish Ministry Kyösti Karjula (http://www.linuxtoday.com/news_story.php3?ltsn=2002-06-17-011-26-NW-DP-PB) as an example of the first type and the deliberation of the autonomous province of Trento on the adoption of open standards and open source software (http://www.linuxtrent.it/Members/napo/deliberaPAT_n1492.pdf) as an instance of the second type.

[16] Smith (2002) contrasts this view arguing that in a large number of countries, not only in the developed ones, a flourishing (proprietary) software industry already exists.

in the packaged software segment[17] and, more generally, in software procurement markets where dominant proprietary systems tie users to single suppliers, thus restricting competition.[18]

A more critical view

During the last few years, several economists and other scholars have scrutinized the possible role of public policies in support of F/OS software. A part from some relevant exceptions, the majority of authors seem to be rather skeptical about the welfare benefits that would accrue from governments directly stimulating F/OS.[19] One leading argument is that Open Source has emerged and, in many cases, has been extremely successful even without any intervention in place; therefore, there seems to be no need for public policies in order for F/OS to flourish. On top of that, focusing on closed source software, many authors claim that there is no clear evidence of significant failures in the software market and, consequently, there is no urge for governments' intervention. Evans (2002) and Evans and Reddy (2002) point out that the software industry is highly competitive[20] and also its performances in terms of growth, productivity and R&D expenditures have been impressively high.[21] In other terms, software markets appear to be an example of a well–functioning markets and, therefore, public funding to stimulate the emergence of alternatives to closed source software are prone to pick the "wrong winner". Moreover, a strong support to F/OS software may seriously undermine the incentives of commercial

[17] Among others, see the statement made by Boris Schwartz, deputy leader of the SPD parliamentary group, during the debate about the transition towards open source systems of the city of Munich (http://www.linuxtoday.com/infrastructure/2003052600126NWSWPB).

[18] See, for instance, the recommendations of the Danish Board of Technology (2002) on supporting the emergence of alternatives in custom built software markets as means to foster competition and the recommendations of the Finish Minister of Finance (2003), suggesting to include the possession of the source code in tender drafts in order to assure competitive bidding in future development and maintenance.

[19] One notable exception is represented by Lessig (2002) who claims that government preference towards F/OS is justified by the presence of externalities that market forces do not internalize. For instance, software developed for or adopted by some branches of the government could be employed usefully also by other branches if it is free or open source; the initial development/adoption decision should take into accout also the potential benefits for future users.

[20] These authors provide several figures to support their argument. In the US the Herfindahl-Hirschman index (HHI) for the software industry is smaller that the average HHI computed for the US manufacturing industries; furthermore, during the period 1996-2000 there has been a decrease by 27% in the quality-adjusted prices for the packaged software.

[21] According to Evans (2002), in the year 2000 the R&D expenditure of software companies represented one tenth of the overall R&D undertaken within the industrial sectors while fifteen years before it accounted for only 1%.

firms to innovate or to improve the quality of their software (Schmidt and Schnitzer, 2003).

One of the main arguments in favor of F/OS is that it guarantees to public administrations significant reductions in software expenses; various authors point out that cost savings obtainable by adopting F/OS rather than proprietary software are by far smaller that those expected. The licensing fees represent only a minor part of software costs and a meaningful comparison between F/OS and commercial software has to be done in terms of the "total cost of ownership" (TCO) which also includes user training, technical support, maintenance and possible upgrades of the software. On these grounds, the overall cost advantage of F/OS is less evident.[22]

The higher degree of innovativeness that, according to supporters, characterizes the F/OS development mode is also a strongly debated issue. Smith (2002) acknowledges the brilliant performances of proprietary software companies in terms of R&D expenditures and resulting innovation and declares himself rather skeptical about F/OS being able to replicate such figures.[23] Evans (2002) and Evans and Reddy (2002) go even further and claim that the theoretical argument according to which open source implies more innovation completely lacks of solid empirical evidence, given that many successful F/OS software projects draw strong inspiration from already existing closed source counterparts.

The discussion we have presented so far reveals a widespread skepticism among economists and closed source advocates about direct government policies in favor of F/OS software; nonetheless, there is a general consensus on the need of a broader set of interventions that somehow ensure the level–playing field in the software market. In particular, various authors are making strong arguments against the current system of protection of intellectual property rights. A long series of decisions taken by US courts during the last twenty years has extended software patent protection and has made it easier for applicants to obtain patents even for obvious inventions. These facts have

[22] The empirical evidence comparing the TCO of open vs. close software solutions does not seem to be conclusive. For a comprehensive overview the reader may refer to the FlossPols report on policy support (Ghosh and Glott, 2005).

[23] Smith, Microsoft's senior vice president, also claims that often, in order to bring the software to the market, additional investments have to be done and these can not accrue from the F/OS world but can only come from the commercial one.

induced large firms to accumulate sizable numbers of software patents, the so-called patent thickets, that can be strategically used in order to block competitors' innovation. As Bessen (2002, p. 13) points out, US patent legislation may actually "sabotage the otherwise healthy open source movement" therefore potentially undermining competition from F/OS solutions.[24]

Finally, an issue that has drawn the attention of several contributors relates to the public funding of software R&D based on open source solutions. In this case, the non–rival and non–excludable nature of software goods, largely due to negligible replication costs, may induce policy makers to sponsor F/OS software projects as a means to increase social welfare.[25] While there is some consensus on the beneficial effects of this kind of interventions, the usage of restrictive licensing schemes (such as the GPL), is still very much debated: the software developed within publicly funded R&D projects should be made available to the widest possible audience but such restrictive licensing terms may undermine private appropriation of publicly funded basic science efforts.[26] In particular, closed source firms may be prevented from adopting and developing complementary applications for software distributed under GLP-like licensing schemes. Lessig (2002) suggests that governments should employ a non–discriminatory approach: publicly funded code should be released in the public domain or employing non–restrictive open source licenses (such as BSD–like ones).

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[24] For an empirical analysis on software patents see Bessen and Hunt (2004). According to these authors the strategic accumulation of patent thickets seems to be the most convincing explanation for the large increase of software patenting in the US. Similarly, several panelists, according to a recent US Federal Trade Commission (2003) report, support the view that the patent protection system poses threats to innovation in the software industry. Lessig (2002) and Von Hippel (2005) argue in favor of lessening the extent of patent protection in the software industry. According to Evans (2002) and Evans and Layne-Farrar (2004), even though some (minor) reform of the patent legislation might be beneficial, software patents should not be banned altogether.

[25] See, for instance DeLong e Froomkin (2000) for an application to digital goods markets.

[26] Smith (2002) and Lessig (2002) hold the view that government should finance R&D activities but the resulting software should not be distributed under restrictive licensing schemes. On the contrary, Varian and Shapiro (2003) focusing on the Linux case argue that the adoption of GPL does not necessarily prevents the development of complementary applications. Henkel (2004) provide empirical evidence that, despite GPL's strict requirements in releasing derived work, firms can adopt several successful strategies in order to protect their own code enhancements.

3. MAJOR INTERVENTIONS IN THE EU

All across Europe, governments and public agencies are intervening in the software market in various ways; since September 2003, the major initiatives are registered on the Open Source Observatory, a dedicated web site compiled by the European Commission within the IDABC program.[27] For each intervention registered on this web site a brief abstract and, usually, a series of official documents and press releases describing the content of the policy are available. In order to derive useful information, we have reviewed the existing documentation focusing on the most important interventions registered on the IDABC site, therefore disregarding public initiatives taken by very small municipalities. The dataset we have compiled starting from the IDABC documentation has been complemented with the information recovered from an independent investigation by the Center for Strategic and International Studies (see Lewis, 2004).

It should be noted that given the methodology used within the IDABC program, the information we have gathered does not represent the complete set of initiatives taken in the European public sector. Some typologies of policies or some countries might be underrepresented in the sample. However, we believe that our effort to summarize the existing policies in favor of F/OS software represents a useful starting point to analyze the major European initiatives within a unified setting.

Overall, we have collected information about 105 interventions, distributed across 14 European countries; France is by large the most active country with more than 28% of the interventions in our sample.[28] Around 8.5% of the policies have been taken at the EU level and therefore they should be common to all European countries.

To summarize the information derived from our dataset, we have grouped policies according to:

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[27] IDABC stands for Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens; the information available on the Open source Observatory is collected by a special webteam from staff members of the European public sector and also by searching the Internet for relevant information. The documentation we have collected is available at the following URL http://europa.eu.int/idabc/en/chapter/491.

[28] The large interest of public authorities in France has been documented also in a previous IDABC report, see Schmitz (2001).

- the type of the software involved by the intervention: we have distinguished between *custom*, *packaged* software and broader interventions aimed at supporting the use of *open standards*/*interfaces*;
- the political and administrative levels at which the intervention is taken: we have applied a two tier classification distinguishing both between *government* and *public agencies*/bureaus (i.e. central government *vs* postal services) and between *central* and *local*/regional level of intervention (i.e. central government *vs* local municipality);
- the type of intervention: we have grouped interventions into three broad categories: *adoption* when the government/agency has decided to adopt a certain software, *advisory* when the policy consists of a general claim of preference towards open source and/or encourages the use of F/OS or it is aimed at informing potential adopters of the existence and characteristics of open source and, finally, *development* when the government actively promotes the creation of new software;
- the rationale for intervention: we have classified policies into seven non–exclusive broad categories: *cost–efficiency,* that pools together motivations such as savings in license fees, economies of reuse of the software, savings from collaborative development of projects, and more efficient employment of public (shift from license fees to investment in human capital); *code availability*, combining motivations connected to the technical advantages assured by transparency, security, robustness and quality of the code; *interoperability*, in which the rationale for intervention lies in stimulating the diffusion of open standards and in promoting interoperability in the software market; *flexibility*, in which motivations are linked to flexibility advantages assured by, for instance, the possibility of tailoring the code to the user's needs, to assure integration and compatibility with existing systems, and so on; *enhanced competition*, combining interventions motivated by levelling the playing field, creating alternatives to proprietary companies, supporting domestic industries, stimulating technical independence from dominant vendors, introducing competition in support, maintenance and upgrade of systems and so forth; *efficiency in the public sector*,

gathering motivations specifically related to the diffusion of best practices in public administration bodies; and, finally, *information diffusion*, a category representing those interventions motivated by the aim of increasing the available information and of raising consciousness about F/OS in the general public or, more specifically, in public administrations.

Table 2 shows the sample distribution of the various policies with respect to their type. F/OS adoption and advisory are the most common interventions in Europe: together they represent more of the 80% of the whole sample.

Intervention	**Freq.**	**%**
Adoption	47	44.8
Advisory	39	37.1
Development	19	18.1
TOTAL	105	100

Table 2: Public policies classified in terms of type of intervention

In Table 3 we go further into the detail and we present how the three types of policies are distributed between central and local decisional levels and between governmental authorities and public bureaus/agencies. More than 80% of the interventions in our sample are taken at the governmental level (both local and central) while agencies have played a much more limited role. Advisory policies aimed at suggesting and promoting F/OS prevail in central governments while at the other levels adoption is the most common type of intervention. This is not surprising once considered that central governments often provide "guidelines" for action while operative decisions are effectively endorsed at the local level and in agency bodies.

	Intervention			
Level	**Development**	**Adoption**	**Advisory**	**TOTAL**
Central Gov.nt	8 (17.8%)	9 (20%)	28 (62.2%)	45 (100%)
Central Agency	1 (8.3%)	9 (75%)	2 (16.7%)	12 (100%)
Local Gov.nt	9 (21.4%)	24 (57.1%)	9 (21.4%)	42 (100%)
Local Agency	1 (16.7%)	5 (83.3%)	0 (0%)	6 (100%)
TOTAL	19 (18.1%)	47 (44.8%)	39 (37.1%)	105 (100%)

Table 3: policies classified in terms of type of intervention and administrative level

In Table 4 interventions are grouped according to the kind of software they are directed to: either software custom or packaged or towards the implementation of open standards. Note that in many cases, the intervention is not restricted to a unique type of software but it may involve two or all of them.[29] Table 4 suggests that local governments are more active towards packaged software while central governments do not seem to follow any particular pattern.

[29] This fact explains why rows sum up to more than 100%.

	Software		
Level	**Custom**	**Packaged**	**Open Std.**
Central Gov.nt	69%	73%	0%
Central Agencies	33%	66%	17%
Local Gov.nt	38%	78%	5%
Local Agencies	83%	33%	0%
TOTAL	53%	72%	8%

Table 4: policies classified in terms of software type and administrative level

Restricting the analysis to central governments and central agencies, we have looked more closely at the motivations behind interventions. According to the available information, only in 37 out of 57 of the cases it was possible to collect official statements explicitly accounting for the rationales for intervention. The information we have gathered is presented in Table 5. Clearly, given the small number of observations, some caution has to be exerted when interpreting this data; however, it is worthwhile to highlight the major trends that characterize European policies.

Total figures in Table 5 show that cost-efficiency motivations are the most popular, followed by interoperability and code availability ones. Regarding specific policies, adoption policies are largely motivated by interoperability (viewed at the level of the single adopter) and cost-efficiency rationales (in particular, savings on license fees) while rationales regarding technical advantages of code availability and flexibility (all subcategory equally represented) are less cited, therefore suggesting that short–term advantages might be more salient than long–term ones in the stated motivations. On the other hand, pure regulatory motivations (such as stimulating market competition) are not explicitly accounted for. As far as advisory policies are concerned, interoperability (also considered at the market level) and cost-efficiency (all subcategories equally represented)

are still fundamental rationales, but other regulatory motivations are popular as well (in particular, enhancing competition and raising awareness in markets). Finally, technical advantages of code availability represents the major rationale for R&D policies, while, surprisingly, motivation regarding cost–efficiency are rather infrequent.

	Type of Motivation							
Intervention	**Total**	**cost–efficiency**	**Code availability**	**interoperability**	**flexibility**	**enhanced competition**	**efficiency in public sector**	**information diffusion**
Development	**6 (100%)**	1 (17%)	4 (67%)	1 (17%)	1 (17%)	1 (17%)	0 (0%)	1 (17%)
Adoption	**11 (100%)**	7 (64%)	2 (18%)	6 (55%)	3 (27%)	2 (18%)	1 (9%)	1 (9%)
Advisory	**20 (100%)**	11 (55%)	7 (35%)	11 (55%)	2 (10%)	8 (40%)	5 (25%)	7 (35%)
TOTAL	**37 (100%)**	19 (51%)	13 (35%)	18 (49%)	6 (16%)	11 (30%)	6 (16%)	9 (24%)

Table 5: public policies classified in terms of rationale for intervention (central government and agencies only)

4. CONCLUDING REMARKS

As we have briefly discussed in Section 2, economists are rather critical about intrusive public policies into the software market and, to some extent, we adhere to this skepticism. Just to mention some arguments, the software industry has really proved to be extremely dynamic, characterized by high rates of growth and, while competition in some software segments might result in "winner–takes–all" outcomes, dominant positions have been frequently displaced by new comers (see Schmalensee, 2000); in a word, markets have performed reasonably well. Moreover, it is not yet clear if the production mode of open source is really more innovative than the proprietary one and empirical evidence on this issue is far from being clear–cut.

However, we believe that looking at the F/OS movement from an economic viewpoint, many relevant aspects have not received so far the attention that they should have deserved and the evidence on the EU experience reported above suggests some of the

directions towards which the analysis should look at in order to better understand the actual effects of these policies.

For example, we believe that the distinction between custom and packaged software has not been properly taken into account in the literature. One of the main concerns against public support towards open source is based on the allegation that such policies would be detrimental for the incentives to innovate by commercial firms. We have already pointed out that almost two thirds of the market is represented by software that has been developed internally or that is customized and, as shown in Table 4, more than half of the interventions in our sample relates to this latter type of software. We are convinced that the above allegation cannot apply to this kind of software: customized software is by definition software "on demand" and the incentives to develop new lines of code arise at the moment of the call for tender, regardless of the open or close nature of the source code.

From the evidence presented in Section 3, it emerges that across the EU, together with cost saving reasons, public interventions in support of F/OS found their motivations primarily on the desire of stimulating an open standard environment for software applications but also on the relevance of source code availability and on the intention to promote more competitive software markets.

It is recognized that proprietary software is likely to create important lock-in positions; the unavailability of the source code renders adopters dependant on the original software provider for further maintenance/development/upgrade of the code. Moreover, the use of closed standards, a typical solution employed by proprietary vendors, makes it more difficult for adopters to disengage themselves from software vendors. The absence of complete and public documentation regarding file and data storage formats and other communication standards might substantially increase the switching costs thus rendering unprofitable the migration to other software packages. Lock–in is certainly a source of a relevant increase in life–cycle costs but these costs are extremely difficult to evaluate when one wants to compute correctly the total cost of ownership of a given software product.

On the contrary, a relevant feature of both open source code and open standards is that competition may be created in the aftermarket, and this may significantly reduce the cost

of service, support, maintenance and interoperability.[30] Moreover, according to this view, fears of picking "wrong winners" through governmental advisory or adoption of F/OS solutions should be lessened if one takes into account that F/OS software is based on open formats that are commonly available and that might be employed by closed source vendors to develop compatible value-added proprietary solutions or interoperable adds–on and complementary products.[31]

While the above arguments apply to custom software in particular, a regulatory policy in support of open standards may found solid justifications also in the context of mass–market software; as a consequence of strong network effects, these segments of the software industry are often characterized by the presence of dominant players whose platforms have the typical features of "essential facilities". Controlling an interface (the key input) allows the dominant firm to protect its position and possibly to extend it to other complementary products. Similarly to the current practice in other industries, also for the case of software the provision of open access to the essential facility should be seriously considered in order to promote competition and to improve market efficiency. It is somehow surprising that these arguments have found so far little agreement among economists, policy makers and practitioners in the software field.

The bottom–line to ensure that markets lead to efficient outcomes and therefore to exclude, based on economic grounds, that public interventions might be beneficial relates to the assumption that all potential adopters are properly informed about the alternatives that are available in the market. A recent empirical study on F/OS in the public sector shows that this is not necessarily the case. Ghosh and Glott (2005) show that a large share of IT administrators in the public sector ignore that in their agencies F/OS was actually

[30] On these lines, Gosh et al. (2002) suggest that whenever it is feasible governments and public institutions should opt for software open source, i.e. granting unlimited access to the source code, the right to modify the software and that to reproduce and distribute an unlimited amount of copies of the modified version under the same license restrictions. Forge (2005, p.492) argues that policy-markers should mandate "backward compatibility, open access to program interfaces, and separation between operating systems and applications".

[31] Moreover, it is worth mentioning that in some cases policies supporting F/OS software are inspired by neutrality principles, therefore suggesting joint use rather than full substitution of closed source software by migrating to F/OS systems.

employed.[32] More interestingly, the fact of being aware or not about the current usage of open source software has a major impact on the evaluation of the potential benefits of F/OS adoption. Nearly 70% of the "aware IT administrators" find it useful to extend the use of open source in their agencies. This percentage shrinks to 30% among the IT administrators that were unaware that F/OS software was already employed in their institutions. Clearly, this evidence provides strong support for policies aimed at informing potential adopters about the characteristics and the availability of open source solutions.[33]

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[32] According to the authors 30% of IT administrators were unaware of F/OS software usage and this figure increases in the case of small budget public agencies.

[33] A welfare analysis of the impact of various policies supporting F/OS in the presence of "unaware" potential adopters can be found in Comino and Manenti (2005).

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