Altruistic individuals, selfish firms? The structure of motivation in Open Source software

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1. Introduction

A growing body of economic literature is addressing the issue of incentives for individuals who take part in the Open Source Software (OSS) movement, while empirical analyses focus on individual developers but neglect firms that do business with it. During 2002, we conducted a large-scale survey on 146 Italian firms supplying OSS in Italy and this paper compares our data on firms' motivations with data emerging from surveys made on individual programmers. Our objective is to analyse the role played by different classes of motivations (social, economic and technological) in determining the involvement of different groups of agents in Open Source activities.

2. Why do individual developers and firms take part in the Open Source movement?

The founding fathers of the Open Source movement trace programmers' enthusiasm for it back to the values of the hacker culture (Raymond, 2001), and a number of motivations, some socially linked (altruism and fighting for software freedom) and others of a hedonistic nature (fun in programming) are considered to be the underlying reasons. However, technological considerations also come into the picture when the prospect of engaging in Open Source activities is concerned. An open code permits the flow of feedback from developers and users which is very useful for improving the software.

From the point of view of the economic theory, motivations having to do with, gaining a reputation among one's peers, signalling quality of human capital and learning are especially significant (Lerner and Tirole, 2002a; Dalle and David, 2003), and have always been important for the scientific community (David, 1991). *Filling an unfilled market* (Green, 1999) is another important economic incentive. Many Open Source projects take shape because of the lack of a specific program for performing a particular task.

New actors are now entering the Open Source arena. Software firms have started to supply products and services based on Open Source software aiming to make a profit from them, and in this they are aided by feedback and contributions from the Open Source community which enable them to lower R&D costs. As a consequence socially-based motivations need to be reviewed now that cooperation is being sought from individual programmers, who are implicitly

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more vulnerable than large software corporations. Indeed, firms purchasing OSS must conform to the values of the OSS community in order not to betray the trust of the developers and must cooperate by gifting their code in order to sustain cooperation. At the same time they must not hijack the code in order to not infringe the norms ruling OSS projects. This would reduce the incentives of individual programmers to contribute to projects for firms. Another important incentive in economic terms is no longer having to be subject to the price and licence conditions imposed by large software companies. The Open Source framework does not allow for profit to be made from licence fees. As a consequence, the business models of firms working with Open Source software are mainly based on the supply of software related services (Wichmann, 2002). If the programs within these services are proprietary, then the company who supplies them is bound topay licence fees to the companies who own the proprietary rights to them.

From a technological standpoint, the reasons for firms to make use of OSS is similar to those of individual developers. The user community comprises a very large group of beta testers for code inspection and programs for firms produced by the Open Source community. This allows firms to perform a bug fixing better. The learning aspect is therefore not to be neglected. Ideas gleaned from Open Source projects may be used to develop commercial solutions (Lerner and Tirole, 2002b).

There are however other underlying motivations. Firms may engage in Free Software activities to obtain indirect revenues by the sale of related products. Let us now consider the business models adopted by O'Really and Associates: publishing manuals for successful Open Source products

3. Open Source motivations: a comparison between individual and firms

We asked OSS producers for a subjective appreciation of the reasons behind their work . They were asked to give a score from 1 (*wholeheartedly disagree)* to 5 (*wholeheartedly agree*) (5 –point Likert scale) for eleven items selected on the basis of the literature. We considered economic, social and technological incentives differently (Feller and Fitzgerald, 2002).

The e variables are fairly concentrated around their mean values (table 3) which range from 3.97 to 2.99 (variance: 0.14). Economic and technological motivations are near the top. All have mean values above the mean value of the variables taken as a whole (3.49). Their median and modal values are 4 and 5 respectively. Social motivations are ranked fifth and sixth.

Motivation	*Acronym*	*Area*	*Mean*	*St. Dev.*	*Median*	*Mode*
Because Open Source software allows small enterprises to afford innovation	M4	E	3.97	1.15	4	5
Because contributions and feedback from the Free Software community are very useful to fix bugs and improve our software	M8	T	3.89	1.21	4	5
Because of the reliability and quality of Open Source software	M10	T	3.87	1.16	4	5
Because we want to be independent of the price and licence policies of the large software companies	M1	E	3.78	1.19	4	5
Because we agree with the values of the Free Software movement	M6	S	3.76	1.29	4	5
Because we wish to place our source code and skills at the disposal of the Free Software community and hope that others will do the same	M5	S	3.41	1.27	4	4
Because good IT specialists are easy to find in the field of Free Software	M3	E	3.37	1.25	3	3
Because we want to study codes written by other programmers and use it for developing new programs and solutions	M9	T	3.29	1.29	3	3
Because opening our source code allows us to gain a reputation among our costumers and competitors	M2	E	3.10	1.20	3	3
to get products that are not available on the proprietary software market	M11	T	2.99	1.35	3	3

Because we think that software should not to be a proprietary asset	M7	S	2.99	1.42	3	2

Table 1: Descriptive statistics of firms' motivations. Note: E: economic motivations, S: social motivations, T: technological motivations

The highest ranking incentive is for Open Source software promoting innovation by small enterprises. M4 has also the highest percentage of high scores (4 or 5: 71.9%) and the lowest percentage of low scores (1 or 2: 12.2%)[1]. This is a remarkable finding that gives a major contribution to the debate on innovation processes within the Open Source framework. Indeed, our data do not corroborate the hypothesis that Open Source is about imitation, not innovation. Emancipation from the price and licence policies of the large software companies is a crucial motivation for 35% of respondents, while learning and reputation rank 8th and 9th respectively next to the *easier availability of good IT specialists in the Free Software field*. In particular, the talent signalling motivation strongly emphasized by Lerner and Tirole (2002) does not play an important role.

Our findings on social motivations agree with literature on the extrinsic nature of socially-based motivations . The respondents in our sample do not agree with opposition to intellectual property rights advocated by the Open Source however they do respect the unwritten laws of the Free Software community (M5, M6), but to save costs and enhance quality.

Among the technological motivations, firms' responses point directly to the fundamental properties of the Open Source. More than 69% of our sample attach much importance to the cooperation with individual developers, and 66% choose Open Source software because of its quality and reliability.

In order to obtain the aggregate of each set of incentives, we calculated the mean values of the scores assigned by each firm to economic, social and technological motivations respectively. The results corroborate the minor role of socially based motivations in determining why firms engage in the Open Source movement.

Variable	*Acronym*	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Dev.*
Economic Motivations	EM	143	1.5	5	3.56	0.80
Technological motivations	SM	142	1	5	3.51	0.79
Social motivations	TM	142	1	5	3.39	1.07

Table 2: Descriptive statistics of the aggregate variables of each motivation set.

Paired-samples T test[2] shows that the differences in the mean values of EM and SM are statistically different from zero (p value = 0.031).

We compared our finding with those emerging from surveys taken among individual programmers (Bates et al. 2002; Ghosh et al., 2002; Hertel et al., 2003; Hars and Ou, 2002). The economic motivations are quite similar between the two groups. Both attach much importance to the emancipation from large software companies. Developer surveys show that gaining a reputation among peers does not rank highly as an incentive for Free Software programmers. This is at odds with the theory that literature propounds stating that reputation ranks highly as a motivation to contributing to Open Source projects. Firms are not so unlike individual programmers in this respect.

Individual developers in all four surveys attach more importance to social motivations than the firms in our sample. In particular, the issue of software property rights shows the higher

[1]M4 displays also the lowest frequency of the value 3. Agents seem to have a clearer view of such incentive with respect to other ones.

[2] Kolmogorov-Smirnov normality test states that the three variables are normally distributed (EM p value= 0.001, SM p value = 0.000, TM p value = 0.001).

percentage differences between the two groups. This supports the finding we analysed above regarding the different nature of social motivations in the two groups of agents.

More than 41% of firms we surveyed attach much importance to the feedback from the community of software developers. Such feedback is considered one of the four top motivations only by 27% of the developers taking part in the Ghosh et al. survey.

Most of the firms in our sample do not regard learning as a crucial motivating factor, while individual developers place much value on the chance to learn through participation in OSS projects. More than 80% of the respondents to the Hars and Ou survey strongly agree that Free Software activities are good for developing human capital.

Reliability and quality of Free Software products represent important incentives for more than 38% of the firms supplying Open Source solutions, while only 11% of the developers (Bates et al. survey) list this among the three most important incentives. Quality and reliability of the solutions are crucial in the software market. This is particularly true for Open Source products and services that have to overcome the effects of network externality which tend to favour the diffusion of proprietary product. However other authors maintain that this is a very important incentive for individual developers also who are often reputed to denigrate the performance of proprietary programs.

The *fill an unfilled market* motivation shows a different pattern. Such motivation ranks among the three top for 33.8% of individual developers while only 16.5% of the firms in our sample strongly agree. This is probably due once again to the service-oriented business models of the respondents to our survey.

Having access to the data gathered by Hertel et al. on 143 developers of the Linux kernel, we performed a direct comparison between their and our findings. There is no discrepancy in measurement parameters - the authors, measure the motivations for taking part in the Free Software movement through a five-point Likert scale. After having picked out the comparable items, we computed descriptive statistics and percentages of the scores for each incentive (table 3).

Comparable items	*Motivation class*	*1*	*2*	*3*	*4*	*5*	*Low score*	*High score*
Gaining reputation as an experienced programmer inside the Linux community	E	4.3	12.1	31.4	29.3	22.9	16.4	52.1
Personal exchange with other software developers	S	0.0	5.0	12.9	37.9	44.3	5.0	82.1
Code should be free	S	0.7	3.6	7.1	26.4	62.1	4.3	88.6
Improving programming skills	T	1.4	2.2	2.2	25.2	69.1	3.6	94.2
Because opening our source code allows us to gain a reputation among our costumers and competitors	E	10.6	22.0	27.7	26.2	13.5	32.6	39.7
Because we want to place our source code and skills at the disposal of the Free Software community and hope that others will do the same	S	6.4	7.8	17.0	27.7	41.1	14.2	68.8
Because we think that software should not to be a proprietary asset	S	20.0	20.7	19.3	20.0	20.0	40.7	40.0
Because we want to study the code written by other programmers and use it for developing new programs and product	T	12.2	14.4	26.6	25.9	20.9	26.6	46.8

Table 3: Comparison of the motivations of firms and individual programmers: percentages of the scores (Hertel et al. data).

Mann Whitney tests have been run to check for statistically significant differences in mean values (Table 4). The comparison highlights the heterogeneity in motivations between firms and individual developers very well. Developers assign higher scores to the items dealing with reputation gain and code reciprocation within the Free Software community, software freedom and learning. This is in accordance with the results of the comparison above. Finally, all mean differences are statically different from zero in the two groups at a significance level of 5% or 1%. The item dealing with software property rights shows the highest mean difference in the two groups.

ID	Comparable items	Motivation class	Mean (our survey)	Mean (Hertel et al.)
A***	Gaining reputation as an experienced programmer inside the Linux community	Economic		3.54
	Because opening our source code allows to gain a reputation among our costumers and competitors		3.1	
B**	Personal exchange with other software developers	Social		4.21
	Because we want to place our source code and skills at the disposal of the Free Software community and hope that others will do the same		3.41	
C***	Code should be free	Social		4.46
	Because we think that software should not to be a proprietary asset		2.99	
D***	Improving one's own programming skills	Technical		4.58
	Because we want to study the code written by other programmers and use it for developing new programs and solutions		3.29	

Table 4: Comparison of motivations of firms and individual programmers (Hertel et al. data). Note: **p value < 0.05, *** p value < 0.01.

5. *Conclusions*

For many theoretical reasons, the question of why people participate in the Open Source movement has attracted the interest of economists and sociologists (Bonaccorsi and Rossi, 2003). Most empirical analyses have addressed the motivational profile of individual programmers, while little empirical evidence is available on firms that base their business model on Open Source.

We find significant differences between the set of motivations of individuals and those of firms. In particular, firms emphasise economic and technological reasons for entering and contributing to Open Source and do not subscribe to many socially-based motivations that are, by contrast, typical of individual programmers. While one might expect these differences, it is interesting to observe that the more pragmatic motivational profiles of firms are accepted in the Free Software community, provided firms comply with the rules of the community. This means that the organisation of Open Source production is robust to a variety of motivations. Business motivations apparently do not destroy the community but on the other hand tend to reinforce it..

References

Bonaccorsi A., Rossi C. (2003) Why Open Source software may succeed, *Research Policy*, 32(7), 1243-1258.

Dalle J.M., David P.A. (2003) *The allocation of software development resources in 'open source' production mode.* MIT Working Paper, http://opensource.mit.edu/papers/dalledavid.pdf, accessed 4 August 2003 .

David P. (1991) *Reputation and agency in the historical emergence of the institutions of Open Science.* Stanford University, CA, March, mimeo.

Feller J., Fitzgerald B. (2002) *Understanding Open Source Software Development.* Addison Wesley, Boston, M.A., USA.

Ghosh R., Glott R., Krieger B., Robles G. (2002) *Survey of Developers*. Free/Libre and Open Source Software: Survey and Study, FLOSS, Final Report, International Institute of Infonomics, Berlecom Research GmbH, http://floss.infonomics.nl/report/FLOSS_Final4.pdf, accessed 4 August 2003.

Green L. G. (1999). *Economics of Open Source Software.* http://badtux.org/home/eric/editorial/economics.php, accessed 19 April 2003.

Hars A., Ou S. (2002) *Working for Free? Motivations of participating in Open Source projects.* International Journal of Electronic Commerce, 6, 25-39.

Hertel G., Niedner S., Hermann S. (2003). *Motivation of software developers in the Open Source projects: an Internet-based survey of contributors to the Linux kernel.* Research Policy 32(7), 1159-1177.

Lerner J., Tirole J. (2002a) *Some simple economics of the Open Source*. The Journal of Industrial Economics, 2 (L), 197-234.

Lerner J., Tirole J. (2002b) *The Scope of Open Source Licensing*. MIT Working Paper, http://opensource.mit.edu/papers/lernertirole2.pdf, accessed on 4 August 2003.

Raymond E. (2001) *The cathedral & the Bazaar. Musings on Linux and Open Source by an Accidental Revolutionary*. O'Reilly & Associates, Sebastopolous , C.A., USA.

Wichmann T. (2002) *Firms' Open Source activities: motivations and policy implications.* Free/Libre and Open Source Software: Survey and Study, FLOSS Final Report, International Institute of Infonomics, Berlecom Research GmbH.