Game Theory and Strategic Decisions

THE APPLICATION OF GAME THEORY TO BREXIT NEGOTIATIONS

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1. Executive Summary

Following a UK-wide referendum in 2016 and a longstanding internal discussion regarding the country's withdrawal from the European Union, the UK left the EU on 31 January 2020, and has now entered an 11-month transition period. Meanwhile, the UK will decide whether to comply with EU regulations, which provide single market trade privileges across 28 member nations, and the EU will finalize trade deals granted to the UK once the transition ends.

This paper models the decision of these two parties – the United Kingdom and the European Union, as a two-player, perfect information sequential game. The UK is a first mover to decide whether to accept or reject EU regulations, and the EU decides whether to grant a good or a bad trade deal as a response. Lastly, the UK gets to make a call on whether to accept the deal or end the transition period with no deal. This paper shows the equilibrium outcome of the game to be that the UK leverages on its first-mover advantage and maximize its payoffs by rejecting EU regulations and leaving the EU with no option but to grant a good free trade agreement to the UK to preserve its payoff.

This paper also discusses the possible strategic moves possibly adopted by the EU and highlights that the EU could alter the equilibrium outcome by combining a threat to punish the UK for rejecting the regulations and a promise to award the UK for complying with the regulations.

This paper ends with an introduction of the third party, the carmakers, representing the automotive industry which will be greatly impacted by the no-deal Brexit outcome. This

modified version of the game alters the outcome equilibrium and complicates the game, which is one step closer to replicating the more complex real-world situation regarding Brexit, EU regulations and Free Trade Agreement.

2. Introduction to Brexit

Brexit began in 2016 when the United Kingdom held a referendum on membership of the European Union. A narrow majority voted to leave the EU. During the campaign Leavers focused on immigration, money and sovereignty, urging voters to 'take back control' from the EU. Remainers stressed the importance of trade with the EU and the damage to the economy from erecting trade barriers by leaving. A coalition of the poorer and older 'left behind', who worried about immigrants taking jobs and crowding public services, joined with right-wing English nationalists to triumph over the younger, more educated, more urban Remainers.[1]

After several years of bitter internal discussions and negotiations with the EU, the UK finally left the EU on January 31, 2020. It did so on the basis of a 'Withdrawal Treaty' and a 'Political Declaration' that aimed to set the tone of the future relationship but left many terms of that relationship to be agreed. Meanwhile both sides are observing a standstill agreement and the UK continues to work with the EU as if it were still a member of the single market and customs union. As a member of the single market, the

[1] "Our Guide to the Brexit Referendum." The Economist Brexit Briefs. The Economist. June 2016.

UK was able to trade tariff- and custom-free with other UK countries as easily as Colorado trades with Montana. More easily perhaps as the single market comes with common regulations covering product standards, minimum labor standards, tax mandates and the rest that are set centrally by the EU and followed by all EU countries. State law does not apply.

The Withdrawal Treaty settled some contentious issues - like the future rights of EU citizens staying in the UK. But it left the trade relationship to be agreed. The UK has given the EU until the end of 2020 to come to terms. The main issues are **how much of the EU regulations the UK should adopt** and how **'generous' an agreement** will be made in terms of tariff levels and border controls.

3. Description of the strategic game

We model the game as a two-player, perfect information, sequential game between the EU and the UK. The UK goes first and must choose whether to accept or reject the EU's regulations as part of the agreement. Then the EU decides whether to grant a 'Good' trade deal or a 'Bad' one. After that the UK decides whether to accept or reject the trade deal. Then the game ends.

3.1 Discussion of game assumptions

This is a simplification and any one of these assumptions can be unpicked. The short deadline for agreement may question whether the game is **sequential or simultaneous.** The EU was smart in the Withdrawal negotiations by carefully sequencing the negotiations. For the current negotiations it is in the UK's interest

perhaps to make this as simultaneous a game as possible - to force the EU to make trade offs without the UK's first making commitments.

Are there really only **two players**? The bureaucracy in Brussels negotiates on behalf of the EU members (who must support any final deal unanimously) and it is not clear that Brussels and the EU 27 have similar preferences. For the UK side, the victorious right-wing of the Conservative party has very different preferences from the UK business lobby or younger British citizens. The Scots and Northern Irish voted to remain.

And what is a **'good' trade deal**? We take the economists' perspective that zero tariff deals among developed countries enhance long-run prosperity. And so both players consider a zero tariff deal preferable to, say, a 10% tariff deal. But some in Brussels may think it is in their interest to raise barriers to deter other members from leaving.[2]

3.2 Discussion of players' preferences

The table below explains our view of the preferences of the players to the elements of the game and to the different possible outcomes. Again, it is very difficult to be sure of the actual preferences of the players given the blizzard of posturing by both sides. We assign preferences based on 4 for the highest/most desirable outcome and 0 for the lowest.

[2] UK Trade in Numbers. UK Department of Trade. 27 February 2020.

Discussion of EU/UK preferences		
	EU	**UK**
Regulations	The EU wants the UK to abide by its single market rules and avoid being undercut by poorer labor standards or product quality.[3] **Preference: 4**	The UK thinks EU regulations are anathema. Why did they go through years of struggle to be free of the EU and take back control if they are to be fenced in by the EU's rules and regs - which they have no say in making? **Preference: 2**
No regulations	The EU sees no regulations as a bad outcome. Brussels is particularly concerned to 'maintain the integrity of the single market'. With a good trade agreement the UK would have the benefits of trading with the EU while able to undercut the EU on standards. The EU is worried the UK would sign FTAs with other countries who will then be able to access the EU through the UK without	No regulations are explicitly stated as the must-have for the UK government. Note that other UK actors may not see it this way. UK business in particular has been complying with EU regs for decades. Only a minority in the UK would espouse freedom from trade regs with the passion shown by the right wing of the Conservative party.

[3] "The Highest Hurdle to a UK-EU trade deal." Sebastian Payne. Financial Times. 26 February 2010.

	following the regulations and enjoying potentially differential tariffs. **Preference: 0**	But we assume the preferences of the UK Conservatives. **Preference: 4**
A good trade agreement	The EU wants to use a good trade agreement as leverage for the UK to abide by its rules and regs. The EU says only 10% of its trade in goods is with the UK, so it needs a good agreement less than the UK, with 50% of its trade with the EU. But see below. **Preference: 3**	Half of the UK's trade in goods goes to the EU. So continuing the current ease of trading with no customs checks and no tariffs would seem very desirable economically. The UK wants a free trade agreement like the recent EU-Canada deal, with very low tariffs and no regulations on Canada. The EU says the UK is 'too close' geographically to Europe to get this favorable deal. **Preference: 3**
A bad trade agreement	The EU may want to 'punish' the UK for leaving. Brussels in particular may feel the need to deter other EU countries from leaving.	The EU has a trade surplus with the UK of *$122 billion*. $41 billion is with Germany. Does BMW really want a 10% tariff on its cars? So the UK believes the EU us bluffing in suggesting a 'bad' agreement is acceptable.

	So a country outside the single market should be seen to be in a worse position. So some tariffs may be desirable. The EU has tended to argue that the short timeline only allows trade in goods not services to be negotiated. **Preference: 2**	The UK has a substantial trade surplus with the EU on **services** and ensuring continued access to the EU market for the City of London's financial industry is important. A bad trade agreement would leave the City exposed. **Preference: 1**
No deal	The EU argues that no deal will cause the UK chaos at its borders as legal treaties expire and arbitrary customs duties are imposed. If the UK opts for no-deal, maybe Brussels gets the punishment of leavers it is seeking. But European business would see no deal as a failure by the bureaucrats. **Preference: 1**	The UK has stressed since the referendum that 'No deal is better than a bad deal.' The UK has argued it can trade on WTO terms using MFN clauses. The EU will want to negotiate a trade deal eventually. British business has consistently argued no deal must be avoided at just about any cost. **Preference: 0**

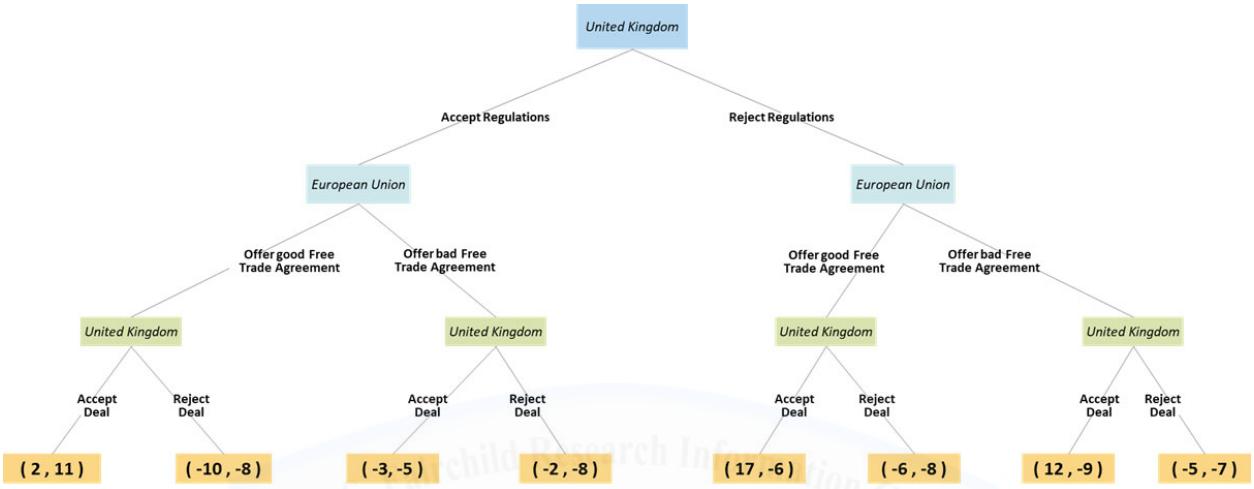
We summarize these preferences in the table below and further comment on the borderline assignments:

Summary of EU and UK preferences			
Ranking (4 = top)	**EU**	**UK**	**Comment**
Regulations	4	2	The UK tends to say it will follow the EU regs anyway - it just wants the *right* to diverge.
No regulations	0	4	This takes both players' declarations at face value. A second iteration of the game would demote these extremes and see if the equilibrium outcome changes.
Good FTA	3	3	At the end of the day, they are trying to grow their economies.
Bad FTA	2	1	The economist's view of the benefits of trade.
No deal	1	0	We assign 'no deal' a low preference for both players despite both loudly saying in the run up to the negotiations that 'no deal' is acceptable to them. We don't believe the UK's posture of 'no deal is better than a bad deal' and have put 'no deal' below a Bad FTA in the UK preferences. On balance we think Brussels wishes to preserve its regulations over 'no deal'. We don't think German car makers think the same.

In assigning pay-offs to the preferences, we have tried to model other gains and losses. For example there are four no deal outcomes in the following extensive form of the game. In general, the EU is assumed to be happier to have no deal if the UK first accepts the regulations, showing a precedent for future negotiations. The UK is happier with a no deal if it has first shown its commitment to no regulations and can blame the EU for inflexibility.

4. Problem Statement and Nash Equilibrium

Given the above description of the payoff structure, the strategic game will be formed in this way:



In order to find the Nash Equilibrium in the game we need to work on the rollback equilibrium and study best responses, starting by The United Kingdom's final response in each possible branch.

- In branch I, UK's best response to offer good Free Trade Agreement is "Accept" since 2>-10
- In branch II, UK's best response to offer bad Free Trade Agreement is "Reject" since -2>-3
- In branch III, UK's best response to offer good Free Trade Agreement is "Accept" since 17>-6

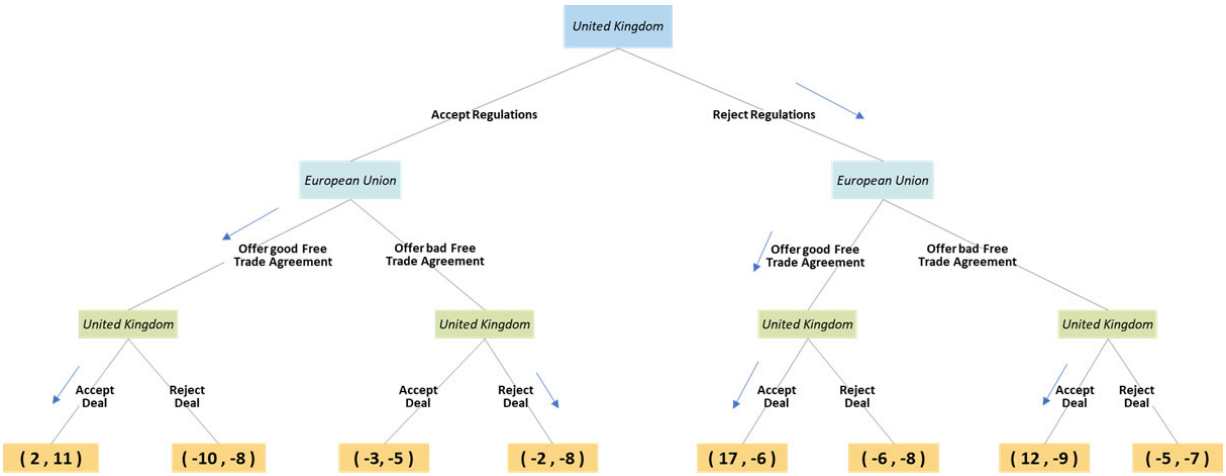
- In branch IV, UK's best response to offer bad Free Trade Agreement is "Accept" since 12>-5

Anticipating the UK final responses, the EU's will make its choices:

- If they offer the UK a good Free Trade Agreement when UK accepts regulations, the equilibrium payoffs at the end of the game will be (2,11) and in case they decide to to offer a bad Free Trade Agreement the equilibrium payoffs at the end of the game will be (-2,-5). Since 11>-5, the European Union's best response to the UK accepting the regulations is to offer a good Free Trade Agreement.
- If they offer a good Free Trade Agreement when the UK rejects regulations, the equilibrium payoffs at the end of the game will be (17,-6) and in case they decide to to offer a bad Free Trade Agreement the equilibrium payoffs at the end of the game will be (12,-9). Since -6>-9, the European Union's best response to the UK rejecting the regulations is to offer a good Free Trade Agreement.

Anticipating the two possible outcomes, the UK will make the initial decision:

- Either accept the regulations, in which case the equilibrium payoffs will be (2,11) or reject the regulations in which case the equilibrium payoffs will be (17,-6).
- Clearly the United kingdom has a strong incentive to reject the regulations (17>2).



- Equilibrium strategies in the game are:
    - **UK:**

      Reject regulations, If the EU offers a good Free Trade Agreement, Accept the Deal.

      If the EU offers a bad Free Trade Agreement, Accept the Deal.
    - **EU:**

      Whatever the UK does, offer a Good Free Trade Agreement.
- Equilibrium Outcome: UK rejects regulations and accepts the good FTA offered by the EU.
- Equilibrium payoffs for this outcome in the strategic game:
    - (17,-6)

Under equilibrium, the UK maximizes its pay-offs - it has a good FTA and has avoided the EU's regulations. The EU is less happy. It has not got its best payoff of a good FTA with the UK accepting its regulations. But once the UK has rejected the EU regulations, the EU has no choice but to offer a good FTA as it wants to avoid no deal at all costs and prefers a good FTA.

5. Potential strategic moves

It The game has a first mover advantage. If the EU went first, offering a good or bad FTA, after which the UK went second accepting or rejecting regulations, and then the EU went third agreeing to the deal or not, then the rollback equilibrium would be EU: offers a bad FTA, UK: accepts regulations and EU: agrees the deal.

This shows how strategic this Brexit negotiation was and is. It may explain the large amount of posturing that has been seen from both sides.

5.1 Commitment

The EU can make a prior commitment to a bad FTA to try to gain this first mover advantage. The EU knows that given this commitment, the UK must accept the regulations (Outcome (UK, EU) is (-3,-5)) since if the UK rejects the regulations, the EU will reject the deal (-5,-7). We have discussed reasons why the EU as Brussels may prefer a bad FTA if the EU thinks it has to play the game again with another European country later. The commitment improves the EU's payoff from -6 in the original equilibrium to -5, but greatly reduces the UK's payoff (17 to -3). So the commitment offers a great deal of negotiating leverage for the EU.

Similarly the UK in fact made a lot of noise before the 2020 negotiations started saying it would never accept EU regulations. The aim in terms of our game is to close down and preempt discussion of the EU's most preferred outcome and cut off the whole left hand side of the game tree.

5.2 Other strategic moves

Apparently the equilibrium payoffs in our original analysis are not the best possible outcome for the European Union. There are several other outcomes where the EU would be better off, for example the equilibrium outcome (Accept regulations, Offer good Free Trade Agreement, Accept Deal) where the payoffs would be (2,11). Let's suppose that this is where the EU is trying to move the equilibrium to, by using different strategic moves like a threat and a promise.

A. Threat

The European Union could threaten the UK by saying that they would offer a Bad Free Trade Agreement in case the latter rejects regulations. This way the equilibrium outcome would be (Reject regulations, Offer bad Free Trade Agreement, Accept Deal). However, in that case, the EU would end up with -9 which is significantly less than -6. This threat is not a successful one since it makes the EU worse off, it is not credible and it would not lead the equilibrium to the point where it was initially desired.

B. Promise

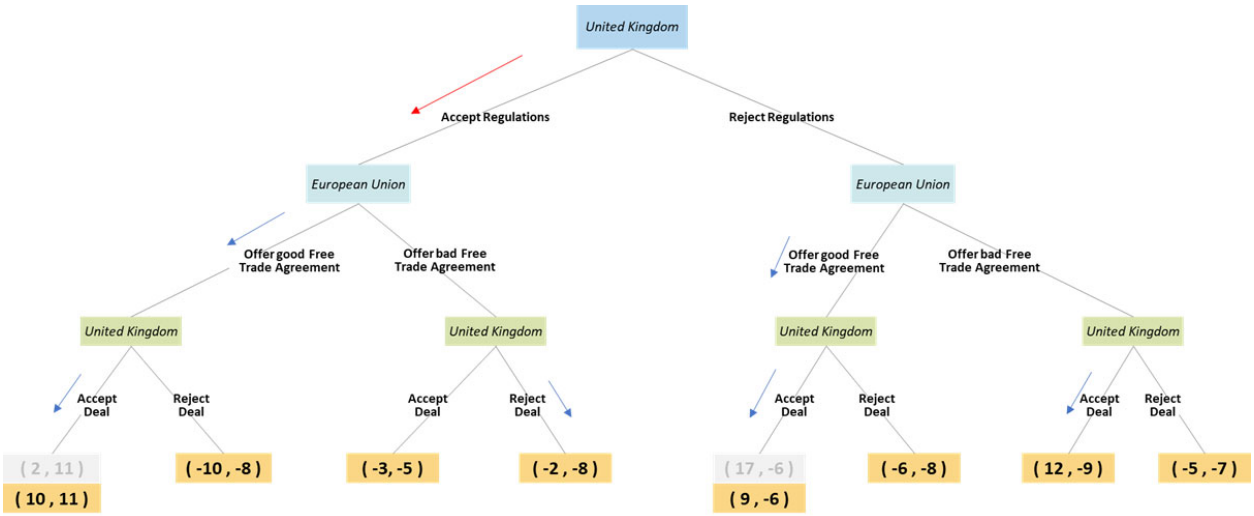
In this game there is not an option for a promise. The equilibrium outcome (Reject regulations, Offer good Free Trade Agreement, Accept Deal) is the best possible outcome in this game for the United Kingdom. There is no way the European union could make a promise that would benefit the UK when the UK already has the best possible outcome.

C. Combination of threat and promise

The EU could alter the equilibrium outcome by combining a threat and a promise and slightly changing the payoffs at certain moves.

- The European Union could threaten that in case the UK does not accept the regulations, they would be very harsh with the good free trade agreement that they will provide. Being harsh could mean offering high tariffs and is depicted in the game as a reduction in the UK's payoffs by 8. In this case the equilibrium outcome still remains (Reject regulations, Offer good Free Trade Agreement, Accept Deal) however the payoffs now are (17-8,-6) or (9,-6).
- The European Union could also make a promise to the UK in case it accepts the regulations. That could be for instance that the Good free trade agreement offered if regulations are accepted will be relatively looser and give no tariffs to the UK. This would be depicted in the game as an increase in the UK's payoffs by 8. In this case the equilibrium outcome still remains (Reject regulations, Offer good Free Trade Agreement, Accept Deal) however the payoff now are (2+8,11) or (10,11)

By combining the two strategic moves described above, the EU could finally succeed in altering the outcome of the game: In case the UK does not accept the regulations, the EU would be very harsh with the bad free trade agreement that they will provide but if regulations are accepted, the good Free Trade Agreement will include special benefits for the UK. In this case the strategic game will be formed in this way:



- Equilibrium outcome in the strategic game:

  (Accept regulations, Offer good Free Trade Agreement, Accept Deal)

- Equilibrium payoffs in the strategic game:

  (10,11)

6. Evaluation and Recommendation of Strategic Move

It can be inferred that the strategic game described above with the threat and promise combination is a good alteration of the game since it leads to a mutually beneficial outcome for both players. Even though the UK will get a lower payoff in this game, it will still be a relatively high payoff the player is getting and at the same time the EU will be in a better position.

It is worth mentioning that it would have been preferable for the EU to be able to change the outcome of the game by using a single threat. As we know, threats are successful when the player does not have to realize it. On the contrary, promises require that, if accepted by the other player, the one who made the promise must have a cost of

realizing it. In our case though, a threat wouldn't be credible enough to convince the UK to change its decision, therefore, the EU had to undertake the cost of promising higher payoffs.

7. Summary

As a conclusion, through this simplification of this broader issue that the European countries are currently facing, we have seen that Brexit is a very strategic game where the players must consider their payoffs and act in a way that promotes prosperity for the greater European area. In other words, this game may not fall under a certain category of strategic games, assurance game or chicken game for instance, and apparently there is no dominant strategy for the players. Therefore, both must take into consideration how the other player is likely to act and act accordingly.

In addition, the use of different strategic moves as well as a combination of them as described above, is a solution that fosters better outcomes for the Eurozone in general and leads the two players to an equilibrium where citizens are better off.

8. More complex game

The EU and UK assess their payoffs, and corresponding moves based on knowing the other player and environment in both versions of the game outlined above. The authors acknowledge the contextual simplification required to allow the preceding important and revealing discussion. An important additional layer are the Carmakers who would alter the game, and provide an opportunity for a strategic move (a threat) for the European

Union. We will unpack the challenge of just one Level 2 negotiator for the European Union, the carmakers which represent the car-making industry.

While reporting outlets predict the UK carmakers would have the most to lose from a no-deal Brexit, the German industry is sounding alarm. For example, the German auto industry association VDA and BMW Group label a no-deal as “fatal” and “worst-case scenario” respectively.[4] Here we assume they would spend significantly against populist parties running for re-election, and communicated their plan. The payoffs assess the carmakers would be more successful in lowering the UK’s payoffs more than the EU’s, and the carmakers would have more than “little effect” as reported last year in the Financial Times.[5]

Another difference from the previous game is to not so deeply price-in lower UK payoffs for Accepting Regulations as UK populist rhetoric has suggested. The carmakers could increase or decrease the no-deal payout, and alter the outcome. A sequential game tree for this new layer could look like:

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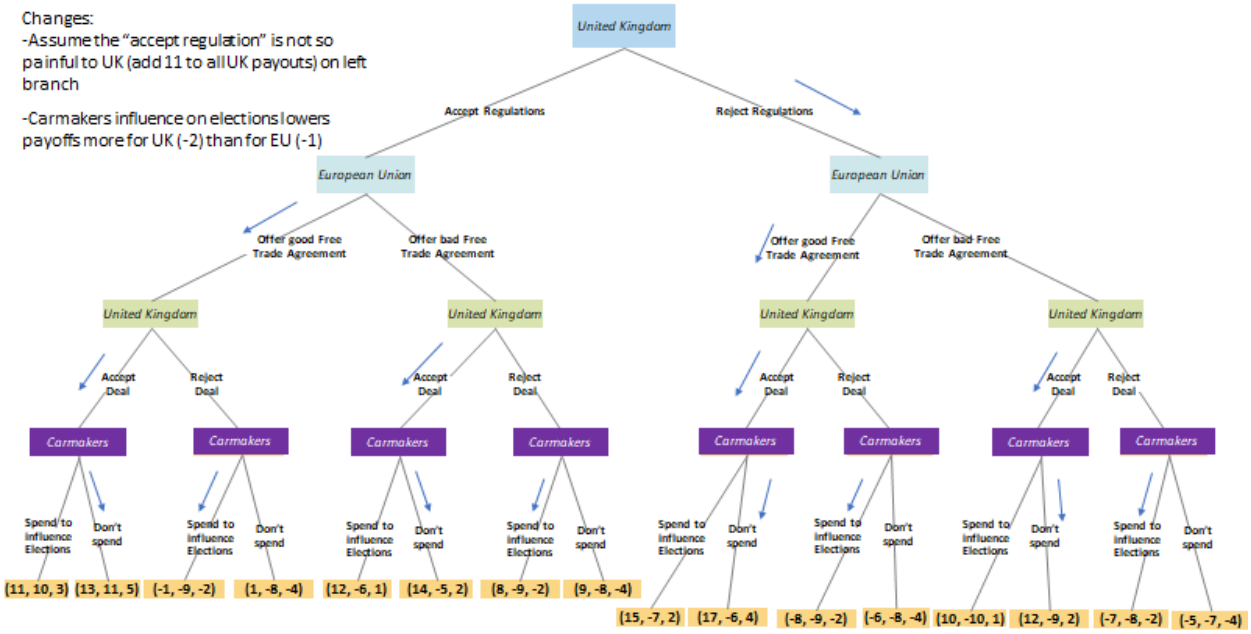
[4] “German Carmakers Warn Hard Brexit Would Be ‘Fatal,’” *Reuters*, January 16, 2019, https://www.reuters.com/article/uk-britain-eu-autos-germany-idUSKCN1PA173.

[5] “German Business Leaders Urge Voters to Resist Populists - ProQuest,” accessed March 20, 2020, https://search-proquest-com.ezp-prod1.hul.harvard.edu/docview/2223422099/fulltext/47D5484A99A84144PQ/5?accountid=11311.

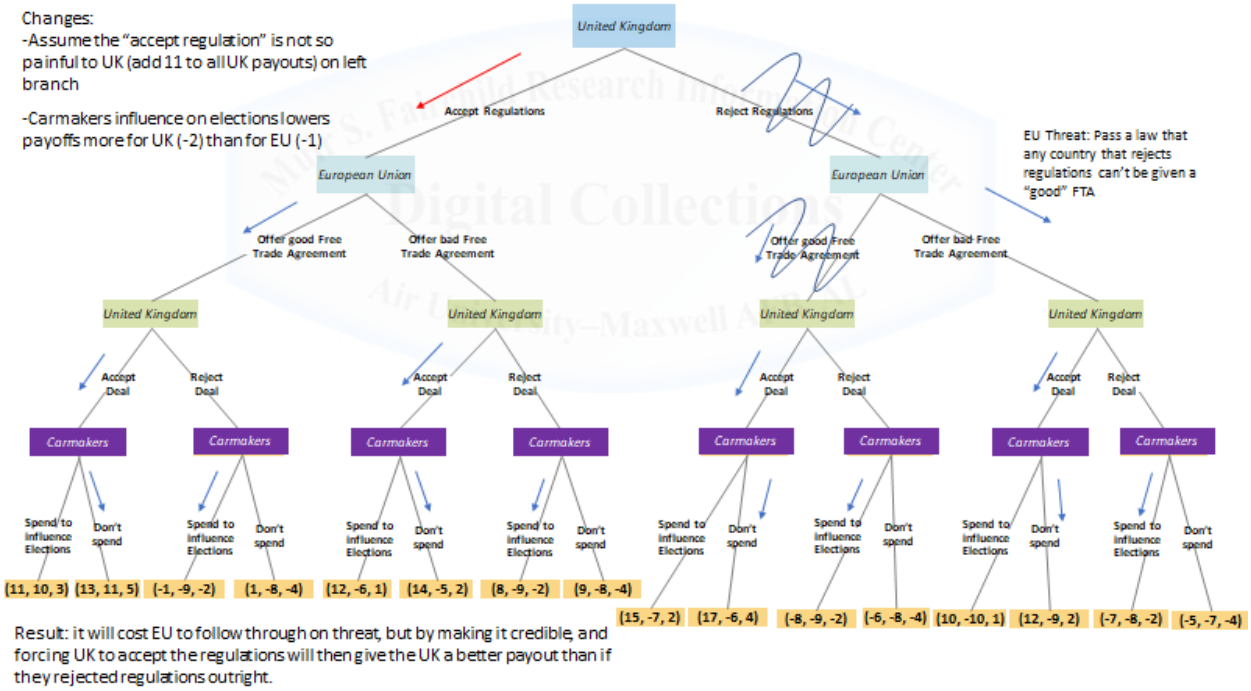


9. Strategic move in the more complex game

The new 3-player game allows for a strategic move such as a threat.[6] The EU's strategic move could be to pass a law (making it credible by reducing their freedom of action) that any country that chooses to reject regulation cannot have a good FTA. By passing the law, the EU would deter other nations from thinking they could get away with rejecting regulations without some consequences, and importantly here, would signal and require the EU follow through on the threat. The move would be seen by all players, and would cost the EU to carry it out should the UK continue to reject

[6] Dixit, A., Skeath, S., & Reiley, D. (2015). Games of strategy (Fourth ed.). New York: W.W. Norton & Company. p 362.

regulations. When executed, the EU moving earlier than just the second sequential player, would deter the UK from their initial strategy, and compel them to select a different path. Knowing the new game, the UK would choose to accept regulations, which would increase the payoff for the EU in either the threatened strategy or the unthreatened one. But, should, the UK still proceed in rejecting regulations, the committed EU with their new law would reduce their payout from either of the two options, and cost them as seen below.



Through the above consideration, there remains opportunity in 2020 for the European Union to influence the decisions of the UK government and negotiators. There is still time for this iteration or even another version to play out. Should players begin to act in probabilistic ways, influenced by the COVID-19 crisis or other developments,

probabilistic threats and brinkmanship could be used, which is outside the scope of this discussion.[7]

10. Conclusion

The number of players included in the game plays a big role in influencing other players, altering payoffs, and ultimately changing the equilibrium of the game. As the author tried to highlight in the paper, when factored in only two players – the United Kingdom and the European Union, Brexit is the desirable option for the UK and there are no credible threats or promises which the EU could employ to persuade the UK to accept the regulations. As a result, the outcome equilibrium is Brexit, and the EU to offer a good Free Trade Agreement as a response to preserve its best possible payoffs.

On the other hand, when the carmakers have been introduced into the game, the EU becomes capable of deploying a credible strategic move to shift the UK's decision away from the Brexit standpoint. One possible strategy is to announce a credible threat by passing the law to only give a bad free trade agreement to the country leaving the Union. This new game yields the new equilibrium outcome where the UK decides not to leave the EU and receive good free trade benefits from the Union and the carmakers do not need to spend on electoral intervention. However, the party who receives their highest possible payoff changes hand from the UK to the EU.

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[7] Dixit et al. p. 575.

Adopting this framework to the broader perspective, there are countless parties and stakeholders, apart from the UK and the EU, whose payoffs are tremendously impacted by the Brexit and free trade agreement decisions, and trying to alter the payoffs and structure of the game, just like the carmakers. The outcome of the game keeps changing once we add a new player into the games, so do the payoff. It is therefore of utmost importance to include all key stakeholders to form the accurate game and to justify the most probable game payoffs, strategies and outcomes. Though nearly impossible, we have time until the end of 2020 to justify who else is required in this game, and how it would alter the equilibrium outcome.