

Experimental Accounting Research on Agency Relationships: Using Inventory Management Game and Maudsley Personality Inventory

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Keywords: Experimental Accounting Research, Agency Relationship, Bounded Rationality, Decision-making under Uncertainty, Maudsley Personality Inventory (MPI)

1. Abstract

The main purpose of this research is to examine the following hypothesis by applying the experimental method.

“In the agency-relationship that consists of a stockholder and manager, when a principal as a stockholder selects an agent as a manager, the principal can increase his/her rationality in decision-making by using the agent's personality information in addition to the accounting information”.

This study consisted of two laboratory experiments, Experiment 1 and Experiment 2. The data obtained from the laboratory experiments were analyzed using a statistical test.

The result of the statistical test almost supported the hypothesis of this research.

Therefore, we can conclude that a principal as a stockholder can expect to increase his/her rationality in decision-making with respect to agent selection by using the agent's personality information in addition to the accounting information. Moreover, we can state that a principal as a stockholder can expect to reduce his/her agency costs.

2. Introduction

The main purpose of this research is to examine the following hypothesis by applying the experimental method.

“In the agency relationship that consists of a stockholder and manager, when a principal as a stockholder selects an agent as a manager, the principal can increase his/her rationality in decision-making by using the agent's personality information in addition to the accounting information”.

This study consisted of two laboratory experiments, Experiment 1 and Experiment 2.

This study analyzed the data obtained from the laboratory experiments by a using statistical test.

3. Aim

The aim of this study is to propose a solution to the agency problem that exists in the real world. In particular, this study deals with the problem of agency costs found in agency relationships (principal-agent relationships). Therefore, the experimental method was employed in this study to solve the agency problem in the real world.

Since the 1960s, in America and Europe, experimental accounting research has been considered as an important field in empirical accounting research. Although experimental accounting research was very rare in Japan, an increase in this type of research is noted recently. Gradually, it is being considered as an important research method.

In recent years, the agency problem has become an important issue in Japan. For example, the corporate law was revised in Japan (passed in June 2005 and effective from May 2006). The primary purpose of this revised corporate law was to reinforce corporate governance.

This revision intends to clarify the mutual role of principals and agents, particularly, the mutual role of stockholders and managers. The reinforcement of corporate governance

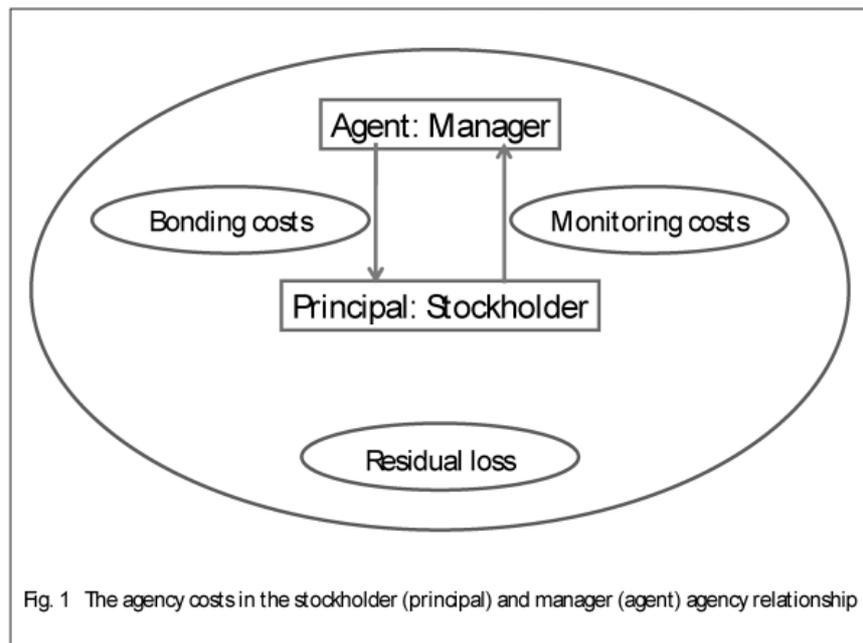
is expected to solve the agency problem, such as the one of agency costs.

The problem of agency costs is a primary issue of the agency problem. Until now, considerable experimental research has been conducted concerning this matter. The present study proposes a new solution to the problem of agency costs.

Jensen and Meckling defined the agency relationship as follows: “We define an agency relationship as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent” (Jensen and Meckling, 1976, p.308).

The agency problem in the relationship between a principal and agent includes three costs (agency costs). Jensen and Meckling defined the agency costs as the sum of the following: (1) monitoring costs, (2) bonding costs, and (3) residual loss (Jensen and Meckling, 1976, pp.308 – 309).

Monitoring costs are designed by the principal to limit aberrant activity by the agent. Bonding costs are designed by the agent to guarantee that certain actions that would harm the principal will not be taken. The residual loss comprises other agency costs.



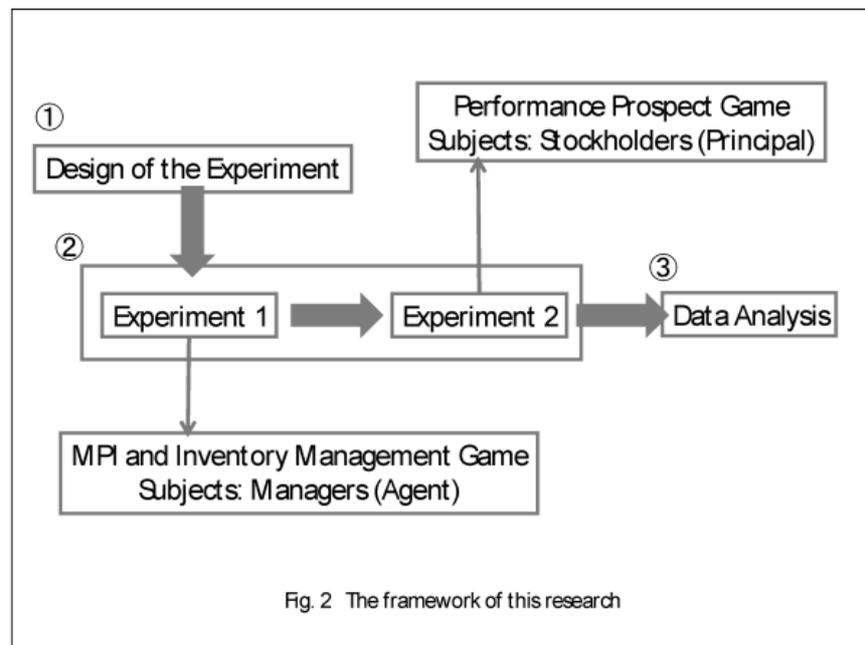
The most typical agency relationship is between a stockholder (principal) and manager (agent). Jensen and Meckling state, “Since the relationship between the stockholders and the managers of a corporation fits the definition of a pure agency relationship, it should come as no surprise to discover that the issues associated with

the ‘separation of ownership and control’ in the modern diffuse ownership corporation are intimately associated with the general problem of agency” (Jensen and Meckling, 1976, p.309).

Figure 1 illustrates the agency costs in the stockholder (principal) and manager (agent) agency relationship.

4. Experimental design

The framework of the experiment has been designed in accordance with the purpose of this study, as illustrated in Figure 2.



The design of the experiment first addresses the most important issue of internal validity, that is, appropriate operation of the experimental variable (independent variable) and control of the extraneous variable (residual variable). According to Maines et al. (2006), “The primary strength of experiments, compared to other empirical approaches, is the ability to infer the direction of causality between independent and dependent variables due to the researchers’ control over these variables” (Maines et al., 2006, p.99).

Next, the two laboratory experiments, Experiment 1 and Experiment 2 are carried out.

The purpose of Experiment 1 is to collect data for the performance prospect game of Experiment 2, and to verify the results of prior studies.

Prior studies, namely Goto (2002) and Mizutani and Goto (2005), and Experiment 1 of the present study intend to show the relation between personal management ability with uncertainty under limited rationality and personality.

Therefore, in Experiment 1, the performance obtained from the inventory management game (five-terms game) is adopted as the criterion of personal management ability with uncertainty under limited rationality, and the Maudsley Personality Inventory (MPI, Japanese version) is adopted as the criterion of personality.

The purpose of Experiment 2 is to test the hypothesis of this study, that is, to show the relation between information usage and personal management ability with uncertainty under limited rationality.

Therefore, in Experiment 2, the performance prospect game is adopted to show the relation between information usage and personal management ability with uncertainty under limited rationality. In the performance prospect game, subjects predict the best performance of each term among the subjects of Experiment 1 (however, the first term is excluded because the subjects have no past performance information on the first term). The subjects are divided into five groups (A, B, C1, C2, and C3) based on their differences in information usage, and each group competes with the other groups.

The result of the performance prospect game is adopted in Experiment 2 as the criterion of personal management ability with uncertainty under limited rationality.

In Experiment 1 as part of a manager's role (agent's role), the subjects are asked to achieve the smallest inventory cost; in Experiment 2 as part of a stockholder's role (principal's role), the subjects are asked to predict the subject (manager) from Experiment 1 with the best performance.

Finally, the data obtained from Experiments 1 and 2 are analyzed.

The data obtained from Experiment 1 are analyzed to verify the result of prior studies, that is, to show the relation between personal management ability with uncertainty under limited rationality and personality. Additionally, the data obtained from Experiment 2 are analyzed to show the relation between information usage and personal management ability with uncertainty under limited rationality. This is done by comparing the average costs incurred during the four terms among each group and using the difference of mean test for each group and the four terms.

5. Prior studies

Prior studies, namely, Goto (2002) and Mizutani and Goto (2005), have also investigated the research question that is examined in this study.

These studies demonstrated the relation between the group decision-making rationality of a group (management ability with uncertainty under limited rationality) and the group member personality.

Goto (2002) succeeded in developing a regression model that illustrates the relation between group decision-making rationality and group member traits (in particular, group member characteristics).

In this regression model, when average MPI score of the combinations of group members (E score: 31.313, N score: 21.418) is obtained, we can expect the highest group decision-making rationality.

Mizutani and Goto (2005) succeeded in increasing the accuracy of Goto's model (2002) by using the dummy variables that were extracted from the result of the Principal Component Analysis (PCA), and succeeded in increasing the usefulness of the model.

Using the outcome of these studies, the present study attempts to show the relation between the personal decision-making rationality (management ability with uncertainty under limited rationality) and personality.

Incidentally, both prior studies and the present study use MPI as the criterion of personality. We can obtain three personality data sets from the MPI test —E score (Extraversion-Introversion), N score (Neuroticism), and L score (Lie scale). There is no interrelation between the E and N scores, moreover, these are designed along a normal distribution (average: 24, maximum: 48, minimum: 0). In the case where the L scale is greater than 20, data from the MPI should be examined for reliability.

6. Experiment 1

A part of Experiment 1, this study executes the business game proposed by Sugihara (1980). Further, the business game is the five-terms (five days in a term) inventory management game. In the inventory management game, subjects forecast the sales amount for the next day by using past performance data, and they purchase goods to correspond to the sales amount and stocks amount (inventory cost is zero).

Purpose

The purpose of Experiment 1 is to collect data for the performance prospect game of Experiment 2, and to verify the results of prior studies, that is, to show the relation between personal management ability with uncertainty under limited rationality and personality.

Experimental Contents

MPI and the inventory management game (By hand).

Experimental Method

The experiments were carried out as detailed below.
Different subjects were used for each experiment.

First Experiment

Date: July 9, 2005, 14:00 – 16:00

Place: Kyoto Sangyo University #1 – 102

Subjects: 34 students

Second Experiment

Date: August 1, 2005, 15:00 – 17:00

Place: Kyoto Sangyo University #5 – 5301

Subjects: 11 students

Third Experiment

Date: August 9, 2005, 10:00 – 12:00

Place: Kyoto Sangyo University #4k – B07

Subjects: 6 students

Subjects

Total: 51 (Undergraduate students from Kyoto Sangyo University, male: 28, female: 23)

Adopted data: 45 (male: 25, female: 20)

Six subjects were excluded due to data entry error.

Data Analysis

This study involved the different experimental contents and collected data on the

various subjects from prior studies, on the relation between the personal decision-making rationality (management ability with uncertainty under limited rationality) and personality.

Therefore, if the result obtained from this study corresponds to that of prior studies, then the present study can be regarded as having succeeded in inheriting the outcome of prior studies.

This study analyzed the data in the following manner.

1. Standardized the data from each experiment (obtained from both prior studies and Experiment 1)
2. Applied a cluster analysis to the personality (E score and N score) of the subjects from each experiment. The subjects were selected based on the criterion of Z score ≤ -1.0 (good-performance subjects).
3. Developed the group (cluster) of good-performance subjects.

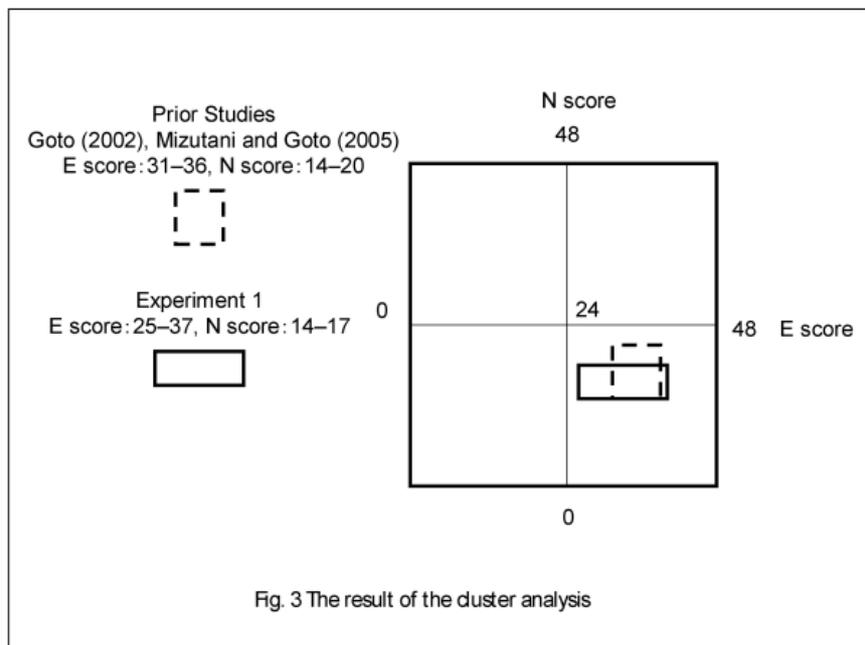


Figure 3 shows the result of the cluster analysis.

It indicates that most of the personality scores obtained each study correspond.

7. Experiment 2

In Experiment 2, the performance prospect game is adopted to show the relation between information usage and personal management ability with uncertainty under limited rationality. In this game, subjects predict the best performance of each term

among the subjects of Experiment 1. Further, the subjects are divided into five groups (A, B, C1, C2, and C3) based on their differences in information usage, and each group competes with other groups.

The result of the performance prospect game is adopted in Experiment 2 as the criterion of personal management ability with uncertainty under limited rationality.

Purpose

The purpose of Experiment 2 is to test the hypothesis of this study, which is, to show the relation between information usage and personal management ability with uncertainty under limited rationality.

Experimental Contents

Performance prospect game (By hand).

In this game, each group was provided with the following information.

Group A: no information

Group B: accounting information

Group C1: accounting and personality information (E score information)

Group C2: accounting and personality information (N score information)

Group C3: accounting and personality information (E score and N score information)

The subjects of group A predict the result of the best performance among the subjects of Experiment 1 without using any information (instinctively).

The subjects of group B predict the result of the best performance among the subjects of Experiment 1 by using accounting information.

The subjects of group C1 predict the result of the best performance among the subjects of Experiment 1 by using accounting and personality information (E score information).

In other words, these subjects choose the cluster of E score: 31 – 36 (9 subjects from Experiment 1) and predict the best performance among the 9 subjects.

The subjects of group C2 predict the result of the best performance among the subjects of Experiment 1 by using accounting and personality information (N score information).

In other words, these subjects choose the cluster of N score: 14 – 20 (14 subjects from Experiment 1) and predict the best performance among the 14 subjects.

The subjects of group C3 predict the result of the best performance among the subjects of Experiment 1 by using accounting and personality information (E score and N score information).

In other words, these subjects choose the cluster of E score: 31 – 36 and N score: 14 – 20 (2 subjects from Experiment 1) and predict the best performance between the 2

subjects.

Experimental Method

The experiments were carried out as detailed as below.

Subjects did not overlap between each experiment.

Pilot Experiment

Date: June 23, 2006, 10:00 – 11:00

Place: Kyoto Sangyo University #5 – 5404

Subjects: 16 students

First Experiment

Date: June 26, 2006, 11:00 – 12:00

Place: Kyoto Sangyo University #5 – 5407

Subjects: 64 students

Second Experiment

Date: July 4, 2006, 15:00 – 16:00

Place: Kyoto Sangyo University #12 – 12402

Subjects: 49 students

Subjects

Total: 129 (Undergraduate students from Kyoto Sangyo University, male: 84, female: 45)

Adopted data: 100 (male: 64, female: 36)

Sixteen subjects were from the pilot experiment, and 13 subjects were excluded due to data entry error.

Data Analysis

Comparison of average cost

Figure 4 shows the result of the simulation which was carried out using the following strategy: “Continue to choose the agent who achieves the smallest cumulative cost.” In other words, the subjects of Experiment 2 chose a subject (agent) from Experiment 1 who achieved the least total cost through all the terms.

The result of the simulation was as follows: group C2 was in first place; C3, second; C1, third; B, fourth; and A, fifth. This result almost supports the hypothesis of this study.

Figure 5 shows the result of the experiment, which was as follows: C1 was in the first place; C2, second; C3, third; B, fourth; and A, fifth. Although this result differs from the result of the simulation, it almost supports the hypothesis of this study.

	Second Term	Third Term	Fourth Term	Fifth Term	Whole Average	Total Cost
A	—	—	—	—	—	—
B	4,200	4,800	4,800 or 6,200	3,000	4,200 or 4,550	16,800 or 18,200
C1	5,600	4,800	3,800	2,800	4,250	17,000
C2	3,400 or 5,600	3,800	4,000	3,000	3,550 or 3,850	14,200 or 15,400
C3	5,600	3,800	4,400	2,000	3,950	15,800

Fig. 4 The result of the simulation (Yen)

	Second Term	Third Term	Fourth Term	Fifth Term	Whole Average	Total Cost
A	3,420	5,480	4,380	6,540	4,955	19,820
B	3,820	6,410	4,540	4,250	4,755	19,020
C1	2,870	3,940	4,420	3,420	3,662.5	14,650
C2	3,340	5,080	4,090	3,990	4,125	16,500
C3	4,820	5,700	4,040	4,400	4,740	18,960

Fig. 5 The result of the experiment (Yen)

Statistical Hypothesis Testing

Figure 6 shows the null hypothesis (H_0) and alternative hypothesis (H_1) in the difference of mean test. The hypothesis in this test is as follows.

In Experiment 2, a group with more information can choose the subject who minimized costs more.

Figure 6 shows H_0 (upper side) and H_1 (lower side), and represents the average cost of each group as follows.

Group A: μ_a , Group B: μ_b , Group C1: μ_{c1} , Group C2: μ_{c2} , and Group C3: μ_{c3} .

This study adopted a one-tailed test (right-sided).

Further, this study adopted the Mann-Whitney U test, which is a nonparametric test (distribution-free test), because the data from each term did not fulfill the prerequisite conditions of normality and homogeneity.

	A	B	C1	C2	C3
A	-	$\mu_a = \mu_b$	$\mu_a = \mu_{c1}$	$\mu_a = \mu_{c2}$	$\mu_a = \mu_{c3}$
	-	$\mu_a > \mu_b$	$\mu_a > \mu_{c1}$	$\mu_a > \mu_{c2}$	$\mu_a > \mu_{c3}$
B	-	-	$\mu_b = \mu_{c1}$	$\mu_b = \mu_{c2}$	$\mu_b = \mu_{c3}$
	-	-	$\mu_b > \mu_{c1}$	$\mu_b > \mu_{c2}$	$\mu_b > \mu_{c3}$
C1	-	-	-	$\mu_{c1} = \mu_{c2}$	$\mu_{c1} = \mu_{c3}$
	-	-	-	$\mu_{c1} > \mu_{c2}$	$\mu_{c1} > \mu_{c3}$
C2	-	-	-	-	$\mu_{c2} = \mu_{c3}$
	-	-	-	-	$\mu_{c2} > \mu_{c3}$
C3	-	-	-	-	-
	-	-	-	-	-

Fig. 6 The null and alternative hypothesis in the difference of mean test

8. Result of the experiments

Figure 7 and Figure 8 show the result of the Mann-Whitney U test.

Here, each figure shows the significance levels as $\alpha = 0.10^*$, 0.05^{**} , and 0.01^{***} ; further, the critical value of the standard normal distribution (z_0) at each significance level is 1.28 (10%), 1.64 (5%), and 2.33 (1%). If the test statistic (z) falls the rejection region (in this case, $z_0 < z$), then the null hypothesis is rejected and the alternative hypothesis is accepted.

The result of the examinations can be considered to almost support the hypothesis of this study.

9. Conclusion

The result of the statistical test almost supported the hypothesis of this research.

Therefore, we can conclude that a principal as a stockholder can expect to increase his/her decision-making rationality (agent selection) by using the agent's personality information from the MPI in addition to the accounting information. Moreover, we can conclude that a principal as a stockholder can expect to reduce his/her agency costs.

Second term	A	B	C1	C2	C3
A	-	-1.113	*1.479	0.191	-2.858
B	-	-	***2.742	*1.316	-2.263
C1	-	-	-	-1.882	-4.177
C2	-	-	-	-	-3.264
C3	-	-	-	-	-

Third term	A	B	C1	C2	C3
A	-	-1.076	*1.487	0.136	-0.553
B	-	-	***2.763	1.224	0.965
C1	-	-	-	-2.082	-3.255
C2	-	-	-	-	-0.861
C3	-	-	-	-	-

Fig. 7 The results of the Mann-Whitney U Test (Second and third terms)

Fourth term	A	B	C1	C2	C3
A	-	-0.831	-0.560	0.778	0.585
B	-	-	0.341	***2.346	**1.887
C1	-	-	-	**1.935	1.202
C2	-	-	-	-	0.290
C3	-	-	-	-	-

Fifth term	A	B	C1	C2	C3
A	-	**1.858	***3.367	***2.612	*1.511
B	-	-	*1.359	*1.536	-0.551
C1	-	-	-	-0.287	-1.118
C2	-	-	-	-	-0.364
C3	-	-	-	-	-

Fig. 8 The results of the Mann-Whitney U Test (fourth and fifth terms)

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* This study is based on Mizutani (2007a) and Mizutani (2007b) (both in Japanese).
(平成19年7月18日受付、平成19年10月31日受理)

エイジェンシー関係に関する会計の実験的研究 在庫管理ゲームとモーズレイ性格検査（MPI）とを用いた実験

水 谷 覚

本研究の目的は、「株主と経営者とからなるエイジェンシー関係において、プリンシパルである株主がエイジェントとしての経営者を選ぶ際に利用する情報として、従来の会計情報に加えてエイジェントの性格特性情報を用いることで、会計情報によるエイジェント選択の合理性を高めることができる」という仮説を実験的手法によって検証するところにある。

そのために、本研究では、「実験1」と「実験2」とからなる一連の実験室実験を設計し、実施した。実験室実験から得られたデータの統計分析の結果からは、本研究の仮説がおおむね支持できることが明らかになった。

このことから、合理性が制限された不確実な状況の下では、プリンシパルとしての株主は従来の会計情報に加えて、モーズレイ性格検査（MPI）によるエイジェントの性格特性情報を利用することによって、会計情報によるエイジェント選択の合理性を高めることができると期待できることがわかった。また、エイジェント選択の合理性を高めることによって、株主と経営者とからなるエイジェンシー関係におけるエイジェンシー・コスト（ここではモニタリング・コスト）の削減にも貢献できることが期待できる。

キーワード：実験会計学、エイジェンシー関係、限定合理性、不確実性下の意思決定、モーズレイ性格検査（MPI）

