The alliance in 2012 offered both Emirates and Qantas a payoff-dominant Nash equilibrium. However, Emirates required commitment from Qantas to enter an alliance, so Qantas moved their hub from Changi to Dubai.

https://www.qantas.com/travel/airlines/media-releases/sep-2012/5440/global/en

In October 2017 Qatar Airways invests in Cathay Pacific, the Hong Kong based carrier. They join the One World Alliance with BA, LATAM and American Airlines. Qatar Airways now poses a credible threat to the Emirates and Qantas alliance. During 2017 Emirates and Qantas renegotiate their alliance. This is their story in a game theory narrative.

Case Study
Emirates and Qantas

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Game dimension

In 2012 Qantas and Emirates announced a global alliance on long haul travel from Australia with a strategic focus on the Australia-Dubai segment. The game was not about domestic internal flights between Australian city pairs. The geographic market was Australia, specifically landing rights at Australian cities to service the long-haul flights using Dubai as a hub and onwards to London. The objective for EK is entry to Australia. The objective for QA is a new global partnership with Emirates to replace the agreement with BA. Increase in international traffic to the Southern hemisphere and the development of an international hub airport at Terminal 3 in Dubai were important 'state of nature' external events (not considered in this design) at the time.

Players

Emirates, EK, is a de novo entrant to the Australia market specifically interested in cities such as Perth, Melbourne and Sydney. They are not a potential entrant with camouflage or signalling soft commitment entry strategies because they had signalled intent to pre-2012 to expand in Australasia as they build a global network.

Qantas, QA, is a dominant incumbent in the Australia market-as-a-game, and the market is non zero-sum. In 2012 were many incumbent competitors already in the game such as Virgin Australia and code-shares arrangement between other incumbents and BA and Air New Zealand. The Australian long-haul market-as-a-game is contestable. EK now pose a credible threat to BA, Singapore Airlines and other long-haul carriers in Southern hemisphere, specifically Asia.

Strategy Set

The classic textbook play is a limit price strategy for QA. It could manifest itself as a strategy to either block entry of EK through lobbying Australian government and the aviation regulator to delay or deny EK landing rights at any Australian city. Or, QA could signal a pre-entry limit pricing strategy to dissuade EK from entering the Australian market.

EK are a global airline with capacity and economies of scope using Dubai as a hub airport. In reply to a limit pricing strategy by QA, EK could adopt a poker strategy and 'call the bluff' of QA and enter at the actual level of the limit price signalled by QA. The limit price might be an economy return fare between Sydney and London Heathrow via Dubai. This would provoke a Bertrand price war. Price wars are costly, and both players know this to be the case. More importantly, EK knows that QA knows that price wars are costly and QA believes that EK have the deep-pocket capacity to prolong a price war on the Australian to Dubai long-haul route.

Playbook

In the pre-2012 pre-alliance time period both players are rational and they each have retained a game theorist as consultants in order to scenario plan the strategy options. They are faced with a classic Prisoners' dilemma: do we compete or do we cooperate? There is imperfect information on player type, so neither player trusts each other. EK has signalled intent so QA believe that EK is about to enter. As a player EK exhibits hard commitment to the long-haul

game. For example, QA can observe EK entering other markets-as-a-game in Europe, Asia and potentially in the US, Latin America and Canada.

Game design

The case study presents one scenario. The cardinal numbers in Table 1 reflect player preferences across the likely strategy options. Hypothetically, during 2011 there is pre-game communication as EK management assume the Stackelberg-leadership player role and signal an alliance with QA. Outside an alliance, either player could secure a payoff of 1 but it is risky. EK could enter and compete or form an alliance with other incumbents. QA could do likewise and retain the code share arrangement with BA. There is common knowledge on player rationality. So, the cardinal number 1 reflects this risky preference and is less than a payoff 2 obtained with an EK/QA alliance.

Table 1 Payoff-Dominant NE

EK/QA	Form alliance	No alliance
Form alliance	2,2 Payoff-dominant	0,1
No alliance	1,0	1,1 Risk-dominant

Payoff-Dominant Solution

With no alliance there is a Nash equilibrium at (1,1). Neither player can change their strategy unilaterally and both realise that to be the case. If both players agree to form an alliance they each receive a payoff of 2. But the payoff (2,2) is also a Nash equilibrium. The (2,2) NE is a payoff-dominant Nash equilibrium offering both players a higher payoff. Since neither player trust the other player EK requires commitment from QA to enter an alliance. Although 1 is a risky payoff for both players EK require a demonstration of commitment from QA.

In the real world this actually happened when QA announced that they were moving their passenger hub (not the cargo hub) from Changi airport, Singapore, where it was located for 20 years, to Dubai. QA also ended its long-lasting partnership with BA. Once QA signalled commitment to the game and give assurance to EK of trustworthiness the (2,2) NE becomes a stable payoff-dominant equilibrium. The alliance is made public for all to see and observe and the alliance is a public Nash equilibrium. It is sustainable.

There are two Nash equilibria in this game design. The payoff (1,1) and the payoff-dominant (2,2). Trust and commitment is required for (2,2) to be a stable equilibrium.

Counter-Strategy

It is now 2017 and QA begins to exact bargaining rights in the game. In particular, on the London-Sydney route, Qantas will revert back to Changi airport, switching away from Dubai. Using Changi as the hub will also allow QA to exploit its economies of scope with investment in low-cost fighting brands such as its fighting ship Jet-star Airways. This strategy will allow QA to further reengage with partners in the One World Alliance to service Asia destinations.

To test the sustainability of the equilibrium post-2017 we need to sketch a counter-strategy. In other words, 'what-if' there was no alliance between EK and QA? Then EK as an incumbent-entrant player must choose to remain in the Australian market-as-a-game unilaterally. Here we are assuming for the purposes of the game in this case study that 'no entry' or withdrawal is not an option and that EK have not approached other incumbents such as Virgin Australia nor considered Auckland in New Zealand with Air New Zealand. The rules of this game are also common knowledge. Both players, EK and QA, know that cheating or 'breaking of promises' is a dominant strategy.

So, what if EK believes that QA would rationally retreat rather than engage in a price war. Hypothetically, if EK had chosen not to enter the Australian market-as-a-game, a payoff = 1 accrues to QA. There is no game EK v QA.

However, with sustained entry by EK and no alliance with QA, EK has to signal attack and show its willingness to compete against QA. This would lead to a price war. As the price war is played out both players would realise that neither player can benefit unilaterally, so QA retreats and signals intent to end the price war and to re-join the alliance with EK. The payoff (2,1) in Table 2 is obtained as a sub-game perfect Nash equilibrium.

Table 2: Sub-game Nash equilibrium

EK/QA	Price Compete/fight	Join Alliance/retreat
No entry/avoid	0,1	0,1
Entry/attack	1, -1	2, 1

What-if there was no alliance?

If there was no commitment from QA to re-join the alliance then it is rational for EK to attack and QA retreats from the price war and re-joins an alliance.

The payoff (2,1) in Table 2 is obtained as sub-game perfect Nash equilibrium.

Unbeatable Strategy

Given the positive news about QA, let's do a scenario for post-2017 to design an unbeatable strategy for both players. For the purposes of the game we will introduce private cost functions to allow for the positive financial news and the dynamic external factors from new fuel-efficient aircraft to passenger preferences. The media conveys information: it facilitates a mediated strategy. With private cost functions we can see how a public NE can break down. It breaks down because of the private cost function, so either it has to be recalibrated or more corporate intelligence about the game has to be gathered.

http://www.patrickmcnutt.com/kaelo/kaelo.html

We assume that the private costs to QA of 'keeping promises' and committing to the alliance with EK post-2017 on all the long-haul routes bar London-Sydney:

$$c(QA) = 2x^2$$

Assume the private costs to EK:

$$c(EK) = x^2/2$$

The private cost accruing to player QA of competing = ½. Plug the payoff ½ into the c(QA) equation to obtain ½. They are prepared to incur this cost. But they would obtain a game payoff of at least = ¼ or ½ so *no worse off* in the game by competing. For EK the private costs of attack and pursue with a punishment strategy = 9/32 = 0.28, a value *less than* the ¾ payoff from the game suggesting that EK is better off with an attack strategy.

Table 3: Payoffs v Private Costs

EK/QA	Price Compete/fight	Join Alliance/retreat
Entry/accommodate	½, ½	¼, ¾
Entry/attack	¾, ¼	0,0

Conclusion

There is a Nash equilibrium at (3/4, ¼) with the probability that price war will occur with a mismatch. If QA now choose to play their weakly dominant strategy of fighting EK post-2017 then EK, if rational, should choose attack as a strategy.

There is an incentive for QA to join the alliance. Assuming the private cost function c(QA) as above, QA management believe the cost = 1.1 *greater than* the payoff = ¾ from the game. If QA could reduce the private costs of playing the alliance game then the alliance strategy is a dominant strategy for QA. This may be a rational explanation for the 2017 news that QA are renegotiating their payoff by aligning their private costs and payoffs. The need to bargain with

EK. There is an inference in the media coverage that QA can improve financial performance with a judicious allocation of new Boeing and A380 capacity thus exploiting economies of scope at Changi as a hub to Asia on Qantas jets.

Signals and Corporate Intelligence

The cost functions for the purposes of this case study indicate that 'always defect' is a dominant strategy for QA in this Prisoners' dilemma characterisation of the game. And the threat of punishment from EK always looms in this game to such an extent that it discourages QA from deviating too much from the EK/QA alliance routes. Increasing routes or availability on a given route increase the probability that quantity (number of passengers carried) becomes strategic substitutes in a zero-sum game. Both players know this.

Prognosis

So, the media coverage of the alliance presents a monitoring of events and allows each player to assess a deviation/defect profile. It is as if the media event transfers value to each player in reassessing their respective cost function. It is a positive learning transfer (PLT) effect for each player and the cost function can be discounted by a PLT weight.

An observer could suspect that QA knows that if they choose to play their weakly dominant strategy of fighting EK post-2017 then EK, if rational, should choose attack as a strategy. And EK knows that QA knows this so both players reach a compromise post-2017 on one or two London destination long-haul routes via Changi for the greater payoff of the alliance between EK and QA given the credible threat from Qatar Airways post-2017 in the market-as-a-game. The London-Sydney route via Changi may relieve congestion at Dubai but unlikely to destabilise this alliance in a global contestable market-as-a-game.

Qatar Airways has joined One World Alliance with BA, LATAM and American Airlines. In October 2017 Qatar Airways invests in Cathay Pacific, the Hong Kong based carrier. It now poses a credible threat to the EK and QA alliance.

https://www.ft.com/content/7ba99556-f7c3-11e1-ba54-00144feabdc0

Corollary: In 2012, QA could not commit to fighting as it had financial difficulties and eventually filed for bankruptcy. It is now 2017 and QA are in a stronger financial position.

https://www.icas.com/ca-today-news/qantas-nine-lives-flying-kangaroo

https://www.ft.com/content/7ba99556-f7c3-11e1-ba54-00144feabdc0

If QA now choose to play their weakly dominant strategy of fighting EK post-2017 then EK, if rational, should choose attack as a strategy. An observer could suspect that QA knows this and EK knows that QA knows this so both players reach a compromise on one or two London destination long-haul routes via Changi.

Game theory concepts from *Emirates & Qantas* Case Study

(in order of appearance)

Player
De novo entrant
Camouflage
Soft commitment
Dominant incumbent
Market-as-a-game
Non-zero-sum
Contestable
Credible threat
Limit price strategy
Pre-entry limit pricing
Capacity & economies of scope
Poker strategy 'call-my-bluff'
Bertrand price war
Classic Prisoners' dilemma
Imperfect information on player type
Player preferences
Pre-game communication
Stackelberg price-leader
Common knowledge
Rationality
Nash equilibrium
Payoff dominant Nash equilibrium
Trustworthiness
Public NE
Sustainable equilibrium
Bargaining rights
Fighting ship as counter strategy
What-if?
Dominant strategy
Sub-game perfect NE
Unbeatable strategy
Private s function
Mediated strategy
Punishment strategy
Mismatch
Weakly dominant strategy
Bargain
Strategic substitutes
Positive learning transfer (PLT)