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**A GAME THEORITICAL APPLICATIONS IN MERGERS AND ACQUISITIONS PRICING**

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**Abstract:**

The method of Mergers acquisitions pricing is generally tedious because it is highly complicated to the compute the price to be paid to buy the targeted concern. In 2009, Game theorists Baker, Pan, Wurgler[13] describe that though corporate finance valuations provide some support, there are some existing psychological factors and the ultimate price may be completely differs with initial estimations. The present research paper improves a two-person Merger and Acquisition model whose aim is to give a simulation model in order to understand whether the final negotiates price of an Merger and Acquisition an transaction is equal to the mid-value of bid price of target and offer price of acquirer. This examines an important part of Merger and Acquisition valuation namely behavioral factors. This paper uses the model to simulate results and determine if it is better in the acquirer to be risk taking or risk averse and for the target to be pessimistic or optimistic.

**Key words:** Mergers and Acquisitions, Game theory, Prospect theory.

**Introduction:**

In corporate finance sector Merger and Acquisitions is a popularized field of research in corporate finance sector. The valuation methods of M and A transactions are available in very large number in the finance literature. Those transactions are priced with the help of balance sheet valuation earnings ratio economic profit, transaction multiples, discount cash flow analysis by investment banking industries. Since different valuation methods give different results. The M and A pricing method has become a biased system of beliefs and psychological anchoring these models are inefficient in giving proper estimates of offer prices that are admissible for M and A transactions. Pan, Baker and

Wurgler[13] and Ruback, Baker and Wurgler(2014) notice that behavioral components. Effect the targets prices in M and A transactions. M and A pricing depicted as a negotiation between the acquirer purchases the target at this price. To review such negotiations, one can use the game theory. The literature in the game theory can give an insight into strategic human interaction in the above negotiations. The existing game theory can be broadly divided into two parts namely cooperative game theory and non cooperative game theory (Nash 2001)[1].Morgenstem and Von Neumann [9] and Nash [1,2] suggested two game theoretic ways to resolve bargaining problems which are either axiomatic or strategic. The cooperative theory also called axiomatic approach helps by giving valuable axioms. But in strategic approach outcomes will be in non-cooperative game. In the light of zero premise or non cooperative games, Mergers and Acquisitions enter.

The main objective of this paper is to improve a M and A theoretical game model which can analyze whether the offer price quoted by an acquirer should equal the mid value of the offer price of acquirer and bid price of target or not. It can analyze whether the acquirer will do better by being risk averse or risk taking or not and whether the target will do better by pessimistic or optimistic.

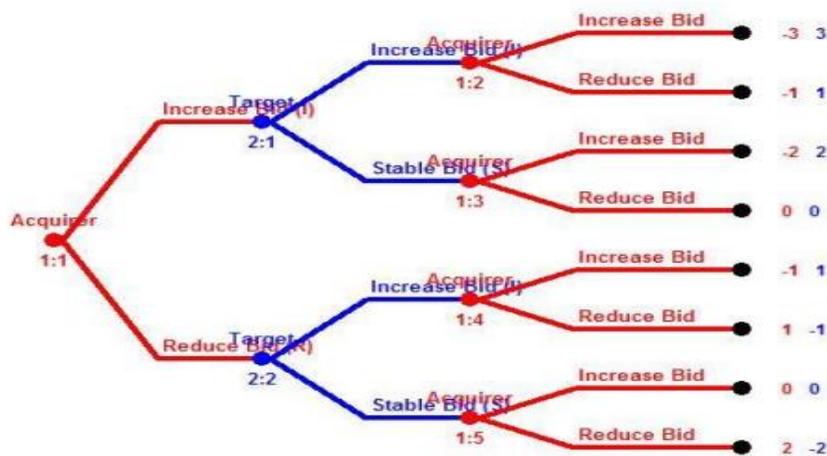
#### **A Model in Merger and Acquisition Game Theory:**

The M and A model with two persons is incomplete information on a game between the target and acquirer. Here both players need to agree to a price which is acceptable to them in order to buy the target company by the acquirer. The extensive form of this game describes three stage games between the acquirer and the target. In this game target chooses either increase bid strategy or stable bid strategy where as the acquirer options either increase bid strategy or reduce bid strategy. This game induces two chance rides. These are associated with probabilities related to the predicted behavior the acquirer where it is either risk taking or risk averse or not and whether target is optimistic or pessimistic or not. Based on the expected behavior the acquirer or target can show, probabilities are assigned. If these probabilities change, then the point of equilibrium of the game changes also. Before going to deep analysis it must be noted that pay-offs for each strategy is relative to any other strategy. Therefore the increase bid strategy can have a pay-off of  $\pm 1$ . Prospect theory due to Khaneman and Tversky [14] is to be applied here. This theory states that humans prefer positive events at least twice as much as negative events. By the applications of prospect theory to game theory due to Metzger and Reiger [15] positive events can have +0.44 pay-off instead of +1. Where on the other hand the reduce bid strategy has +1 pay-off and

-1 pay-off. The stable bid strategy can be associated with 0 pay-off. The detailed or diagrammatic form of the game consisting the sequences of game plans player by every player and normal form of Merger and Acquisition 2-person model are being given here.

**Research Study:**

Diagram 1 describes characteristic form of the M and A 2-person model. Here acquirer can make the starting offer and if the target wants to accept that offer then he will decide on the same node. If the target rejects this offer then the acquirer will either increase or decrease the bid in the future which is being represented by the node. Increment in bid happens when the acquirer thinks to buy the target and decided to pay more. But it may be possible that the value of the target will be decreased between time interval on which initial and the next offers are quoted because of a large number of reasons. Consequently the acquirer will either increase or decrease the offer based on the momentary circumstantial. In the same way the game is being continued till the moments namely target agrees to the offer, unwillingness of the acquirer come. Here offer approaches a limit point and he is dislike to pay higher amount. The characteristic form of this game is transferred to its isomorphic normal form. Game plans in the normal form may be directly translated back to the characteristic form for both the target and the acquirer for instance the strategy “IS” for target and the strategy “IIP” for the acquirer means that the acquirer will choose the “Increase Bid” first strategy in play one.



**Diagram 1: Characteristic form of 2-person Merger and Acquisition model with complete data.**

Now the target also will select the “Increase Bid” strategy in responding to the above as it follows the strategy “IS”. This means that if the acquirer selects the “Increase Bid” plan then the target will choose the same and of the acquirer options for “Reduce Bid” policy then the target follows “stable Bid” strategy. In the same way the acquirer will go for the

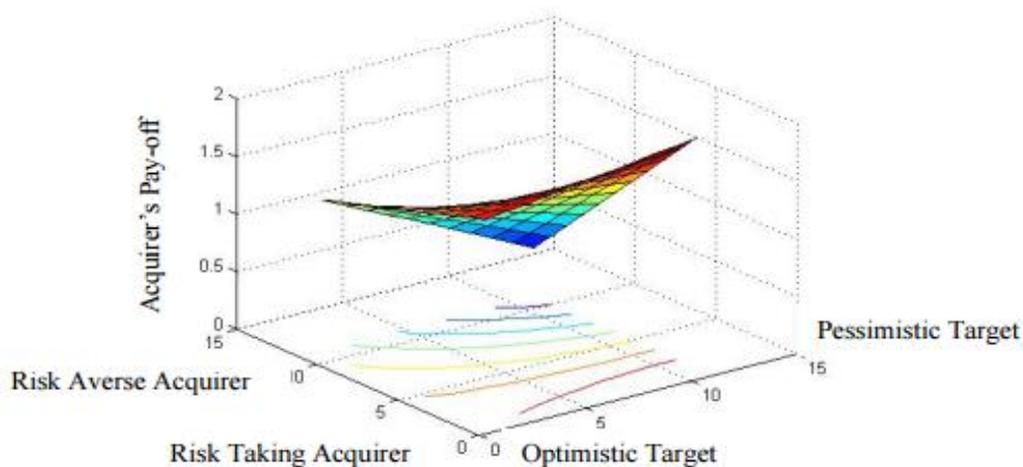
“Increase Bid” plan because the target follows III plan. This happens as the acquirer chooses the “Increase Bid” strategy if the target has chosen the “Increase Bid” or “stable Bid” strategies. But it is necessary to discuss the computations of pay-off in the strategic form before improvisation of the normal form. By increasing the bid every time, the acquirer receives a pay-off +1. Similarly the acquirer takes a pay-off of -1 by reducing the bid every time. These two are depicted by the strategies “I” increase Bid and “R” Reduce Bid respectively. Hence the strategies “RII” and “IRR” can receive a zero pay-off for the acquirer as in phase one he increases the bid and in phase two he decreases the bid. In the similar manner the target can receive the opposite of these pay-offs. That is +1 for Increase Bid “I” and 0 for stable Bid “S”. Hence the pay-off for “SI” and “IS” are similar for the target with pay-off +1.

		Player 2's Strategies			
		II	IS	SI	SS
Player 1's Strategies	III	-3	-3	-2	-2
	IIR	-3	-3	0	0
	IRI	-1	-1	-2	-2
	IRR	-1	-1	0	0
	RII	-1	0	-1	0
	RIR	-1	2	-1	2
	RRI	1	0	1	0
	RRR	1	2	1	2

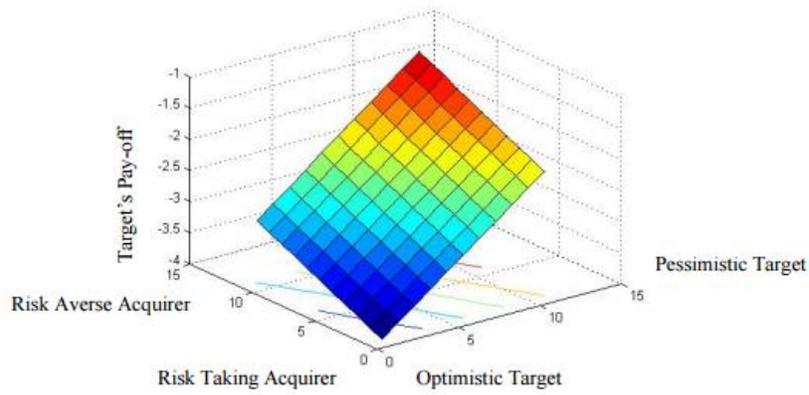
**Diagram 2: Picture of Normal form of 2-person M and A model with complete data.**

Using the strategies and payoffs given by the strategic and normal forms of this game one can notice that the acquirer is at a greater disadvantage than the target when compared to reduction of price as he can lose 3 units if the price is increased by the target and acquirer (Known as absolute maximum point). Here reduction of price is called absolute minimum point. This happens because of the strategies followed by the target. The target company always goes to increase the price whenever possible instead of reducing the price and in this case imbalance in the pay-off structure generates and results in a situation in which equilibrium state is much suitable for the target when compared to the acquirer. Suppose these is a 2-person Merger and acquisition game with in sufficient data including conditions that the acquirer and the target do not know the type of other party that the probability of choosing “Increase Bid” or “Stable Bid” by the target. Usually acquirer and targets firms do not reveal their bid prices and expected offer because they do not wish the opposite parties to know how much they are prepared to offer or how much they want before going to the

agreement. The base case of extensive form of the 2-person M and A model is the situation at which the target is pessimistic and acquirer is risk taking. Moreover if the acquirer has a strong dislike to take risk and the target is pessimistic then the payoffs will be decreased by fifty percent from the base case. In contrast if the acquirer is risk averse and the target is optimistic then the pay-off will be increased by hundred percent from the base case with the acquirer is risk taking and the target is optimistic. The purpose of this phenomenon is that the acquirer taking risk has an idea of paying more when compared to a risk adverse acquirer while an optimistic target can demand for more in order to sell his firm compared to pessimistic target. Usually there are optimistic people and pessimistic people. In addition to these there are other behavioral skills which can be applied to improve highly realistic M and A valuation games. Owing to behavioral characteristics and strategies which are meant frame the M and A valuation game changes in pay-off will be occurred. It is assured that game theory is used frequently for M and A valuation as it supports the variances in psychological pricing which are not ready available through the classical corporate finance valuation methods. These methods give the theoretical basement to the M and A valuation decision making structured. But it is impossible to get an understanding about most optimal offer known as Nash Equilibrium point because there are some behavioral biases. Here Nash Equilibrium point can present the good deal to both the acquirer and the target. Moreover the central idea of prospect theory can have a sufficiently great impact on pricing techniques but the traditional valuation model cannot consider it. Hence the 2-person M and A model has been improved to get a device which can be used to simulate M and A pricing method which is able to present a map to the valuation of potential M and A transaction associated to situations of the real world.



**Diagram 3: Pay-off design of acquirer.**



**Diagram 4: Pay-off display of target.**

In an incomplete game, where the acquirer has no information about the optimistic or pessimistic nature of target and the target has no idea the risk taking or risk averse behavior of acquirer, it is advisable and important to recall the paper deal. Owing to this truth information is constructed in the neighborhood of node types. For instance while using the “IIII” strategies against the “II” strategy used by the target are needs to compute the pay-off for the acquirer. It is necessary to add the pay-off at every instant where the acquirer uses the “IIII” strategy multiplied by the probabilities of acquirer and target. Therefore it is  $(1.0)(0.1)(-6)+(1.0)(0.9)(-4.5)+(0.0)(0.1)(-3)+(0.0)(0.9)(-1.5)$  and equals -4.65. In the similar fashion the target’s pay-off is calculated as +2.07.

		Player 2's Strategies			
		II	IS	SI	SS
Player 1's Strategies	IIII	(-4.65,2.07)	(-4.65,2.07)	(-3.1,1.37)	(-3.1,1.37)
	IIIR	(-1.95,0.86)	(-0.6,0.27)	(-1.75,0.77)	(-0.4,0.18)
	IIRI	(-4.65,2.07)	(-4.65,2.07)	(0,0)	(0,0)
	II RR	(-1.95,0.86)	(0.6,-2.43)	(-1.35,0.59)	(1.2,-2.7)
	IRII	(-1.55,0.68)	(-1.55,0.68)	(-3.1,1.37)	(-3.1,1.37)
	IRIR	(0.39,-1.26)	(-0.2,0.09)	(0.97,-1.17)	(-0.4,0.18)
	IRRI	(-1.55,0.68)	(-1.55,0.68)	(0,0)	(0,0)
	IRRR	(0.39,-1.26)	(1,-2.61)	(0.59,-1.35)	(1.2,-2.7)
	RIII	(-4.25,1.89)	(-4.05,1.8)	(-2.9,1.29)	(-1.35,1.2)
	RIIR	(-1.55,0.68)	(0,0)	(-1.55,0.68)	(0,0)
	RIRI	(-4.25,1.89)	(-3.87,1.4)	(-0.2,0.09)	(0.18,-0.4)
	RIRR	(-1.55,0.68)	(1.37,-3.1)	(-1.55,1.36)	(1.37,-3.1)
	RRII	(-1.26,0.39)	(-1.35,0.59)	(-2.61,1)	(-2.7,1.2)
	RRIR	(0.68,-1.55)	(0,0)	(0.68,-1.55)	(0,0)
	RRRI	(-1.28,0.39)	(-1.17,0.19)	(0.09,-0.2)	(0.18,-0.4)
	RRRR	(0.68,-1.55)	(1.37,-3.1)	(0.68,-1.55)	(1.37,-3.1)

**Result:**

Results depict that the equilibrium price known as Nash equilibrium point is much closed to offer price of acquirer. But using the simulating of the behavioral factors it can be seen that the most optimal outcomes for the acquirer and target are being a risk takes and being pessimistic respectively. This appears as a most advisable option as the acquirer will be thinking of giving a higher offer and the target will be clearer to receive a reasonable offer. Owing to many reasons this can happen. One of these reasons is that the target does not wish to provide a low price as it is deserved to get a higher price when the acquirer is ready to give more price. In the similar manner the acquirer does not wish to reveal his expected offer price as he dislike to pay too much to purchase the target firm. Usually both the target and the acquirer want to trace the expected offer and bid price and they will go to offer a price that is suitable to both of them. Here acquirer began with a lower price then they try to negotiate and meet at an equilibrium price.

		Player 2's Strategies			
		II	IS	SI	SS
Player 1's Strategies	III**I	-3.00	-3.00	-2.00	-2.00
	IIIIIR	-1.67	-1.00	-1.33	-0.67
	IIIIRR	-1.67	0.33	-1.33	0.67
	IIRIRI	-0.33	-1.00	0.00	-0.67
	IIIRRR	-0.33	0.33	0.00	0.67
	IIR**I	-3.00	-3.00	0.00	0.00
	IIRIIR	-1.67	-1.00	-0.67	0.00
	IIRIRR	-1.67	0.33	-0.67	1.33
	IIRRII	-0.33	-1.00	0.67	0.00
	IIRRRR	-0.33	0.33	0.67	1.33
	IRI**I	-1.00	-1.00	-2.00	-2.00
	IRIIIR	-1.00	-0.33	-1.33	-0.67
	IRIIRR	-1.00	1.00	-1.33	0.67
	IRIRIR	0.33	-0.33	0.00	-0.67
	IRIRRR	0.33	1.00	0.00	0.67
	IRR**I	-1.00	-1.00	0.00	0.00
	IRRIIR	-1.00	-0.33	-0.67	0.00
	IRRIRI	-1.00	1.00	-0.67	1.33
	IRRRIR	0.33	-0.33	0.67	0.00
	IRRRRR	0.33	1.00	0.67	1.33
RIIIII	-2.33	-2.00	-1.67	-1.33	
RIRIII	-2.33	-2.00	-0.33	0.00	
RRIIII	-1.00	-0.67	-1.67	-1.33	
RRRIII	-1.00	-0.67	-0.33	0.00	
R**IIR	-1.00	0.00	-1.00	0.00	

**Diagram 6: Design of normal form of 2-person merger and acquisition.**

Here probabilities for the seller to be optimistic, to be pessimistic are respectively taken as 33% of the time and 66% of the time. In this game the chance for the target to be risk taking and risk averse as 33.3% and 66.6% respectively.

Though these probabilities may change and the behavior of the opposite party is unknown they are set to prove the possibility of the state of stable equilibrium.

As mentioned in the previous discussion this happens in reality where the players imagine the behavior of their opposite parties. These imaginations help them to choose the suitable strategy. In the assessment of this incomplete information game the value for the target is -1 and the value for the acquirer is +1. The player 1 or requirer chooses the strategy “R\*RRI” and “R\*RRR” with the probability of the 0.499 each and player 2 or target chooses the strategy “II” with probability 0.489 and chooses the strategy “SI” with probability 0.511. This is same as the strategies in which the target and acquirer choose in the complete data. This tells that the incomplete data cannot change the optimal strategies of acquirer and target. This happens because of the fact that the acquirer’s primary thought is to decrease the price using the strategy “R\*RRR” and the target aim is to increase the price using strategy-II. But both do not wish to push the opponent too harshly to avoid the deal being broken. In the light of those they can use the strategies “R\*RRI” and “SI” also. Generally this happens in reality because target firms and acquirers use mixed optimal strategies similar to what is proposed to get the finer results. Other three options are inefficient to give such suitable result. The present research paper aims at primary research in this filed. But it described that there is some chance to simulate psychological and behavioral factor in the valuation of two person Merger and Acquisition transactions. This is a special case because classical corporate finance models can’t explain the significant factor of psychological pricing where the Merger and Acquisition valuations can do. The present study is going to make map for other models to develop and to simulate behavioral factors relations to Merger and Acquisition valuations.

### **Significance of the Study**

The two person Merger and Acquisition modal notices the behaviors of the target and acquirer which will carry between players depending on the Merger and Acquisition transactions. Usually it is difficult to estimate the conducts of the opponents and the related chances of these conducts to order to compute potential NEPs for such games. But this model is going to present a significant insight on the accurate analysis of Merger and Acquisition transactions. The exact computations help the acquirer or target follow against the opponent. A simulation of 2-person Merger and Acquisition model helps us to make things clear that the target will be able to gauge if he should act optimistically or pessimistically and the acquirer should choose to be risk taking or risk averse. The information from the simulation of two person

Merger and Acquisition model depicts that Nash equilibrium point for such a series of games lies at (2, -2) and this is associated to risk taking acquirer and pessimistic target. In daily life picture those results make sense because if the acquirer is taking risk then he will be ready to pay more. But on the other hand if the target has pessimistic nature then he will negotiate with the acquirer for a reasonable price. In the reverse order situation the acquirer is risk averse and the target is optimistic then there is a small chance for successful negotiation. In the simulation like acquirer's unwillingness to offer higher price and dislike to accept lower price the break downs happen. The same break downs may happen when the acquirer is risk averse and the target is pessimistic and in this case the Merger and Acquisition valuation favors the acquirer not the target. Consequently target leaves the game. Though the acquirer is risk taking and the target is optimistic, these may be a chance of happening of three events namely target asks more, Merger talks stop with different mentalities and with risk taking and risk averse are across the business sectors.

## **Conclusion**

Output of the 2-person Merger and Acquisition model depicts that the strategies applied by the acquirer are "RRRR" or "RRIR" against the strategy of the target namely "II". The results of this are: pay-off to the acquirer is +0.88 and the target is -1.55. When this model is applied to the simulate the psychological behavior of the target and acquirer it can be seen that it would be better for the target to be pessimistic and for the acquirer to be risk taking. This can help the acquirer would be willing to more where the target is ready to accept less amount. It should be notated that the present research study provides only preliminary results as thus model can be developed further and the results discussed here can through light into more complicated phenomenon namely Psychological Pricing of Merger and Acquisition Transactions.

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