A Hellenic Tragedy: Greece, the Troika and the Euro – A Game Theory Approach

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In this paper, Stephen Garavan aptly applies the principles of game theory to his exploration of the bailout negotiations that took place between Greece and the Troika in the summer of 2015. His extended model, which he skilfully adapts to capture interactions involving both perfect and imperfect information, identifies the conditions under which Greece will request and subsequently be granted a bailout by the Troika.

Introduction

The Greek crisis of 2015 remains one of the most captivating economic and political dramas of recent years. The negotiations between Greece and its creditors – the triumvirate of the IMF, the European Commission and the ECB, collectively referred to as the Troika – over the state of the Greek economy reached existential proportions for both the Hellenic Republic and for the future and viability of the Euro. While the central issues that lay at the heart of the negotiations were often masked by political and economic rhetoric, this paper will analyse the game that was played by both sides.

The Greek economy was in freefall between 2008 and 2015, with Gross Domestic Product (GDP) collapsing from over €350 billion to under €195 billion (World Bank, 2015). The implosion of Greek market activity corresponded to a series of bailouts delivered in 2010 and 2012. The bailout by the Troika in 2010 totalled €110 billion (Magnay et al, 2010). In 2012, an even bigger bailout valued at €130 billion was required to keep the Greek economy afloat (Spiegel & Barker, 2012). By 2015, the Greek State's inability to meet the terms of these bailouts put it on a collision course with its creditors. Negotiations over a new bailout continued with the possibility that failure to agree could result in Greece exiting the Eurozone. By July 2015, Greece's membership hung on a knife edge after the Greek electorate rejected the terms of a bailout negotiated by the Syriza government with the Troika in a referendum.

In the aftermath of the referendum, the Greek prime minister defiantly announced that the result had simply increased his negotiating position (Hope, 2015). A Greek exit, or 'Grexit', from the Eurozone would not simply have damaged the Greek economy, but would, in addition, have wrought damage on the entire Eurozone (Wolf, 2015). The prospect of Greece defaulting on its debts brought the Greek government and the Troika into a classic game scenario, whereby each player had a considerable amount to

lose in the negotiations that dominated the news cycle in the summer of 2015. This paper attempts to capture the fundamental strategic decisions made by each player during these months.

Model

The model represents a scenario, in which the Greek government can choose between requesting a bailout from the Troika and exiting the Eurozone. Greece's need for a bailout depends on whether it is solvent or insolvent in the long-term. If it is solvent, and a bailout is granted, the Troika will recuperate their money and the country will recover economically. If Greece is insolvent and receives a bailout, it will remain in the Eurozone for a period of time. The Troika, however, will not recover its money and the Greek economy will not recover. It is assumed that if this happens, the game will revert to the beginning and a new round of negotiations will take place at a later date. If the Greek government opts to leave the Eurozone without requesting a bailout, the game will end and the Troika will not have to make any strategic decision.

This paper will analyse two cases. A simple sequential game with perfect information will first be assessed. Secondly, an extensive form game with incomplete information will be examined. In the case of asymmetric information, the type space of the Greek government will be two-fold; Type 1, in which the Greek government represents a solvent country and Type 2, where the Greek government represents an insolvent country. A third player, Nature, will determine which type of player the Greek government is. Nature moves first. There is a probability of 0.4 that Greece is solvent, and a probability of 0.6 that Greece is insolvent. In the game with imperfect information, the Greek government will always know what type of player it is, but the Troika will not know which type of Greece they are playing with.

Assumptions

There are a number of assumptions that govern each player's behaviour in the game. The utility functions for both players are assumed to be homogenous. Given this, it is assumed that both the Greek government and the Troika prefer that Greece remains in the Eurozone. It is assumed that the Troika prefers not to lose money. If they give a bailout to an insolvent Greece, the game assumes that this money is lost. The Troika have a further preference for making the correct economic forecast. In other words, they prefer to grant a bailout application if Greece is solvent, and reject a bailout application if Greece is insolvent. It is assumed that the Greek government strictly prefers to secure a bailout, given either state of nature. The Greek government do, however, have a further preference for honesty. By asking for a bailout, it is assumed that the Greek government are claiming that they are solvent. A premium is given if this is true, and similarly a premium for honesty is given if an insolvent Greece decides to leave the Eurozone without

requesting a bailout. The payoffs for each outcome, which are listed in the appendix, can be used to form the game's preferences.

Perfect Information

A simple sequential game with complete information will first be analysed. In the case of perfect information, the Troika knows whether Greece is solvent or insolvent. The Greek government moves first and either requests a bailout from the Troika, or chooses to exit the Eurozone before the Troika has a chance to move. If the Greek government requests a bailout, the Troika will then decide whether or not to grant it.

(i) Greece is Solvent:

By backwards induction, the sub-game perfect equilibrium can be found. The Troika will always give a bailout once Greece requests one. Knowing this, Greece will always choose to request a bailout over exiting the Eurozone.

(ii) Greece is Insolvent:

The sub-game perfect equilibrium can again be found using backwards induction. The Troika will never chose to give a bailout to an insolvent Greece. Knowing this, the Greek government will chose to exit the Eurozone in order to maximise their payoffs.

Imperfect Information

If players are constrained to pure strategies, an equilibrium cannot be reached. However, by allowing for mixed strategies, a Bayesian Perfect Equilibrium can be obtained. If the Greek government represents a solvent nation, it will always choose to request a bailout from the Troika. If they represent an insolvent nation, the Greek government will mix between requesting a bailout and voluntarily opting to exit the Eurozone. By mixing between these strategies, the Troika cannot determine what type of player the Greek govermment is. If the Greek government requests a bailout, it may still represent an insolvent nation. The strategies and beliefs of each player can thus be described as follows:

(i). Greek Government's Strategy:

- If the country is solvent, then it will always request a bailout.
- If the country is insolvent, then it will request a bailout with a probability of ρ.

(ii). The Troika's Strategy:

- Choose to grant a bailout with a probability of α.

(iii). The Troika's Beliefs:

- If the Greek government request a bailout, then they are solvent with a probability of 0.5.

The equilibrium can be described as follows. If Greece is solvent, the Greek government will request a bailout with a probability of 1. They will never opt to exit

the Eurozone. If Greece is insolvent, the Greek government will mix between exiting the Eurozone and requesting a bailout. If they are insolvent, there is a 0.66 chance that Greece will still request a bailout. The Troika believe that if the Greek government requests a bailout, there is a chance of 0.5 that Greece is solvent. The probability the bailout will be granted in response to this request is 0.33. The solution is outlined in full in the appendix.

Analysis

The game outlined above is a simple simulation of the strategic decisions made by both the Greek government and the Troika during the summer of 2015. The game shows that, if Greece is solvent, requesting a bailout is a strictly dominant strategy for the Greek government. However if Greece is insolvent, the Greek government will still mix its strategies between exiting the Eurozone and applying for a bailout. This Bayesian perfect equilibrium, obtained from the imperfect information game, is a fascinating outcome for a number of reasons. Although the Greek government is aware that if the country is insolvent they will be unable to repay any of the bailout funds to the Troika, they will choose to mix strategies as the bailout can keep them in the Eurozone. Information asymmetries regarding the underlying state of the Greek economy allow the Greek government to mix strategies. In the game with perfect information, subgame perfect equilibria give the 'optimal' result. An insolvent Greece voluntarily exits the Eurozone, while a solvent Greece obtains a bailout.

The introduction of information asymmetries alters this result. By mixing strategies, the Bayesian perfect equilibrium allows for a probability that sub-optimal game outcomes are observed. The case where the Greek government successfully applies for a bailout, in spite of the country's insolvency, is particularly interesting. Under the game's assumptions, the bailout, in this case, will result only in the underlying insolvency of the Greek state being covered up for a period of time. The game simply returns to its starting position and a new game is played. The 2015 negotiations played out this way. In a process that former Greek finance minister Yanis Varoufakis (2011) has labelled 'extend and pretend', both players end up facilitating bailouts that they know will not actually fix the Greek economy. The bailouts only temporarily solve Greece's economic problems. Inevitably, the same issues will arise again in the future.

Conclusion

The game shows that the Troika's payoffs are always maximized with symmetric information. However, in the case of asymmetric information, the Greek government can potentially increase payoffs by mixing between requesting a bailout and exiting the Eurozone, if the Troika similarly mixes between granting a bailout and rejecting a bailout. This outcome is based upon highly restrictive assumptions, which could be modified to model a game that more closely reflects the reality of interactions between the Greek government and the Troika. An obviously limiting assumption in the game put forward in this paper is that both players face a binary choice between Greece exiting the Eurozone and a bailout being granted. If this assumption were relaxed to allow a third option, such as an option to restructure or write off Greek debt, the game would perhaps be deemed more realistic, in that it would better match the reality of the negotiations that took place in 2015. Such an addition would require a reworking of the game described here, where the solvency of the Greek State is determined not exogenously by nature, but rather by outcomes of strategic interactions between the players.

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Appendix:

Payoffs for the Troika	
Not Losing Money	2
Keeping Greece in Eurozone	1
Making the "Correct" Economic Forecast	1
Base Pay-off	1
Maximum Potential Pay-off	5

Table 1

Potential Pay-offs for the Greek Government	
Securing a Bailout	2
Staying in the Eurozone	1
Honesty Premium	1
Base Pay-off	1
Maximum Potential Pay-off	5

Table 2

Parameters of the Incomplete Information Game	
Natural Probability that Greece is Solvent	q
Troika's Belief that Greece is Solvent	k
Probability that an Insolvent Greece Will Request a Bailout	ρ
Probability that a Solvent Greece Will Request a Bailout	β
Probability that the Troika will Grant a Bailout from within the Information Set	α

Table 3

Calculation of Troika's belief that they are playing a solvent Greece:

U_{Troika}(Grant Bailout) = 5k+2(1-k) = 3k+2

U_{Troika}(Don't Give Bailout) = 3k+4(1-k) = -k+4

These are equal when k = 0.5

Calculation of the behavioural strategy of the Greek government:

(i) k=0.5.

k = (Solvent | Request a Bailout)

$$k = \frac{P(\text{Request a Bailout} \mid \text{Solvent})P(\text{Solvent})}{P(\text{Request a Bailout} \mid \text{Solvent})P(\text{Solvent})+P(\text{Request a Bailout} \mid \text{Insolvent})P(\text{Insolvent})}$$

$$k = \frac{0.4}{0.4+\rho(0.6)} \rightarrow \rho=2/3$$

Therefore (Request a Bailout | Insolvent)=$\rho=2/3$

(ii) k>0.5.

The Greek government will always play requesting a bailout. In other words $\rho=1$. This cannot be a perfect Bayesian equilibrium.

(iii) k<0.5.

The Greek government will always play leaving the Eurozone. In other words $\rho=0$. This cannot be a perfect Bayesian equilibrium.

Calculation of the probability with which the Troika mixes between granting and rejecting a bailout application:

$$4\alpha+1(1-\alpha)=2$$