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PUBLIC INTERVENTION FOR FREE/OPEN SOURCE SOFTWARE

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I. — INTRODUCTION

Free/Open Source Software (F/OSS) has become increasingly attractive for the public sector. In Europe, public interest towards F/OSS has been visible since the Lisbon Strategy and the corresponding 2002 and 2005 eEurope Action Plans approved by the European Commission. The last work programme of the IDABC (the Interoperable Delivery of pan-European eGovernment services to public Administrations, Business and Citizens) places considerable emphasis on the actions that should be taken by public administrations to promote open source software and open standards (1), which are seen as two key drivers in pursuing the general objective of giving all citizens the opportunity to participate in the global information society.

This attention is not limited to Europe: all over the world governments are considering various interventions to support F/OSS. These policies range from the provision of best practices for the usage of open source software to information campaigns aimed at making market participants aware of all software

(1) See (www.epractice.eu/en/library/315212). All the URLs provided in this paper are active at the moment of wrapping up the paper (October 2010).

alternatives, and from simple expressions of preference towards F/OSS to large scale adoption of open source solutions in public offices and schools.

The role of the public sector in the software market is of primary importance. Governments not only set the legal and regulatory framework where economic agents interact, but are also themselves major buyers of software products (2). With this double role, governments are key players in determining the future evolution of the software market and it is therefore of crucial interest to understand both the motivations and the effects of public interventions in this sector.

In this paper we critically review the main arguments in favor and against government policies supporting F/OSS, we provide a quantitative picture of the various public initiatives undertaken by European countries and we reflect on the implications of such empirical evidence in the debate between supporters and skeptics of public intervention.

More specifically, the paper is structured in three sections. Section 2 is devoted to review the literature concerning F/OSS public support; we make a synthesis of the by now quite substantial literature by distinguishing between pros and cons of public interventions in the software market. In Section 3, we present some evidence concerning the main public initiatives in Europe. Rather than focusing on any specific case study, we have collected information from the Open Source Observatory and Repository for European public administrations (OSOR.eu, hereafter), a platform created under the auspices of the European Commission and aimed at sharing information, experiences and code for use in public administrations across Europe. We draw some general considerations on the motivations and the characteristics of government interventions implemented across the EU. Section 4 concludes by bridging the theoretical discussion with the empirical analysis.

II. — LITERATURE REVIEW

The literature which addresses the topic of public support to F/OSS is quite substantial, especially if one considers that F/OSS is itself a rather recent phenomenon. Supporters of F/OSS have advocated the adoption of such technologies by the public sector and have based their arguments mostly on technical, cost-efficiency or political-idealistic grounds, while regulatory scopes and rationales based on the consequences of F/OSS public adoption on the functioning of the market have comparatively received a more limited attention.

- (2) Just to give a relevant example, in 2008 in Italy the aggregate spending for software applications by the Public Administration was around 430 million Euros, which accounted for around 20 per cent of the whole expenditure for ICTs (*source*: www.cnipa.gov.it).

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

In what follows, we briefly summarize the ongoing debate. The first subsection provides a general overview of the arguments that have been proposed to justify public support. In the second subsection we look at this issue from the perspective of the non-interventionists. It has to be noted that the participation in this discussion is not only multi-disciplinary but has also benefited by the contribution of many open source and closed source advocates and practitioners. Such views, while fruitfully fueling the debate, have in some cases blurred the line between positive and normative perspectives on the topic. In what follows we will try as much as possible to stick to the latter approach in reporting the different opinions.

2.1. The case for intervention

Several rationales have been proposed in the literature in favor of public policies supporting F/OSS (3), ranging from pure idealistic-philosophical motives to technical considerations and from cost-benefit comparisons to more comprehensive analyses on the consequences of public intervention on market performance. Leaving aside idealistic-philosophical motives, we focus on technical and economic rationales; more specifically, the arguments in favor of public support to F/OSS that we take into account can be grouped into the following five broad areas: *i*) F/OSS is a technically superior product, *ii*) it allows cost savings and code reuse, *iii*) it stimulates innovation in the software industry, *iv*) it fosters competition and *v*) it promotes e-government practices.

The first argument finds its justification on the perception by several commentators that F/OSS is superior to proprietary software from a technical point of view. The presence of an active community of developers that helps improving the software and fixing possible bugs (4), as well as the availability of the source code that makes possible for end-users to adapt the software to their own personal needs, makes F/OSS superior in terms of reliability, security, flexibility and maintainability of the code (Wheeler, 2007). Moreover, being typically based on open interfaces, F/OSS favors interoperability, namely the compatibility with software realized by other vendors and/or with other product families (Ghosh *et al.*, 2008; Varian and Shapiro, 2003). Cost-efficiency is the second most common justification for public interventions. In this case the argument is twofold: on the one side, compared to proprietary alternatives,

(3) See Comino *et al.* (2007) and Rentocchini and Tartari (2010) for recent reviews on this topic.

(4) Quoting the Linus' law popularized by Raymond (1999): « given enough eyeballs, all bugs are shallow ».

the adoption of F/OSS allows significant savings in terms of licensing fees (5) ; on the other side, the availability of the source code makes the public adopter of F/OSS independent from the initial software vendor, thus guaranteeing potential future cost reductions. This second argument is particularly relevant if one considers software not only as an intangible asset that generates maintenance costs during its lifetime, but also as an instrument to store data, such as documents or databases. According to this view, long-term accessibility to such data represents a critical issue for public administrations ; it is therefore desirable to avoid « lock-in » positions in the relationship with the original provider of the software (Ghosh *et al.*, 2007 ; Bijlsma *et al.*, 2009) (6).

According to Lessig (2002), another important benefit of F/OSS is related to the enhanced opportunities of reusing the code : programs developed for or adopted by some branches of the government could be usefully employed also by other branches ; therefore, a comprehensive evaluation of the benefits of publicly developed or sponsored software should take such reuse economies into account.

The third argument in favor of F/OSS support suggests that public interventions are beneficial since they stimulate innovation : being the software sector a typical example of industry where innovation is highly cumulative, the availability of the source code, which is guaranteed by F/OSS licensing terms, is of crucial importance in order to provide follow-on inventors with a fertile environment for innovation. This argument is reinforced by the findings of a recent series of theoretical and empirical contributions that have stressed the importance of innovations obtained in a more open context where intellectual property rights are weak, or are not enforced by companies (Chesbrough, 2003 ; Boldrin and Levine, 2008). In particular, Bessen and Maskin (2009) show that the pace of technological growth in industries where innovation is cumulative might be significantly enhanced when the protection granted by patents is limited. Their argument runs as follows : with a weaker protection of intellectual property rights, the number of potential inventors that have access to the existing technology increases and, provided that their R&D projects are imperfectly correlated, this stimulates follow-on innovations. More closely related to the software industry, Varian and Shapiro (2003) and Bessen (2002) argue that F/OSS encourages third-party innovation in terms the development

- (5) According to Lee (2006), reducing IT costs and ensuring compatibility are the main reasons behind many of the actual government interventions.
- (6) Lock-in positions and, more generally, the presence of long-run, well established customer-vendor relationships are relevant factors also in determining F/OSS adoption. In a study focusing on the US health system, Munoz-Cornejo *et al.* (2008) show that the tendency towards adoption of F/OSS in hospitals occurs when healthcare IT vendors embrace, provide, and maintain F/OSS products ; this happens when software vendors not only supply the software but they offer services for installation, customization and maintenance of F/OSS applications.

of adds-on, complementary products and solutions (7). Similarly, Benkler (2002) considers self-organization in distributed peer production 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 and von Hippel (2004) push this argument further, claiming that user innovation, a fundamental trait in F/OSS development, is welfare enhancing.

Often, according to the fourth argument that we have listed above, the support to F/OSS is also seen as a policy tool to improve competition in the software market or to stimulate the domestic software industry, especially in those countries where the software sector is lagging behind or not sufficiently competitive. Following this view, Varian and Shapiro observe that the GNU/Linux operating system can be considered as « an open platform on which commercial or open source applications can be built, thereby spurring the development of a robust domestic industry » (8).

The last argument in favor of pro-F/OSS policies stresses the importance of this instrument in order to promote e-government best practises. The European Commission has clearly stated that the main characteristics of F/OSS (code availability, software reuse, efficiencies in the cost of development and license savings) make it a key enabler for the spread of e-government services (9). According to this view, by reducing the costs of installing and maintaining software applications, F/OSS can help spread good practices in e-government more quickly. Some preliminary empirical evidence on the positive relationship between F/OSS adoption and the diffusion of e-government practices is reported by Rentocchini and Tartari (2010) in a study about F/OSS adoption by public administrations in the Emilia Romagna region of Italy.

2.2. The case against intervention

In order to provide a comprehensive overview of the debate surrounding the government interest on F/OSS, the arguments in favor of intervention must be counterbalanced with the skeptical opinions that have been put forward. The leading argument is quite simple: F/OSS has emerged and has in many cases

- (7) Maurer and Scotchmer (2006), investigating the innovation incentives in F/OSS, observe that: « open source works in environments where the knowledge created (*a*) is complementary to some other good whose profitability is immune to imitation, such as human capital or another proprietary product, or (*b*) where the motives to invent are intrinsic and have nothing to do with appropriating value ».
- (8) See also Lee (2006) for a discussion on this topic. Kshetri (2004) focuses on developing countries and argues that F/OSS represents an opportunity to catch up in the technological race.
- (9) See the EU thematic portal on e-government for the details: (ec.europa.eu/information_society/activities/egovernment/index_en.htm).

proved to be extremely successful even without any intervention; therefore, there seems to be no need for public interventions to stimulate it. Public intervention in the software market is not justifiable also from a broader perspective: focusing on proprietary software, many authors claim that there is no clear evidence of significant failures in the software market and, consequently, there is no urge for regulations in this direction. Using market data, Evans (2002) and Evans and Reddy (2002) show that the software industry is highly competitive and that its performance in terms of growth, productivity and R&D expenditures has been impressively high (10). Software markets appear to be well-functioning markets, therefore public funding to stimulate alternatives to closed source software are prone to pick the « wrong winner », while at the same time incurring the risk of undermining incentives for firms to innovate or to improve the quality of their software (Schmidt and Schnitzer, 2003).

As we have discussed above, one of the arguments in favor of F/OSS is that it guarantees significant savings in licensing fees; various authors point out that the amount of cost savings obtainable by adopting F/OSS rather than proprietary software are by far smaller than those expected. Licensing fees represent only a minor part of software costs and a meaningful comparison 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/OSS turns out to be far less evident (11).

The higher degree of innovativeness that, according to supporters, characterizes the F/OSS development model is also criticized. Smith (2002), acknowledging the brilliant performance of proprietary software companies in terms of R&D expenditures, is rather skeptical about F/OSS being able to replicate such figures. Evans (2002) and Evans and Reddy (2002) go even further claiming that the argument according to which open source increases the rate of innovation lacks of solid empirical evidence, given that many successful F/OSS projects draw strong inspiration from already existing closed source counterparts.

This discussion reveals a widespread skepticism among several economists and closed source advocates about direct government policies in favor of F/OSS; 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

(10) 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 per cent.

(11) The empirical evidence comparing the TCO of open vs. closed 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).

current system of protection of intellectual property rights. A long series of decisions taken by US courts during the last twenty years has extended to software the patent protection system and has made it easier for applicants to obtain patents even for obvious inventions. Large firms have then been induced to accumulate sizable numbers of software patents, the so called « patent thickets », that can be strategically used in order to block competitors' innovation. Bessen and Hunt (2007) provide an empirical support to this view: according to their econometric analysis, the strategic accumulation of patent thickets seems to be the most convincing explanation for the large increase of software patenting in the USA.

Finally, an issue that has drawn the attention of several scholars relates to public funding of 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/OSS projects as a means to increase social welfare (DeLong and Fromkin, 2000). 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. In particular, closed source software companies may be prevented from adopting and developing complementary applications for software distributed under GPL-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).

III. — EMPIRICAL EVIDENCE ON PUBLIC INTERVENTION

From our survey of the literature, it seems to emerge that the majority of the contributions have considered pros and cons of public intervention towards F/OSS from an extremely general point of view. On the contrary, we believe 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. Our claim is that many existing contributions in the literature have based their arguments without properly taking into account such distinctions.

Public administrations play a double role as far as the software industry is concerned. On the one side, being big spenders for packaged software licenses and custom software solutions, their adoption behavior represents a significant share of the demand in many segments of the market, thus having a major impact on market outcomes. On the other side, governments do in various ways affect the evolution of the market; for instance, 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 it suggests a regulatory intention of the proponents.

In addition, 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 (12). 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.

From this lively theoretical debate, a relatively abundant amount of empirical studies on government policies towards F/OSS has flourished in the recent years; the vast part of this literature focuses on software use within public administrations. Schmitz (2001) reports on the adoption of F/OSS in six European countries and in European Commission institutions, showing a still relatively low rate of adoption, varied attitudes towards adoption in server and desktop environments and the existence of clear differences in the strategies pursued by the different countries. Ghosh *et al.* (2002) list some relevant practices, policies and implementation strategies within public sector organizations and institutions, as well as actual policy directives towards F/OSS for six EU countries (France, Germany, Spain, United Kingdom, Belgium and Austria). Similarly, Wichmann (2003) describes the use of F/OSS by public institutions in Germany, Sweden and UK, and Williams (2008), in an e-government survey conducted over a thousand municipalities across seven European regions, shows that F/OSS adoption is gaining momentum despite few formal policies supporting it. Other contributions enlarge the scope of investigation, by explicitly taking into account also regulatory policies, but limiting the focus at the national level. Ghosh and Glott (2003) describe the adoption strategy of Dutch authorities on open standards and open source software, while Waring and Maddocks (2005) report about eight case studies on the adoption of F/OSS by UK local public bodies and national agencies. A somehow larger picture is offered by the FLOSSPOL project (Ghosh and Glott, 2005) which measures via a large survey the attitudes towards adoption and usage of F/OSS in the public sector in thirteen EU countries. Among other findings, this study highlights that around 78 per cent of public administrations use, at least to some degree, F/OSS, albeit in 4 out of 10 cases administrations are unaware users.

(12) According to European Commission – DG Enterprise (2006), the share of packaged software in Europe accounts for only 19 per cent of the whole market; the remaining part of the market is represented by custom software (52 per cent) or internally developed software (29 per cent).

3.1. Public interventions across Europe: a look at the data

In this section we provide a simple empirical exercise on the public support towards F/OSS in Europe; our analysis draws from the information gathered on the Open Source Observatory and Repository (OSOR.eu), a dedicated website compiled by the European Commission within the IDABC program (www.osor.eu), which debuted on January 2007 (13).

This website collects detailed information about the major initiatives taken within the various European countries. This information is gathered by using different sources. Local or central authorities that have taken an initiative can submit information related to it by using the « Submit your news » service available at the OSOR web-site. Such information is then filtered by the OSOR's staff. Alternatively, the information is collected directly by the OSOR's staff (14). For each intervention a brief abstract and, usually, a series of official documents and press releases describing the content and the nature of the policy are available. Moreover within the OSOR.eu website, since 2009, an online repository (a « forge » in the industry jargon) has been created to provide public administrations with useful tools to control and manage software development, and to mutually share open source solutions specifically intended for the public sector (forge.osor.eu). To our knowledge, OSOR.eu represents the most comprehensive source of information available about public interventions in the F/OSS domain (15). In what follows we first analyze the data on European public interventions and then we describe the figures regarding collaborative development of F/OSS in European public administrations.

Public interventions

We have collected information about public policy initiatives towards F/OSS registered on the OSOR.eu website between January 2007 and April 2010. We started from the full set of 653 news entries, out of which we selected 231

- (13) It deserves to be noted that an earlier version of the website (named Open Source Observatory, OSO), no longer available online, collected news regarding policies in favor of F/OSS. We already analyzed these data in Comino *et al.* (2007) focusing on the period Sep. 2003-Dec. 2005; we have decided against joining OSO data with the OSOR.eu dataset to avoid to introduce a bias related to different methods used to collect the information. Moreover, the combination of the two datasets is made problematic by the presence of a time gap between the two periods.
- (14) Obviously, this way of collecting information guarantees a comprehensive representation of large scale interventions, while for the small scale ones there is the risk of under-representation.
- (15) Lewis (2008) also maintains a list of selected government F/OSS policies and legislations considered by national, regional or local governments around the world. This dataset is much poorer compared to OSOR.eu and, as documented also in Ghosh *et al.* (2008), it largely underestimates the overall set of government policies; furthermore no information is provided about how data are collected and selected.

interventions, distributed across 29 European countries (all the 27 EU members, with the exception of Cyprus, plus Norway, Switzerland and Turkey). We discarded those entries that were not clearly recognisable as public interventions, such as informal statements of support by public officers or other initiatives by advocacy groups or industry representatives. Moreover, we excluded from the sample law proposals (both the failed ones and those which were not yet converted in bills at the moment of the dataset collection). To select the relevant sample of public interventions, as well for the subsequent phase of coding, two authors screened independently all the OSOR.eu news entries. The accordance rate was higher than 90 per cent and discrepancies in the sample selection or in the coding phase were later solved via face-to-face sessions involving all the three authors.

Tables 2 to 7 provide various statistics based on our dataset. In the tables we have grouped policies according to:

— the *level* at which the intervention is taken. We distinguish among *local* (taken by municipalities or regional governments), *national* (national governments or authorities), and *supranational* level (when involving more than one country);

— the *type of software* involved by the intervention: *custom*, *packaged*, *open standards/interfaces* (this latter when the intervention is aimed at supporting open interfaces), and *generic* (for broad spectrum interventions or policies generically promoting F/OSS without an explicitly focus towards a specific category of software);

— the *type of intervention*: *adoption*, *advisory*, *development* and *subsidy*. Adoption occurs when the government/agency adopts a certain software, advisory in case the government/public agency encourages the use of F/OSS in public administrations or informs potential adopters about the existence and characteristics of open source, development when the government actively promotes the creation of new software, and, finally, subsidy, when a monetary transfer for F/OSS adoption is provided.

It is immediate to see that, in absolute terms, France, Spain, Italy, Germany and the Netherlands are the most active countries, accounting for more than a half of the entire number of interventions (16). This finding only partially confirms previous evidence in the literature: in Ghosh and Glott (2005), Spain,

(16) Table 1 provides a broad picture of the distributions of interventions in Europe. Obviously, a more rigorous analysis would require some form of standardization of the data. Nonetheless, it is quite evident that, being far smaller, the Netherlands is certainly a more interventionist country than France, Italy, Spain and Germany.

Austria, Italy and Germany were found to be the most heavy users of F/OSS in the public sector (17).

Notably, out of the 231 initiatives, 51 have been endorsed in the first year of observation, 76 in 2008, 80 in 2009, and the remaining 24 during the first four months of 2010; according to these numbers, the pace of interventions towards F/OSS shows a slightly positive trend over time.

Tables 2 and 3 (see next page), illustrate the distribution of the various policies with respect to their type and the kind of software developed. According to Table 2, F/OSS adoption and advisory are the most common interventions in Europe, together accounting for nearly 80 per cent of the whole sample,

*TABLE 1. Shows the total number of interventions undertaken by the different countries in our sample
Number of public policies – distribution across countries*

| Country | N. interventions | Country | N. interventions |
|------------|------------------|-------------|------------------|
| Austria | 5 | Luxembourg | 0 |
| Belgium | 12 | Malta | 2 |
| Bulgaria | 2 | Netherlands | 22 |
| Czech Rep. | 2 | Norway | 3 |
| Denmark | 10 | Poland | 7 |
| Estonia | 2 | Portugal | 6 |
| Finland | 5 | Romania | 2 |
| France | 26 | Slovakia | 0 |
| Germany | 21 | Slovenia | 2 |
| Greece | 2 | Spain | 26 |
| Hungary | 2 | Sweden | 3 |
| Ireland | 2 | Switzerland | 4 |
| Italy | 24 | Turkey | 3 |
| Latvia | 3 | UK | 10 |
| Lithuania | 2 | EU (18) | 21 |

Source: our elaboration from the OSOR.eu website (19)

- (17) The difference may accrue to the fact that, while Ghosh and Glott (2005) survey usage of F/OSS by public administrators, we focus on a wider set of interventions. It has also to be noted that usage figures reflect also past adoptions, where in our case we only monitor adoptions, which occur during the period of observation.
- (18) Initiatives taken at the European Union level.
- (19) (www.osor.eu/news/).

TABLE 2: public policies classified in terms of type of intervention

| Intervention | Freq. | % |
|--------------|------------|------------|
| Adoption | 105 | 45.5 |
| Advisory | 74 | 32 |
| Development | 43 | 18.6 |
| Subsidy | 9 | 3.9 |
| TOTAL | 231 | 100 |

Source: our elaboration from the OSOR.eu website

TABLE 3: public policies classified in terms of type of software

| Software type | Freq. | % |
|---------------|------------|------------|
| Custom | 48 | 20.8 |
| Packaged | 81 | 35 |
| Open Standard | 27 | 11.7 |
| Generic | 75 | 32.5 |
| TOTAL | 231 | 100 |

Source: our elaboration from the OSOR.eu website

while direct public involvement into the development of F/OSS occurs less frequently, although still in a relevant number of cases. Public subsidisation of F/OSS instead is rather infrequent.

Looking at the distribution of interventions with respect to the type of software they are directed to, Table 3 shows that initiatives target significantly the various types of software: custom, packaged, open standards, or generic support towards F/OSS.

Going more into the details, it is useful to look at the distribution of the different types of initiatives conditional on the kind of software involved. From Table 4 some interesting observations can be drawn: a large share of adoption policies (60 out of 105) are aimed at mandating the adoption of packaged software while development policies mostly focus on customized software (29 out of 43). Advisory interventions have mainly a « generic » nature (44 out of 74).

In Table 5 we present how the various types of policies are distributed between local, national and supranational decisional levels. Interestingly, while at the local level, the preferred type of intervention is adoption (69 out of 107), at national level both advisory and adoption policies seem to be equally impor-

TABLE 4: public policies classified in terms of type of intervention and type of software

| | | Type of software | | | | |
|--------------|-------------|------------------|----------|-----------|---------|-------|
| | | Custom | Packaged | Open Std. | Generic | TOTAL |
| Intervention | Adoption | 16 | 60 | 10 | 19 | 105 |
| | Advisory | 2 | 14 | 14 | 44 | 74 |
| | Development | 29 | 6 | 3 | 5 | 43 |
| | Subsidy | 1 | 1 | 0 | 7 | 9 |

Source: our elaboration from the OSOR.eu website

TABLE 5: policies classified in terms of type of intervention and administrative level

| | | Intervention | | | | |
|-------|-----------|--------------|----------|-------------|---------|-------|
| Level | | Adoption | Advisory | Development | Subsidy | TOTAL |
| | Local | 69 | 19 | 15 | 4 | 107 |
| | National | 36 | 45 | 23 | 5 | 109 |
| | Supranat. | 0 | 10 | 5 | 0 | 15 |

Source: our elaboration from the OSOR.eu website

tant (36 and 45 out of 109 respectively). This is not surprising once considered that central governments often provide guidelines for action, while at the local level administrations focus more on operative decisions. Supranational interventions account only for a small fraction of the whole sample and are naturally oriented towards advisory policies (10 out of 15).

In Table 6 interventions are grouped according to the kind of software they are directed to and the decisional level where they are implemented. At the table suggests that local governments are more active towards packaged software while national governments show interest for all the different types of software, although there is a slight preference towards generic interventions. The large part of the supranational interventions are generic as well, as one should expect.

TABLE 6: policies classified in terms of software type and decisional level

| | | Software | | | | |
|-------|------------|----------|----------|-----------|---------|-------|
| Level | | Custom | Packaged | Open Std. | Generic | TOTAL |
| | Local | 24 | 53 | 2 | 28 | 107 |
| | National | 21 | 27 | 21 | 40 | 109 |
| | Supra nat. | 3 | 1 | 4 | 7 | 15 |

Source: our elaboration from the OSOR.eu website

The data that we have collected can be useful in order to evaluate empirically some of the arguments that have been proposed to justify active public policies. In particular, there are two motivations in favor of public support towards F/OSS that can be validated through an international comparison: *i*) open source adoption and usage as an instrument to stimulate e-government and *ii*) the support to F/OSS as a way to help a domestic industry which is lagging behind (20).

- (20) In order to test also the other motivations in favor of public interventions towards F/OSS, such as open source technical superiority, higher cost efficiency or possibility of code reusing, we would need a rather different country-level dataset rather than the geographic distribution of interventions.

**TABLE 7: interventions at national level,
e-government diffusion and software goods trade balance**

| | Interventions national level (A) | e-gov index (B) | Sw exp Sw imp (C) | | Interventions national level (A) | e-gov index (B) | Sw exp Sw imp (C) |
|------------|--|-----------------------|-------------------------|-------------|--|-----------------------|-------------------------|
| Austria | 3 | 100 | 1.86 | Luxembourg | 0 | 68 | 0.88 |
| Belgium | 6 | 70 | 0.58 | Malta | 2 | 100 | |
| Bulgaria | 1 | 40 | | Netherlands | 9 | 79 | 1.78 |
| Czech Rep. | 1 | 60 | 2.08 | Norway | 3 | 80 | 0.16 |
| Denmark | 7 | 84 | 0.82 | Poland | 2 | 53 | 0.91 |
| Estonia | 2 | 90 | | Portugal | 6 | 100 | 0.09 |
| Finland | 5 | 89 | 0.23 | Romania | 1 | 45 | |
| France | 15 | 80 | 0.62 | Slovakia | 0 | 55 | 0.25 |
| Germany | 8 | 74 | 1.77 | Slovenia | 0 | 95 | |
| Greece | 0 | 45 | 0.21 | Spain | 9 | 80 | 0.19 |
| Hungary | 2 | 63 | 0.75 | Sweden | 1 | 95 | 1.09 |
| Ireland | 1 | 83 | 7.53 | Switzerland | 2 | 32 | 0.37 |
| Italy | 7 | 70 | 0.13 | Turkey | 2 | | 0.05 |
| Latvia | 1 | 65 | | UK | 7 | 100 | 1 |
| Lithuania | 2 | 60 | | | | | |
| Corr (A,B) | 0.32 | | | | | | |
| Corr (A,C) | -0.16 | | | | | | |

Source: our elaboration on OSOR.eu, Eurostat and OECD data

In order to evaluate issue *i*), we look at the correlation between the number of interventions taken in each country (column (A) in Table 7), and the degree of e-government services available to citizens in the same country, as measured by the 2009 Eurostat *e-government index* (column (B) in Table 7) (21). In order to eliminate from our sample the distortions due to different country size and to different number of local authorities, we consider only interventions taken at the national level (22).

The correlation between these two measures is positive and of significant magnitude (0.32); this finding suggests that countries whose governments and

- (21) The Eurostat e-government indicator measures the on-line availability of 20 basic public services (see epp.eurostat.ec.europa.eu).
- (22) Alternatively, we could have employed some form of standardization (*i.e.* interventions per capita/per country size) in order to increase data comparability. While having the advantage to keep all the available information, this method would have exposed us to the typical risks of ad-hoc standardization. For these reasons, we have preferred to restrict the analysis to national interventions, which is reasonably comparable across countries, despite paying the cost of losing part of the information contained in our dataset.

central authorities support more strongly F/OSS are generally the same countries where e-government services are more developed. Obviously, this empirical observation does not say anything about the causal relationship between the two measures and should be interpreted cautiously.

As far as issue *ii*) is concerned, we have followed a similar procedure: we have looked at the correlation between the number of interventions at the national level and the trade balance of software goods, computed as the ratio between the value of exports and the value of imports for each country (column (C) in Table 7) (23). Countries with a trade ratio larger (smaller) than 1 are net exporters (importers) of software goods: this ratio proxies the presence of a more or less developed domestic software industry. As shown in the table, we find a negative correlation, although of little magnitude, between the two measures. This finding is in line with the arguments put forward in the discussion about the pros of supporting F/OSS: countries whose domestic software industry is lagging behind are more active in supporting F/OSS.

The OSOR.eu Forge

The OSOR.eu Forge, a repository of F/OSS projects hosted within the OSOR.eu website, represents another interesting source of information. This online platform is aimed at promoting the collaboration between programmers developing software projects intended for public administrations. As it happens in other F/OSS repositories, administrators can register their software project, upload the code and other resources and make use of various tools to promote collaboration with other developers (ranging from mailing lists and message forums to revision control systems in order to manage access to the code repository and keep track of changes). Naturally, the visibility provided by the platform facilitates software reuse and re-distribution as well as the creation of an active community around a project. The OSOR.eu Forge represents therefore a powerful tool to spur both the collaborative development and the reuse of IT solutions valuable for public administrations.

The OSOR.eu Forge is of recent creation (July 2009), and in its first year accomplished to gather 155 software projects, which as a whole have collected over 174,000 downloads, and a lively community composed of over 2,600 registered users, and 206 code contributors, which collectively have submitted over 42,000 code commits, nearly 4,000 bug reports and more than 7,000 mailing list messages (24). Table 8 provides some interesting statistics about the characteristics of the projects hosted in the Forge.

(23) Data on software goods balance are taken from OECD (2008) and refer to year 2006.

(24) It deserves to be noticed that, beyond these 155 projects directly hosted on the repository, OSOR.eu provides access to other software projects intended for public administrations and that are hosted in national repositories. The two most relevant repositories are the Spanish *Forja de Rediris* (hosting more than six hundred projects) and the French *Adullact* (hosting nearly five hundred projects).

TABLE 8: characteristics of the projects hosted on the OSOR.eu Forge

| Development status | | License | | Topic | |
|----------------------------|------|---------|------|-------------------|------|
| Initial/intermediate stage | 29 % | GPL | 51 % | Office/enterprise | 21 % |
| Advanced/mature | 71 % | EUPL | 28 % | Communications | 15 % |
| | | LGPL | 9 % | Sw tools | 10 % |
| | | BSD | 3 % | Database | 8 % |
| | | Other | 9 % | System admin. | 7 % |
| | | | | Financial | 7 % |
| | | | | Education | 6 % |
| | | | | Internet | 6 % |
| | | | | Security | 6 % |
| | | | | Other | 14 % |

Source: our elaboration from the OSOR.eu Forge website (25)

Despite being a relatively new initiative, the vast majority of projects hosted on the OSOR.eu Forge is represented by ready-to-use software packages. Indeed, 71 per cent of the projects is considered at an advanced stage of development (26).

While it is probably too early to draw some clear-cut conclusions from these data, the relatively high share of projects in an advanced stage of development compared to the short age of the repository suggests that the Forge is at least in part used to host projects, as a way to promote the reuse and re-distribution of relatively mature F/OSS projects initially developed elsewhere. This observation is reinforced by the large number of downloads: 174,000 with twelve projects that have been downloaded more than one thousand times each. The limited available figures on the Forge activity make less clear to what extent this platform is also able to stimulate collaborative development on new projects, and further inquiries will probably be needed to measure this phenomenon (27).

(25) (forge.osor.eu).

(26) The OSOR.eu Forge is organized in a way similar to SourceForge, the largest online platform for open source users and developers. Project leaders provide information about their project. Among the information required, there is the stage of maturity of the project classified into six possible categories: planning, pre-alpha, alpha, beta, stable, and mature. In Table 8 we have summarized these information: initial/intermediate includes all projects that were classified in the first three categories, while advanced/mature includes the projects that were classified as beta, stable, or mature.

(27) The importance of software reuse within public administrations has already been observed in Ghosh *et al.* (2008); according to their survey, 10 per cent of public administrations were willing and capable to release their software as open source, and among the non-releasers, the main reason not to re-distribute was related to the lack of skills within their organization.

The GPL is by and large the most popular license for software redistribution. However, a significant share of projects is released according to the European Public License (EURL), a licensing scheme that has been approved by the European Commission in January 2007. Similarly to the GPL, the EURL includes a *copyleft* provision, *i.e.* the fact that derived copies of the original such software must be released under the same EURL terms, and this makes license a highly restrictive scheme as the GPL (28). According to several commentators, despite being similar to the GPL, the EURL is preferable since it has been specifically created to be compatible with the European jurisdictions and it is available in all the EU languages (29). Other less restrictive licenses such as the BSD are very marginal and employed in a very small number of projects. Finally, as far as the content of the software is concerned, the most common domain of application is represented by office applications.

IV. — CONCLUDING REMARKS

As the survey of the literature at the beginning of this paper has shown, the debate on the public support to F/OSS is highly articulated, and its implications are often inconsistent and controversial, both from the theoretical and empirical standpoints. Our intention in this paper has been to shed light on some aspects that we believe are relevant to reach a better understanding on the topic of public intervention in software markets. In particular, we find that the empirical evidence regarding European public policies, summarized in the previous section, can be considered as a fruitful input to further the theoretical debate between supporters and anti-interventionists, along the following lines.

The first aspect refers to the need of distinguishing between custom and packaged software whenever the economic impact of public intervention towards F/OSS is under evaluation. This issue has not received in the literature the attention that it deserves. In fact, one of the main concerns against public support towards F/OSS is based on the allegation that such policies would be detrimental to the incentive to innovate by closed source software companies. As we have pointed out, more than two thirds of the market is represented by software that is developed internally or that is customized and, as shown in Table 3, only in a minority of the cases (around 35 per cent) interventions are related to packaged software (and even then, they tend to have a rather limited scope, mostly consisting in adoption policies occurring at the local level, as suggested by Tables 4 and 5). Hence, we are convinced that the above allegation is less relevant in relation to custom developed software, which is by definition software « on demand », where the incentive to develop new code arise at the moment of the call for tender, regardless of the open or closed nature of the source code.

(28) We borrow the distinction between highly restrictive (*e.g.*, GPL), restrictive (*e.g.*, LGPL) and unrestrictive (*e.g.*, BSD) F/OSS licenses from Lerner and Tirole (2005).

(29) See (www.osor.eu/news/european-public-licence-preferable-to-gplv3).

The second observation that emerges from our previous analysis refers to the so-called reuse economies. One of the arguments in favor of supporting and sustaining open source is related to the fact that F/OSS licenses spur code reuse, thus generating a positive externality; the evidence emerging from the experience of the OSOR.eu Forge confirms this argument and shows that code reuse by public administrations is indeed a common phenomenon.

Another relevant message of our empirical exercise is about the potential role of F/OSS as a key enabler for the spread of e-government services. We find that the support to open source correlates with a wider availability of e-government services; this may be due to several reasons: one reason is well explained in Ghosh and Glott (2005) and refers to the technical superiority of F/OSS in guaranteeing servers' workflow, a crucial element to ensure an efficient and effective functioning of e-government services. F/OSS spurs e-governments also due to other less technical reasons: as discussed in Rentocchini and Tartari (2010), F/OSS creates among civil servants a more fertile environment towards the usage of ICT solutions.

We have discussed how the presence of lock-in should induce administrations to favor open source software; in fact, it is widely recognized that proprietary software is likely to create important lock-in positions due to the unavailability of the source code that turns adopters dependant on the original software provider for the subsequent activities of maintenance, development and upgrade of the code. The relevance of this issue clearly emerges when one looks at the tenders launched by public administrations in Europe; according to a recent report conducted by the IDABC (see Ghosh *et al.*, 2008), more than one third of a sample of interviewed IT administrators in the public sector said that backward compatibility is the most relevant criterion to select applications for new software. The same study reports that among more than three thousand software tenders published between January and August 2008, 36 per cent requested explicitly Microsoft software, 20 per cent Oracle and 12 per cent IBM software. All these figures confirm how relevant is lock-in in public administration software adoptions.

A last argument that we have not considered so far but that we believe goes in favor of F/OSS relates to the characteristic of « essential facility » of software standards. As a consequence of strong network effects, software platforms are often characterized by the presence of dominant players, whose standards have the typical feature of essential facilities. The control of the standard (the key input) allows the dominant firm to protect its position and possibly to extend it to other complementary products. This behavior raises antitrust concerns, the controversial issue being to what extent competition policies should impose the dominant player to share its technology with the rivals. This issue is at the center of a vigorous debate characterized by diverging views between the two sides of the Atlantic, as discussed in Vickers (2009). The availability of the source code, and the fact that it heavily relies on open interfaces, imply that in the case of F/OSS access to the essential facility is usually granted.

REFERENCES

- BENKLER Y. (2002), « Coase's Penguin, or Linux and the Nature of the Firm », *Yale Law Journal*, 112(3), pp. 369-446.
- BESSEN J. (2002), « What Good is Free Software ? », in R. Hahn (Ed.), *Government Policy Toward Open Source Software*, Washington, DC: AEI-Brookings Joint Center For Regulatory Studies, pp. 12-33.
- BESSEN J., & HUNT R.-M. (2007), « An Empirical Look at Software Patents », *Journal of Economics and Management Strategy*, 16(1), pp. 157-189.
- BESSEN J. & MASKIN E. (2009), « Sequential Innovation, Patents, and Imitation », *RAND Journal of Economics*, 40(4), pp. 611-635.
- BIJLSMA M., De BIJL P., KOCSIS V. (2009), « Competition, Innovation and Intellectual Property Rights in Software Markets », *Communications and Strategies*, 74(2), pp. 55-74.
- BOLDRIN M. & LEVINE D. (2008), *Against Intellectual Monopoly*, Cambridge University Press.
- CHESBROUGH H.-W. (2003), *Open Innovation: the New Imperative for Creating and Profiting from Technology*, Cambridge MA: Harvard Business School Publishing.
- COMINO S., & MANENTI F.-M. (2005), « Government Policies Supporting Open Source Software for The Mass Market », *Review of Industrial Organization*, 26, pp. 217-240.
- COMINO S., MANENTI F.-M., & ROSSI A. (2007), « On the Role of Public Policies Supporting Free/Open Source Software. An European Perspective », in Kirk St. Amand and Brian Still (Eds), *Handbook of Research on Open Source Software*, Idea Group Inc. (IGI), Chapter XXXII.
- DELONG J.-B., & FROOMKIN A.-M. (2000), « Speculative Microeconomics for Tomorrow's Economy », *First Monday*, 5(2).
- EVANS D.-S. (2002), « Politics And Programming: Government Preferences for Promoting Open Source Software », in R. Hahn (Ed.), *Government Policy Toward Open Source Software*, Washington, DC: AEI-Brookings Joint Center For Regulatory Studies, pp. 34-49.
- EVANS D.-S., & REDDY B. (2002), *Government Preferences for Promoting Open-Source Software: A Solution in Search of a Problem*, *n/e/t/a/* report, 21 May 2002.
- EUROPEAN COMMISSION – DG ENTERPRISE (2006), *Study on the Economic Impact of Open Source Software, on Innovation and the Competitiveness of the Information and Communication Technologies Sector in the EU*, (online: <http://flossimpact.eu/flossimpact.eu>).
- GHOSH R., KRIEGER B., GLOTT R., ROBLES G. (2002), « Free/Libre and Open Source Software: Survey and Study », in *Open Source Software in the Public Sector: Policy Within the European Union*, Netherlands, Maastricht: University of Maastricht, International Institute of Infonomics, Deliverable D18, Final report, Part 2B.
- GHOSH R.-A. & GLOTT R. (2003), *Open Standards and Open Source Software in the Netherlands. A Quantitative Study on Attitudes and Usage in Dutch Authorities on Behalf of the Office the Ministry of the Interior and Kingdom Relations and the Ministry of Economic Affairs*, Maastricht: University of Maastricht, MERIT.
- GHOSH R. & GLOTT R. (2005), *Free/Libre and Open Source Software: Policy Support, Results and Policy Paper From Survey of Governments Authorities*, Netherlands, Maastricht: University of Maastricht, MERIT.
- GHOSH R.-A., GLOTT R., GERLOFF K., SCHMITZ P.-E., AISOLA K. & BOUJRAF A. (2007), *Study on the Effect on the Development of the Information Society of European Public Bodies Making their own Software Available as Open Source*, European Commission.
- GHOSH R.-A., GLOTT R., SCHMITZ P.-E., & BOUJRAF (2008), *OSOR Guidelines. Public Procurement and Open Source Software*, UNU MERIT.
- HENKEL J., & von HIPPEL (2004), « Welfare Implications of User Innovation », *The Journal of Technology Transfer*, 30(1-2), pp. 73-87.
- KSHETRI N. (2004), « Economics of Linux Adoption in Developing Countries », *IEEE Software*, 21(1), pp. 74-81.

- LEE J.-A. (2006), « New Perspectives on Public Goods Production: Policy Implications of Open Source Software », *Vanderbilt Journal of Entertainment and Technology Law*, 9, pp. 45-112.
- LERNER J. and TIROLE J. (2005), « The Scope of Open Source Licensing », *Journal of Law Economics and Organization*, 21(1), pp. 20-56.
- LESSIG L. (2002), « Open Source Baselines: Compare to What? », in R. Hahn (Ed.), *Government Policy Toward Open Source Software*, Washington, DC: AEI-Brookings Joint Center For Regulatory Studies, pp. 50-68.
- LEWIS J. (2008), *Government Open Source Policies. Technical Report*, Washington, DC: Center for Strategic and International Studies (CSIS), retrieved from (csis.org).
- MAURER S.-M. & SCOTCHMER S. (2006), *Open Source Software: the New Intellectual Property Paradigm*, NBER Working Paper 12148.
- MUNOZ CORNEJO G., SEAMAN C. & KORU A. (2008), « An Empirical Investigation into the Adoption of Open Source Software in Hospitals », *International Journal of Healthcare Information Systems and Informatics*, 3, pp. 16-37.
- OECD (2008), *Information Technology Outlook 2008*. OECD Publishing, Paris.
- RAYMOND E. (1999), *The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*, Cambridge: O'Reilly.
- RENTOCCHINI F. & TARTARI D. (2010), *An Analysis of the Adoption of Open Source Software by Local Public Administrations: Evidence from the Emilia-Romagna Region of Italy*, (online: papers.ssrn.com/sol3/papers.cfm?abstract_id=1141782).
- SCHMIDT K., & SCHNITZER M. (2003), « Public Subsidies for Open Source? Some Economic Policy Issues of the Software Market », *Harvard Journal of Law and Technology*, 16(2), pp. 473-505.
- SCHMITZ P.-E. (2001), *Study into the Use of Open Source Software in the Public Sector*, Brussels: Unisys.
- SMITH B.-L. (2002), « The Future of Software: Enabling the Marketplace to Decide? », in R. Hahn (Ed.), *Government Policy Toward Open Source Software*, Washington, DC: AEI-Brookings Joint Center For Regulatory Studies, pp. 69-86.
- VARIAN H., & SHAPIRO C. (2003), *Linux Adoption in the Public Sector: an Economic Analysis*, mimeo, University of Berkeley, California.
- VICKERS J. (2009), *Competition Policy and Property Rights*, Discussion Paper 436 Department of Economics, University of Oxford.
- WARING T. & MADDOCKS P. (2005), « Open Source Software Implementation in the UK Public Sector: Evidence from the Field and Implications for the Future », *International Journal of Information Management*, 25(5), pp. 411-428.
- WICHMANN T. (2003), *Use of Open Source Software in Firms and Public Institutions. Evidence from Germany, Sweden and UK*, FLOSS Final Report, part 1.
- WILLIAMS M. (2008), « E-Government Adoption in Europe at Regional Level », *Transforming Government: People, Process and Policy* 2(1), 47-59.
- WHEELER D.-A. (2007), *Why Open Source Software/Free Software (OSS/FS, FLOSS, or FOSS)? Look at the Numbers !* (oww.dwheeler.com/oss_fs_why.html).