



Contents lists available at ScienceDirect

Electronic Commerce Research and Applications

journal homepage: www.elsevier.com/locate/ecra

An incentive mechanism designed for e-marketplaces with limited inventory

Yuan Liu*, Jie Zhang

School of Computer Engineering, Nanyang Technological University, Singapore

ARTICLE INFO

Article history:

Received 25 February 2013
 Received in revised form 7 November 2013
 Accepted 8 November 2013
 Available online xxxx

Keywords:

Incentive mechanism
 Buyer and seller honesty
 Electronic marketplaces
 Limited inventory

ABSTRACT

In electronic marketplaces, reputation systems and incentive mechanisms are prevalently employed to promote the honesty of sellers and buyers. In this article, we focus on the scenario in which the inventory is in short supply, i.e. an *e-marketplace with limited inventory (EMLI)*. The challenges are in twofold: (a) for sellers who aim to maximize their profit, they may intentionally conduct dishonest transactions since the limited products are likely to be sold out regardless of their reputation; (b) for buyers who intend to gain the limited products, they may provide untruthful ratings to mislead other buyers. To address these issues, we propose an incentive mechanism to promote buyer and seller honesty for this type of e-marketplaces. Specifically, the mechanism models the honesty of buyers and sellers as *scores* and *reputation*, respectively. It then offers a higher price to the products of more honest sellers (with higher reputation) and allocates the products to more honest buyers (with higher scores). In this way, both sellers and buyers are well encouraged to be honest. Furthermore, we impose proper membership fee on new sellers to cope with the *whitewashing attack*. We finally theoretically analyze and empirically demonstrate the efficacy of the proposed mechanism and its nice properties.

© 2013 Elsevier B.V. All rights reserved.

1. Introduction

In e-marketplaces, buyers and sellers conduct transactions through the electronic media, such as the Internet. Along with the convenience that e-marketplaces bring, the lack of trust and reliability has been frequently criticized as one of the key factors that discourage buyers from participation. A reputation system, aggregating the ratings shared by the buyers with whom the sellers ever conducted transactions, is an effective way to help the buyers choose a reliable transaction partner (seller) (Mui et al. 2002a,b), even though the negative ratings cannot be regarded as the evidences of punishing the dishonest sellers by law (Wang and Singh 2006). In order to be chosen by many buyers, the sellers have to maintain high reputation by delivering promised products, given that the ratings provided by the buyers can truthfully reflect sellers' behavior in the transactions. Thus, reputation systems can effectively elicit seller honesty in delivering products. However, the buyers may provide untruthful ratings to promote some low quality sellers or demote some high quality sellers. To address this issue, incentive mechanisms, e.g. (Jurca 2007, Wang and Vassileva 2007, Zhang and Cohen 2007, Zhao et al. 2011, Phoomvuthisam 2011), have been designed to elicit truthful ratings from buyers so that the reputation systems can work properly.

One common and implicit assumption in the reputation systems and incentive mechanisms is that sellers can provide a large number of products compared to buyers' demand. However, in some realistic scenarios, the supply of sellers cannot satisfy the demand of all the buyers. For example, the dentist booking in U.S., as a marketplace, has been observed the phenomenon that there are more dentist bookings than the number of dentists (Collier 2009). Another example is the hotel booking system for a famous tourism area during a peak season since booking a satisfactory hotel is often difficult. Similar marketplaces also include second-hand marketplaces where some used and workable goods (e.g. textbooks) are often in short supply due to lower prices. There are two common properties of these marketplaces: (a) each seller has limited inventory, e.g. the number of dentists, rooms of a hotel, and used textbooks, to provide within a unit of time; (b) buyers compete with each other so as to purchase one piece of the inventory. We define such a marketplace as an *e-marketplace with limited inventory (EMLI)*. More generally, this concept is applicable to an e-marketplace where only a few sellers could provide promised products. In this article, for simplification and clarification, we focus on the e-marketplaces with limited inventory in the narrow case where the supply is less than the demand and leave the general scenario for future investigation.

New challenges are imposed on promoting buyer and seller honesty in an EMLI. Sellers with limited inventory, given that other sellers also hold limited inventory compared to buyer demand, may behave maliciously in their transactions to gain more profit,

* Corresponding author. Tel.: +65 85885936.
 E-mail address: Yliu3@e.ntu.edu.sg (Y. Liu).

by not delivering promised products or reducing the quality of delivered products. Given that their reputation will be decreased due to negative ratings from buyers cheated by them, the sellers may still be willing to increase their profit by sacrificing their reputation. Even though the sellers can attract more buyers by sustaining higher reputation, they can only provide the limited inventory which disables them from benefiting as much as in the e-marketplace where the supply outweighs the demand. Therefore, in these e-marketplaces, reputation itself may not be effective enough to motivate sellers to behave honestly. Moreover, buyers may also have incentives to report untruthful ratings. After a successful transaction with a seller, the buyer knows that the particular seller is good. If the buyer provides a truthful (positive) rating about the seller, then other buyers considering the positive rating are more likely to conduct transactions with the good seller which reduces the buyer's opportunity of doing business with the particular seller in the future, due to the limited inventory that the seller has. If the transaction is unsuccessful, reporting a truthful (negative) rating also reduces the buyer's opportunity of doing business with other good sellers because other buyers will be less likely to do business with the bad seller but with the other good sellers, after taking the buyer's advice. Thus, buyers may lose their chance to purchase products because of providing truthful ratings. In other words, in the EMLI, providing truthful ratings is costly for buyers. The existing incentive mechanisms seldom consider these costs imposed on providing truthful ratings, which is demonstrated in Section 6.2.4 by applying one representative incentive mechanism, i.e. side-payment incentive mechanism (Jurca 2007), in EMLI.

In this article, we propose an incentive mechanism to promote buyer and seller honesty together with a reputation system¹ for e-marketplaces with limited inventory, which overcomes the above-discussed challenges. In our mechanism, buyer honesty is measured by a *normalized proper scoring rule*, making sure that a buyer can and only can gain maximal scores by providing truthful ratings. Seller honesty is measured by the reputation system that aggregates ratings provided by buyers (weighted based on the buyers' scores) such that honest sellers are able to gain high reputation. Our mechanism also consists of a pricing algorithm and an allocation algorithm, making sure that: (a) the products of sellers with higher reputation are offered with a higher price; (b) buyers with higher scores have more opportunities to conduct transactions with more reputable sellers. Thus, both sellers and buyers can benefit from behaving honestly. In addition, to make the mechanism robust against the whitewashing attack where dishonest buyers or sellers may leave the marketplace and rejoin using a new identity to erase their bad history, we discuss how to initialize buyer scores and seller reputation for new buyers and sellers and properly determine the membership fees for new sellers. The properties of our mechanism have been theoretically analyzed in terms of individual rationality, incentive compatibility, and social welfare. Finally, we conduct experiments to validate the proposed mechanism, and compare the performance of our mechanism with a classical (side-payment) incentive mechanism in e-marketplaces with unlimited and limited inventory respectively, to demonstrate the wider applicability of our mechanism.

The rest of the article is organized as follows. Section 2 summarizes the related work. In Section 3, our system environment is specified by explicitly listing the assumptions and clearly defining the concept of e-marketplaces with limited inventory. Section 4 presents the proposed incentive mechanism. Section 5 is devoted to the theoretical analysis of the properties of the proposed mechanism. In Section 6, a set of experiments are conducted to evaluate the efficacy of the proposed mechanism. Finally, Section 7 concludes the article and discusses future research directions.

2. Related work

The problem where buyers may provide untruthful ratings to promote or demote some sellers has been acknowledged by many researchers in the literature of trust research (Wang and Vassileva 2007, Zhang and Cohen 2008, Phoomvuthisam 2011). In this section, we first summarize related work proposed in the area of incentive mechanism design to address the problem. We then discuss the limited studies about EMLI of our concern.

Several incentive mechanisms for eliciting truthful ratings from buyers have been proposed. Jurca proposed a side-payment incentive mechanism (Jurca 2007) where truthfully providing ratings is buyers' optimal strategy. In the mechanism, buyers would gain some amount of side payment if their ratings coincide with the referred raters. Since buyers could gain the maximal expected side payment through providing truthful ratings, they have incentives to be honest. Furthermore, Jurca and Faltings (2009) developed an enhanced version of the side payment mechanism such that it can achieve the minimal cost imposed on the marketplace owner and discourage agents from conducting the collusive attack where three pure collusive strategies were considered: all positive ratings, all negative ratings, and opposite ratings. The reward scheme (side-payment) was obtained by solving a linear optimization problem, subject to certain constraints, e.g. each honest buyer could achieve the maximal and non-negative utility.

The *credibility mechanism* (Papaioannou and Stamoulis 2010) is another type of incentive mechanisms which punish dishonest buyers and sellers. It required both buyers and sellers to submit ratings on the performance of each other in their mutual transactions. The credibility of buyers and sellers were modeled to indicate their honesty. If the two ratings submitted for a transaction was disagreement, then both the buyer and the seller were punished and prevented from conducting transactions for some period which was inversely determined by their credibility, i.e. the number of period of not allowing to conduct transactions was smaller if the agent was more credible, and vice versa. The punishment is reasonable, because such a pair of disagreed ratings signals that one of them is lying and the less credible agent is more likely to be the one who lies and deserves the more punishment.

Furthermore, a trust-based incentive mechanism was proposed (Zhang et al. 2012). In this mechanism, a community is organized by a buyer who selects some trusted other buyers to be his advisors. An honest buyer is then more likely to be selected as advisors by many other buyers. On the other hand, honest sellers would prefer to provide some extra profit, i.e. lower prices or higher quality products, to the honest buyers (advisors), as these advisors will be helpful to reveal and propagate the trustworthiness of the honest sellers such that the sellers can attract more buyers to purchase their products. As a result, buyers would have incentives to provide truthful ratings to gain the chance of obtaining the extra profit offered by the honest sellers.

In the existing incentive mechanisms discussed above, there is a common and implicit assumption that sellers have a large number of products to sell compared to the demand of buyers, and sellers can gain more profit from sustaining a good reputation given truthful ratings provided by buyers. However, in an e-marketplace with limited inventory (EMLI) where the supply is in short, the sellers may not concern much about the amount of sales, thus the reputation itself may not be effective enough to motivate the sellers to be honest (Ramezani et al. 2011, Zhang 2009). In addition, as discussed in Section 1, buyers will have to bear additional cost for providing truthful ratings in an EMLI because of competition from other buyers on the limited inventory. Considering the competition cost and the property of an EMLI, the side-payment, credibility and trust based incentive mechanisms may fail to work. For the

¹ The reputation system is included as a part of the proposed incentive mechanism.

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات