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The Big M Game

Kjetil Haugen[1], Knut P. Heen[1]

1 Molde University College

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Abstract

This article discusses "extreme" Prisoner's Dilemma games, and questions Nash equilibrium as a solution concept in such situations. A slight reformulation of the concept is suggested, securing that a more reasonable solution is chosen.

A small warning to the reader: This article is special, not everything is true. That is, there are fictional parts. The reader is left for deciding what is fictional and what is science. Perhaps we could categorize the paper as a quiz where the objective is to rule out fictional parts from the content which at least is meant to be scientific.

Kjetil K. Haugen*

Faculty of Logistics

Molde University College, Specialized University in Logistics

Molde, Norway

Kjetil.Haugen@himolde.no

ORCID iD: 0000-0002-6373-0321

Knut P. Heen

Faculty of Business Administration and Social Sciences

Molde University College, Specialized University in Logistics

Molde, Norway

Knut.P.Heen@himolde.no

*Corresponding author

1. Introduction

Two enemies are located in separated rooms. In front of each enemy (named Player I and Player II), a red button and a clock counting down are facing them. They are both given the following information:

> *You can choose to press the red button or not until the clock has reached 00:00. If you press the red button before the clock has counted down, your enemy will be killed. If you choose to do nothing, your enemy will not be killed. Your enemy has been given the same information[1].*

The two enemies are clones, so they judge the pay-off of living and dying as equal $\{M, -M\}$[2] respectively. However, as they are enemies, a death of the enemy has positive pay-off of ϵ for each of them.

2. A game model

The situation described above (in section 1) is easily transferred into a simultaneous 2 player game of complete but imperfect information as shown in figure 1.

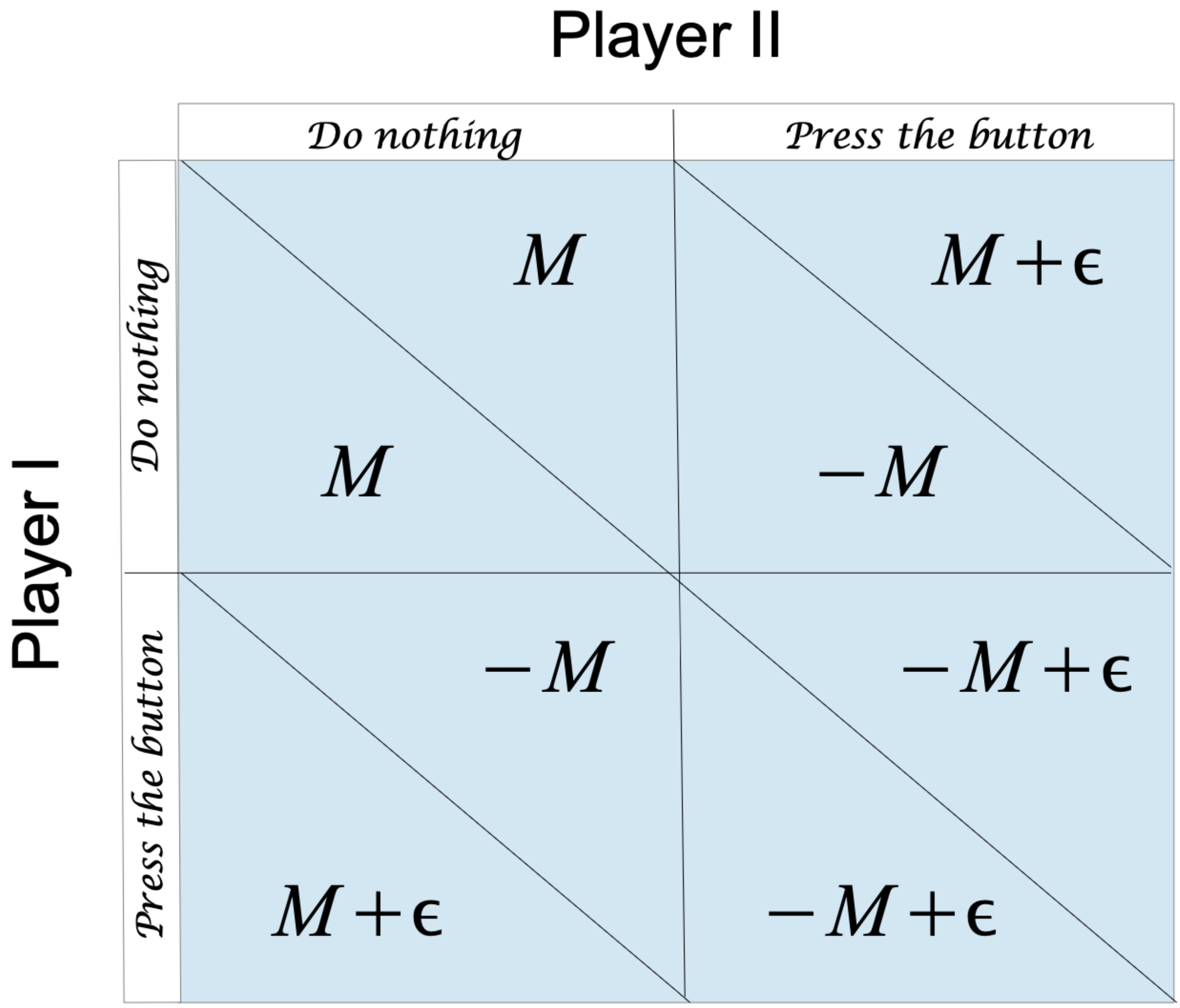

Figure 1. The Big *M* game in normal (or strategic) form.

The game in figure 1 is easily analysed, producing the unique Nash equilibrium (NE)[3], of {Press the button, Press the buttom}, as indicated in figure 2:

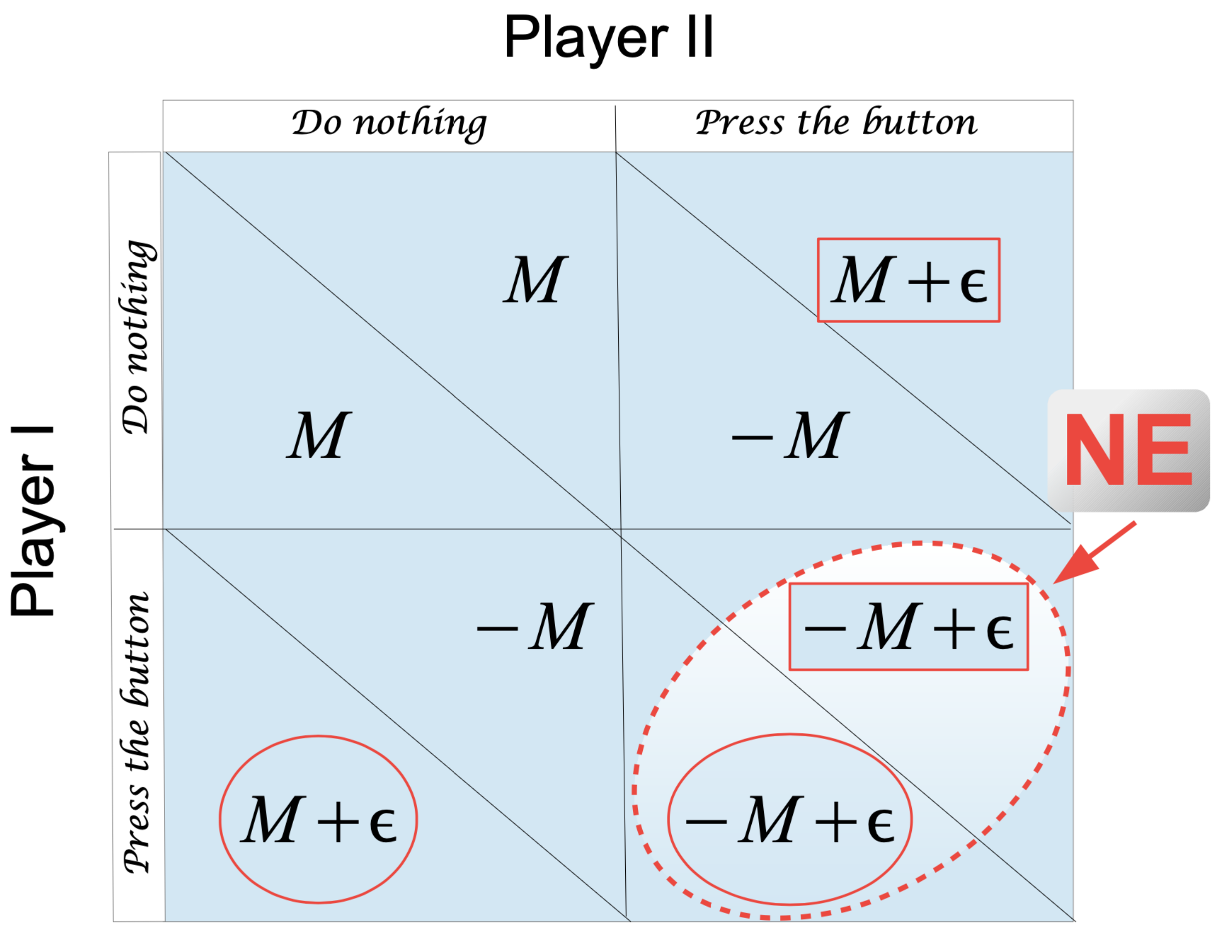

Figure 2. The Big *M* game with a unique NE.

3. Some thoughts

Obviously, the game of figures 1 and 2 are a Prisoner's dilemma game, as the NE is not pareto optimal. However, this game may be considered to be an "extreme" version. Perhaps so extreme, that the question on whether a Nash equilibrium, or a Dominant Strategy equilibrium for that matter, is a reasonable solution concept at all. We[4], the authors find it very hard to believe that if real people had played this game for real, very few (if any) would have chosen to press the button.

One way of analysing this problem further could have been to apply a hot topic in modern economic theory; experimental economics. Se for example [1] and [2], [3] for some pioneering as well as more recent work on the topic.

4. An experiment

Unluckily, or perhaps more correctly, luckily for the potential poor experimental objects, today's high ethical standards forbid us to perform economical experiments close enough to reality to observe how real human beings would play this type of game. We could of course try to mimic behaviour by using money instead of guns, but such experiments would be too costly for our very limited research money. So, we decided to drop this research.

However, something very surprising happened. One of the authors got hold of an old peculiar document. We will not tell the full story of this achievement here, but simply state that we have all reasons to believe that this document is genuine[5]. The document [4] contains a very precise description of experiments close enough to fit the game description in section 1. Although we could add a lot on these data, we limit ourselves to the relevant parts, the outcome of the experiments. Out of 500 identical twin pairs exposed to a real situation close enough to the description of the game in figure 1, only two pairs died as a consequence of the experiment. Unfortunately, 50 died of other reasons[6]. But, and that is important here; a vast majority of the experimental objects did not choose to push the button. That is, almost nobody chose to follow the Nash-prediction.

It is always difficult to judge whether using these type of data is ethically correct. The application of Nazi data holds an ethical paradox, as discussed by several authors - see for instance [5][6]. We have however chosen to use these data her, although at a very indicative level.

Some might argue that Game Theory and Dominant Strategies were not very well known concepts around the end of World War II. Does it even make sense to assume that such ideas were available to Josef Mengele in the very end of 1944? Surely, Von Neumann and Morgenstern's famous book [7] was published in 1944, but as many may not be aware of, the basic ideas of this book were developed much earlier. In fact, Von Neumann published a paper on the matter already in 1927 [8]. As a consequence, it does not seem unreasonable to assume that these ideas could be available for Mengele at the time of the article [4].

5. Conclusions

So, our initial reluctance, to accept Nash equilibrium as a sensible solution concept for games of the type as described above seems confirmed by Mengele's experiments. As such, it is tempting to suggest a slight change in the NE concept. We suggest the following principle.

> ***In most games, Nash equilibrium is well founded on a logically good principle for finding game predictions or solutions. However, in certain games, were the "difference" between a possible obtainable pareto dominant solution and the Nash equilibrium is "too big", Nash equilibrium should be rejected as the solution, and the pareto dominant one (if unique) should be chosen as the game prediction or the "solution". In cases with multiple equilibria more research is obviously needed.***

Surely, we offer no real mathematically sound solution, as the concept of "too big" must be defined exactly. We leave this challenging problem to the mathematical community. We feel certain that many papers and PhDs can be written on the subject.

Footnotes

[1] A press on the button does not lead to a direct kill. Some outside authority checks both players decision immediately after the time has run out, and kills according to the given rules.

[2] It seems reasonable to assume that these M's are big numbers, definitely bigger than ϵ. However, they should be finite.

[3] This NE is also a Dominant Strategy equilibrium.

[4] My co-author, Knut P., claims stubbornly that he would have pushed the button. I do not buy his persistence, and the readers should not either. He has actually set up this experiment intending to prove to me that he is right. Unfortunately (or perhaps fortunately), he has not been able to find any opponents for his real world experiment.

[5] The authors will provide access to copies of the document upon request by interested readers.

[6] According to the article [4] almost all were suspected to have died of hunger.

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