An Insight into an Innovative Group-Trading Model for E-Markets Using the Scenario of a Travel Agent

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Abstract. A Core Broking Model (CBM) has been proposed, which is a core-based model and uses physical brokers to resolve group-trading problems in e-markets. Some solution concepts are adopted in this model, so that three essential factors can be considered, namely incentive compatibility, distributed computing, and less computational complexity. A fees system including the commission for the brokers was suggested to the model. An example illustrates the innovative process of group-trading in the model and shows that the CBM successfully creates a profitable situation for customers, providers and brokers in e-markets.

Keywords: Brokers, Coalition, Core, E-Markets, Stability.

1 Introduction

Researches related to coalition problems in e-markets have been extensively studied in both economics and Computer Science [1, 2]. In Computer Science, coalitions are formed in a precise structure to maximise the overall expected utility of participants and formation algorithms of less computational complexity are prescribed [3]. On the other hand, the economics literature traditionally stresses the incentives of each selfish participant in a coalition [1]. The traders are self-interested to join a coalition only when it is to their own advantage [4]. A coalition with stability is when every member has the incentive to remain in the coalition. The earliest proposed concept related to stability notions was called the stable set [5]. For many years, it was the standard solution concept for cooperative games [6]. However, subsequent works by others showed that a stable set may or may not exist [7], and is usually quite difficult to find [8].

The core assigns to each cooperative game the set of profits that no coalition can improve upon [9]. It has become a well-known solution concept because the core provides a way to find a stable set and gives that set incentive compatibility. However, the core is incapable of dealing with large coalitions at least due to three problems: no stable set, high computational complexity in a large coalition and difficulty in obtaining information needed for locating a core [10]. The growth of Internet e-commerce is so rapid [11] that most companies have included e-markets into their business models. However, it is difficult to apply the core in e-markets [10].

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Building an online group-trading model can be a real challenge because incentive compatibility, distributed computing, and less computational complexity have to be considered at the same time [10]. A new core-based model for e-markets: Core Broking Model (CBM) has been built. Besides providers and buyers, brokers play important roles in the trading process in it. A fees system was set up for it, so that the providers and the buyers contribute the commission for the brokers. An example illustrates the process of the CBM applying to real-world e-markets. This is demonstrated through the case study in the group-trading project using the scenario of a travel agent to show the benefits of providers, customers and brokers.

2 Core Broking Model (CBM)

The CBM involves joint-selling of multiple goods in e-marketplaces, offering volume discount for group-buying coalitions in the e-marketplaces. Several providers are involved in transactions of bundle selling, while, on the other hand, many buyers form coalitions for the amount discount in the e-markets. It inherits two useful techniques from the core concept, but makes six precise improvements to have incentive compatibility, distributed computing, and less computational complexity than the core has. The CBM is composed of core brokers, projects, providers' coalitions, a Core Broking System (CBS), e-markets, market brokers and buyers' coalitions. Fig. 1 represents the structure of the CBM and gives an overview of the model. It shows that core brokers initiate projects, which involve multiple providers, on the CBS website and recruit market brokers to form a team to work on a session of group trading. The market brokers list the project on the appropriate shopping sites and form buyers' coalitions there.

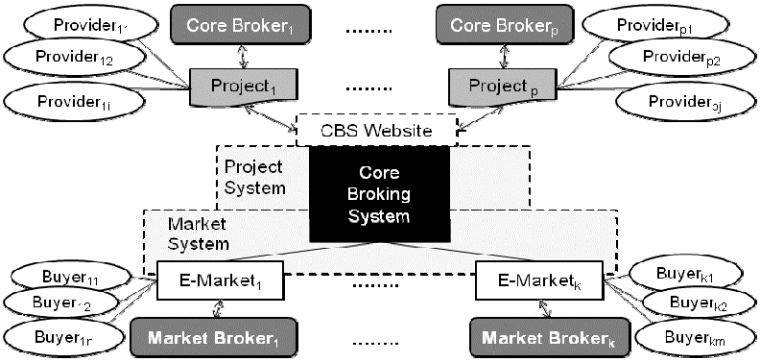

Fig. 1. The Structure of the CBM

Brokers make possible the collaboration between the members of coalitions in online group-trading. There are core-brokers and market-brokers. The core-brokers encourage providers to perform joint-selling to increase the 'competitive advantage' [12]. They act as the representatives for the coalition of providers, and a market-broker is the representative for a coalition of buyers. The core-broker is like a project manager. On the other hand, the market-brokers are like salesmen in the CBM.

The core-broker provides all the necessary information to the market-brokers for them to promote the product and market it. Commissions for online broking sites seem to be charged differently, therefore the fees for online shopping sites need to be investigated in order to set up a fees system for the new model. A survey has been made based on some popular marketplaces selected by AuctionBytes [13]. There are three types of fees which sellers are charged commonly: online store fees, insertion fees and final value fees. An online store fee is paid monthly by a seller who opens a store on the sites. An insertion fee is calculated at the time an item is listed. A final value fee is charged when an item is sold. In the CBM, a suggested session fee of £30 is paid by core-brokers every time they enter a listing for a session on a project on the site. An online store fee of £24.50 is a suggested monthly fee for market-brokers. A final value fee is 7% of the final selling value and is divided into two portions. The market-broker takes 4% and the core-broker gains 3%. A handling fee is suggested to be 10% of the extra discount, after each of the brokers has processed the orders.

3 An Illustration

Core-broker Ben created group-trading project S1: 'Summer Time around the Midlands' by integrating the products from the three providers offering inexpensive hotel rooms and low car rentals for economical travel in the Midlands. The purpose of the project is to enable sessions of bundle selling by integrating the resources of the providers. By offering wholesale discounts, customers may form groups in order to purchase items. Coupons can be chased and sent to the providers on them and exchanged into hotel rooms or car for the buyers to travel around the Midlands in the UK.

It would be unlikely to collect a real-world data of a group-trading project. A simulation system was therefore implemented and is used to generate random data needed for the illustration. The details of the products from three providers are listed in Table 1.

Table 1. Details of Products

Supplier ID	Name	Product ID	Retail Price	Stock	Cost
P1	Bob	Ca	98.29	48	25.15
		Cb	63.38	36	16.66
		Cc	47.04	42	12.56
		Ra	82.88	40	23.21
P2	Tom	Ca	96.29	40	27.62
		Cb	62.93	29	18.09
		Cc	46.64	31	11.29
		Cd	26.28	30	7.46
		Ra	87.27	38	21.39
P3	Ken	Ca	96.26	49	24.72
		Cb	68.98	34	20.70
		Cc	45.78	37	11.71
		Cd	26.89	26	6.46

Table 2. Products in Project S1

Project ID	Supplier	Product ID	Retail Price	Stock	Cost
S1	Ben	Ca	96.98	137	25.72
		Cb	65.17	99	18.47
		Cc	46.50	110	11.92
		Cd	26.56	56	7.00
		Ra	85.02	78	22.32

Table 2 shows the new contents of the project providing table. The price of each product is the averages price and so is the cost. In this way, project S1 looks to customers as if there was only one supplier, who is Ben himself. He works out the volume discount for the products he wants to include in the proposal. The project price list in Table 3 is compiled.

Table 3. Price Lists in Project S1

Project ID	Product ID	Range No	Minimum Amount	Discount
S1	Ca	1	2	5%
		2	5	10%
		3	10	20%
		4	20	30%
		5	50	40%
	Cb	1	5	5%
		2	10	10%
		3	20	20%
		4	50	30%
	Cc	1	10	5%
		2	20	10%
		3	50	20%
	Cd	1	20	5%
		2	50	10%
	Ra	1	3	5%
		2	8	10%
		3	15	18%
		4	25	25%
		5	45	35%

The system flow chart of the model is shown in Fig. 2. There are four stages in the CBM, namely commencing, gathering, combining and closing. After a project is initiated, a group trading session can be started. Each session has a starting and an ending date. The suggested duration for a session is usually one week. Ben registered himself and project S1 on the CBS site and uploaded three documents: project specs, product descriptions and price lists to the site. He then listed S1 and began a session of group-trading.

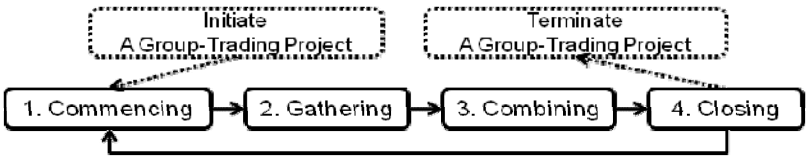

Fig. 2. The System Flow Chart of the CBM

3.1 Commencing

The Core-broker performs two tasks here: recruit market-brokers and start a session of group-trading. Ben recruits three market-brokers. After giving the information about the project to the market-brokers for their websites, he starts a session of the group-trading project. Session 01 of project S1 begins on the morning of 22 August 2013 at 9:00 and will end at 23:59 on 29/08/2013. Three market-brokers, Paul, Tim and Phil, are assigned by Ben to the project. Three ID: MK21, MK30 and MK37 have been given to them respectively. They are in charge of gathering customers locally, from their own geographical areas. The project that the core-broker has initiated now has global proportions. In Table 4, each record shows the status of the respective market-broker. The field headed 'total' is the total payment of the market order of a market-broker. The received payment, which the market-broker has paid, is stored in the *received* field.

Table 4. Trading Records

Project ID	Session	Broker ID	Order ID	Order Date	Order Time	Total	Received
S1	01	MK21	OP10121	29/08	18:42:56		
S1	01	MK30	OP10130	29/08	09:24:50		
S1	01	MK37	OP10137	29/08	13:52:43		

3.2 Gathering

There are four steps in this stage: setup websites; accept orders; produce market orders and submit market orders. The market brokers list goods for a session in the group-trading project and perform online group-buying transactions in their shopping websites.

Table 5. Original Details in Tim's Customers' Orders

Order ID	Product ID	Quantity Ordered	Expected Discount	Customer ID	Actual Discount
O081101	Cb	2	10%	C92	0%
O081101	Cc	17	20%	C92	10% (5%)
O081101	Cd	14	10%	C92	5% (0%)
O081101	Ra	11	18%	C92	10%
O081109	Cc	9	10%	C34	0%
O081109	Cd	4	10%	C34	0%
O081109	Ra	6	25%	C34	5%
O081207	Cc	5	20%	C92	10% (0%)
O081207	Cd	6	10%	C92	5% (0%)
O081211	Cb	5	30%	C108	5%
O081211	Ra	8	35%	C108	10%

Martin, Steve and John are Tim's customers and their customer IDs are C34, C92 and C108. Orders O081109 and O081211 are from C34 and C108. Steve's two orders, O081101 and O081207 have different shipping addresses. Because he places his needs in two orders, so the actual discount must reflect the total amount of every product. The data of 4 orders is randomly generated by the simulation system. Table 5 shows the details of the orders including the actual discounts for every order line. Steve orders 20

units of product Cd altogether and gets 5% discount. He expects to get 10% discount out of product Cd. His intention is shown in the expected discount field. A market-broker can only be allowed to give Ben one market order for one session.

Table 6. Details in Tim's Market Order

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP10130	Cb	7	30%		5%
OP10130	Cc	31	20%		10%
OP10130	Cd	24	10%		5%
OP10130	Ra	25	35%		25%

Tim's market order has his ID, MB30 on it. It does not include any information from Tim's customers. This effectively protects the information of his customers. In Table 6, the field headed 'quantity ordered' stores the total quantities of the products in the orders that have been combined by the market-brokers. In Table 5, the discounts of product Ra are not greater than 10%. The quantity of Ra in Table 6 is 25. So the actual discount becomes 25%. Combining the orders is beneficial because every product in the market bigger chance to gain better discounts.

The 'date/time ordered' field stores the actual submission time of a market order. After the current coalitions have been transformed into market orders, the actual submission time will be recorded in them as the order date/time. Tim submitted his order at 9:24:50 on 29/08/2013, which is the critical time in the event of a stock shortfall. At this point, he does not have any way of knowing whether the stock is enough for all the market-brokers, so the best policy for him is to submit the market order as early as possible.

The expected discounts of product Ra are 18%, 25% and 35% originally. The expected discount for product Ra in the market order is the largest discounts, that is, 35%. The quantity of the order line in the market order will be set to zero by the core-broker, when its expected discount is higher than its actual discount. The consequences of this will be quite serious, because now nobody in the group that the market-broker has assembled will get the product. It is the market-brokers' duty to make sure that every member of their group gets the goods they want in the trading session. A warning report lists all the market orders which contain over-high expected discounts.

Table 7. Details in Tim's Customers' Orders

Order ID	Product ID	Quantity Ordered	Expected Discount	Customer ID	Actual Discount
O081101	Cb	2	5%		0%
O081101	Cc	17	10% (20%)		10%
O081101	Cd	14	5% (10%)		5%
O081101	Ra	11	18%		10%
O081109	Cc	9	10%		0%
O081109	Cd	4	5% (10%)		0%
O081109	Ra	6	25%		5%
O081207	Cc	5	10% (20%)		10%
O081207	Cd	6	5% (10%)		5%
O081211	Cb	5	5% (30%)		5%
O081211	Ra	8	25% (35%)		10%

Tim has negotiated with his customers and tried to cut down their expected discounts. Table 7 shows the order detail table from customers after Tim has fulfilled his duty. The new order detail table of Tim reveals excellent results after the negotiation. The details of the revised market order are given in Table 8.

Table 8. Details in Tim's Market Order

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP10130	Cb	7	5%		5%
OP10130	Cc	31	10%		10%
OP10130	Cd	24	5%		5%
OP10130	Ra	25	25%		25%

3.3 Combining

The purpose of this stage is to obtain higher discounts by going through the following steps: check stability; rank orders; combine orders; calculate discounts and deliver notices. The details of the market orders from the three market-brokers are shown in Tables 8, 9 and 10, which are used to illustrate how the core-broker processes the orders, as the four steps are followed through. Ben checks the stability of the coalitions by making sure that the current coalition's total benefit is larger than the total benefit of its every subset. It turns out that the coalition, which combines the three market orders from the market-brokers, is stable, because it has the largest benefit, i.e. £6321.38. He then combines these market orders into a single large order after the orders are sorted in ascending order according to the dates on them, because the principle that the CBM uses in dealing with the orders is first come first served. The actual quantity ordered is checked against the quantity in stock to take account of any shortfall. The quantity of product Cd is 78, but the stock of product Cd is only 56. Ben may try to contact the providers and request a further supply, but in this case, Ben did not succeed. The highest 35% is then put into the expected discount field in product Ra.

Table 9. Details in Phil's Market Order

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP10137	Cb	12	20%		10%
OP10137	Cc	15	20%		5%
OP10137	Cd	16	10%		0%

Table 10. Details in Paul's Market Order

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP10121	Cb	10	30%		10%
OP10121	Cd	28	10%		5%
OP10121	Ra	36	35%		25%

Table 11. Possible Core

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP101ALL	Cb	29	5%	7	5%
OP101ALL	Cc	56	10%	31	10%
OP101ALL	Cd	78	10%	78	10%
OP101ALL	Ra	61	35%	56	35%

Table 12. Final Details in Phil's Market Order

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP10137	Cb	12	20%	0	0%
OP10137	Cc	15	20%	0	0%
OP10137	Cd	16	10%	16	10%

Table 13. Final Details in Tim's Market Order

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP10130	Cb	7	5%	7	5%
OP10130	Cc	31	10%	31	10%
OP10130	Cd	24	5%	24	10%
OP10130	Ra	25	25%	25	35%

Table 14. Final Details in Paul's Market Order

Order ID	Product ID	Quantity Ordered	Expected Discount	Actual Quantity	Actual Discount
OP10121	Cb	10	30%	0	0%
OP10121	Cd	28	10%	16	10%
OP10121	Ra	36	35%	36	35%

The order lines of order OP101ALL need to be adjusted if their expected discount is higher than their actual discount. Table 11 is the combined order after being adjusted. Ben works on the actual discounts for each market-broker, which are in Tables 12, 13 and 14. Table 15 shows the total payments for each market-broker. By observing above four totals, one can see how important the role of a good market-broker is. Tim's coalition has bought the biggest number of items and has the highest total payment. Ben delivers the notices to the market-brokers normally via e-mail and awaits payment from them. The payment from a customer includes the handling fees and the final value fees for the market-broker and the core-broker. Ben receives payments from the market-brokers after the latter collect money from their clients. Ben has no way to contact the customers.

Table 15. Trading Data with Totals

Project ID	Session	Broker ID	Order ID	Order Date	Order Time	Total	Received
S1	01	MK37	Phil	29/08	08:42:56	382.46	0
S1	01	MK30	Tim	29/08	09:24:50	3686.65	0
S1	01	MK21	Paul	29/08	13:52:43	2372.87	0

3.4 Closing

There are three steps in this stage: prepare invoices; purchase coupons and close transactions. The market-brokers prepare invoices for the customers, when the notice has been received. According to customer Martin's order, market-broker Tim works out an invoice for him. Martin can settle the total payment of £824.40 via Tim's PayPal account.

Table 16 shows the amounts of every product to each provider which are distributed fairly by using Shapley value. According to this, Ben works out orders to providers. The amount that Ben receives for each product includes the final value fee and the handling fee. The payment for each item to the providers needs to exclude the expenses, which are the brokers' commission and the PayPal fee. In order to calculate the providers' net profits, the cost of each product is given. The money is transferred into Ben's bank accounts and coupons are sent out in exchange. The market-brokers need fill in the customers' names on the coupons and pass them on to the customers. The customers will claim the products from the providers. Finally, Ben pays the providers and closes the transactions to end the current session of group trading. The process is repeated until Ben decides to terminate the project and drop the list from the CBS website.

Table 16. Shares of Items

Product ID	Bob	Tom	Ken
Cb	3	2	2
Cc	11	10	10
Cd	0	30	26
Ra	23	22	16

Table 17. Benefits of Customers and Providers

Product ID	Discount of Tim's Customers	Discount of Phil's Customers	Discount of Paul's Customers	Provider Bob's Profit	Provider Tom's Profit	Provider Ken's Profit
Cb	0.00	22.81	0.00	117.74	75.64	70.42
Cc	0.00	144.15	0.00	277.55	265.02	260.82
Cd	42.50	63.74	42.50	0.00	423.78	393.28
Ra	0.00	744.28	1071.76	614.51	627.83	533.56
Total	**42.50**	**974.98**	**1114.25**	**1009.80**	**1392.26**	**1258.07**

Table 17 shows the benefits for the customers and providers. Both the discounts and profits have excluded the commissions for the brokers. The commissions for the core and market-brokers in this group-trading session are given in Table 18. Tim's handling fees are shown here, but in the real-world, would only be disclosed to anybody except the market-brokers and their clients. Ben has no way to know the handling fees. Although Ben seems to have more information than the other participants, the customers' orders and personal information will always remain hidden from him.

The rates of commission for the brokers are fixed throughout the illustrations. In practice, they are fixed for the duration of the session, but the handling fee from customers and the final value fee from the providers are definitely negotiable. The session fee and the online store fee are also subject to negotiation in real-world websites. Some of the expenses incurred by the brokers may be not considered in the

Table 18. Commissions for Brokers

Product ID	Market Broker Phil's Commission	Tim's Handling Fee	Market Broker Tim's Commission	Market Broker Paul's Commission	Core Broker Bens Profit
Cb	0.00	4.84	17.34	0.00	12.62
Cc	0.00	0.53	51.89	0.00	37.79
Cd	15.30	24.88	22.95	15.30	48.28
Ra	0.00	28.95	55.29	79.62	148.63
Total	**15.30**	**59.20**	**147.47**	**94.91**	**247.32**

examples, such as a £30 session fee for Ben to list the session of the group-trading project on the site. Every participant seems to get a reasonable benefit out of the group-trading session in the project.

4 Conclusion

The above section provides a deeper insight into the functioning of the CBM and to demonstrate the applicability of the model to real-world markets. The model appears to bring good benefits for all the participants in the group-trading session. The customers are meant to have better discounts there than they are in a tradition market for they obtain volume discounts by ganging up with other buyers. The providers may earn more profit from more customers attracted by high discounts. The brokers gain the commissions they deserve. The CBM seems to create a win-win-win situation for all the participants.

A comparison between the results of the CBM and a traditional market shows that the way to find a core in the new model is superior to the latter's, in terms of three criteria: the use of distributed computing, the degree of computational complexity and incentive compatibility [13]. The outputs from a simulator demonstrate that the model can attract customers and deal with online group-trading problems in a large coalition [13]. An evaluation of the techniques applied in the CBM was made showing that all of them have produced the desired results effectively and efficiently [14]. The market-brokers distribute the items here among his clients by using FCFS. They can use Shapley value instead. An agreement may also be reached amongst the customers on the distribution over the conflicting issues through a multiple stage negotiation process [15]. The other assumptions of the CBM have been listed [16] for the model to function properly. The main contribution of this research is the CBM itself, but three additional issues have emerged which also made a contribution to knowledge in this field: (a) the advantages and problems of the core (b) a stability check for a coalition and (c) the use of brokers in group-trading.

There will be two major targets for future research. One target is to create more incentives for participants. Another target will be to expand the CBM by including particular e-markets and selling a great diversity of products and services on them. To select suitable products for bundle selling would be a practice way for the model. Involving customers in the path of new products development is effective for providers to offer successful new products [17]. However, it is difficult for sellers to collaborate with buyers together [18]. The CBM involving brokers is an innovative way and it may make sellers and buyers cooperate together. This should bring out a

good market result because core-brokers understand what providers can offer and market-brokers know what customers want [19].

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