CONTRACTORS' BIDDING BEHAVIOR IN A RECURRENT BIDDING SITUATION

W.K. FU and D.S. DREW
Department of Building and Real Estate, The Hong Kong Polytechnic University,
Hung Hom, Hong Kong

Abstract

This paper examines contractors’ bidding behavior in a recurrent bidding situation and in particular considers the extent to which the standardization of building contract affects contractors’ competitiveness and the number of times that contractors repeatedly bid for such work. The analysis shows a strong correlation between standardization of building contract and contractors’ competitiveness, with contractors on average being almost twice as competitive for the most standardized building contracts (i.e. secondary and primary schools) as compared to the least standardized building contracts (i.e meat and vegetable markets). It is suspected that socially acceptable pricing is a major influence behind this relationship. There is insufficient evidence to show that a greater degree of contract standardization leads to a higher level of recurrent bidding. Possible reasons for this is the client limiting the amount of work undertaken by any one contractor at any one time and excessive competition between contractors. It is suggested that public sector clients can rationalize their tender lists by developing separate lists for those building contracts which are standardized in design according to type and size of work, built to a standard specification and awarded on a regular basis.

Keywords: bidding, competitiveness, contractor, construction, experience, public sector, regression analysis, standardization.

1 Introduction

Public sector clients, such as the Hong Kong Special Administrative Region (SAR) Government, provide contractors numerous opportunities to bid for construction work. Many of the contracts on offer are standardized in design and are built to a standard specification. Also, in order to maintain public accountability, bidding procedures are rigorously adhered to.

Conditions such as these provide a recurrent bidding situation to those contractors who choose to bid regularly for such contracts. The experience gained from bidding and undertaking such work provides a learning opportunity whereby contractors can become more competitive and successful and in so doing may be able to specialize in undertaking certain building contracts. However, contractors are faced with great difficulties in undertaking the work they really want on a regular basis. Large lists of contractors kept by clients coupled with procedures which are designed to ensure that competitive bidding takes place, often gives rise to excessive competition. This results in contractors having less control over the choice of contract they really want to undertake with more contracts being awarded on the basis of errors of omission [1] or to more potentially high risk contractors. This is recognized in the Latham Report [2] which points out that tender lists have increased in recent years, with most lists being excessive, and that tender lists arrangements need rationalizing. It is suggested that one approach clients may consider adopting in rationalizing their lists is by analysing the bidding behavior of their contractors. For example, in cases where likely competitiveness is likely to be greater (i.e, differences in bid prices are likely to be smaller) such large numbers of contractors need not be encouraged to tender.
Using data from Hong Kong SAR Government building contracts, this paper examines contractors’ bidding behavior when they operate in a recurrent bidding situation. The analysis focuses on the extent to which the standardization of building contract affects contractors’ competitiveness and the number of times contractors repeatedly bid for such work.

2 The competitive environment

The environment within which contractors compete for work is largely dictated by the construction clients. It is the clients who decide on both the bidding system and procedures. For the vast majority of its contracts, the Hong Kong SAR Government operates an open tendering system based on lists of approved contractors in which the contract is awarded to the lowest bidder [3]. The Government lists of approved contractors are divided into groups according to type (i.e., (1) building, (2) port work, (3) waterworks, (4) site formation and (5) roads and drainage) and size of construction work. Group A listed contractors are eligible to bid for contracts up to HK$ 20 million, Group B for work up to HK$ 50 million and Group C for work of unlimited value.

In general, local contractors are not allowed to bid for contracts exceeding the tender limit of the group they are listed in. Foreign contractors can only bid for contracts exceeding HK$50 million. There are also limits on the amount of work contractors can undertake at any one time. Newly registered contractors are required to undergo a probationary period and many register as Group A contractors and based on performance, resources and experience may be promoted to Group B or C. The total number of registered contractors for building works in Groups A, B and C are shown in Table 1. Those on probation are denoted with the letter P and those foreign are denoted with the letter X.

The open tendering system gives contractors the freedom to select which contracts to bid for and the large numbers of listed contractors gives rise to a highly competitive environment.

<table>
<thead>
<tr>
<th>Group</th>
<th>List I</th>
<th>List II</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of contractors</td>
<td>AP</td>
<td>A</td>
<td>BP</td>
</tr>
<tr>
<td>54</td>
<td>20</td>
<td>37</td>
<td>16</td>
</tr>
</tbody>
</table>


3 The strategic response

In a market based construction industry in which competitive bidding prevails, contracting firms need to formulate appropriate bidding strategies to win contracts. Strategies include random bidding when work is low, selective bidding and severely competitive bidding with claim back options within the limit of the contract [4]. It has also been suggested that some firms aim at lower standards of work than others and that there are differences in efficiency and therefore cost [5].

Rawlinson and Raftery [6] point out that the strategies adopted by contractors vary according to time and are affected by the market climate. One study found the need for work, experience and number of competitors to be the three major factors affecting a UK contractors’ decision to tender [7]. It has also been suggested [1] that contractors have differing degrees of selectivity between contracts. Contractors who are more selective may be regarded as ‘market’ or ‘preference’ (or ‘experience’) driven while contractors who are less selective and place more emphasis on workload may be regarded as being ‘resource’ or ‘constraint’ (or ‘need for work’) driven. The authors also point out that these categories are neither exhaustive nor mutually exclusive and some bidders may place equally high or low emphasis on market and resource factors.
Fine [4] undertook a study in which the influence of a contract’s description affected the bid price. Two groups of contractors were given identical outline drawings and specification, one group for a project which was described as a barn and the other for a project which was described as a theatre. It was found that the average bid price for the theatre was ten times higher than that of the barn. A further study was carried out comparing nurses’ homes built as part of a hospital project with student hostels. From these findings Fine concluded that there was a socially acceptable price for any building and it was the contractor’s perception of that price which determined the bid. Fellows [8] points out that many firms submit a bid on the basis of what the directors, or equivalent, believe to be the market price of that contract on that occasion and that this is bidding based on the perceived socially acceptable price.

4 Standardization of contracts and the effect of recurrent bidding

Most building work contract packages are arranged according to building type (eg offices, hospital) and nature of work (eg. new work, alteration work). This is determined by the client. Although of the same building type and job nature, contract packages are likely to differ in considerably in terms of contents (eg. contain either or both superstructure and substructure work). They may also contain work of a more repetitive nature and be more variable in terms of number of units (eg. housing). Some contract packages may be regarded as being more complex because of building layout and/or method of construction. These differences should also give rise to a wider range of competitors since some contractors do not possess the necessary resources to bid for large contracts while others may not possess the necessary expertise to construct the more complex buildings. Such differences are also likely to lead to a greater range of bid prices between contracts of the same building type and nature of work. In addition, bid competitiveness should also be more variable since contractors would seem less certain of the market price.

Other contract packages may be more standardized in both size and complexity in that some contract packages may almost be identical from one contract to the next contract. This is more likely to occur with public sector organizations which have large ongoing construction programmes. Here complexity would not seem to be an important issue, since the vast majority of contracts on offer would be viewed by contractors as being for typical construction work based on standard drawings and standard specification. The degree of contract package standardization according to size would seem to be a major factor influencing the degree of competitiveness.

Contracts which are standardized and offered on a more regular basis are likely to result in more competitive bids since contractors will become more aware of what the market price is. The contractors’ bidding opportunity cost should be less making bidding for such contracts more attractive. Contractors would also be in a better position to assess the market trend and current market prices by reviewing their previous tender submissions [9]. Feedback is essential to bidding practice. Ogunlana [10] suggests that not only can a feedback mechanism accrue in estimating accuracy but can also help to reduce production costs.

Some contractors are likely to become more successful in being awarded contracts for particular type and size of contract and be able to specialize in undertaking such work. For example, it was found [11] that a UK contractor was highly successful in undertaking primary school contracts, winning 9 out of 12 contracts that were on offer.

5 Measuring contractors’ bidding behavior and standardization of contracts

Construction contract bidding is about contractors’ competing for work. Contractors’ competitive bidding behavior is often measured according to a common scale. Given that the Hong Kong SAR Government adopts a low bid method and that the lowest bid can be taken to be the maximum level of competitiveness, a frequently used measure [eg. see 1] is to express competitiveness as a percentage relative to the lowest bid (ie. (contractor’s bid – lowest bid / lowest bid) x 100%).
Lower percentage values indicate greater competitiveness with the lowest bidder having a competitiveness value of zero percent. By aggregating the percentage values over a series of competitions it is possible to determine average competitiveness and variability in bidding by using a variability measure such as variance.

The degree to which contract packages are standardized can be measured by considering the variability in contract size according to type of new build construction work. Given that the Government uses identical or similar designs according to a general specification for different new build construction work, one approach to measuring the degree of construction contract standardization is by considering the variance of contract size for each type of construction work. A smaller variance in contract size provides an indication of greater standardization and vice versa.

It is hypothesized that a higher degree of contract package standardization represented by different types of construction work will produce more competitive bids. In other words, by relating bidders’ average competitiveness (y) to variance of bid price (x), a positive linear regression line should be produced (ie. \( y = a + bx \)). The slope of the regression line, b, serves as a measure of the sensitivity of average competitiveness (the response variable) to bid price variance (the independent variable). A larger value of b means that competitiveness is more affected by the standardization and vice versa.

The extent to which recurrent bidding takes place can be measured by considering the extent to which differing numbers of contractors bid repeatedly for the various types of construction work. This is based on the work of McCaffer [12]. It is hypothesized that a greater degree of construction contract standardization will lead to a greater degree of recurrent bidding.

6 Data set
A total of 3554 bids from 172 bidders for 265 contracts awarded between 1990 and 1996 were collected from a Hong Kong SAR Government department. This represented general construction contracts (including new work and alteration work) for 53 types of building according to CI/SfB classification. For comparison, all bid prices were updated to a common base date based on the Hong Kong Government tender price index for building work.

From this data set contracts appertaining to six building types for new work contracts were selected on the basis of being a frequently bid building type and comprised 1191 bids from a total of 130 contractors for 71 contracts. It is interesting to note that the average number of 17 bidders per contract is identical to the average number of bidders found in a previous study [1] based on a 1980’s data sample.

7 Analysis
The first part of the analysis focuses on degree to which standardization of contract packages affects contractor competitiveness. By developing McCaffer’s [12] study, the second part considers the effect of recurrent bidding by considering the extent to which contractors repeatedly bid for various types of construction work.

7.1 Standardization of contract and its effect on contractors’ competitiveness

Table 2 provides a breakdown of the descriptive statistics according to building type. Although the number of contracts awarded for secondary schools are more than double that of any other type of work, it can be seen that the average number of bidders competing for each of the different types of building does not vary that much. On average, secondary schools and primary schools have the smallest contracts and are almost identical in terms of average bid price. The remaining contracts vary in terms of size with government quarters having the largest average contract size.

The degree of bid variability according to type of construction work can clearly seen in the box and whisker plot shown in Figure 1. All contracts display a skewed distribution, apart from sports
complex which resembles a normal distribution. Secondary and primary school contracts appear to be most standardized type of construction work with meat and vegetable markets and government quarters being the least standardized. In respect of contractors’ competitiveness toward type of building work, Table 2 shows secondary schools, the most standardized type of construction work having, on average, the most competitive bids. This is closely followed by primary schools. It can be seen that meat and vegetable markets, the least standardized, also has, on average, the least competitive bids.

Figure 1  Box and Whisker Plot of Contract Size According to Type of Building Works

<table>
<thead>
<tr>
<th>CI/SfB Code</th>
<th>Contract type</th>
<th>No. of contracts</th>
<th>No. of bids received</th>
<th>Av. no. of bidders</th>
</tr>
</thead>
<tbody>
<tr>
<td>342</td>
<td>Meat and Vegetable Market</td>
<td>11</td>
<td>170</td>
<td>15</td>
</tr>
<tr>
<td>422</td>
<td>Clinic</td>
<td>9</td>
<td>163</td>
<td>18</td>
</tr>
<tr>
<td>562</td>
<td>Sports complex</td>
<td>7</td>
<td>124</td>
<td>18</td>
</tr>
<tr>
<td>712</td>
<td>Primary school</td>
<td>10</td>
<td>131</td>
<td>13</td>
</tr>
<tr>
<td>713</td>
<td>Secondary school</td>
<td>25</td>
<td>433</td>
<td>17</td>
</tr>
<tr>
<td>816</td>
<td>Government quarter</td>
<td>9</td>
<td>170</td>
<td>19</td>
</tr>
<tr>
<td>Overall</td>
<td>All building type</td>
<td>71</td>
<td>1,191</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CI/SfB Code</th>
<th>Contract size (in HK$ millions)</th>
<th>Average competitiveness percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>342</td>
<td>149.79</td>
<td>54,687.41</td>
</tr>
<tr>
<td>422</td>
<td>86.08</td>
<td>2,847.42</td>
</tr>
<tr>
<td>562</td>
<td>119.02</td>
<td>3,061.14</td>
</tr>
<tr>
<td>712</td>
<td>60.86</td>
<td>687.37</td>
</tr>
<tr>
<td>713</td>
<td>60.59</td>
<td>509.18</td>
</tr>
<tr>
<td>816</td>
<td>233.42</td>
<td>30,263.29</td>
</tr>
<tr>
<td>Overall</td>
<td>105.35</td>
<td>16,682.61</td>
</tr>
</tbody>
</table>
At a 2.5% significance level, Spearman’s rho of 0.943 indicates that there is a strong association between contractors’ average competitiveness and standardization of different types of building. The regression coefficients derived from the least squares approach are 15.21 (intercept) and 1.46439E-16 (the slope). The prediction equation is shown in Figure 2. In respect of the utility statistics, an R square statistic of 0.67 is produced indicating that standardization of building type, based on bid price variance accounts for 67% of contractors’ competitiveness. The F-test statistic is also found to be significant ($F_{0.05} = 8.18, \ p = 0.0459, df = 1, 4$). Table 3 shows the standardized residuals versus the contract size variances. There appears to be no apparent pattern other than a positive linear line. Thus a positive linear line is considered appropriate for interpreting the relationship of average competitiveness and bid price variance.

![Figure 2: The prediction equation](image)

### Table 3: Standardized residuals versus contract size variances

<table>
<thead>
<tr>
<th>Contract type</th>
<th>Contract size variance (in HK$ millions)</th>
<th>Average competitiveness</th>
<th>Standardized residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>342</td>
<td>54,687.41</td>
<td>24.20</td>
<td>0.99</td>
</tr>
<tr>
<td>422</td>
<td>2,847.42</td>
<td>15.61</td>
<td>-0.01</td>
</tr>
<tr>
<td>562</td>
<td>3,061.14</td>
<td>19.71</td>
<td>4.06</td>
</tr>
<tr>
<td>712</td>
<td>687.37</td>
<td>14.13</td>
<td>-1.18</td>
</tr>
<tr>
<td>713</td>
<td>509.18</td>
<td>13.56</td>
<td>-1.72</td>
</tr>
<tr>
<td>816</td>
<td>30,263.29</td>
<td>17.50</td>
<td>-2.14</td>
</tr>
</tbody>
</table>

7.2 The effect of recurrent bidding behavior according to type of building

In respect of the extent to which recurrent bidding takes place, Table 4 shows the number of times contractors have repeatedly bid for different types of building. Standardized internals have been used so that direct comparisons can be made between the different types of building. For example, for meat and vegetable markets it can seen that there are 48 contractors (out of 87 contractors) (ie. 55.17%) bidding not more than two times. This equals to approximately 15% of 11 contracts. It can also be seen that no contractor has bid for more than 50% of the meat and vegetable market contracts on offer. This is the least standardized type of construction work. In contrast six contractors have bid for more than 90% of the sports complex contracts on offer. Although the degree of recurrent bidding for the most standardized contracts (ie. secondary and primary schools)
is similar to those contracts which are less standardized (ie. meat and vegetable markets, government quarters and clinics), it can be seen that degree of recurrent bidding is slightly higher for secondary schools. Table 4 shows that a small number of contractors have bid for over 75% of the secondary contracts on offer.

<table>
<thead>
<tr>
<th>All building type</th>
<th>71 contracts</th>
<th>130 contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized interval</td>
<td>15%</td>
<td>30%</td>
</tr>
<tr>
<td>Min. no. of bids submitted</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>No. / % of contractors</td>
<td>40/30.77</td>
<td>16/12.31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meat and vegetable market (342)</th>
<th>11 contracts</th>
<th>87 contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized interval</td>
<td>15%</td>
<td>30%</td>
</tr>
<tr>
<td>Min. no. of bids submitted</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>No. / % of contractors</td>
<td>48/55.17</td>
<td>23/26.44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sports complex (562)</th>
<th>7 contracts</th>
<th>54 contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized interval</td>
<td>15%</td>
<td>30%</td>
</tr>
<tr>
<td>Min. no. of bids submitted</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>No. / % of contractors</td>
<td>54/100.0</td>
<td>33/61.11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinic (422)</th>
<th>9 contracts</th>
<th>77 contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized interval</td>
<td>15%</td>
<td>30%</td>
</tr>
<tr>
<td>Min. no. of bids submitted</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>No. / % of contractors</td>
<td>77/100.0</td>
<td>23/29.87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary school (712)</th>
<th>10 contracts</th>
<th>61 contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized interval</td>
<td>15%</td>
<td>30%</td>
</tr>
<tr>
<td>Min. no. of bids submitted</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>No. / % of contractors</td>
<td>28/45.90</td>
<td>17/27.87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary school (713)</th>
<th>25 contracts</th>
<th>86 contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized interval</td>
<td>15%</td>
<td>30%</td>
</tr>
<tr>
<td>Min. no. of bids submitted</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>No. / % of contractors</td>
<td>39/45.35</td>
<td>18/20.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Government quarter (816)</th>
<th>9 contracts</th>
<th>74 contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized interval</td>
<td>15%</td>
<td>30%</td>
</tr>
<tr>
<td>Min. no. of bids submitted</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>No. / % of contractors</td>
<td>74/100.0</td>
<td>28/37.84</td>
</tr>
</tbody>
</table>

On balance there does not appear to be sufficient evidence to support the hypothesis that a greater degree of standardization of construction work type leads to greater degree of recurrent bidding. This, however, could be because of restrictions on the amount of work that any one contractor can win at any given time. It should also be noted that although markets being least standardized fits the hypothesis, an important factor influencing this result may be the restriction that contractors are not allowed to bid for contracts exceeding their listed group. In addition, the higher degree of recurrent bidding for sports complex may simply be because of the comparatively small sample size for this type of work.

It is also suspected that an important factor influencing the effect of recurrent bidding behavior according to building type is the degree of competition. Perhaps the competition is so severe for Hong Kong SAR Government Work that some contractors to bid on the premise that the more jobs they bid for the more chance they have of winning rather than being more selective in the type of work that they bid for.
8 Conclusions

A recurrent bidding situation occurs where many of the contract packages on offer are standardized in design and according to size and type of construction work, built to a standard specification and where bidding procedures are rigorously adhered to. Using Hong Kong SAR Government data, this paper examines contractors’ bidding behavior in a recurrent bidding situation and in particular considers the extent to which the standardization of contract package affects contractor’s competitiveness and the number times that contractors repeatedly bid for such work.

In a sample of contracts appertaining to six building types it was found that the degree of contract standardization varied considerably and that contractors are more competitive toward the more standardized contracts. On average, contractors are almost twice as competitive for the most standardized building types (ie. secondary and primary schools) as compared to the least standardized building type (ie. meat and vegetable markets). Spearman’s rho of 0.943 at a 2.5% significance level indicates that there is a strong association between contractors’ average competitiveness and contracts which are standardized in design according to type and size of work and built to a standard specification. This is also reflected in the regression equation which is found to be statistically useful in predicting competitiveness as indicated by the F test statistics ($F_{0.05} = 8.18$, $p=0.0459$, df=1,4) and R square statistic of 0.67.

It is suspected that socially acceptable pricing is a major influence behind this relationship. The next stage of this research will examine various approaches to bid prices with a view to determining the extent to which market oriented pricing takes place.

In respect of the number of times contractors repeatedly bid for different types of building, there is insufficient evidence to show that a greater degree of contract standardization leads to a higher degree of recurrent bidding between certain groups of contractors. It seems, however, that this could be a reflection of the bidding environment created by the client. Not only are contractors restricted in the amount of work they can undertake at any one time but the level of competition in this sample is found to be excessive with an average of 17 contractors bidding for every contract. In addition, the average number of contractors bidding for the different contracts only varies between 13 to 19.

Public sector clients (such as the Hong Kong SAR Government) need to maintain public accountability by ensuring that effective competition takes place, yet at the same time ensure that the degree of competition is not excessive. It would seem that excessive competition not only adversely affects the quality of the buildings being constructed but also stifles the whole of the construction industry’s research and development. It is suggested that one relatively simple approach in rationalizing tender lists of contractors, yet still be relatively assured of receiving a competitive bid, is to develop separate lists for those contracts which are standardized in design according to type and size of work and awarded on a regular basis (such as primary schools and secondary schools).
9 References