Chapter – 6

Financial Applications of Auctions with Constraints in Banks

Introduction: In simple terms Basel II, is a term widely referred to the framework for risk management measures, which banks are required to adopt in their operations. Adoption of Basel II framework requires that banks must identify different types of risks which they are exposed to and provide adequate risk capital to cover unexpected and expected losses. It also requires that these practices should be adopted continuously. In order to adopt these practices banks must identify different types of risks, determine adequate risk capital and allocate risk capital appropriately. In earlier Basel I setup, allocation of risk capital was done on a fiat or an order. Banks were asked by the banking supervisor to provide certain percentage of capital (between 9% to 12% as risk capital). However in the new set up risk capital allocation has to be done by banks themselves. Further, the process for risk management has to be validated by the banking supervisor. In this section it has been shown that how the bidding mechanisms designed in chapters 3, 4 and 5 can help banks to improve the process of estimation and allocation of risk capital.

This has given rise to two very fundamental problems (1) what should be the adequate risk capital for any banking organization and (2) how the available risk capital should be allocated. In this work the main focus is on the problem of allocation of risk capital. One of the most fundamental questions in banking organizations concerns the allocation of available risk capital within the organization in any one period. A banking organization is a multi tier structure. It has a number of different departments. These departments are divided into operational and controlling or head office departments. An operational department of the bank operates through number of branches or delivery channels. The head office departments are engaged in planning and management or control activities. These activities are carried out centrally, keeping the entire organization in view. The work of allocation of risk capital is also carried out centrally. The set of persons carrying out these activities will be referred to as central planners.
This gives rise to the problem of ensuring that risk capital is going to its most efficient uses within the bank? This problem arises because allocation exercise is carried out centrally keeping in view entire organization. The persons carrying out this exercise may not have complete knowledge about the risks, ground realities and opportunities. The operational persons working in branches or concerned departments have hands on and practical knowledge of ground realities. However, these operational persons have little incentive to reveal this information when it is used for planning and control purposes. In fact these managers may be encouraged to understate risk capital requirements per rupee of business activity in order to improve expected risk-adjusted returns. It may be noted that the risk capital is fundamental to the financial health of banks and financial institutions. The departmental Managers know that they cannot expand their departments without at least some capital to support the department against unexpected losses, yet they are tempted to understate their total risk capital requirements per rupee of business in order to improve expected or actual returns. In case of operational departments, higher expected returns presents a higher probability of receiving the financial resources to expand the departments. As capital cannot be priced in the same way as other resources, it cannot be allocated on the basis of “who wants the most”. It is a well known fact that risk capital requirements of Rs. 100 million residential mortgage portfolio and a commercial loan portfolio of the same amount are different. The former, being a portfolio with lesser risk may require less risk capital. However it may still require more risk capital than the activity of Rs. 100 million worth of interest rate swaps. The planners know that the departmental managers have incentives to misrepresent their information in order to receive a more favorable allocation of resources. The decision problem of the central planners is to decide how much capital should be allocated and the price of that allocation.

In fact if the total amount of risk capital C is known. Let $X_i$ be the risk capital to be allocated to $i^{th}$ department. Let $R_i$ be the risk factor associated with $i^{th}$ department. Then allocation problem can be formulated as a linear programming problem as follows.

$$\text{Max } \sum_{i=1}^{n} R_iX_i$$

subject to $\sum_{i=1}^{n} X_i = C$
However the main problem here is to estimate $R_i$.

Banks and other financial institutions determine the allocation of risk capital to different departments based on a value-at-risk approach. In economics and finance, value at risk (VAR) is a measure (a number) saying how the market value of an asset or of a portfolio of assets is likely to decrease over a certain time period (usually over 1 day or 10 days) under usual conditions. It is typically used by security houses or investment banks to measure the market risks of their asset portfolios (market value at risk), but is actually a very general concept that has broad application. In this approach maximum potential loss for the given activity over specific time period is estimated. This approach uses historical data from expected return on different activities. The magnitude of the worst-case losses can be estimated by this approach. So banks can compare the performance of different activities like lending, fund raising, underwriting and derivatives trading. These diverse activities can be compared, as VAR approach provides common basis for measuring the maximum potential loss. So the risk capital to be allocated to these activities can be estimated and compared. The value-at-risk approach is an objective basis for determining risk capital allocation. It does not require a specific assessment of risk by different persons, which may be subjective and a misrepresentation of what they believe or know. However value-at-risk approaches for determining risk capital depend upon historical data. So they provide an accurate assessment of risk only to the extent that historical price or earnings volatility is repeated in the planning period. These methodologies are based on statistical analysis of past prices or earnings movements. Using historical data expected ranges over which prices or earnings movements are likely to occur are worked out. In many cases historical price/earnings volatility may not be an accurate predictor of future price or earnings volatility. Due to this, resource allocation based on value at risk approach may result in a significant misallocation of capital within the organization in some cases. If historical volatility in earnings or prices proves not to be an accurate representation of actual risks, some departments will have lower risk capital than required, while others will have more than required. This can result in two potential problems as follows.
(1) In such cases it may not be always possible to transfer risk capital from department with lower risk capital allocation to department with higher allocation. In the event of unexpected loss a department may not have adequate capital exposing it to potentially high losses.

(2) The managers of departments with excess risk capital are likely to take up high risk activities to earn acceptable returns on allocated capital.

As a result the bank is exposed to higher level of risk. The main problem here is how to use the information available with the operating staff, in order to improve estimates of $R_i$. However the operating staff has no incentive to reveal the information to others. In order to overcome this problem, dynamic bidding based approach has been proposed. In this approach the relevant information is sought from operational people in the form of bids. The mechanism followed ensures that the operational persons have incentive to reveal the true information. This information can be useful to banks in many ways. In the first case it can be used by banks to improve the estimates obtained by VAR techniques, by following other approaches like Bayesian inference techniques (prior and posterior data). Alternatively banks can use it to allocate a part of risk capital by bidding based mechanism and remaining part by other techniques. In this work the main focus is on bidding process, as such the VAR techniques and Bayesian approaches are not discussed any more. It is assumed that the bidding mechanism is used allocate surplus or a part of total risk capital.

In a bidding based approach different departments of bank and persons attached to them can periodically compete for part of surplus risk capital. This mechanism can achieve its objectives, if persons submitting bids have incentives to truthfully reveal their correct risk assessment. The format that is employed is auctions with different types of constraints. The constraints are introduced to ensure that allocation process follows directions of supervisory bodies. We employ single object multi unit auctions as well as double auctions with constraints. It is proposed to follow uniform price auction mechanism. As already stated in this format bidders have incentive to misreport volumes. One problem with bidding mechanism approach is the subjectivity in the process due to dependence on
managers. In the second stage it is proposed that double auction based format with different types of constraints whereby bids are invited from managers (buyer side) and an independent assessment based value at risk approach (seller side) may be used to allocate risk capital.

Auction mechanisms are used when sellers have uncertain information regarding the market value of the goods. In the same way banking persons involved with the exercise of allocating risk capital have uncertain information. Due to this, dynamic bidding process under which departments periodically compete for surplus risk capital has been proposed. As already stated this mechanism compliments existing approaches and helps in improving obtained estimates by incorporating the information available. The persons submitting bids must have incentives to reveal their expectations regarding volatility in prices or earnings (so that the appropriate level of risk capital can be allocated to their activities) and expected returns on allocated capital, per unit of risk.

In this bidding approach, we the have following basic assumptions.

1. All bidders have independent private values. Each bidder has his private valuation about risk associated with different activities. He uses it for bid submission.
2. The valuations of bidders are drawn from independent and identically distributed random variables. If any two bidders have the same valuations then they will submit the same bids. Bank is fair to all the bidders.
3. Banks may set the constraints and bidders are in general not aware about the constraints. Further some activities or positions may offer considerable diversification benefits to the bank and may be preferred ahead of other higher bids. These decisions are based on policies and external constraints of the organization.
4. Bidders are risk neutral. Bidders are assumed to view gains and losses symmetrically, with their only interest being to maximize expected the payout.
5. The risk capital available for allocation is fully divisible.

Operational assumptions: Further it is assumed that the bank has existing mechanism in place to verify the utilization of allocated risk capital. In other words the department, which allocates risk capital is able to assess with accuracy the actual volatility of prices or earnings for a given activity, position or departments over the predetermined time horizon. It is also able to verify whether the activities or positions are within the risk
tolerance level set by the bank. It is possible to verify the net income of the department. In other words bidders cannot misreport earnings and utilization of capital. The different departments are insulated against position or risks that are beyond their control – for example, corporate lending departments are insulated from interest rate risk and funding risk but not credit risk. The system also ensures that the risk capital is linked to controllable risks within the unit. In bank there is a system in place, which insulates managers of departments or positions against different categories of risks. In case of corporate lending unit, unexpected losses derive from bad debts. In the case of under-provisioned losses, total income to the unit would be lower than expected and overall earnings volatility larger.

If the auction mechanism is to be effective it must elicit truthful revelation of risk capital requirements from managers and achieve an efficient allocation (capital is allocated to those activities that are expected to generate the highest risk-adjusted returns). The main considerations in the design of bidding mechanism are the valuation of risk capital, the term of risk capital and the minimum unit bid size.

Application of Multi Unit Auctions with Constraints: There are number of auction formats, which can be used for proposed bidding mechanism. One format that can be considered is the sealed bid discriminatory auction format. In this type of auction the highest bidders win and pay the prices they bid. This format is inappropriate for excess risk capital allocation process for two reasons. This type of auction provides incentives for participants to submit bids below their true valuations in order to try to gain the object at a lower price. There is a possibility that the participant may lose the auction. There are also incentives to learn what competitors are planning to bid. This is one of the reasons for the US Treasury experimenting with uniform-price sealed-bid auctions over the multiple-price sealed-bid auction (discriminatory auction). This format is not suitable for risk capital allocation. In this exercise, it is required to place a ‘value’ on risk capital and encourage truthful revelation of risk capital requirements, whereas this format does not do that exactly. Another format that can be employed is ascending bid auction. This format provides participants with information (price discovery) through the process of bidding. The sealed bid format does not provide this information to the bidders. However both formats provide truthful revelation of bidder’s valuations in a private value setting.
In both formats the price paid for unit is independent of a bidder’s individual bids. The sealed bid format has a slight advantage to the extent that it avoids the need to bring parties together. It has been argued that a sealed bid format may not be desirable because the incentive to reveal true value is lost if this information is relevant to subsequent transactions. This is the case in this exercise. The ascending bid format reveals only that the minimum winning price. It does not reveal other information. However this problem can be overcome in the sealed bid case if the winning bids are not made public across the bank.

The auction format that is proposed is Single Object Multi Unit Auction (considered earlier in chapter 5). The format can be used with or without constraints. A bank can impose group constraints like total risk capital allocation to all credit departments should not exceed certain fixed amount. Then the bids can be collected. Our algorithm can work out the optimum assignment. Then Vickrey payment rule can be used to determine the estimate of risk capital. This format has properties of efficiency and truthful bidding. It ensures that truthful bidding is the dominant strategy. One important characteristic of the Vickrey auction is the discount that bidder gets. The amount paid is independent of his bid. In these auctions the equilibrium strategy for participants is to bid true cost or value. This equilibrium strategy is also a dominant strategy because it is optimal to reveal the truth even if a bidder assigns a positive probability to the possibility that other bidders in the auction will deviate from their equilibrium strategies. The auction also leads to an efficient allocation because the bidders with the highest values always win. These are the desired outcomes of an auction mechanism for allocating risk capital within a banking organization. It is an essential requirement that the mechanism induce managers to truthfully reveal their beliefs or knowledge regarding the level of risk capital necessary to support their proposed activities. It is also a requirement that central planners are able to use this information to allocate part of risk capital to those activities that are able to earn the best returns per unit of risk. So it follows that this bidding process reveals expected risk capital requirements. However in case there are different types of constraints it may not be possible to obtain Vickrey payoff in some cases. In such cases it is proposed to use Uniform Price Auction. It has been shown by Vickrey that the uniform price auction is...
not an efficient allocation when bidders desire more than one unit of the commodity because of demand reduction incentives. However this can be overcome to some extent by introducing discriminatory mechanism discussed in chapters 4 and 5. Further double auction mechanism can also be used inviting bids from others.

Bid Format: The bid consists of department identification, required number of risk capital units and the expected return per unit of risk capital bid. A bidder can submit a single pair or multiple risk capital units and associated expected return per unit of bid capital. Let there be n bidders. Let RC be the total risk capital to be allocated. Let $RC_b$ be the total bid capital to be allocated by bidding process and $RC_a$ be the capital allocated by other approach. Then we have the relation $RC = RC_b + RC_a$. Let $RC_{bi}$ be the risk capital to be allocated to $i^{th}$ department by bidding process. So $RC_b$ can be written as

$$RC_b = \sum_{i=1}^{n} RC_{bi}$$

Let $RC_{ui}$ be the risk capital units required by $i^{th}$ bidder. Let $ER_{ui}$ be the expected returns. So the bid is of the type $(ER_{ui}, RC_{ui})$ $i = 1, 2, ..., n$. A bidder is also allowed to submit range of risk capital units and expected returns corresponding to it. A bidder can submit m such pairs. So the bids can be of the form $\{(ER_{ui1}, RC_{ui1}), (ER_{ui2}, RC_{ui2}), ..., (ER_{uim}, RC_{uim})\}$. Alternatively it can be of the form $\{(ER_{ui1}, (RC_{ui0}, RC_{ui1})), (ER_{ui2}, (RC_{ui1}, RC_{ui2})), ..., (ER_{uim}, (RC_{uim-1}, RC_{uim}))\}$. The optimization problem in this format is as defined in chapter 5. We just state it here for reference.

Let us define

$$x_{ij} = \begin{cases} 
1 & \text{if j th expected returns interval is selected for i th bid} \\
0 & \text{otherwise} 
\end{cases}, \quad i = 1, 2, \ldots, n \text{ and } j = 1, 2, \ldots, m$$

If $k^{th}$ bidder specifies only expected returns, risk capital units required, pair then $m = 1$ for $i = k$.

Let $RA_{ij}$ be the risk capital unit allocated to $i^{th}$ bidder at expected returns $ER_{uij}$. Then we define our optimization problem as follows

$$\max \sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} RA_{ij} \cdot ER_{uij}$$
Total risk capital = \[ \sum_{i=1}^{n} \sum_{j=1}^{m} RA_{ij} \leq R_b \], \; i = 1, 2, ... , n \; , \; j = 1, 2, ... , m

Group Constraint: Let \( A \) be the set of departments, such that there is a limitation on total risk capital that can be allocated to them. There can be more than one such set. Let \( RG_a \) be the total risk capital, then we have

\[ \sum_{i \in A} \sum_{j=1}^{m} RA_{ij} \leq RG_a \]

where \( i \in A \) for all such groups.

The other constraints are

\[ \sum_{j=1}^{m} x_{ij} \leq 1 \] for all \( i \) and all \( RA_{ij} \) are non negative integers.

In double auction formats two set of bids are submitted for the same department by independent persons. The bid format remains the same; however, the competing bid is submitted by another person or can be obtained from VAR approach. The bid by departmental manager is treated as buyer’s bid, while that from another source is treated as seller’s ask. Then the remaining formulation can be carried out as stated in chapter 3. As such this formulation is not stated here.

Adjustments: The bids are subject to certain adjustments. These adjustments are described in the next few sentences. The expected return here is basically risk adjusted return described later. The risk capital unit is treated as quantity and expected return as price. The risk capital is divided into common size bid units so that a bid consisting of pairs of number of units required and the yield per unit can be submitted (Type 2 bid described earlier). The appropriate size of units is related to the size of the department, the nature of its business, and/or whether capital is allocated on a transaction or portfolio level basis or a departmental level. If the latter is adopted, the minimum bid size may be, say, Rs. 10 million in risk capital. The larger the minimum bid unit, the more difficult to track risk capital allocations to actual positions, and this would work against the key assumption that risk capital utilization is verifiable after allocation. The bid information refers to specific time horizon. The risk capital is viewed as an insurance against unexpected losses. So it can be considered to be allocated for the residual life or maturity of the transaction or portfolio. Such a risk capital should absorb all unexpected losses over the life of the activity or portfolio. In general this means if activity or portfolio
duration is longer, then the amount of risk capital has to be higher. The volatility of cumulative default rates is expected to be higher, when the time horizon is longer. This means, as time progresses, it may be necessary to incorporate a pro-rata reduction in risk capital. At the time of bidding one has to adjust risk capital suitably, taking into account the remaining time horizon. One has to ensure that with longer term, activities or portfolio require more risk capital. This does not mean that frequency of performance measurement depends upon the term of the capital – quarterly or monthly (or daily for trading activities) in order to assess earnings volatility. It may be as per the policies of the bank. The risk capital is viewed as insurance against that fraction of risk that is unavoidable only in the short-run. Rather than viewing capital as an insurance policy subscribed at origination and remaining linked with the facility until maturity, this approach sees risk and capital management as ongoing and proactive processes. The short-term focus of capital arises because corrective action can be taken to reduce risks or limit losses whenever risks increase (for example, an increase in earnings variability can be addressed with credit swaps or asset sales/securitizations). Further, capital can be raised to hedge unexpected risks as they appear. This approach would have the term of risk capital at one or two years and be more aligned with the frequency of performance measurement. Once problem formulation is done as above, developed algorithms are used to obtain optimum allocation. Then the risk capital to be allocated is obtained based on VCG mechanism or discriminatory mechanism proposed earlier. Then the capital to be allocated by bidding mechanism is worked out. A simple example is shown in the next section.

The risk capital (and funding for banking book positions) is allocated against those bids presenting the highest expected risk-adjusted returns, within constraints set by the overall operational plan and constraints of the bank. For example, a high-yielding loan portfolio may not be allocated funds because the bank is overexposed to this industry or customer segment, that is, the bank has a concentration of credit risk in this area. This mechanism guarantees a truth-revealing strategy for risk capital and expected return on the part of bidders.

This is due to the relation between risk capital and risk-adjusted return, expressed in the following simple identity:
risk-adjusted return = earnings / risk capital.

It is assumed that the bank can verify expected earnings. If a manager expects before-tax earnings of Rs. 1.4 million from a given activity and estimates the risk capital requirement for the position to be Rs. 10 million, the appropriate bid is a yield of 14% for risk capital of Rs. 10 million. The payment rule in our auction format ensures that it is non-optimal for the department’s manager to understate the risk capital requirement (say to Rs. 9.5 million) and overstate the expected risk adjusted return (in this case the yield increases to 14.74%) in order to improve the probability of winning resources in the auction. Before proving this it is necessary to incorporate the bank’s compensation mechanism into the auction design. Recall that under the Vickrey payment rule each successful bidder is offered a rebate that is just high enough to remove the incentive for bidders to misrepresent their respective valuations. The amount of this rebate corresponds to the difference in the marginal valuation curve of the successful bidder and the marginal valuation curve of the highest-losing bidder if they had instead been allocated the commodity under auction. In the bank case, department managers derive value from risk capital to the extent that risk-adjusted returns feed into the compensation mechanism. That is, the ‘rebate’ paid to managers must be a function of the actual return generated, the actual risk capital absorbed and the highest rejected yield lodged by another bidder in the auction. This can be expressed as follows:

\[ P_i = \Upsilon \left[ K_{ai} ( r_i - c_i ) \right] \]

where \( P_i \) is the compensation payment associated with a given position \( i \), \( \Upsilon \) is a fixed coefficient, \( K_{ai} \) is the actual level of risk capital utilized by position \( i \), \( r_i \) is the actual risk-adjusted return on capital on position \( i \), and \( c_i \) is the yield bid by a losing competitor at which \( ka_i \) was secured. In next section an example of our approach is presented.

Suppose a manager estimates a risk capital requirement of Rs. 10 million (non-verifiable ex-ante) to support a Rs. 100 million portfolio. The verifiable expected earnings on the portfolio are Rs. 1.4 million, resulting in an expected risk-adjusted return on capital, before tax, of 14%. The manager is required to bid for risk capital under a sealed-bid Vickrey multiple-unit auction. Compensation will be paid to the departments based on the compensation formula expressed above, with the coefficient \( \Upsilon = 1 \). The manager will
submit a demand curve detailing the volume of capital required and the expected return on that capital. The manager has three bidding options:

1. Understate risk capital and overstate the expected return. Here the manager bids for Rs. 9.5 million in capital at a yield of 14.74%. The higher yield increases the probability of winning the auction and securing the required funding.

2. Bid truthfully on risk capital and expected return. Here the manager bids for Rs. 10 million in capital at a yield of 14%.

3. Overstate risk capital and understate expected return. Here the manager bids for Rs. 10.5 million in capital at a yield of 13.34%. The shading of the bid increases the potential gain should the funds be secured but reduces the probability of winning the auction.

Suppose the manager estimates that competitive bidders may bid yields of 15%, 14.5%, 14%, 13.5%, 13% and 12.50% with equal probability. What is the optimal bidding strategy for the manager?

Table 6.1 shows the expected payoff to the manager/departments if the first option is taken and a bid of 14.74% is placed (expected yield is overstated by understating risk capital). Only a competitor bid of 15% will result in this auction being lost. However if a competitor bids 14.5%, the manager will win the auction but incur a negative rebate given the actual yield realizable is 14%. The rebate is – Rs. 0.1 million, calculated using the compensation formula:

\[ P_i = \gamma [ Ka_i ( r_i - c_i ) ] = 1 \times [RS. 10 m (0.28 – 0.29)] = -RS. 0.1 m \]

<table>
<thead>
<tr>
<th>Bid</th>
<th>Competitor Bid</th>
<th>Auction Result</th>
<th>Actual Requirements</th>
<th>Spread</th>
<th>Payoff in Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.74%</td>
<td>15.0%</td>
<td>Lose</td>
<td>14.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.74%</td>
<td>14.5%</td>
<td>Win</td>
<td>14.0%</td>
<td>-1.00%</td>
<td>-0.1</td>
</tr>
<tr>
<td>14.74%</td>
<td>14.0%</td>
<td>Win</td>
<td>14.0%</td>
<td>0.00%</td>
<td></td>
</tr>
<tr>
<td>14.74%</td>
<td>13.5%</td>
<td>Win</td>
<td>14.0%</td>
<td>1.00%</td>
<td>0.1</td>
</tr>
<tr>
<td>14.74%</td>
<td>13.0%</td>
<td>Win</td>
<td>14.0%</td>
<td>2.00%</td>
<td>0.2</td>
</tr>
<tr>
<td>14.74%</td>
<td>12.5%</td>
<td>Win</td>
<td>14.0%</td>
<td>3.0%</td>
<td>0.3</td>
</tr>
<tr>
<td>Expected Payoff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.083</td>
</tr>
</tbody>
</table>
For any competitor bids below 14%, the manager receives a positive rebate as shown in table 1. The total expected payoff from this strategy is Rs. 83,000, and this payoff decreases for higher bids.

Table 6.2 shows the expected payoff if the second option is taken and the manager bids on the basis of true expected return (28%). Despite the lower probability of winning the auction relative to option one, the expected payoff is larger at Rs. 100,000.

Table. 6.2: Truthful Bid on Risk Capital and Expected Yield

<table>
<thead>
<tr>
<th>Bid</th>
<th>Competitor Bid</th>
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<th>Spread</th>
<th>Payoff in Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.0%</td>
<td>15.0%</td>
<td>Lose</td>
<td>14.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.0%</td>
<td>14.5%</td>
<td>Lose</td>
<td>14.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.0%</td>
<td>14.0%</td>
<td>Tie</td>
<td>14.0%</td>
<td>0.00%</td>
<td></td>
</tr>
<tr>
<td>14.0%</td>
<td>13.5%</td>
<td>Win</td>
<td>14.0%</td>
<td>1.00%</td>
<td>0.1</td>
</tr>
<tr>
<td>14.0%</td>
<td>13.0%</td>
<td>Win</td>
<td>14.0%</td>
<td>2.00%</td>
<td>0.2</td>
</tr>
<tr>
<td>4.0%</td>
<td>12.5%</td>
<td>Win</td>
<td>14.0%</td>
<td>3.0%</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| Expected Payoff | 0.1 |

Table 6.3 shows that the third option involving bid shading does not increase the expected payoff. At a bid yield of 13.34% the expected payoff is Rs. 83,000.

Table 6.3: Overstate Risk Capital – Understate Expected Yield

<table>
<thead>
<tr>
<th>Bid</th>
<th>Competitor Bid</th>
<th>Auction Result</th>
<th>Actual Requirements</th>
<th>Spread</th>
<th>Payoff in Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.34%</td>
<td>15.0%</td>
<td>Lose</td>
<td>14.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.34%</td>
<td>14.5%</td>
<td>Lose</td>
<td>14.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.34%</td>
<td>14.0%</td>
<td>Lose</td>
<td>14.0%</td>
<td>0.00%</td>
<td></td>
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<tr>
<td>13.34%</td>
<td>13.5%</td>
<td>Lose</td>
<td>14.0%</td>
<td>1.00%</td>
<td>0.1</td>
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<tr>
<td>13.34%</td>
<td>13.0%</td>
<td>Win</td>
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<td>2.00%</td>
<td>0.2</td>
</tr>
<tr>
<td>13.34%</td>
<td>12.5%</td>
<td>Win</td>
<td>14.0%</td>
<td>3.0%</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| Expected Payoff | 0.1 |
In fact the best outcome that can be achieved is an expected payoff of Rs. 100,000, which matches that of the truth-revealing strategy but embodies a lower probability of winning the auction.

The dominant bidding strategy is to bid truthfully. All three strategies result in a maximum payoff equivalent to \(( r_i - c_i )\). However the strategy of understating risk capital in order to improve expected return is dominated because it exposes the bidder to a negative rebate should the highest losing bid exceed the expected return of the bid in question (that is, \( c_i > r_i \)). The strategy of bid shading is also dominated because it reduces the probability of winning the auction without increasing the size of the rebate that would be secured should the auction be won. Consequently misrepresenting risk capital and expected return on risk capital is a non-optimal strategy. The auction mechanism is also efficient allocation because risk capital is allocated to those departments that value it the greatest; meaning those units that can generate the highest risk-adjusted returns on the bank’s capital.

Limitations: In this approach a part of risk capital is valued by departments managers because their compensation structure is directly influenced by the actual capital utilized and the realized return on risk capital. Managers are offered a rebate based on the difference between the realized yield per unit of risk capital and the opportunity cost of assigning that risk capital to the departments. The auction mechanism induces truthful revelation of information because the size of the rebate is independent of the manager’s bid on expected yield. A truthful bid on yield corresponds to a truthful bid on risk capital because expected earnings can be verified at a later stage. There are certain limitations to this analysis. First it was assumed that managers were risk-neutral (that is, winning and losing the auction are viewed symmetrically). Risk averse managers will place excessive weight on the fear of losing the auction. Risk-averse bidders would thus be inclined to submit excessively high bids to mitigate the likelihood of not acquiring capital in the auction. Under the auction design developed, there is a positive probability that these managers would incur negative rebates through the compensation mechanism. As a consequence, there is the potential for post-contractual moral hazard if these managers subsequently take on extra risks in order to increase actual returns and subvert the potential negative rebate. These managers may also be inclined to misrepresent the
earnings of their departments in order to influence the measurement of risk capital utilized. The consequences of risk-aversion on the part of department managers and the design/modification of the allocation mechanism to deal with moral hazard are the subject of further research by the author. The allocation mechanism also relied on the assumption that risk capital utilization was verifiable. The standard deviation of earnings or prices may be readily measured, but a complication arises to the extent that the appropriate level of risk capital is not just some multiple of earnings or price volatility. The earnings-at-risk represents the amount of expected earnings that management is willing to forego in any one period without causing a change in business plans. That is, the role of capital is to provide a buffer against future unexpected losses while still leaving the bank or departments able to operate at the same level of capacity. Unexpected losses in any period absorb risk capital. A bank in this situation would need to scale down operations in order to ensure that the remaining level of risk capital is appropriate to support its high risk activities. Alternatively the bank could raise more capital to replace that absorbed by losses, but it is doubtful that this could be raised on favorable terms following a period of large un-provisioned losses. The implications are that while it may be possible to measure earnings or price volatility, it may not always be possible for the centre to measure accurately the adequacy of risk capital held by a department over a certain period. However constraints can be imposed so that no department is missed out. Alternatively only part of risk capital can be allocated through bidding mechanism. A mortgage insurance business line, for example, may not generate high returns relative to other businesses when measured on a stand-alone basis. The business may, however, provide a gateway to new mortgage business or provide diversification benefits across the organization. A problem arises to the extent that the managers of such business lines can only bid in the auction for risk capital on the basis of expected yields on the stand-alone business. In fact line managers could not be expected to know that their businesses provide ancillary benefits to the organization, as this information is typically only observable at the centre. If expected returns on the stand-alone business are low (or possibly lower than the internal hurdle rate) these managers may face a disincentive to bid for capital in the current period. At the same time the centre is likely to be aware of these benefits and may encourage bids by signaling an intention to gross-up yields for
these businesses to incorporate these expected benefits. However incorporating these adjustments into the compensation mechanism may be problematic and threaten the credibility of the system if other managers perceive this as interference or favoritism from the centre. A final consideration is the frequency of auctions. The risk capital allocation process must be sufficiently flexible to ensure that departments have the risk capital necessary to support their day-to-day operations. Without this flexibility it is conceivable that a department would be placed in a situation where it had to reject important business acquisition opportunities because it could not be guaranteed of securing risk capital to support the business in the next ‘scheduled’ auction. From this perspective, the auction mechanism for allocating risk capital should perhaps only be considered when there are large competing demands for capital at the beginning of the planning period. While the mechanism has attractive truth-revealing properties and is proved to be efficient allocation in a theoretical setting, too rigid an application may result in costs that outweigh benefits.

Further Work: An important limitation of this work is that the bids from manager are subjective. On the other hand estimates of value at risk are objective. This aspect of minimizing effect of subjectivity can be an important future work.