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# A Market Mechanism for Scientific Communication: An Explorative Proposal\*

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March 16, 2001

## Abstract

This paper designs a market mechanism for scientific communication. The conventional scientific communication tools do not provide any well-defined incentive for reviewers. Therefore, it would not be wrong to argue that the quantity and quality of feedback to scientific findings is ad hoc. Perhaps one exception is journal publication, in which feedback to a paper is certain. Nonetheless, journal feedback is the final and ultimate step of scientific communication and it works very slowly. Scientists need feedback especially before this final and ultimate step in order to increase the quality of their preprint papers. We argue that scientific community needs a well-defined ('incentivized') refereeing process in order to increase the quality of scientific writings. This paper develops a market mechanism for scientific communication, where reviewers as much as authors have well-defined incentives to act. The contribution of the paper may be seen as a first preliminary step to the development of a global marketplace for scientific communication. This makes our proposal novel to the scientific community.

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\*This is a very preliminary draft. Please do not quote and circulate without the consent of the authors.

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# 1 Introduction

It is well known that scientific knowledge is engine of economic growth. Policy makers are eager to put more resources into scientific research in order to accelerate the ongoing economic growth. Part of these resources are devoted to scientific communication, which is part of research and development (henceforth R&D) process. In this work, by media of scientific communication, we mean all tools like scientific journals, books, working papers, conferences, seminars, etc. that allow researchers to disseminate their findings and, in turn, to get some "scientific feedback" from their colleagues.

There are two main benefits of scientific communication. First, scientific communication improves the quality of R&D output via feedbacking. Second, scientific communication allows other researchers to benefit from the frontier knowledge and to use it in their own research that fosters further research. This aspect refers to the public good character of scientific knowledge. Perhaps this is the reason why researchers show increasing interest to scientific communication and policy makers give increasing support to R&D in general and scientific communication in specific.<sup>1</sup>

We argue that the current set of media of communication for scientific communication, enumerated above or not, are necessary but neither sufficient nor efficient. The conventional scientific communication is not (effectively) sufficient because, scientists seem to have too few (effective) alternatives for promoting their findings and receiving feedback in return. Our argument is based on two observations. First, in practice, most of researchers have some form of close-circuit feedbacking system. By close-circuit, we mean that researchers establish their own personal and informal scientific links in order to get some feedback for their scientific writings. Then, practically, the variety of media of communication is bounded by the

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<sup>1</sup>See, for example, OECD (2000), supporting this argument.

number of tools used by the informal network that the researcher is in. Thus, due to personalization of communication environment, the variety of media of communication becomes (effectively) insufficient. Second, the cost of scientific communication is increasing. Many researchers, especially those of developing countries, are finding themselves under more stringent conditions that do not allow them to use all types of media of communication.<sup>2</sup>

Existing media of communication are also inefficient because potential reviewers lack well-defined incentives to provide any feedback. In our terminology, we argue that the conventional scientific communication is not well-*incentivized*. There are several examples showing the lack of incentives in the conventional media of communication. Take, for example, seminars and conferences. In both of them, if the author (presenter) is lucky, there is a discussant. But this is not the end of the story. First, there is no guarantee that the discussant is specialized in the subject of the paper. It is common to hear that a discussant starts his/her speech by saying "though I am not expert in this field, I will do my best (...)". This is a clear signal of a discussant to the audience that his comments would not be at high quality. Second, since the only incentive that exists for a discussant is the prestige earned, the quality of review is ad hoc because the (net) benefit of loose review is close to zero or may even be negative. It might be negative because the opportunity cost of time spent for a good review could be very high. Thus, in many cases, discussants simply touch very general points corresponding to the paper and ignore reviewing the paper at *full* detail. In addition to this, open-floor discussion made by audience also results in ad hoc feedback given the fact that many of the audience are exposed to

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<sup>2</sup>It is difficult to find data supporting our argument. But the unequal distribution of R&D expenditures is an indirect proof of our argument. For example, within OECD, in 1999, the United States accounts for 48 percent of OECD expenditure, followed at a distance by Japan (18%), Germany (about 8%), and France (about 5.5%), which add up about 80 percent. This shows that developing countries within OECD have very tiny R&D expenditures. It is not wrong to generalize this conclusion. See OECD (2000) and visit [http://www.oecd.org/dsti/sti/s\\_t/index.htm](http://www.oecd.org/dsti/sti/s_t/index.htm) for details.

the paper for the first time. Furthermore, the small size of audience (there are always parallel sessions in conferences) further reduces the probability of getting good feedback. It would not be wrong to argue that, effectively, only the author adds prestige to his career and promotes his ideas via seminars and conferences, and in that sense, scientific communication takes place dominantly in one direction. Similar to seminars and conferences, working papers, papers posted in personal or departmental Web pages lead to one-way communication flowing from the author to the audience. In conclusion, audience feedback is ad hoc because of lacking proper incentives and therefore the conventional media of communication is inefficient.

One exception is the case where scientific communication is carried out through scientific journals. In that case, there is a well-defined reviewing process, though the set of incentives for reviewers may or may not be defined.<sup>3</sup> Moreover, a paper that is submitted to a scientific journal is usually not in a preliminary form anymore. That is, a paper submitted to a journal is supposedly at its 'best' quality (that the author(s) can do). In conclusion, the best and scientifically satisfactory reviewing mechanism is only available at the *final stage* of scientific communication, and this also implies that the process of communication that precede the journal submission is inefficient in terms of the number and quality of feedback received.

All of these shortcomings motivate oneself to work on alternatives. Several attempts have already been made, especially after the development of ICT technologies in general and the Internet in specific.<sup>4</sup> Surprisingly, the focus of these attempts was to create a substitute of (real marketplace)

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<sup>3</sup>Being a referee, especially for a top scientific journal, brings personal prestige and also signals that that person is considered as an expert in a certain field. Nonetheless, this side-benefit effect that exists for top journals cannot be generalized. Some scientific journals even provide monetary incentives for referees to induce them to react in a timely manner, eventhough such an incentive may not be really necessary (see the analysis of Engers and Gans (1998)). In conclusion, it is not wrong to argue that journal-refereeing is not well-incentivized.

<sup>4</sup>We will make a general introduction in this section. More details for these attempts can be found in the text.

journals rather than questioning and improving the whole scientific communication process. Perhaps the reason behind this bias is the so-called journal crisis and the lengthening periods of reviewing. On the one hand, rising journal prices have started to limit library budgets and thus libraries have started to cut their expenses by unsubscribing to journals. This has caused reduced access to scientific knowledge.<sup>5</sup> On the other hand, given the fact that referee incentives are not well-defined in journal publication, the duration of reviewing has been steadily increasing since 1970s.<sup>6</sup> These two apparent problems motivate scientists to develop alternative ways of publication. Especially after the invention of the Internet, many sites aiming to be a platform of scientific communication are founded. The main characteristic of all these platforms is the fact that none of these platforms targeted the essence of the problem, i.e., introducing incentives for reviewers.<sup>7</sup>

In contrast, in this paper, we focus on developing a mechanism that provides incentives for reviewers. Furthermore, our focus is on pre-journal phase of the scientific communication process. That is, on the process in which the results of scientific research is still at its preliminary form.<sup>8</sup> In that respect, our attempt deviates significantly from other attempts.

The idea developed in this paper is perhaps best understood by using industrial organization conceptualization. Let us suppose that the ultimate form of scientific communication is scientific journal publication. Thus, if we perceive a paper that is published in a journal as a '*final good*', then the journal market can be viewed as a final good market. The buyers (deman-

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<sup>5</sup>See Odlyzko (1994), an old but the best paper on this issue. There are several other papers on this issue. See, for example, CPB (2000a) and CPB (2000b) and references cited in the latter.

<sup>6</sup>See Ellison (2000), a very recent and comprehensive study of the slowdown in the economics.

<sup>7</sup>We are aware of the fact that this argument is too strong. Actually, there are some attempts offering incentives to referees. However, these incentives are loosely defined and are mainly pecuniary rewards. We shall discuss them in more detail within the text in the subsequent sections.

<sup>8</sup>Roughly speaking, any paper that has not been submitted to a journal yet falls into this stage, according to our definition.

ders) are those who are interested in knowing the frontier research findings, while the sellers are obviously the authors. One of the characteristics of this market is that authors always try to shape their papers towards a publishable form, which can be loosely associated to passing a certain threshold of quality. As is mentioned before, an author has several options to use in order to pass this threshold, such as circulating the paper among his/her colleagues, presenting in seminars, and participating in conferences. If we borrow the industrial organization analogy, all of these options can be considered as intermediate inputs needed in the production of the final good. Throughout this study, we will call this the intermediate process of scientific communication.

As we stated above, the question that we would like to address is whether or not we can establish such a formal intermediate market that provides well-defined incentives for reviewers as much as for authors and thus enables an improvement in the quality of scientific output being at the intermediate stage. More precisely, this paper develops a market mechanism that allows researchers to communicate and receive feedback based on well-defined incentives. To this end, we use a simple law of physics.<sup>9</sup> The marketplace allows researchers to submit their papers to the market, where some other colleagues are willing to give feedback due to a well-defined incentive mechanism available in the proposed design.

We argue that people tend to take for granted this intermediate process, and do not bother to question or improve it. In contrast, this paper attempts to develop an alternative media of communication for this intermediate process in order to increase its sufficiency and efficiency. In that respect, to our knowledge, our paper is the first that opens the '*black-box*' of this intermediate process.

We use the Internet to facilitate the workings of this intermediate market

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<sup>9</sup>This idea is first brought into attention by Yetkiner (2000). See the subsequent discussion in the text for details.

for scientific writings. Given the fact that economic and physical distance is greatly reduced by the existence of the Internet, efficiency gains due to reduced transaction costs are obvious. This aspect of the Internet is well-known and highly benefited by some other recent innovative attempts in scientific communication and even by the conventional media of communication. However, the marketplace character of the Internet has been rarely used for scientific communication. Our new design, on the other hand, raise on the marketplace character of the Internet.

The format of the paper is as follows. Section 2 describes the model and its components. Section 3 makes the first attempt towards theoretical representation of the model. Section 4 compares and contrasts our design with other alternatives proposed for increasing the efficiency in scientific communication and thus determines strengths and weaknesses of our design. Section 5 illustrates the model via an application to real life. We believe that illustrating the model with a concrete application is crucial especially at the proposal stage. Finally, section 6 concludes the paper.

## **2 The Framework**

One version of an old joke has an editor tells a referee, "You are probably the second and last person to read this paper", to which the referee replies "Second? Are you sure the author has read it?" This old joke points out to the importance of quality in scientific papers. Quality of scientific papers is not a rabbit out of a magician's hat. It desperately needs, among other things, scientific communication and feedback. In what follows, we propose a model that, we argue, could help in improving the quality of research papers, which are in their preliminary form. The framework developed below explains the basics of the market mechanism.



## 2.1 The Basic Set-Up

There are some important factors for such a formal market to exist. The first and foremost is perhaps *the existence of market participants*, i.e. buyers and sellers. The question then boils down to whether or not we have such participants in the area of scientific communication? The answer is yes. To illustrate this, let us assume that there exists a number of scientists joining a certain scientific network. We make some simple assumptions. First, the membership to this network is voluntary, and members are rational. Second, membership requires certain qualifications. This implies that voluntariness is necessary but not sufficient for membership. In addition to this, the network membership requires some scientific qualifications. For illustration, several examples can be given. Having a Ph.D. degree (e.g., in physics) from any university of the United States or having published at least one paper in a A-class journal are two examples. Third, all members are ready to act as an author and reviewer given that incentives are sufficient. Assumptions two and three implicitly imply that each member has sufficient ability to act both as an author and a reviewer. Fourth, if there exists a middleman, it has enforcement power over members. That is, given incentives for members to act as either an author or an reviewer, the middleman has enforcement power of the best matching among the authors and reviewers. Figure 1 depicts the setting that we described above.

The circle represents all scientists that are members of the network. We assign them dual roles as both an author and a reviewer. However, some of them at a given time may act only as either an author or a reviewer (respectively, area II and III). It is obvious that if area I disappears, that is, when we have a situation in which members are only *willing* to shoulder a single role, either as an author or as a reviewer, then the network will not be operational.

Therefore, the main objective of our mechanism is to encourage members

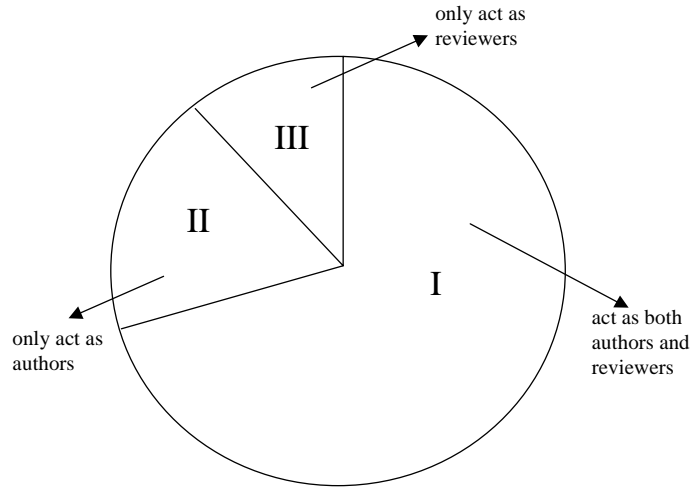


Figure 1: The Setting

to assume the dual role. This is tantamount to saying that we have to minimize area II and III. In other words, borrowing from the contract theory, we have to establish an '*individually rational*' condition for members to assume these dual roles. Obviously, it is impossible to eliminate areas II and III completely due to the possibility of non-existence in matching. For instance, when a potential reviewer does not find a paper to be reviewed which is in his/ her field of interests, then he/she is located in area III.

Note that areas II and III can be reduced more smoothly if there is a middleman, who possesses *full authority* in distributing papers to potential reviewers. This brings us to the question of the existence of the third element of the network, the middleman. Without a middleman, the matching between authors and reviewers will have to rely on a voluntary mechanism given that there exists sufficient incentives for acting as author or reviewer.<sup>10</sup> The weakness of this system is the likelihood that some authors may not

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<sup>10</sup>The readers should bear in mind that the network we are describing is run in the cyberspace. Thus, even in absence of a middleman, it is possible that authors and reviewers can match without incurring big transaction costs. In the real market, this matching would be very costly, if not impossible.

be able to find reviewers and some reviewers may never be asked to review papers due to some reason. That is, there is a chance that the authorship-reviewership will distribute unevenly during the workings of the network, though the marketplace have well-defined incentives for members who would like to act as an author or a reviewer. This may arise for several reasons. For example, some members might be very well-known in their field, which makes them preferable for reviewing, compared to other members.

With a middleman, the match of authors and reviewers can be handled more easily. This is because we assume that the middleman have full information about members. The second benefit of using a middleman perhaps rests on its enforcement power. We stated above that enforcement power of middleman concerning the matching is taken for granted by the members of the network. Then, necessarily, it is much more possible to minimize areas II and III in figure 1.

## **2.2 Market Participants**

In what follows, we discuss the design of the market for scientific communication that we have in mind. We begin with the description of the market participants. Market participants (i.e., members of the network in the design) are researchers/scientists working in a specific discipline, for instance economists. They are accommodated within a scientific network, and this network is designed to be the place where the exchange takes place.

### **2.2.1 The Authors**

The basic incentive of members to act as an author is the need to get feedback for their preliminary papers. Members, as authors, submit their papers to the network at their own will.<sup>11</sup> They might do so if they think that they can get valuable feedback for their paper(s) from other members of the net-

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<sup>11</sup>Note that members are not obliged to submit all of their preliminary papers to the network. That is, not only membership, but also submitting a paper is voluntary.

work. Actually, the first two assumptions we made in the previous section implies that this is a trivial question because, first, anyone who believes that this network does not add any value to their scientific activities would never become a member, and, second, membership requirements for the network can be associated with the scientific advancement of members. In that respect, authors must rationally expect to get some invaluable feedback from their colleagues in the network.

There might be some other benefits to the author from being an active user of the network. A fall in scientific communication costs, a more reliable knowledge spillover, and a chance to build a personal (social) network are among them. With the conventional media of communication, an author has to spend quite a big amount of resources like registration fees and travel expenses for conferences and time to organize things and for travelling, etc. By shifting (partly) from using conventional media of communication to our design, members of the network would lower scientific communication costs. This is especially true for developing countries. In developed countries, communication costs are generally paid by institutions the researchers are affiliated. In developing countries, on the other hand, where (public) resources available for conventional scientific communication are scarce, researchers do pay themselves. Thus, the usefulness of our network design to researchers in developing countries can be much more significant. In sum, researchers (authors) do benefit directly or indirectly from being a member of this network.

Second, our design allows for a greater and more reliable knowledge spillover across scientists in the same field. It is natural to imagine that those papers submitted to the network and reviewed would be made available to other members and even to non-members.<sup>12</sup> As discussed elsewhere in the text, the quality and quantity of feedback a preliminary paper receives at

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<sup>12</sup>We believe that this must be possible on the consent of the author.

the intermediate process is ad hoc. Therefore, until a paper is published in a journal, and even after then, there is always a risk that a paper may contain big mistakes. A review available at the intermediate stage increases the reliability of a preliminary paper. Thus, other researchers, who would like to benefit from the framework and the results of that preliminary paper, reduce the risk of building their own research on false grounds.

Third, our design allows for interactivity between authors and referees, which may contribute significantly to the quality of the review especially if there exists controversial findings in the paper under review. One of the characteristics of the Internet is that it allows for online real time interactivity at very low costs. In the standard journal refereeing, most journals follow single-blind or double-blind refereeing process. In other words, authors never know who is refereeing to their paper. In our design, on the other hand, for example with the initiation of the referee, an interaction between author and referee is possible during reviewing process.<sup>13</sup> The referee might need interaction with the author especially in case of controversial findings. The usefulness of interaction from the viewpoint of author can be great. Similarly, this network would allow for building a social network among scientists. The Internet allows for interaction not only between an author and a referee, but also among members. Those scientists that have never found any chance to interact before would have the opportunity to set up social as much as scientific relations between them.

Finally, let us check the significance of assumptions we made in the previous section from the viewpoint of authors. First, remember that we assume there exists a large number of members in the network, normally specialized in various fields. The importance of large number comes from the following: Perhaps members, acting as reviewers, would be grouped according

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<sup>13</sup>See Armstrong (1982) on the importance of this interaction. In the classical journal refereeing, Armstrong offers "note to referees", describing the hypothesis and design, serving to the same purpose.

to their fields of specialization. The large size assumption guarantees that any author that submits a paper in any subject within the main interest area of the network would get a 'good' match out of potential reviewers. Otherwise, lacking a satisfying number of members in a specific field would be a significant disincentive for researchers that are specialized in the same field. Second, "qualified members" assumption ensures that authors are able to produce scientific research above a certain minimum quality level. This brings into homogeneity of authors, which is very important from the viewpoint of any member. There are many other issues that have to be discussed. We shall defer discussing them in detail to the application section. Later discussion will put flesh on bone.

### **2.2.2 The Reviewers**

Remember that by committing to become a member, an author also commits to become a reviewer. Furthermore, a member in this network can act simultaneously as an author and a reviewer.<sup>14</sup> Here, the crucial question is whether or not members have sufficient incentives to act as a reviewer. If the reviewing process had been unincentivized, then reviewers would have tended to avoid this duty. Thus, at equilibrium, all members would (prefer to) function as authors and nobody would function as a reviewer. In our framework, however, we provide a mechanism that creates an incentive for members to become a potential reviewer.

The idea is not very much different than the idea of Pascal's law, a law of physics. Pascal's Law states that in a fluid at rest in a closed container a pressure change in one part is transmitted *without loss* to every portion of the fluid and to the walls of the container. Similarly, let us assume that

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<sup>14</sup>It may be worthwhile to think of the current setting in terms of market matching literature. In this literature, we usually have a 'one-sided' matching, in the sense that a party which assumes a certain role (e.g. a buyer) is matched with another party which assumes another role (e.g. a seller). The type of matching that we have in this paper is 'two-sided' matching, in which a party assumes two roles, e.g. both as a buyer and a seller. This is because an author is also a potential reviewer.

each member is a particle in a closed system. When a member moves in a certain direction (i.e., asks the system to review his preliminary paper), the pressure created by this movement causes another member (i.e., the reviewer) to move in the opposite direction *at equal distance*. Opposite movement occurs because the pressure created by the author (within the system) is *exactly* (without any loss) transferred to another particle (in our case, to the reviewer). But since the main incentive is to move in a certain direction (to get reviews by submitting papers to the system), in the next round or at any time, the *ex*-reviewer also has incentive to move in the direction that the *ex*-author has moved. When the *ex*-reviewer submits a paper to the system, it moves in the opposite direction that had moved before and forces simultaneously someone (a new-reviewer) in the direction that he moved before. If we use the terminology of economics, we construct the marketplace in such a way that any pressure coming from demand (supply) is transmitted to supply (demand) and thus the market always stay at equilibrium at each instant of time. Furthermore, this process continues endlessly, if there is no loss of pressure. Normally, there is no pressure loss because we assume that the system is closed.<sup>15</sup> Here, we use "close" not to mean that the system is not open to new members but to mean that there is no pressure leakage in the system.

At cost of some repetition, we would like to describe the application of Pascal's Law with an illustration. If we look at figure two below, initially, all members are centered at the same point and thus constructs a mass. When the 'game' starts, each member takes up a direction (some members prefer to be authors and some others prefer to be reviewers). After authors match with reviewers, authors move in a certain direction and, simultaneously, the pressure their movement created drives away the matching reviewer in the opposite direction. This is illustrated at the middle circle in figure two. The

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<sup>15</sup>See the application section for some puzzling cases.

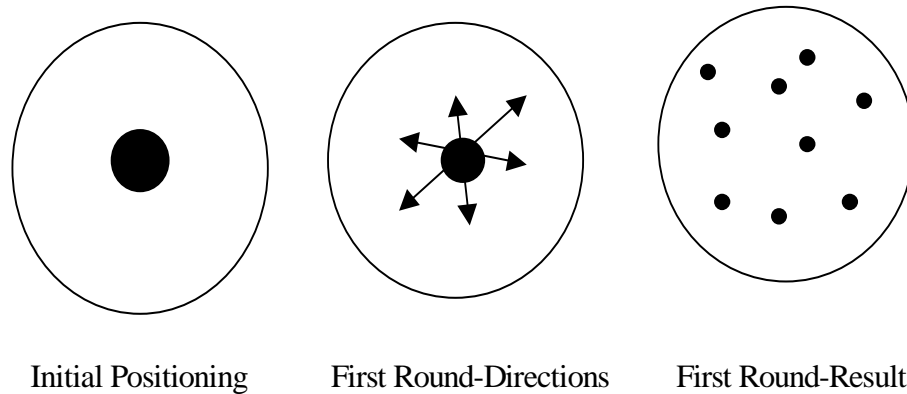


Figure 2: Insight from Pascal 's Law

final position of authors and reviewers are not identical (for each group) because of several reasons. First, some members may stay idle due to non-matching. Second, some members may act simultaneously as an author and a reviewer. Third, the pressure created by each author may not be identical. All these effects result in the scattered distribution of members (their positions) after the first round. This is illustrated in the third circle in figure two below.

Perhaps it is intuitive to compare our system with journal refereeing. The increasing journal refereeing literature has shown that the only real incentive for a referee is the prestige of being a referee in a journal. A researcher that acts as a referee is generally considered as at the frontier of his specialization and thus may benefit from several side benefits like early reading of frontier research, being promoted in academic and non-academic positions, receiving project awards, etc. Otherwise, journal refereeing does not have any well-defined incentive mechanism. For example, Laband (1994, p.343) explicitly states that



”reviewers (...) are residual claimants to little of value in exchange for their efforts. True, they may benefit from early reading of high-quality research findings, but, in general, there is no quid pro quo for their reviewing services”.

On the other hand, in our model, the reviewer has a sufficient incentive that drives him to review a paper. The reviewer knows that the reviewing act allows him to submit his paper later for being reviewed by others.

In addition to this, reviewing is still a source of prestige in our design, like journal refereeing. Similar to journal refereeing, the names of reviewers may appear in several occasions. First, members that serve as a reviewer may be announced time to time within the network. Second, as an option, the name of the reviewer may be declared to the author, after a preliminary paper is reviewed within the network. When the author would be able to publish this paper in a journal, than the name of the reviewer may appear in an acknowledgment footnote and thus may provide some prestige to the reviewer. This prestige would be a very powerful one if the network is prestigious. In that respect, our design provides for a strong prestige to reviewers. Moreover, the association between the paper and its reviewer does not have to be blind in our design. This implies that this prestige might be a very powerful one, indeed.

Besides the cost of effort, a member also faces opportunity cost while acting as a reviewer. Reviewing takes time, and thus the opportunity cost would be in the form of time spent on reviewing activity which could have been spent on, for example, writing a new paper instead. In the language of contract theory, this opportunity represents an *outside option* for a member. Thus, instead of joining as a member and thus committing to reviewing a paper, this member can decide not to enter the network and instead spend his (her) time on another activity. In this paper, we assume that the benefit gained by being member of this network (i.e., having papers reviewed) is

greater than the cost of effort plus the opportunity cost of time spent for acting as a reviewer. Then, obviously, a (potential) member that values the cost of effort plus opportunity cost higher than the benefit gained by having papers reviewed by others, would quit the system or would never attempt to become a member. For instance, we could imagine that a very well-known scholar with a good research record may be reluctant to join the network, as he values his time highly. However, many scholars and especially young scholars with unknown reputation would benefit a lot from such a system.

The quality of reviews of submitted papers is vital from the viewpoint of the author. If the quality of feedback is below a certain level, nobody would like to be member of the system. There are two points here. First, we assume that required qualifications for membership assure that the quality of review of a submitted paper is at satisfactory quality level. This assumption is not different than the one that we assume on the quality of the scientific outgrowth of the author. Furthermore, remember that each member undertakes both to be an author and reviewer. In that respect, selective-membership system assures that the quality of author's submitted papers and the reviewer's feedback are above a certain level. Second, given the fact that the reviewer's effort is not observable, not only our design, but also any of conventional communication tool cannot assure quality. There are only indirect ways to assure a minimum quality in the review other than selective-membership, and we will discuss them in due course in the text.

## **2.3 The Institutional Setting**

### **2.3.1 A System without a Middleman**

Without a middleman, the network will have to rely on voluntary matching. By this, we mean that authors submitting papers to the network will also look for potential reviewers that may like to provide feedback to their paper. Similarly, reviewers that would like to review papers (because they

want to gain some 'pressure' to move in the opposite direction in the next round) look at the marketplace for proper papers. An analogy between this kind of marketplace and barter marketplace can be set up on the grounds of workings of the two marketplaces. In a barter marketplace, each market demander must find such a supplier where the supplier demands what the demander supplies and simultaneously the supplier must match with such a demander where the demander supplies what the supplier demands. Obviously, transaction costs is very high in such a marketplace. Similar inefficiency exists if there is no middleman in our design. Without middleman, each author must match with a reviewer that he would like to match and simultaneously the reviewer would like to match with the author because what the author supplies is what the reviewers would like to review. In sum, the matching process of the author and the reviewer is highly inefficient.

One result of having marketplace without middleman, with a high likelihood, would be uneven distribution of the submission and reviewing process. Some papers may draw a lot of interests, and many reviewers would like to review only those interesting papers. Similarly, some reviewers would be relatively more preferable compared to others and thus many authors would prefer to have their papers reviewed by these reviewers. In conclusion, the market design will be biased.

We argue that, in order to increase the efficiency of the marketplace and in order to create a more even distribution of the reviewing process, a middleman (an administrator) that helps to match between authors and reviewers is inevitable. In the following subsection, we analyze the role of a middleman.

### **2.3.2 A System with a Middleman**

Let us now consider our design with a middleman (a principal). In this structure, the '*task*' of the principal is to make the best match between the

submitted papers and reviewers. The incentive for the middleman can be several. Actually, the incentives for a middleman can be associated with the extent of the boundaries of the network. For example, let us suppose that the middleman is a public organization operating within national border. In that case, the main incentives of a middleman is the efficiency in terms of higher-quality pre-print papers and lower scientific communication costs due to better matching of the authors and the reviewers. First, the middleman contributes to the outcome of higher-quality preliminary papers. Then, it is natural to expect that those researchers that are members of the national network would be more successful in being able to publish their researches in better journals and with higher chance and thus increase the level of scientific communication. Given the assumption that the middleman is a public organization concerning the level and quality of scientific communication within the border, our design provides for an excellent mechanism to achieve this. Second, our design allows for reduction in aggregate communication costs if some substitution from using conventional media to our design can be achieved. Transaction costs are lower in the Internet marketplace once a set up is made. This is true for any type of marketplace and scientific communication via the Internet is not an exception. Given the higher costs of conventional media, if some shift in the intensity of use can be achieved, then, at aggregate, reduction in communication costs can be achieved. This can also be a strong incentive for a middleman.

Second, the middleman may be a commercial unit. Then, the middleman will define itself according to commercial incentives, e.g. profit maximization. Suppose that the boundary of the network is extended by adding membership fees in addition to the assumptions that we made at the beginning (note that a public organization may also charge a fee; actually, any mix of incentives that we discuss here is possible in our design). Then, the middleman's incentive is to maximize profits via achieving the best match of

authors and reviewers in the network. Note that a commercial middleman cannot maximize profits in the long run if it cannot achieve the best match. Then the question boils down to whether or not potential members would like to be members of this network. Then, we must modify our condition on the membership: the benefit gained by having papers reviewed must be greater than the cost of effort plus the opportunity cost of time spent for acting as a reviewer plus the membership fee.

Third, the middleman can be a non-profit international organization. In that case, the boundaries would be extended to the globe. Some fee may also be charged (normally, it must be lower than the fee charged by a commercial middleman). In that case, the main incentive of the global middleman can be the advancement of a scientific disciplinary or field via increasing the efficiency of scientific communication.

These examples are comprehensive but not exhaustive. Any mix of three types of boundaries is possible. Or, it is possible to define the boundary of the membership in a way other than the three possibilities given above. In conclusion, our design allows for a big flexibility in defining the boundaries of the network and thus the incentives for the middleman. Due to this reason, we will focus on the general usefulness of middleman from now on. First, when the matching task is delegated to the middleman, the market design operates more efficiently due to the fact that the middleman have full information about members. The second benefit of using a middleman perhaps rests on its enforcement power. Given its legal entity and possible scientific and social network identity, the middleman creates a prestige over members and within the scientific community. This allows it to undertake matching more smoothly and perhaps in a serious way. Thus, the middleman system could lead to a better allocation of reviewing process.<sup>16</sup>

One more note on the tasks of middleman. We stated before that our

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<sup>16</sup>The workings of the mediator would be more clearer when we work on a concrete example.

design does not ensure the quality of reviewing process, as neither journal refereeing nor any other reviewing process secures. The existence of a middleman, however, works like journal editors. Journal editors examine submitted papers and referee reports. This check may be argued to bring some quality to the refereeing process.<sup>17</sup> Similarly, the middleman himself may examine the submitted papers and the reviews or may delegate this job to a third person. In that case, we may argue that this may assure some minimal quality level in the papers submitted and the reviewing process. The middleman may use pecuniary or nonpecuniary incentives (depending on the boundary of the middleman) in order to increase the quality of reviews.

## **2.4 The Benefits of the System**

In the previous subsections, we have discussed incentives for market participants. In this section, we discuss the overall benefits of the system to scientific community. The value added of our design to scientific community are various. First, our design allows for quick dissemination of reliable preliminary papers. In old times, scientists considered journals as the most frequently used source of information for keeping them up to date with the latest developments. Nowadays, however, with lengthening duration between submitting a paper and having it printed in a journal, it is rarely possible to get frontier scientific knowledge. Therefore, most researchers rely on (online) working papers and homepages of colleagues for keeping themselves up to date. But, a paper at this stage is not reliable and may contain serious mistakes because there is a low probability that it has ever been reviewed thoroughly. The biggest advantage of our proposed system is that those papers that are posted on the Network's homepage with the consent of the author are reviewed (and revised, if necessary), and therefore

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<sup>17</sup>As much as some conflict between referees and editors: several cases are known where classical papers were rejected by referees and/or editors at first. See, for example, Gams and Shepard (1994).

can relatively rarely contain serious mistakes. Since the duration between the first appearance of a paper and its journal publication is very long, serious mistakes in a paper may mislead other researchers and thus may result in negative externality. Relevant to this, researchers are increasingly citing working papers and papers at their preliminary forms available at homepages of authors. If there is any mistake in cited papers, it disseminates across the scientific community. Our design alleviates this problem given the fact that all papers are reviewed before they are posted in the Network's homepage.

Second, this is a marketplace for ideas that provides an efficient way to separate the good ideas from the bad. Conventionally, journal publication is the only way that was used for this separation. Allowing a separation at an intermediate step would increase efficiency of researchers and journals. Researcher efficiency will increase because they would not spend their time on bad ideas. Journal efficiency increases because those papers that are low-quality would never be sent to journals and thus journals would be able to select among those submitted papers that have already been screened. This is obviously a value added to authors and to journals. One indirect implication of this preliminary reviewing process would be shortening in lengthened periods of journal publishing. Editors might be quicker in replying the author on the contribution of the paper when they recognize that the submitted paper has been reviewed within such a network (even the network review might be sent to journal editor) and the referee might be more positive (negative) in his/her refereeing process due to positive (negative) review comments. In any case, the process may be quickened, which is a all-gain result.

Third, this may add some more democracy to the reviewing process. Many journals are blamed for favoritism.<sup>18</sup> One reason behind this blame

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<sup>18</sup>See, for example, Laband and Piette (1994), examining some journals in economics blamed for favoritism.

is the fact that good researchers are educated in good research centers, and these centers also publish good journals. So, editors and reviewers may have tendency to be more ready to accept those papers that are sent by people affiliated to good research units.<sup>19</sup> Our design allows any member of the network to have a review process without any bias because reviewers or middleman has no incentive like having famous names appearing in a journal. Conversely, a paper reviewed in our design would get an extra quality sign, which may lead to easier acceptance of good papers written by unknown authors to good journals. This means some equalization (more democracy) across the scientific community in good-journal publication. This may be especially true for scientists from developing countries.

Fourth, replicability of scientific output is very important. It is not wrong to argue that a very minor percentage of published papers is replicated, currently. One reason behind this is the fact that many journals have size limitations. Though (online) working papers or preliminary versions posted on personal homepages may include some or more details of (technical) analysis, they are not available in the final version. In that respect, the network is an excellent place to submit and post papers in full-detail.<sup>20</sup> In the cyberspace, the marginal cost of adding more pages is almost zero and especially young researchers and Ph.D. student would benefit the most from having all details of derivations.

#### **2.4.1 The Role of the Internet**

The Internet greatly facilitates the working of our framework. It fosters and eases the feedbacking process, and also provides a marketplace for the exchange. Therefore, before going 'deeper' into the incentive analysis, it is useful to discuss the role of the Internet in general. We conjecture that

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<sup>19</sup>If a journal follows double-blind reviewing process, then only editor-bias is relevant.

<sup>20</sup>For example, all technical details can be added as anexes to the paper and thus can be easily detached by the author before submitted to a journal



scientific community uses the Internet below at its full capacity. This conjecture arises from the observation that the two characteristics of the Internet are frequently confused by scientists, by and large. We argue that the Internet has two important characteristics. First of all, the Internet is a general-purpose technology (GPT).<sup>21</sup> A GPT is defined as those technologies that are characterized by "the potential for pervasive use in a wide range of sectors and by their technological dynamism".<sup>22</sup> Two good examples are steam engine and electric power. Few scientists (and especially few economists) recognize the GPT character of the Internet, though this is what they mean by saying, "the Internet will make radical changes in (...)". Using the Internet for promoting a department and staff, announcing conferences, posting downloadable articles on an Internet site are all some examples of benefiting from the GPT character of the Internet and nothing more than this. Scholars use the Internet in order to increase their efficiency by lowering their transaction costs (mostly in terms of time), by and large. However, this is rather a 'passive' way of using the Internet for scientists. Take, for example, sharing pre-print versions of scientific papers. If this is the intention, after saving a working-paper in a server, it is reachable and downloadable by curious researchers at their own interest at zero cost to the provider. This quickens the dissemination of ideas and earn some prestige to the author but does not create added value to the author, in general.

The second quality of the Internet is that it has the capability to create a marketplace for (almost) anything. That is, demand for and supply of almost any good or service can be matched in the cyberspace. If we look at current application of the Internet by business, this is what the Internet is used for, by and large. You can sell or buy a car or an old LP in few seconds from the Internet marketplace. Moreover, the size of the market (which is virtually the world population) and low transaction costs suggest

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<sup>21</sup>See Harris (1998) advancing this idea.

<sup>22</sup>See Breshnahan and Trajtenberg (1995).

that the Internet marketplace cannot be worse than real marketplace (at least in theory). We believe that recognizing the marketplace character of the Internet is an important step for further stimulation in that direction. While the GPT property of the Internet rather eases communication in one way (or in a passive way) without relying on market forces, the marketplace character of the Internet allows for emergence of an "equilibrium" in the market.

Perhaps one reason that no one considered before to apply the idea that we developed in this paper in the real marketplace is the fact that our model leads to huge transaction costs in the real marketplace. Compared to the conventional marketplaces, the Internet offers huge savings on transaction costs (expressible mainly in terms of time) due to the fact that it shrinks physical and economic distances. It also improves the flow of information between buyers and sellers, and thus facilitates market transparency and efficient resource allocation (at global level). Given the fact that transactions can be carried out much faster with relatively low costs in the Internet marketplace, the question is how can we utilize the marketplace character of the Internet in order to create a virtual marketplace for scientific pre-published papers.

In our design, both properties of the Internet are used together. On the one hand, the GPT character of the Internet appears as a software that acts on behalf of the mediator; monitors and arranges (most of) transactions. Members (and non-members) can download papers, communicate with others, raise questions, etc. On the other hand, the same software creates a cyber marketplace that allows researchers to supply their papers to the pool, where some others demand to review these papers. Thus, demand and supply match at each instant of time and 'equilibrium' is reached. Transaction costs are low in the cyberspace, approaches to zero for voluminous transactions and thus the system is efficient for sufficiently high number of

transactions.

### 3 The Optimal Incentive Mechanism

Let us begin with the incentive of a potential member to join the network in the first place. The crucial question to ask is, under what condition it is individually rational for a member to participate in the network. In other words, how does the *participation constraint* of a member look like? Note that we assume an author produces a paper which will be reviewed by a referee. There are  $n$  members in the network.

From our previous discussion, the main benefit of joining the network is the feedback that a member (lets denote the member with subscript  $i$ ) will receive. The usefulness of this feedback depends on the quality of the review given by a reviewer (lets denote the reviewer with subscript  $j$ ). Let us denote the usefulness of the feedback with  $\gamma(e_j)B$ , in which  $\gamma(e_j)$  represents the quality of the feedback provided by a reviewer  $j$ . The higher the effort exerting in reviewing a paper, the higher this quality parameter will be. For simplicity let us assume that  $0 \leq \gamma(e_j) \leq 1$ , and that an author is only matched with a reviewer (a bilateral relationship). There is still another benefit from joining the network, namely the cost saving in term of conference fees and transportation costs. Let us denote this cost saving with  $F$ . Exerting effort for reviewing is costly for a member. To capture this we assume that the disutility of effort for the member can be expressed as  $c(e_i)$ , which is convex in  $e_i$ .

Hence, the utility obtained by a member ( $i$ ) from joining the network is,

$$U_i = \gamma(e_j)B + F - c(e_i) \tag{1}$$

The participation constraint can then be expressed as,

$$\gamma(e_j)B + F - c(e_i) \geq T \quad (2)$$

in which  $T$  represents the outside option for a member (time opportunity cost).

As the quality of feedback, and hence the usefulness of the feedback depends on the effort, members have to be given incentive to exert their best effort in reviewing. There is an asymmetric information here, as reviewers know exactly the intensity of effort that they exert, while authors do not have this information. It is therefore important that the design of the network ensures that it is incentive compatible for reviewers to exert their best effort. The incentive compatibility constraints can then be expressed as,

$$\gamma(e_j^*)B + F - c(e_i^*) > \gamma(e_j)B + F - c(e_i^*) \quad (3)$$

$$\gamma(e_j^*)B + F - c(e_i^*) > \gamma(e_j)B + F - c(e_i) \quad (4)$$

These constraints essentially say that *bilaterally* exerting the best effort level (as indicated by superscript \*) will give a higher utility than exerting any other effort level. Note that it is important here to have bilateral optimal effort.

### 3.1 The Free-Rider Problem

It is apparent from expression (1) and (2) that there could potentially be a free-rider problem, because the utility of a member ( $U_i$ ) is increasing in the reviewer effort ( $e_j$ ) and decreasing in own effort ( $e_i$ ). To avoid this free rider problem, we should have complementarity in effort levels, which essentially says that a member's effort level ( $e_i$ ) is increasing in other member's effort level ( $e_j$ ), and thus  $\frac{\partial e_i}{\partial e_j} > 0$ . The question is then, how to bring about this

complementarity condition? Technically, we can impose that in the model; however, intuitively, this complementarity condition may not exist.

The condition may prevail in a world in which members can observe the effort level intensity of other members. In this case, when a member observe that another member who is supposed to review his (her) paper shirks, then he (she) can 'punish' the shirker and thus shirking.<sup>23</sup> At the end, both become worse off. Thus, the observability of effort level would act as a disciplinary device, and thus act as an incentive balancing device. The presence of observability will eliminate the incentive compatibility constraints as well.

Unfortunately, we are living in a world with asymmetric information problem. Reviewers' effort level is not observable to authors. Under non-observability, there has to be another instrument to sustain this balanced incentive. A middleman could perhaps be such an instrument. The role of this middleman would then mainly be verifying the quality of reviews. There is a threshold value of acceptable quality that has to be defined. The weaknesses of this system lies on the difficulty of measuring the quality of reviews, because quality is a subjective matter, and also the burden of work that the middleman has to bear. Presumably, the middleman will have to read many papers and review reports on these papers to judge their quality. It seems that this proposal is hard to implement from the practical point of view. We would rather prefer to stop discussing this issue at this point due to two reasons. First, measuring quality in review process is not only problem of our design, but a general problem in any reviewing. Second, our design brings into scene an alternative media of communication. Though we cannot assume individual review quality, it is our right to argue that the increasing quantity of reviews will bring some quality increase in any case. The advantage of our model is that marginal cost of a review is close to zero for the middleman.

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<sup>23</sup>Here, we use 'punish' figuratively. Under the assumption of observability of shirking, punishment can be defined and executed by the middleman.

### 3.2 A Related Scheme

The mechanism we propose is somehow related to a mechanism which is commonly used in the design of environmental policy, i.e. emission trading mechanism. In this system, firms who achieve a certain target of emission of environmentally polluting substances receive a permit credit. In our system this permit is similar to the pressure exposed (points awarded to members when they review a paper). The more the firms satisfy the target the more credits they obtain. Similarly, the more a member performs refereeing act, the more points he/ she gets.

If a firm cannot achieve the target (in order to conform with the target), it can buy permits from firms which have some excess permits . The price of the permits is determined in the market for tradeable permits. Thus, this kind of system provides a sufficient incentive for firms to care about environment because it allows flexibility and also generates some revenues from emission permits trading. In our system, when a member would like to have his paper reviewed, he/ she must pay a fixed price to the potential reviewer using the points he/ she obtained (from the initial endowment or from the previous refereeing act).

The main differences between the two mechanism are the followings. First, trading permits are renewed in each period while our system is closed at aggregate. Second, while points have fixed price in our mechanism, in the emission trading mechanism, the price of the permit is determined by the supply and demand of permits. We are aware of the possibility to extend our mechanism to allow for points trading and thus flexible prices of points. Thus, for example, a member who would like to have his/ her paper refereed, but has not enough points can buy the points from other members who have points in surplus. Thus, flexible price aspect of emission trading permits allows for providing an additional incentive for members, that is, to generate some revenues. We believe that such an extension is plausible and

adds extra strength to our model but we stop discussing it in more detail to keep the unity of the current frame.

## 4 The Strength and Weaknesses of Our Design

In this section, we would like to discuss weaknesses and strengths of our design. To this purpose, perhaps it is meaningful to look at several attempts that have already been made in this direction by several people, organizations, and dot.coms. This would allow us to place our design among the current set of efforts made by several scientists that are not happy with the conventional media of communication. We discuss in the introduction that current effort is towards creating substitutes to hard-print journals because publishing companies, and especially commercial ones, are aware of the fact that library demand is price inelastic, which allows them to skim large profits by charging far higher than their average costs. Second, most hard-print journals have very long reviewing processes that makes published papers out of date when they are published. Several alternatives have already been developed and we hereby will discuss them at moderate detail.

First, some efforts are directed towards quick dissemination of scientific findings at its most simple way. After the ICT revolution and especially after the Internet, cyberspace has become the most easiest way of scientific communication. Homepages of university departments, personal homepages, non-profit Internet networks like Social Science Research Network (SSRN), Research Papers in Economics (RePEc), Working Papers in Economics (WoPEc) can all be classified in this group. Take, for example, SSRN.<sup>24</sup> Within this network, all potential authors can submit their papers. In fact, this network is quite successful in motivating authors to disseminate their research. Many submitted papers are downloaded, as can be checked from web-counter at the Internet site of SSRN. Unfortunately,

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<sup>24</sup>Visit [www.SSRN.com](http://www.SSRN.com).

very few authors receive feedback from researchers who downloaded their papers. Thus, it seems that there is no balanced-incentive between submitting papers and reviewing papers. Thus, it appears that the main function of these homepages is to provide easy and quick dissemination of ideas from the author to the reader without any feedback mechanism. In that respect these homepages are falling far out of our interest.

Second, some efforts are towards creating online journals aiming at cheaper subscription rates and quicker reviewing process. Some of these attempts are not different than hard-versions of journals in terms of the workings of their suggested mechanism. Take, for example, the Electronic Society for Social Scientists (ELSSS).<sup>25</sup> This attempt directly aims to develop substitutes of a commercial company's journals. ELSSS initiators argue that

”hundreds of millions of dollars have been transferred from the academic community to some commercial publishers whose pricing policies not only have effectively priced out of the scientific communication loop most developing and transforming economies, but also have put under increasing strain university and research libraries in the developed world”

Starting from this argument, ELSSS aims to create a new template for academic journal publishing, where publishers are almost totally disqualified and thus the benefits of publishing is channelled to authors, referees, editors, and to the academic community. ELSSS's approach is simple. Initiators invite researchers to become active contributors of their online journals, as authors, editors and referees. Some of these journals are Development Economics (substitute for Journal of Development Economics), Review of Economic Dynamics and Control (substitute for Journal of Economic Dynamics and Control), European Economic Journal (substitute for European Economic Review). ELSSS promises that subscription

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<sup>25</sup>Visit [www.ELSSS.org.uk](http://www.ELSSS.org.uk).



rates would be 50% cheaper than comparable commercially-produced journals, a fee/honoraria/stipend to author/referee/editor, and free distribution to developing countries.

As we stated above, the ELSSS's attempt is not more than moving the real journal marketplace to the cyberspace. In that sense, the benefits of their system arises from the lower transaction costs in the cyberspace. In that sense, their effort is appreciable but not novel to the community. And it is a big question as to how successful would they be in channelling libraries and individuals from the real marketplace to theirs.

Third, Economics Bulletin (EB) has been initiated, which targets specifically Economics Letters.<sup>26</sup> The main argument of advocers of EB is again the slowdown of publication in that journal and high subscription costs. The mission of the EB is "to foster free and extremely rapid scientific communication across the entire community of research economists". EB plans to publish Notes, Comments, and Preliminary Results, all refereed, in all area of economics. EB claims to make a decision in two months and publish immediately. EB believes that "manuscripts published in these categories will form the foundation for more complete works to be subsequently submitted to other journals". In that respect, EB coincides with our design. Finally, EB does not plan to charge subscription fees but to charge moderate submission fees. Obviously, EB does not offer any novelty but raise on the transaction cost-cutting character of the Internet.

Fourth, and finally, we would like to discuss a new initiation, that is very similar to ours in essence, but has been set up at the final-good marketplace.<sup>27</sup> The aim of Bepress.com is not different than the ones that we discussed above: to put the reader and scholarly author into direct contact at low cost without error or delay. The novelty bepress.com applies is that it benefits reviewers by more equitably distributing the burden of refereeing across the

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<sup>26</sup> Visit <http://www.economicsbulletin.com/>.

<sup>27</sup> Visit <http://www.bepress.com/index.html>.

profession not only by pecuniary rewards but also a possibility of having refereeing service in return. Bepress.com argues that

”The tradition in peer-review publication has always been that the ”price” of having one’s own work reviewed is that the author is expected to review the work of others. In essence, it was an informal credit relationship: I borrow reviews on my work and promise to repay by doing reviews of others’ work”.

They achieve this via constructing a market mechanism, so-called Authors & Reviewers’ Bank, similar to our closed system. According to their construction, each author has two options while submitting a paper. First, the author may pay a submission fee, which is close to subscription rates of commercial publishing companies. Then, part of these submission fees become a payment to referee, which is a pecuniary incentive. Second, each author, may accept to review two or three papers (depending on the type of journal) in return for having received a review for his/her paper. This latter mechanism is similar to our mechanism, in essence.

Though bepress.com has a very strong argument favoring sharing the burden of refereeing within the scientific community (as can be followed from the quotation above), they follow a mixed (commercial!) strategy, in practice. Bepress.com charge submission fees to those who would not like to (or cannot do) refereeing. This brings into several questions on the applicability of their model. First, submission rates are very high (\$1000 and \$500) and bepress.com plans to charge subscription fees to readers, as well. On the other hand, many journals published by commercial companies do not charge submission fees. Then, for research units, there is a breakeven point, where it is more profitable to continue to subscribe to conventional journals rather than paying subscription fees and submission fees (for each of authors affiliated with them). Second, the quality of reviews, promised

by authors, by no means, has any quality guarantee. Bepress.com is free not to use a bad-quality referee report and switch to a new referee but this possibility bring into minds the survivability of their system. We can clarify this with an example. Suppose that an author from anywhere in the world is ready to referee two papers in return for submitting his paper under condition of returning some review. What ensures the quality (background) of that author? For example a new Ph.D., just completed his Ph.D., may submit a good-quality paper. He may be able to write a good article but does this mean that he is capable of reviewing papers? We believe that the way bepress.com constructed its mechanism does not promise any answer to any of these and similar kinds of questions (at least the content of the homepage of bepress.com does not provide any answer to these and similar questions).

The other benefits of their system (like any online journal) are as follows. If the paper is accepted, after a refereeing process, which takes utmost eight weeks, then bepress.com promises to publish it immediately. The author benefits from shortening periods of publishing. It benefits the editor by offering easy-to-use online editorial management software that they call EdiKit. Finally, the bepress.com system benefits the reader by offering top-notch journals with cutting edge research via a timely and convenient medium.

The main shortcoming of all types of designs discussed above is that they compete with an existing pattern of scientific communication, and this lowers the success of these proposals, at least in the short run. On the other hand, our design is different than existing and suggested designs in the community. It aims a different market, an intermediate input marketplace. The most obvious advantage of our design is that it does not aim to substitute existing media of communication but offer a new one. In that sense, existing pattern of scientific communication is not an obstacle for using our design.

Furthermore, in our design, neither the author nor the reviewer are bounded by formally-defined journal publication procedures. By this we mean that our mechanism does not necessarily raise on double-blind or single-blind reviewing, page limitation, format requirements, enveloping hard copies, etc. In a sense, all formality and bureaucracy is (can be) reduced. Moreover, its cost to members is (can be) substantially low, compared to existing and suggested designs. thus, we would like to conclude that our proposal has clear advantages over them, and this makes it novel to the literature.

## 5 An Application: NAKE

In what follows, we describe the workings of the model by using its framework to economics network in the Netherlands.<sup>28</sup> The Netherlands Network of Economics (Netwerk Algemene en Kwantitatieve Economie, commonly known by its acronym as NAKE) provides a national graduate program in general and quantitative economics in the Netherlands. This network is a joint initiative of the economics faculties in the Netherlands. It started out in 1986 as the Network of Quantitative Economic, and subsequently merged with the Network of General Economics (in 1991) to become the Netherlands Network of Economics. In this example, we will ignore educational tasks of NAKE and focus on its network-for-economists character. The network has an extensive base of Fellows, who as a group span almost all areas of economics. The NAKE Fellows have been chosen on the basis of proven excellence in both research and teaching. This makes NAKE an excellent example of our design.

Suppose that NAKE initiated our design. Let us call it NAKE-Virtual,

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<sup>28</sup>Thus, the boundary of the network is limited by national frontiers. Note that there are many other scientific networks in the Netherlands like Network of Business Economics (Landelijk Netwerk Bedrijfseconomie, LNBE), Landelijk Netwerk Bedrijfskunde (NOBO), National Operation Research Network (Landelijk Netwerk Mathematische Besliskunde, LNMB), CERES (for evelopment studies), Posthumus Institute (network for economics and social history), etc. We prefer NAKE because we are acquainted with it.

a network that NAKE members can be member of it voluntarily. NAKE-virtual assigns 100 points to each member at the beginning. Each member of NAKE-virtual has the right to demand feedback to his/her paper from other members through the middleman if he has enough (sufficient) points. Suppose that the cost to an author of submitting a paper is calculated according to the number of pages of the preliminary paper. If a paper is 20 pages, this costs the author 20 points, and the new balance of the author drops to 80.<sup>29</sup> NAKE-Virtual examines the set of members who works in the same field and assigns a member the task of reviewing according to a rule. This rule can be the first person on the list sorted according to surnames, for example. Each member who completes a review goes immediately to the bottom of the list and thus he never does review until his next round comes in the list. Or, NAKE-Virtual may select the reviewer according to the specialization of members and the exact topic of the paper. For example, if the paper is on the recent development efforts of Malaysia, NAKE-Virtual may immediately assign a member who is expert on the issue. We assume that, under normal conditions, each member is ready to review any paper assigned to him. If necessary, several upper and lower reviewing limits might be set. For example, each member may be set to review at least one paper and at most five papers each year. These design details are very much dependent on the nature of discipline, the number of members in each field, the amount of research done in each field, etc. It is natural to set a deadline for the reviewing process from the viewpoint of NAKE-Virtual. This deadline might be alike or might vary across fields. The reviewer may have the right to refuse reviewing a certain paper under certain conditions. These and many other details are matter of interaction between the author, the reviewer and NAKE-Virtual through time and many of them can be easily settled via NAKE-Virtual software (see the discussion below).

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<sup>29</sup>The pages can be automatically standardized according to a pre-specified style defined by the NAKE-Virtual.

The reviewer that has been assigned for reviewing a 20-page preliminary paper earns 20 points when he finishes his review. Thus, he is equipped with some extra points that he can use it up later by asking NAKE-Virtual to provide him reviewing services. Note that the main incentive of the reviewer is to improve his capability of asking NAKE-Virtual to provide him reviewing services in the future. Given the assumption that the benefits of having feedback for preliminary paper is greater than its cost to the author (as a reviewer), all members stay within the system and all will undertake (demand) reviewing as much as asking reviews from others. Naturally, for those that the benefit is less than the cost, the rational behavior is either to stay inactive (keep 100 intact) or to quit the system. One more note on NAKE-Virtual marketplace. The price of reviewing in terms of pages would be fixed in this example. And the quantity would be determined by demand. But this is an example, and there are other possible representations of the same idea that there may be flexible prices.<sup>30</sup>

NAKE-Virtual can handle most of the transactions via NAKE-Virtual Software. A server with sufficient capacity and a software that can handle repeating-tasks of the middleman would be sufficient and minimize transactions costs. Actually, there are examples of such kind of software from on-line journal experiences. For example, the Conservation Ecology Project, an on-line peer-reviewed journal project, invested in development of a software that does most of the work of editor (middleman) and office work.<sup>31</sup> For this project, \$233,000 has been invested. Though we do not know how much of this money is spent for software, this amount shows us an upper limit to the cost of software development. NAKE-Virtual software would use both characteristics of the Internet. On the hand, it can allow members and non-members to download papers, to communicate with colleagues, to develop social networks, etc. Information that an economist needs can be unified

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<sup>30</sup>We leave this discussion to another study.

<sup>31</sup>Visit [www.consecol.org/Journal/consortium.html](http://www.consecol.org/Journal/consortium.html) for details.

at the NAKE-Virtual software. All data sets, subscribed on-line journals, other research resources, and even jokes can be unified.

### **5.1 Measuring Value-Added**

Is it possible to measure the value-added created by NAKE-Virtual? Our answer to this question is positive. Since the aim of the design is to improve the quality of preliminary papers (of NAKE-Virtual members), the outgrowth of this supposed increase must lead to two results. First, the average acceptance ratio to journals must rise. Second, the average publishing time (in a journal) must decrease. These expected results also pinpoint the measure of change. The NAKE-Virtual software can record all journal submissions (members are required to send information on this) such as the date the paper is sent and accepted/rejected, the date of referee report, the date the final version is sent, and the date the article is published. These data, compared to global statistics, would show the value added by the NAKE-Virtual. We argue that the benefit of the system would be immense given the big need for feedback for preliminary papers.

### **5.2 Some Intriguing Questions**

Our example (and the model) have several puzzling questions that have to be discussed. These puzzling questions and perhaps many others will arise when the model is applied to real world. Since each discipline has its own features that differentiates it from other disciplines, the proposed design might lead to different problems for different disciplines. Nevertheless, as long as the main features of the model does not change, the workings of the design will not be harmed. Hereby some of them.

What are the rules for members that would like to quit the system? The rule for quitters in order not to harm the system's balance is very simple: the quitters must first balance their points before they quit from the system. This simple rule is intuitive and necessary. Intuitive because membership is

voluntary. In that sense, those who become voluntarily member of the system must also leave the system after completing their responsibilities. It is necessary to the system because otherwise, keeping the balance (pressure) of the system is not possible. That is, points per member would change (would be different than 100) and thus new members would have varying points at different times. Point leakages or injections weaken the basic characteristic of the system, its closedness.

What happens if a member dies? As we construct a close system in terms of points, leakages or injections harm the system's balance. Therefore, from the middleman's viewpoint, the most important thing that must be secured is the balance of points. Suppose that a member dies. If he has 100 points when he dies, then the system's balance is undisturbed. If a member owns 135 points when he dies, then he is a creditor to the system. We want to keep the system as simple as possible. For that reason, we suggest to 'transfer' these extra points to the middleman. Why so? The reason is simple. The middleman must have some balancing points in order to counterweight the reverse case, that is, the death of debtor members. For example, a member that dies as a debtor, e.g., owns 45 points when he dies implies that there are 55 extra points remained in the system. Then, the mediator balances this extra by exchanging 55 points with 35 points. The probability of death of members being debtor must be the same as those being creditors to the system. Statistically, there is no concrete reason that the number of 'extra' points debtors hold are greater than the number of extra points creditors hold.<sup>32</sup> That is, leakages and injections must balance out on average. Thus, this puzzle is not really a puzzle when the middleman balances leakages and injections.

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<sup>32</sup>Some may argue that people would tend to be debtor to the system when they feel that they would soon die. First, when people feel that they soon die, they have some other serious things to do. Second, scientists do pretend to keep their prestige high as much as possible under any condition. It is not rational to expect someone to cheat when he feels that he soon will pass away. Third, perhaps many researchers will quit the pool when they retired.



### 5.3 Ph.D. Students

The main benefit of this system is perhaps to Ph.D. students in economics in the Netherlands. By definition, Ph.D. students are inexperienced in scientific writing. They need a lot of feedback in their initial writings. Moreover, by definition they make research at the frontiers of their field and this fact increases the need for supervision and feedback. In many cases, Ph.D. students receive feedback only from their own supervisors. Our design (example) does not allow Ph.D. students to be member of the system. There are many reasons behind this assumption (set up). First, it is not possible to qualify Ph.D. students having capability to review scientific papers. Second, the Ph.D. 'market' is not stable. Many Ph.D. students change their minds in this or that way during their dissertation. Some quit their job, some change their field. And the time spend by each on their dissertation varies greatly. All these factors force one to separate the Ph.D. students from the system. We believe that allowing Ph.D. students to be member of NAKE-Virtual would highly lower the reliability and credibility of the system.

Nevertheless, this does not mean that Ph.D. students cannot benefit from the design. As we state at the beginning, perhaps the main benefit of the system is to Ph.D. students. We argue that Ph.D. students can be integrated into the NAKE-Virtual system by a special design. Naturally, this design may change from discipline to discipline. At this point, the enforcement power and capabilities of the middleman becomes important. Several alternatives are available. In case of NAKE-Virtual, NAKE can provide not points but other value added for papers of Ph.D. students reviewed by members of the system. Reviewing a Ph.D. student's paper may be added in yearly academic performance statistics, may earn the reviewer financial support for his research, may provide pecuniary benefits, etc.<sup>33</sup>

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<sup>33</sup>For example, refereeing to Ph.D. students' papers may be considered as equivalent to giving a course. Suppose that a course is 48 hours. Course preparation may require 12 more hours. Thus, total time spent for a course is 60 hours. Equivalently, if a member

## 6 Conclusion

This paper proposes a novel idea to improve quality of scientific writings and thus productivity. The novelty of the paper originates from the fact that the proposal designs a new (alternative) market mechanism for scientific communication. This paper first elaborates current situation in the scientific communication market. It argues that the existing media of communication is neither sufficient nor efficient. Furthermore, current attempts to improve scientific communication targets journal publication, which may not be a quicker solution to the general problem because these problems are occurring in established markets with low price elasticity and therefore it is difficult to change the patterned behaviors.

Next, the paper discusses basic elements of the model. In the model, there are two participants: an author and a reviewer. The author and the reviewer are the same person, in essence. The novelty is that not only the author but also the reviewer has well-defined incentives in order to take place in the mechanism. We achieve this by designing our mechanism in a closed system. Its closedness is not in terms of number of agents in the system but in terms of 'pressure'. The amount of pressure per member (aggregate pressure divided by number of members) never changes, though individuals might have varying pressure levels at any time. Figuratively speaking, when an agent moves in a certain direction, it creates a pressure change (at individual level), and this change forces another agent in the opposite direction at equal distance. In the next round, the one that was driven out in the opposite direction moves in the direction of the member that drove him out and simultaneously drives another member in the opposite direction this time. This process continues without end because there is no pressure leakage in the system. The benefit is to all members. Members acting as authors

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of NAKE-Virtual reviews 60 pages of Ph.D. student papers, then he can be considered as completed one course load.

receive feedback for their preliminary papers and thus improve the quality of their preliminary paper before they submit it to a journal. As quality improves, the chance to have papers *accepted* in a *shorter* period also increases. Members acting as reviewers, gains the right to act as authors and thus the same benefit applies to them. If there exists a middleman, the incentives (benefits) for middleman are various, depending on the definition of it. If a middleman is a national organization, then main benefit is efficient and sufficient communication across scientists at the national boundaries. If a middleman is a commercial entity, then making profits as much as gaining efficiency in scientific communication can be attained. Furthermore, any combination is possible and thus the mechanism allows for varieties for the middleman.

We define our mechanism in the cyberspace. Main characteristic of cyberspace is low transaction costs. Furthermore, a middleman can optimize the matching between demanders and suppliers. In that respect, our design may achieve significant efficiency increases in scientific communication.

Actually, our attempt of using the Internet marketplace is not novel to the community. Several people and organizations, that are not happy with the ever-increasing prices of journals and lengthening periods of publishing, have already attempted to develop substitutes to hard-print journals by benefiting from the efficiency increases of the cyberspace. However, the main target of these attempts are commercial journal publications and thus its effect is limited in increasing scientific communication and quality of scientific outgrowth. Our design, on the other hand, targets the intermediate process of scientific publishing, and in that sense, it is completely novel to the community. Before us, the cyberspace was only benefited to the extent that allows for one-way dissemination of ideas.

Next, we attempted to formalize our idea. To this end, we set forth the problems that may appear, such as for instance the free-riding problem, and

quality of review problem. We also draw some comparisons with a related mechanism that is widely used in the conduct of environmental policy. In the future, we plan to work further on the formalization of our idea.

Finally, we illustrate our model by a real life example. For this purpose, we select a public organization, NAKE, a joint organization of quantitative economists in the Netherlands. We develop the idea of NAKE-Virtual, which is the digital version of NAKE in the Cyberworld. NAKE-Virtual is assumed intermediating transactions between members. We show that if the boundaries of the network is bounded by national boundaries, then the value-added of our design can be easily measured quantitatively. This naturally applies to other types of middleman designs.

We argue that our design may be beneficial to researchers from developing countries, if a functioning design is made. Given the fact that many developing countries have few number of scientists in many disciplines, a set of (neighboring) countries may make use of our design jointly. More than this, scientists from developing countries may have more chance to become members of such kinds of networks at the intermediate level.

We conjecture that our design may substantially change the media of communication at the intermediate level, and this may have spillover effects to journal publication in the long run. If this system can be well-founded, then necessarily the level of attention to intermediate process will increase. This attention, in the long run, may lead to declining role of journal publication, if, and only if, this intermediate process has become a serious way of (online) publication. By this, we mean that if our design become a significant marketplace of scientific communication, then why should researchers try to publish their papers in journals. A well-reviewed paper at intermediate level can be as reliable as a paper refereed by journal. In that sense, depending on the weightiness of the marketplace created, compared to journal market, the former may substitute out the latter.

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