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On the Use of Games Theory in Financial Studies: The Case of Mixed Strategy Equilibrium

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Since the 1980s, there has been an increasing use of games theory in the field of finance, including stock and forex trading [1]. The standard assumption of perfect competition was challenged. Analysis with the assumption of strategic interactions which uses games theory implicitly or explicitly becomes more popular. The use of games theory in the field of finance brings many new insights and should definitely be encouraged. But it also means that finance specialists need to be familiar with a new field of knowledge. Furthermore, one should also caution that games theory itself is a relatively new field and many of the game theoretic solution concepts are still being researched, refined and revised, and are not without controversy.

I would like to give an example of a paper that relies on the use of a controversial game theoretic concept. That controversial concept is mixed strategy equilibrium, a fact well known among games theorists [2]. The paper I quoted below is Dezsi [3]. This is of course not denying the interesting and insightful results that the study had generated. The paper models the strategic interactions between a stock market manipulator and the National Securities Commission, the regulatory authority. It is a complete information simultaneous game. The manipulator chooses between manipulating the stock market for private gains and not doing so [4]. The National Securities Commission chooses between investigation in the stock market to punish and deter manipulation or not doing so. There is no pure strategy equilibrium. There is a unique mixed strategy equilibrium in which both the manipulator and the National Securities Commission randomizes. While the results are interesting, further examination reveals certain anomalies that are common to models involving the use of mixed strategy equilibrium.

The unique mixed strategy equilibrium is

$$q = \frac{c}{a + com \cdot (1-\alpha)}, \quad p = \frac{r}{a}$$

Note that when the gains from market manipulation (r) increases and finally equals to the fine (a) imposed by the National Securities Commission, and when the cost of investigation (c) incurred by the National Securities increases and finally equals to the gains of investigation $a + com(1-\alpha)$, the unique mixed strategy equilibrium has the manipulator playing manipulation with greater probability and with certainty when r equals a and, the National Securities Commission playing investigation with greater probability and with certainty when $c = a + com(1-\alpha)$. The problem, however, is that when c equals to $a + com(1-\alpha)$, we have $c - a = \alpha \cdot com > 0$. That being the case, from the payoff matrix, it is clear then the strategy Investigate is weakly dominated by the strategy Not Investigate. As such, the equilibrium result that strategy Investigate is played with probability one is implausible. On the other hand, when r decreases and equals to 0 and c decreases and equals to 0, the mixed strategy equilibrium becomes p=0 and q=0. Yet, in this case, NI is weakly dominated by I and the unique mixed strategy equilibrium is again implausible. Of course, such anomalies of mixed strategy equilibrium are well known among games theorist (Table 1).

Probabilities	NSC	p	1-p
INV	Strategy	I	NI
q	M	$\pi + r - a$ $com + a - c$	$\pi + r$ $\alpha \cdot com$
1-q	NM	π $com - c$	π com

Inv=investor
NSC=National Securities Commission
M=Manipulation
NM=No Manipulation
I=Investigation
NI=No Investigation
π=Payoff without manipulating the market
r=additional payoff generated by manipulating the market
a=fine imposed on market manipulation (a>r>0)
α=proportionate loss of NSC for not investigating manipulation of market (α<1)
c=cost of investigation
com=NSC's gains from commissions charged from capital market participants

Table 1: The game's payoff matrix.

In sum, there is a lot to gain for researchers to be more familiar with games theory and apply it to the field of finance.

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