Applied Economics

Have Cake and Eat it: A Game Theory Analysis of the Upcoming Brexit Trade Talks

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Theophile Pastre employs a game theoretical approach in his analysis of the outcomes of the much-anticipated Brexit negotiations. This extensive game, in which information asymmetries are expertly modelled, outlines the strategies that are likely to be adopted by Britain and the EU and can offer guidance to negotiators in the upcoming trade talks.

Introduction

British Prime Minister Theresa May has continually stated her commitment to initiate the procedure to leave the European Union (EU) in March 2017 to the Commons Liaison Committee. The UK government plans to have reached a deal by March 2019, when the two-year legal deadline, set by Article 50 of the Lisbon Treaty for the withdrawal of a Member State from the EU, expires. As trade negotiators draft their strategies, and assess how they can get the most – or rather, lose the least – from the upcoming Brexit negotiations, it is instructive to use game theory models to analyse the options faced by each side of the negotiating table. The Leave vote, which set the UK on a path towards separation from the EU, campaigned on an anti-globalisation platform, vowing to 'take back control' of national borders. While the preferences of the UK in the Brexit trade talks, to maintain access to the European Single Market (SM) and implement strict migration controls, are, for the most part, known to both parties, the same cannot be said for the position of the European Union. Imperfect information, in this strategic interaction between trade negotiators, sets the stage for an insightful game-theory approach to the upcoming trade talks.

Outline

This paper models an extensive game with imperfect information, involving British and European trade negotiators. The aim of British negotiators is to secure a successful exit from the EU, imposing limits on immigration while maintaining as much access to the SM as possible. In contrast, the negotiators representing the 27 member states wish to ensure that the departure of the UK does not lead to the collapse of the Union. The game features two players - British and EU-27 trade negotiators. For simplicity's sake, they

will be referred to as UK and EU27 respectively. The type space for the two players is as follows: UK has only one type, while EU27 can be one of two types, either political or economic. In this sequential move game, Nature moves first and determines EU27's type. The probability that EU27 is political is 1/3, and the probability that EU27 is economic is 2/3. After Nature's signal, only EU27 is aware of its own type. The UK assigns a probability to each of EU27's types after it observes EU27's first action.

Having identified its type, EU27 decides whether to be tough in Brexit talks and insist that access to the SM must go hand-in-hand with the free movement of people, or to be accommodating and allow the UK to maintain partial access to the SM and to impose limits on migration. If EU27 chooses to be accommodating, the UK is satisfied with the outcome of the trade talks and the game ends. However, if EU27 instead chooses to be tough, the UK must decide whether to reiterate its demands for migration caps by investing in bilateral diplomatic efforts, or to exit the talks, in which case the UK's trading relationship with the EU is relegated to World Trade Organisation (WTO) status. If the UK decides to exit the talks, the game ends. Finally, if the UK chooses to invest in diplomatic efforts, then EU27 will choose whether to give in to British demands, or stick to its tough line. If it chooses to stick to its tough line, an agreement is not reached within Article 50's two-year time frame. In this case, the UK's trading relationship with the EU is relegated to the WTO status.

Assumptions

Three assumptions underlie this model. Firstly, the model assumes that the UK negotiators do not know precisely whether their EU counterparts will begin the Brexit trade talks with a focus on political outcomes or economic outcomes. It is assumed that EU countries are twice as likely to favour a compromise that keeps the UK in the SM while allowing it to cap migration in order to minimise the economic impact on the EU (economic type of EU27) than they are to push for a demotion of the UK to the WTO status so as to discourage other Eurosceptic movements across the Union (political type of EU27). It is assumed that the EU-27 countries will speak with one voice at the negotiation table. This reduces the number of players from 28 to two, thus simplifying the model. Finally, this model assumes that the UK will not go back on its pledge to leave the EU. This simplifies the game tree by reducing the number of branches, effectively ruling out the status quo whereby Britain is a member of the EU.

The pay-offs, presented in the game tree above also rely on a set of assumptions about the actions and preferences of each player type. It is assumed that the pay-offs to the UK do not depend on EU27's type. That is, the UK is indifferent between the outcome of negotiations with a political EU27 and reaching that same outcome with an economic EU27. Furthermore, it is assumed that the UK prefers to maintain access to the SM and being permitted to impose migration controls than moving to WTO status,

where it would have full autonomy on migration controls but no preferential access to the Single Market. It is also assumed that the UK's diplomatic efforts bear a cost, and that they benefit EU27 countries, towards which they are oriented. Thus, the UK assigns a higher pay-off to reaching an outcome without having to invest in diplomatic efforts. Conversely EU27 assigns higher pay-offs to outcomes where the UK has invested in diplomatic efforts.

As for EU27, it is assumed that its two types have different preferences. The political type hopes to prevent the collapse of the EU by pushing for a tough trade deal in the hope that it will discourage Eurosceptic impulses across the Union. Thus, it favours a WTO outcome over allowing access to the SM and the implementation of migration controls. In contrast, the EU27 economic type aims to prevent the collapse of the EU by protecting the economic stability of the EU. Hence, it would choose to make concessions to the UK, rather than see it relegated to WTO status.

These elements can be synthetised into the following pay-off table for the three player types:

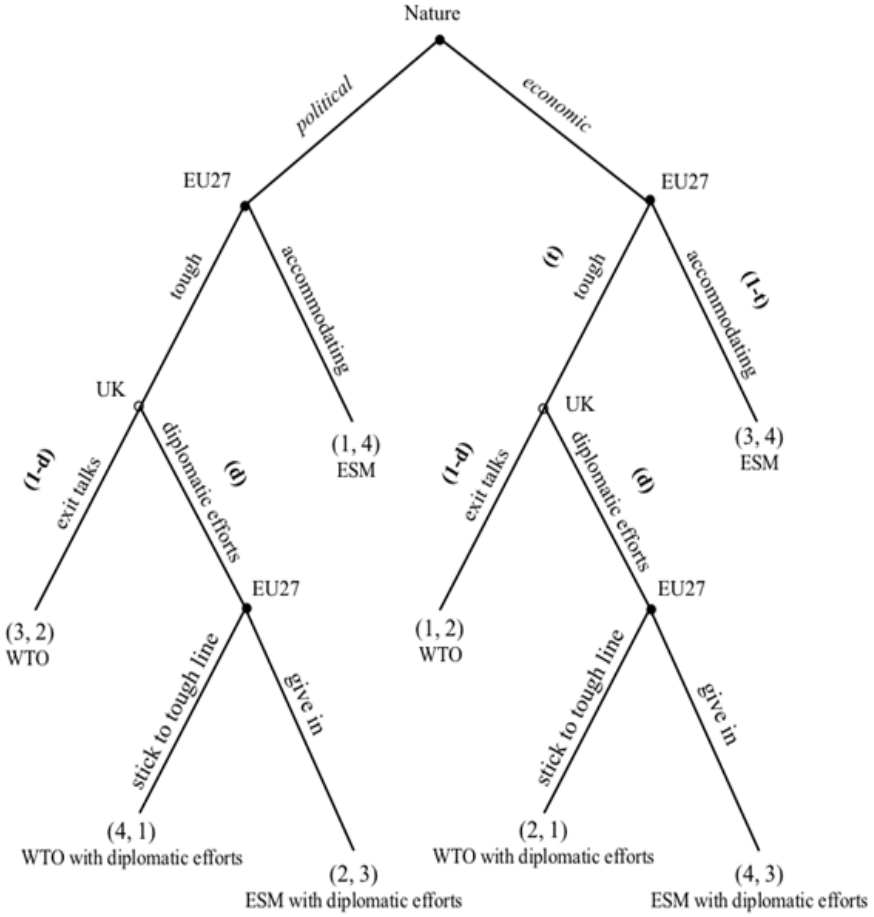
Outcome	UK Pay-offs	*Political* EU27 Pay-offs	*Economic* EU27 Pay-offs
Market Access and Migration Control, no diplomatic efforts	4	1	3
Market Access and Migration Control, with diplomatic efforts	3	2	4
WTO status, no diplomatic efforts	2	3	1
WTO status, with diplomatic efforts	1	4	2

Equilibria

The extensive Bayesian game modelled above yields three equilibria. If the UK believes that there is less than a 50% chance that EU27 is politically motivated given it played tough, then it will invest in diplomatic efforts, in the hope that it will face the economic type. In this scenario both political and economic EU27 will play tough at the first node in order to maximise their pay-offs. On the other hand, if the UK believes that there is more than a 50% chance that EU27 is politically motivated, given it played tough, then it will exit the trade talks, so as not to waste resources on the presumed political type. In this scenario the political type will still play tough at the first node, as it is the dominant strategy, but the economic type will be accommodating at the first node so as to prevent the UK from exiting the negotiations. If the UK believes that there is an exact 50% chance EU27 is politically motivated given it played tough, then it will alternate between investing in diplomatic efforts and exiting the trade talks with probabilities 2/3 and 1/3 respectively, as it is unsure as to whether it is facing the economic or the political type. In this scenario, the political type will still play tough at the first node as it is the dominant

strategy, and the economic type will mix its strategies, with a probability of ½ for both tough and accommodating at the first node.

Model



Extensions and Analysis

The aforementioned assumptions will now be discussed in terms of their impact on the game's outcomes, and the extent to which they hold up in the real world. First, the biggest assumption made by this model relates to the probabilities associated with each of EU27's types. It is realistic to assume that the UK does not know EU27's type ahead of the negotiations, since the EU has formally asked its members not to conduct bilateral talks with the UK regarding Brexit before it triggers Article 50. However, the calculation of accurate probabilities for the likeliness of each type proves a more complicated exercise.

Although EU27 countries currently emphasise that access to the single market can only be granted if EU rules on the free movement of people are adhered to, Theresa May's latest speech evidences a belief among British negotiators that EU27 countries will want to minimise the economic damage incurred by Brexit, especially those with the strongest trading relationships with the UK, such as Ireland, Belgium, the Netherlands and liberal-minded Nordic countries. This mindset underpins the assumption that Prob. (economic) = 2/3 and Prob. (political) = 1/3. However, it could be the case that UK negotiators actually believe those probabilities to be different. For instance, if the probabilities were ½ and ½ respectively, it would upset the final equilibria of the game. In such a case, the only equilibrium would be for UK to play exit while political EU27 plays (tough, stick to tough line) and economic EU27 plays (accommodating, give in). In short, the outcomes of this model rest on the assumption by UK that the probability of the political type of EU27 is low.

The model also assumes that the 27 member states negotiating with the UK will speak with one voice. While this facilitates a simple two-player game, it must be noted that European countries have markedly different economic interests. Indeed, France for instance is keenly interested in poaching the UK's activity in financial services, while the Visegrad Four (Czech Republic, Poland, Slovakia, and Hungary) are more interested in defending the free movement of workers in the EU. The assumption, however, can be deemed realistic, as it is likely that the 27 member states will meet to establish a united position before March 2017 in order to negotiate effectively with the UK. While the EU27 entity is not an individual, its type reflects the consensus that will have been reached among by member states. Relaxing this assumption and designing a 28-player game would alter the structure of the model and prove much more difficult to solve.

The model makes the assumption that the UK will not renege on its commitment to leave the EU. This assumption is realistic, given the recent announcements by the May government that Brexit will go forward, as well as the self-imposed deadline to initiate the Article 50 procedure in March 2017. Nevertheless, Irish Taoiseach, Enda Kenny, and President of the European Council, Donald Tusk, have invited the UK to keep the option of not leaving the EU in the trade negotiations and many British citizens are against leaving the EU. Including this 'Remain' option in the game would add another branch to the game tree (representing the status quo), which would significantly change the structure of the game as well as the strategies of the players involved. In such a case, the dominant strategy of EU27's economic type would instead be to push for a non-Brexit.

It is quite possible that Britain might opt to leave the SM altogether, as Theresa May's announcement on 20th January 2017 suggested (Mance, 2017). This scenario is coherent with the above model, where the probability that EU27's type is economic is at least as high as the probability that EU27's type is political. As previously mentioned, in this case, the model predicts only one equilibrium, where the UK plays exit while political EU27 plays (tough, stick to tough line) and economic EU27 plays (accommodating, give

in). These are the strategies both sides of the negotiating table seem to be choosing today. It is, therefore, reasonable to expect the Brexit talks to result in the UK's exit from the SM, and the relegation of its trade relationship with the EU to WTO status.

Conclusion

This paper presents an extensive model that is useful when it comes to understanding the complex decisions facing both British and EU negotiators. The Bayesian game proposed yields three equilibria, which can provide diplomats with guidance as to the strategy they should adopt in the upcoming Brexit negotiations in order to maximise their pay-offs. However, this paper also notes that, while most of its assumptions are intuitive, these outcomes are dependent on the probabilities assigned to the economic and political type of EU27. Altering these probabilities could dramatically reduce the number of equilibria.

References

Harrington, J. E. 2015. Games, Strategies and Decision Making. New York: Worth Publishers.

Mance, H. 2017. 'Theresa May unveils plan to quit EU single market under Brexit' https://www.ft.com/content/a6b9c062-dca8-11e6-86ac-f253db7791c6 Accessed: January 17th 2017

Appendix: Finding the Equilibria

Using backward induction and starting at the end of the game, it emerges that the *political* type of EU27 will decide to stick to its *tough line*, while the *economic* type of EU27 will *give in* to British demands. These are the relevant pay-offs to use when comparing outcomes for decisions earlier in the game. Moreover, it appears that the *political* type of EU27 has a dominant strategy (*tough, stick to line*); it will always prefer to play *tough* at the second node, regardless of the action the UK decides to take at the third node.

Let t represent the probability that the *economic* type of EU27 plays *tough*.
Let d represent the probability that the UK decides to invest in *diplomatic efforts* and reiterate demands for migration caps.

This paper starts by looking for the UK's best response at the third node, as a function of its beliefs.

UK will prefer investing in diplomatic efforts if the expected utility of playing *diplomatic efforts* is greater than the expected utility of playing *exit*:

Let p denote the UK's belief that EU27 is *political*, given it played *tough*.

EU_{UK} (*diplomatic efforts* ÷p) = p(1)+(1-p)(3) = 3-2p
EU_{UK} (*exit*÷p) = p(2)+(1-p)(2) = 2
EU_{UK} (*diplomatic efforts*÷p) > EU_{UK} (*exit*÷ p) <=> 3-2p > 2
<=> p < ½

Therefore, the UK's best response is:
- if p < 1/2, UK will invest in *diplomatic efforts*
- if p > 1/2, UK will *exit* the trade talks
- if p = 1/2, UK will be indifferent between investing in *diplomatic efforts* and *exiting* the trade talks.

The UK's belief must be consistent with EU27's strategy and with Bayes' rule. Thus, it is possible to work out what value of t would lead to each belief.

p = Prob (EU27 is *political*÷ *tough*)
p = (Prob (*tough*÷*political*) x Prob (*political*)) / (Prob (*tough*÷*political*) x Prob (*political*) + Prob (*tough*÷*economic*) x Prob (*economic*))
p = ((1) (1/3)) / ((1) (1/3) + t (2/3))
p = 1 / (1+2t)

For what values of t will p < 1/2?
p = 1 / (1+2t)
p < 1/2 <=> 1 / (1+2t) < 1/2
<=> 2 < 1+2t
<=> t > 1/2

Case 1: t > 1/2 → p < 1/2:
Since p < 1/2, UK will always invest in *diplomatic efforts*.
If UK always invests in *diplomatic efforts*, then the *economic* type of EU27 should play *tough*.
Hence t =1.
This is consistent with the starting point and is therefore an equilibrium.
Equilibrium:
Political EU27: (*tough, stick to tough line*)
Economic EU27: (*tough, give in*)
UK: (*diplomatic efforts*)
Beliefs: Prob (EU27 is *political*÷*tough*) < 1/3.

Case 2: t < 1/2 → p > 1/2:
Since p > ½, UK will always *exit* the trade talks.
If the UK always *exits* the trade talks, then the *economic* type of EU27 should play *accommodating.*
Hence t = 0.
This is consistent with the starting point and is therefore an equilibrium.
Equilibrium:
Political EU27: (*tough, stick to tough line*)
Economic EU27: (*accommodating, give in*)
UK: (*exit*)
Beliefs: Prob (EU27 is *political*÷*tough*) > 1

Case 3: t = 1/2 → p = 1/2:

Since p = 1/2, UK is indifferent between investing in *diplomatic efforts* and *exiting* the trade talks.

If t = 1/2, then the *economic* type of EU27 is mixing between being *tough* and being *accommodating*.

In order for the *economic* type of EU27 to be willing to mix between these two strategies, it must be indifferent between them: given UK's strategy, the expected pay-off from both actions must be equal. This can only be the case if UK is also mixing.

EU_{EU27} (*tough*÷ d) = 4d+(1)(1-d)

EU_{EU27} (*tough*÷ d) = 3d+1

EU_{EU27} (*accommodating*÷d) = 3.

EU_{EU27}(*tough*÷ d) = EUEU27 (*accommodating*÷ d) <=> 3d+1 = 3

<=> d = 2/3

The UK is willing to invest in *diplomatic efforts* with this probability, because in this scenario the UK is indifferent between investing in *diplomatic efforts* and *exiting* the trade talks.

Equilibrium:

– *Political* EU27: (*tough, stick to tough line*)
– *Economic* EU27: (*tough* with probability 1/2, *accommodating* with probability 1/2, *give in*)
– UK: (*diplomatic efforts* with probability 2/3, *exit* with probability 1/3)
– Beliefs: Prob (EU27 is *political*÷*tough*) = 1/2.