Efficient Multi-Attribute Procurement Auction

Hiroshi FUKUI¹) and Kiyoshi KOBAYASHI²)

1) Department of Urban Management, Graduate School of Engineering, Kyoto University

2) Graduate School of Management, Kyoto University
Purpose of the Presentation

• Provide a topic of **multi-attribute tender**
  
  examples  
  The U.S.  
  EU  
  Japan

• Introduce a **theoretical approach** to public procurement
  
  Auction Theory
  
  Introduce our research (H.Fukui and K.Kobayashi)
Increasing Trend away from Traditional Procurement Tender

Price-Only Tender

Multi-Attribute Tender (multi-criteria selection)

AWARD CRITERIA

Price
+
Nonmonetary attributes

- completion time
- environmental characteristics
- running cost
- etc..
EXAMPLE 1. The U.S.

The U.S. State Highway Authorities’ procurement for highway repair jobs

A + B method

\[
\begin{align*}
A &: \text{the estimated cost} \\
B &: \text{the estimated duration for project completion}
\end{align*}
\]
EXAMPLE1.  The U.S.

A + B method

\[
\text{TCB} = \text{ECC} + (\text{DRUC} \times \text{EPD})
\]

TCB=Total Combined Bid
ECC=Estimated Construction Cost for the project
DRUC=Daily Road User Cost
EPD= Estimated Project Duration for project completion

The winning bidder is the bidder who submits the lowest total combined bid
EXAMPLE2. EU

In the European Union (EU), the public procurement procedure is regulated by the EU legislation.

New Public Procurement Directives

2004/18/EC
for works, supply and service contracts in the public sector;

2004/17/EC
on contracts with entities operating in the "special sectors" of water, energy, transport and postal service.

was adopted in 2004
EXAMPLE 2. EU

PUBLIC PROCUREMENT PROCEDURES

- The open procedure
- The restricted procedure
- The negotiated procedure
- The competitive dialogue

CONTRACT AWARD CRITERIA

- The Lowest Price
- The Most Economically Advantageous Tender (MEAT)

or
EXAMPLE2. EU

• Request for tenders (RFT) must state all criteria being applied and their relative weightings.

• Evaluation process must be demonstrably objective and transparent based solely on the published criteria.

• Objectivity and transparency are best achieved by use of a weighted scoring system based on the published criteria.
EXAMPLE 3. Japan

PUBLIC PROCUREMENT PROCEDURES

- Open Bidding System
- Nominated Tendering System
- Negotiated Contract

CONTRACTS AWARD CRITERIA

- The Lowest Price
- Multi-attribute tender
EXAMPLE 3. Japan

The Public Works Quality Assurance Promotion Law

The contractor is selected on the basis of total score

scoring rule
designed by government

Price
+ Nonmonetary attributes
### EXAMPLE3. Japan

<table>
<thead>
<tr>
<th></th>
<th>Southern Cross Group</th>
<th>Mitsui Fudosan, Taisei, Toshiba</th>
<th>Orix</th>
<th>Nishimatsu</th>
<th>Itochu</th>
<th>Takenaka</th>
<th>Maeda</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bidding price score (/85)</strong></td>
<td></td>
<td>￥14,460</td>
<td>￥13,018</td>
<td>￥12,996</td>
<td>￥11,581</td>
<td>￥12,488</td>
<td>￥13,800</td>
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<tr>
<td><strong>(million yen)</strong></td>
<td></td>
<td>Score 68.08</td>
<td>75.62</td>
<td>75.75</td>
<td>85</td>
<td>78.83</td>
<td>71.33</td>
</tr>
<tr>
<td><strong>stability score (/5)</strong></td>
<td></td>
<td>long term stability 4.28</td>
<td>5</td>
<td>5</td>
<td>3.75</td>
<td>5</td>
<td>4.28</td>
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<td></td>
<td></td>
<td>risk management Continuance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>service score (/7)</strong></td>
<td></td>
<td>functional characteristics 0.7</td>
<td>5.6</td>
<td>2.1</td>
<td>0</td>
<td>3.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>total design Consideration to ambient surrounding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>management score (/3)</strong></td>
<td></td>
<td>managerial stability 0.19</td>
<td>2.63</td>
<td>1.88</td>
<td>0</td>
<td>3</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>work contents</td>
<td>reconcile with art museum</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Total Score (/100)</strong></td>
<td></td>
<td>73.25</td>
<td>88.85</td>
<td>84.73</td>
<td>88.57</td>
<td>90.33</td>
<td>75.8</td>
</tr>
</tbody>
</table>

Winner: Maeda
Theoretical Approach to Public Procurement

・Auction Theory

・Introduce Our Research
  (2010, H. Fukui and K. Kobayashi)
How can we describe bidders’ bidding behaviors?

What type of procurement procedure is efficient system?

• have a new viewpoint to understand the mechanism of tender
• Obtain some implication to construct more efficient institution
Reserve Price Policy in Japan

Reserve price: an upper limit of payment calculated by the buyer

The government must set the reserve price in every tender because it is strictly required by Public Accounting Act

reserve price  ○  ○  X  bidding price
Effect of Reserve Price in Price-Only Tender from Auction Theory Analysis

Bring highly intensified competition among bidders where all participating bidders have capacities of proposing contact price that is lower than reserve price.

Buyer can make a contract with lower procurement cost.

Not participate
Our Research (H. Fukui and K. Kobayashi)

In Japan, the government adopts reserve price policy in multi-attribute tender because of the regulation of Public Accounting Act

However,

• Is it really efficient policy in multi-attribute tender?
• Isn’t there any other policy that is more efficient?

Still Not Clear
Our Research

**method of study**

- Game theoretic approach (Auction Theory)
  - Analyze the mechanism of multi-attribute tender
  - Clarify the effect of reserve price in multi-attribute tender

**Results**

- Reserve price policy is **not** efficient in multi-attribute tender
- Reserve **score** policy that sets the lower limit of score is more efficient policy in multi-attribute tender
The Aim of Government in Public Procurement

1. Maximizes social surplus

2. Improves the Expected Utility
Scoring Auction

Multi-Attribute Procurement Auction can be analyzed by scoring auction

Each participant proposes

$p$
$q$

Contract Price

Promised quality

Scoring Rule $S : (p, q) \rightarrow \mathbb{R}$

$S(p, q) = \phi(q) - p$

$\phi' > 0, \phi'' < 0$

Score

government

We restrict attention to Quasi-Linear Scoring Rule
Model Structure

Scoring Rule

\[ S(p, q) = \phi(q) - p \]

design the scoring rule

government

evaluate each bidder on the basis of score

make a contract

the bidder who got the highest score

each firm proposes price and quality

\( (p^1, q^1) \) \( (p^i, q^i) \) \( (p^n, q^n) \)

\( n \) firms

the government designs the scoring rule:

\[ V(q) - p \]
Efficient Scoring Rule

We considered the following question.

How should the government design the scoring rule?
Efficient Scoring Rule

Proposition

In order to maximize social surplus (achieve social efficient quality), the government should set the scoring rule

\[ S(p, q) = V(q) - p \]

1. Maximizes social surplus
2. Improve the Expected Utility
Reserve Price Policy vs. Reserve Score Policy

Both policy is intended to get more competition among bidders to improve the expected utility of government

\[ S(p, q) = V(q) - p \]

Reserve score policy requires all bidders to meet the lower limit of the score \( \xi \)

\[ V(q) - p \geq \xi \]

Reserve price policy requires all bidders to bid the price that is smaller than the upper limit of price \( r \)

\[ p \leq r \]
Reserve Price Policy vs. Reserve Score Policy

- **Reserve Price Policy**
  - Propose the social efficient quality that maximizes social surplus
  - Propose the quality which is *smaller* than the social efficient quality
  - Not participate in the auction

- **Reserve Score Policy**
  - Propose the social efficient quality that maximizes social surplus
  - Propose the quality which is *smaller* than the social efficient quality
  - Not participate in the auction
Conclusion

1. Maximizes Social Surplus
2. Improves the Expected Utility

- Quasi-Linear Scoring rule
  \[ S(p, q) = V(q) - p \]
- Reserve Score Policy
Limitation and Future Study

Several important aspects are ignored in our analysis

• Possibility of moral hazard after the contract

• Transaction cost
Thank you for your attention