NORTHWEST PASSAGE
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Brexit's Endgame:
A game-theoretic preview of Brexit negotiations

The triggering of Article 50 by UK Prime Minister Theresa May renews speculation over the final Brexit outcome. Now begins a period of prolonged uncertainty for investors and markets as negotiations are expected to take the full two years permitted under Article 50. Even then, contingent on the nature of the split, it may take significantly longer to assess the full impact on UK trade relations globally as well as the economic impact for both parties.

Adding a new perspective on the disparate Brexit speculation, this report utilizes basic game logic to gauge the direction of the future negotiations. To highlight the move-countermove dynamics of negotiation scenarios, the rules of the Theory of Moves (TOM) are applied instead of the simultaneous moves expectation of standard game theory.[1] The developed games combine likely Brexit scenarios with the expected preferences of the players, with differences in preferences driving the interactions and allowing players to "move," by switching strategies, to achieve a better outcome.

Possible Brexit Outcomes
Across the numerous Brexit scenarios, the parties face the same essential tradeoffs. For the UK, it must weigh greater political autonomy against economic interests of tariff-free access to the European market. European Union (EU) leaders must choose between accommodating the UK, to steady economic ties and reassure markets, versus preserving the EU's institutional integrity and punish the UK for leaving.

While preliminary, a short-list of conceivable Brexit outcomes includes these four scenarios:

- **Hard Brexit**: This scenario assumes the parties' inability to reach an agreeable resolution. Absent an agreement, and assuming the UK's successful rectification, the World Trade Organization's (WTO) rules would be the expected default provisions governing trade between the parties. Economically, this scenario would be the least desirable accompanied by prolonged uncertainty following the end of the negotiations. Politically, however, this situation offers the greatest political autonomy for the UK, allowing May's government to satisfy "Leave" proponents' desires to control immigration and avoid EU budget payments. This option also maintains EU institutional integrity by not creating a new and unique membership status.

- **Modified Canada model**: Under this scenario, also referred to as the Swiss model, the UK negotiates a new membership status to remain in the European Economic Area (EEA), but enlarging the menu of opt-out provisions, including the budget and immigration. However, trade access could be restricted, as in the example of Canada, with only goods receiving preferred treatment. This would upset key service sectors (e.g. banking and financial services) for which the UK would seek preferential treatment. While maintaining economic cohesion, this special membership, especially if providing preferential treatment for services, would mark a significant EU concession in carving out a unique membership, one that other members might desire in the future.

- **Norway model**: This often-mentioned scenario entails remaining in the EEA, but with the political drawbacks of continued budget dues and observance of the freedom of movement for labor. While economically advantageous, this offers the least political autonomy. It fails to satisfy May's promise of a "clean Brexit." Meanwhile, for the EU, this model would be

NWP Takeaway: The parties face conflicting choices, for the UK political autonomy v. economic integration; for the EU economic accommodation v. institutional integrity

viewed favorably as it protects institutional integrity by moving the UK into an established quasi-member status and preserves EU-UK economic ties.

- **EU 2.0**: UK membership and participation in the single market remain intact subject to negotiated special concessions over budget payments and immigration controls. While preserving economic ties, this would be a difficult pill for both parties to swallow politically as it would not constitute a true Brexit for the UK and, from the EU's standpoint, necessitates major changes to EU policies, although through existing treaty frameworks.

A normal form 2x2 game matrix is drawn using the four outcomes and indicating the player's strategic choices. The UK can either prioritize political autonomy or economic access while the EU player must choose between economic accommodation or punishment. A game's outcome ultimately depends on the interaction of the players' preference sets. Depending on the interaction of the players' preferences, players may achieve better outcomes by switching strategies.

Figure 1. EU-UK Brexit Game Matrix

		EU	
		Accommodate	Punish
UK	Economy	EU 2.0	Norway
	Autonomy	Canada	Hard Brexit
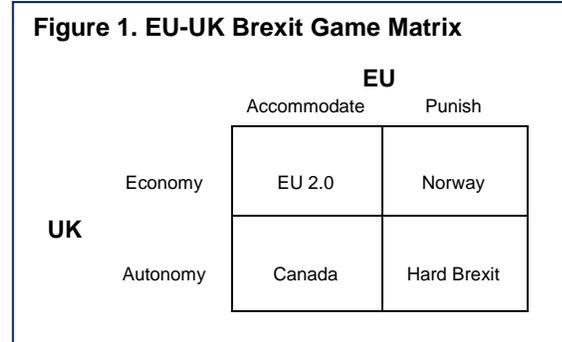
The Players' Preferences
Forgoing a lengthier examination of the actors' outlooks, a preliminary analysis indicates both the EU and the UK as espousing hardline bargaining positions; the EU player prioritizing membership integrity and the UK prioritizing political autonomy. These scripts prioritize the preference of outcomes for the players, from best to worst, appear as follows:

> **EU hardline script**: Norway>Hard Brexit >EU 2.0>Canada
> **UK hardline script**: Canada>Hard Brexit>Norway>EU 2.0

NWP Takeaway: Current expectations suggest the parties taking a hardline, although a more cooperative approach is possible

Alternatively, more cooperative, conciliatory preference scripts can be hypothesized. Of course, this assumes the players willingly adopt a more cooperative stance, which runs counter to current signals. The main difference is the devaluing of the Hard Brexit outcome, but maintaining the players' top priorities:

> **EU conciliatory script**: Norway>Canada>EU 2.0> Hard Brexit
> **UK conciliatory script**: Canada>Norway>Hard Brexit>EU 2.0

Gaming Brexit
Combining the players' scripts results in four distinctive game interactions. However, for the purposes here only two games are shown. The two games not shown, pitting hardline against conciliatory scripts, unsurprisingly, results in the hardline player receiving their best outcome.
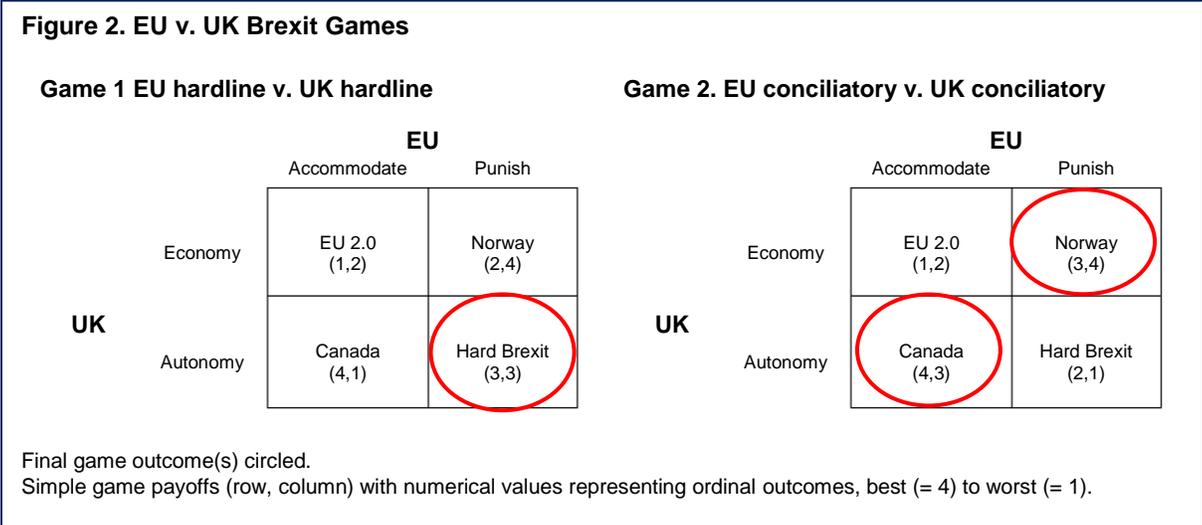
Game 1: EU hardline v. UK hardline. The combination of both players' hardline scripts results in the troublesome Hard Brexit (3,3) outcome (Figure 2). While not novel given recent headlines, through constructing the game matrix the rationale behind this outcome is shown. The outcome of this game is driven by both players possessing a dominant strategy (UK=autonomy, EU=punish) offering a superior outcome, as versus their alternative option, regardless of the other player's strategic choice. Accordingly, the Hard Brexit outcome holds regardless of the initial state of the game as the move and counter-move sequence always ends at Hard Brexit (3,3). By example, from the initial state of EU 2.0 (1,2) both players are motivated to move as they can do better and, assuming complete information, know that their move will be followed

by a counter-move by the other player shifting the game to (3,3) which is still preferable to (1,2). If Hard Brexit (3,3) is the initial state neither player is motivated to move as doing so makes them worse off.

NWP Takeaway: Pairing of hardline scripts results in Hard Brexit

As to the real-world consequences, Hard Brexit provides the May government with its maximum desired political autonomy, enabling the UK to exercise full control over immigration and eliminating EU budget payments (not including the so-called "divorce bill"). For the EU player, this result serves their desired goal of avoiding concessions over key policies like the free movement of labor. Though this scenario also represents a fundamental and potentially uncertain transformation in the trading relationship.

Figure 2. EU v. UK Brexit Games

Game 1 EU hardline v. UK hardline

	EU	
	Accommodate	Punish
Economy	EU 2.0 (1,2)	Norway (2,4)
Autonomy	Canada (4,1)	Hard Brexit (3,3)

UK

Game 2. EU conciliatory v. UK conciliatory

	EU	
	Accommodate	Punish
Economy	EU 2.0 (1,2)	Norway (3,4)
Autonomy	Canada (4,3)	Hard Brexit (2,1)

UK

Final game outcome(s) circled.
Simple game payoffs (row, column) with numerical values representing ordinal outcomes, best (= 4) to worst (= 1).

Game 2: EU conciliatory v. UK conciliatory. The pairing of the parties' conciliatory preference scripts results in a more complex anticipation game, offering two potential outcomes.[2] Both the starting point, as well as the order of the players moves, impact whether the game ends at the Norway (3,4) or Canada (4,3) outcome. This game highlights what TOM calls "order power."[3] At the initial states of EU 2.0 (1,2) and hard Brexit (2,1), both players do better when the other move first. Hence, each is expected to hold out in hopes of waiting out the other. Assume a starting point of Hard Brexit (2,1), both players are motivated to avoid this sup-optimal outcome, however, by waiting for the other to switch their strategy and move first, they receive their best outcome. Alternatively, at the initial states of the Norway (3,4) or Canada (4,3), the outcome may be influenced if either player possesses so-called threat power where they can inflict a sub-optimal outcome for both players knowing that the other, in seeking relief, will move resulting in the threatening players' best outcome.[4] Therefore, from an initial state of Norway (3,4) the UK player can threaten, or move, to Hard Brexit (2,1). The EU, preferring the Canada (3) outcome over Hard Brexit (1), will logically switch their strategy resulting in a move to the Canada outcome, the UK player's best outcome.

NWP Takeaway: While avoiding Hard Brexit, the cooperation game has its own uncertainty as to the outcome

As to actual results, the two outcomes of this interaction are preferable to the greater uncertainty surrounding a non-agreement Hard Brexit. Although this game assumes the parties share a willingness to avoid Hard Brexit, one should expect prolonged negotiations. If, as appears to be the case from recent reports, the initial state of the negotiations is Hard Brexit both parties will try to hold out hoping the other caves first and offers significant concessions.

Conclusion

Before officially triggering the Article 50 withdraw process, the economic impact of Brexit had been modest leading to Brexit apathy for some investors given the market's rebound after the initial shock of the June 23 referendum result. However, investors should brace for prolonged, and at times contentious, Brexit negotiations. In this case, slow is preferable to fast. While perpetuating uncertainty, drawn out talks suggest a willingness of the parties to strike a deal. Although, as the cooperation game played out here highlights, both parties will hold out as long as possible, hoping the other will first offer concessions. The alternative is the more disconcerting Hard Brexit outcome. These findings are preliminary, of course; players can change their preferences over time. Moreover, in this situation, the very players could change over time as well given shifting political dynamics. Regardless, the underlying logic and assumptions of these games hold going forward.

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[1] For a complete discussion of TOM and its rules see Brams, Steven J. *Theory of Moves*. Cambridge: Cambridge University Press, 1994. The six primary rules of TOM are as follows:

> *Rule 1. Play starts at an initial state, given at the intersection of the row and column of a payoff matrix (i.e., one of the four entries in a 2x2 payoff matrix).*
>
> *Rule 2. Either player can unilaterally switch his or her strategy (i.e., make a move), thereby changing the initial state into a new state, in the same row or column as the initial state. The player who switches is called player 1 (P1).*
>
> *Rule 3. Player 2 (P2) can respond by unilaterally switching his or her strategy, thereby moving the game to a new state.*
>
> *Rule 4. The alternating responses continue until the player (P1 or P2) whose turn it is to move next chooses not to switch his or her strategy. When this happens, the game terminates in a final state, which is the outcome of the game.*
>
> *Rule 5. If play returns to the initial state, the initial state becomes the outcome. (termination rule)*
>
> *Rule 6. Each player takes into account the consequences of the other player's rational choices, as well as his or her own, in deciding whether or not to move from the initial state or any subsequent state. If it is rational for one player to move and the other player not to move from the initial state, then the player who moves takes precedence: his or her move overrides the player who stays, so the outcome will be induced by the player who moves. (two-sidedness rule)*

[2] An anticipation game is where the initial state is undetermined and where a player chooses a strategy in hopes of commencing the game at a specific initial state which they believe will lead to a particular desired outcome.

[3] Under TOM, order power is defined as "the ability of a player to dictate the order of moves in which the players depart from an indeterminate initial state (a state where the outcomes induced depends on which player moves first) in order to ensure a preferred outcome for itself."

[4] In this game, the threat power is compellent in nature, where the player threatens to stay at a strategy to induce the other choose a game states associated with the threatening player's best outcome.