A GAME THEORY ANALYSIS OF DONALD TRUMP'S PROPOSED TARIFF ON CHINESE EXPORTS

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In this essay, Jake McGwire employs the principles of game theory in his examination of Donald Trump's trade policy. He utilises both strategic and extensive form games in order to shed light on the optimal outcomes for both the USA and China in this strategic interaction, and, in doing so, he provides a clear understanding of the complex trade decisions facing world leaders today.

Introduction

On the 20th January 2017 Donald Trump, the 45th president of the United States of America, took office. However, what will take place over the next four year is, as of yet, shrouded in uncertainty. Four words echoed throughout his campaign: "Make America Great Again".

How does he plan to to achieve this? Trump's administration hopes to 'bring back American jobs' through a series of strategic trade policy decisions: withdrawal from the Trans-Pacific Partnership (TPP), renegotiation of the North American Free Trade Agreement (NAFTA), the implementation of tariffs on Chinese goods, and, if met with resistance, potential withdrawal from the World Trade Organisation (WTO). The magnitude of these decisions may seem extreme, but when framed in the context of increasing domestic jobs and incomes it seems palatable to Americans and, if his reasoning is to be believed, possible. These benefits do assume that, regardless of how the USA treats its trading partners, there will be no repercussions. Unfortunately, both economic theory and history suggest some fundamental flaws in this logic. This paper will examine the theory behind trade policy and apply this logic to the gargantuan, yet fragile, trade relationship between the USA and China.

Strategic trade theory describes the decision making of governments when trying to influence the outcome of an economic interaction between themselves and another nation. The concept of trade policy dates back to Ancient Greece when Athens placed duties of five percent at all ports in the empire in an attempt to increase revenue (Scheidel et al, 2008). History has identified the significant role of trade policy, in particular protectionism, and the huge influence it exerts on trade, price convergence and welfare. This was particularly true during the 19th and 20th centuries.

Trade theory suggests that a country's welfare can be increased by the

repatriation of profits from foreign firms to their domestic competitors. This refers to the classical macroeconomic equation, in which GDP (often considered a proxy for welfare when looked at in per capita terms) is equal to C+I+G+(X-M), where (X-M) represents net exports. According to this relationship, as imports rise, more profits are sent abroad and the result is a decline in GDP. In theory, it is, therefore, rational for a country to impose tariffs on foreign goods and provide subsidies for domestic goods, as it will result in an increase in net exports, which in turn will have the effect of increasing GDP per capita. Applying this logic, it is rational for each player (country) to opt for protectionism over free trade. Unfortunately, this incentive is shared by all nations. Thus, this strategic trade interaction represents a prisoner's dilemma situation, whereby each player's best response is to employ tariffs, resulting in a sub optimal outcome for all. Therefore, strategic trade theory stresses the importance of trade agreements and the role of supranational institutions (such as the WTO) to police international trade, in order to restrict the ability and incentive for countries to deviate in the direction of protectionism.

Traditionally considered to be countercyclical, protectionist trends have historically had a significant negative effect on the volume of world trade, and, as such, provide empirical support for the prisoner's dilemma argument. The most significant example of this was at the start of the Great Depression, when the world economy experienced a huge shift towards protectionism, following the implementation of the 1930 Smoot-Hawley Tariff in the USA (Eichengreen & Irwin, 2009). Although this tariff is not considered to have caused the Great Depression, various papers attach blame to it for identifying the USA as a target for discriminatory and retaliatory trade policy (Irwin, 2011).

The decisions facing Trump can be understood if considered in the context of Game Theory. A basic model will first be explored, followed by the incorporation of a set of further assumptions, which aim to make the model more realistic and applicable.

Strategic Form Game

The matrix conceptualises the standard way of thinking about tariffs, and, as the payoffs show, this is representative of a prisoner's dilemma situation. The game is set up as follows: There are two players, the USA & China, and each has two available strategies -impose tariffs (T) or maintain free trade (F). Their preferences are defined as:

USA:
TF>FF>TT>FT

China:
FT>FF>TT>TF

		China: T	China: F
USA	T	**2,2**	5,0
	F	0,5	4,4

The best response for each player is to impose tariffs, which results in the Nash

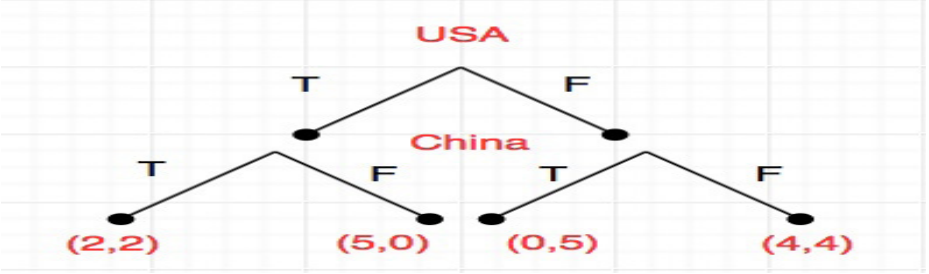
Equilibrium (NE) of (TT), from which neither player has an incentive to deviate. Although this is the NE and, as such, it is their optimal response, both countries could have received higher payoffs if they had coordinated. In reality, this 'coordination' is both encouraged and policed by the WTO. If both the USA and China maintained free trade, then both countries would have benefitted from higher levels of trade, and received higher payoffs. O'Rourke (2007) and Edwards & Van Wijnbergen (1987) present evidence supporting this idea, namely that free trade allows for higher utility and welfare levels. Their research suggests that increased trade has the effect of increasing income per capita and lowering living costs, both of which are indicators of utility.

The payoff matrix suggests that if the USA imposes tariffs, and China does not, then, in theory, America's exports will be unaffected but the price of foreign goods will increase and thus, the demand for them will decrease. This decline in demand for foreign goods will be transferred to goods from domestic producers, which will in turn increase domestic output and GDP. Conversely, if China is subject to American tariffs and choose not to reciprocate, they will see a decline in their export levels, while their imports will be unaffected. Given that the Chinese economy is so reliant on export-led growth, this is a dangerous possibility. It must be noted that the model assumes that both the USA and China are immune to penalties imposed on them for imposing tariffs and breaking WTO and other trade agreements. Payoffs, therefore, are directly representative of the impact of the chosen strategy on exports and imports. As it stands, the payoffs are symmetrical and so the rationale above can be applied when the strategies are reversed. If both countries opt for free trade, then a prosperous free trade environment remains, and, as aforementioned, if both impose tariffs, the result is a dramatic decline in world trade and a subsequent fall in GDP and welfare.

Viewing this in a strategic simultaneous format, however, implies that this interaction is simultaneous and that there are no opportunities for either country to respond to the actions of the other. This lacks real-life validity. A sequential game is a more realistic model.

Extensive Form Game

The model below depicts the standard trade policy dilemma between two nations. Here, a starting point of free trade, which is similar to today's trade environment, is assumed.



In this game, with these assumptions in mind, it is always rational for China to choose T in each subgame. The USA must, therefore, opt for tariffs to ensure a payoff greater than zero. Hence, the subgame-perfect Nash Equilibrium (SPNE) is (T,TT). However, given China's reliance on trade, it is unlikely that they would opt for a protectionist policy without being provoked. In reality, they are aware that this interaction is not confined to a two-stage game. This analysis, however, assumes that this interaction is limited to one move per player with USA playing first.

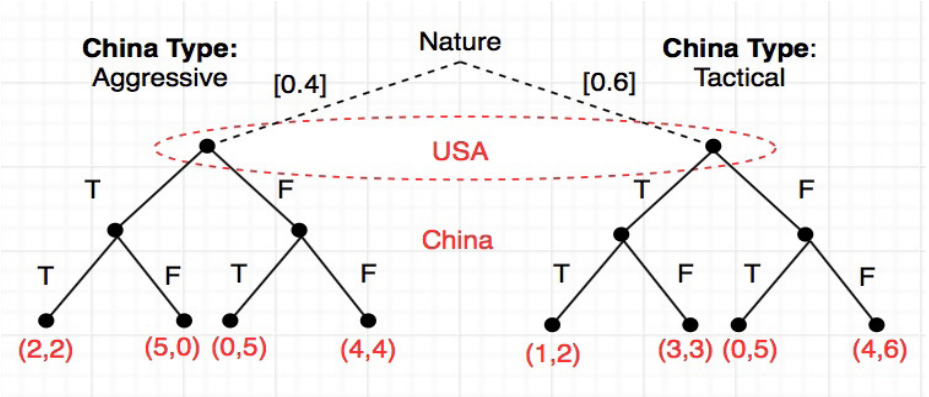
Imperfect Information

It is reasonable to assume that the USA does not fully understand the motivations behind Chinese trade policy or the country's reliance on trade, owing to the authoritarian nature of the Chinese government, which curtails free speech and censors foreign media outlets. The model, therefore, assumes that the USA is dealing with different 'types' of China, with each type requiring a different response.

This imperfect information is incorporated into the model (below). It is assumed that there are two types of Chinese government. The first type is aggressive. This is based on the observations of Irwin (2011), who, when analysing the effect of the 1930 Smoot-Hawley Tariff, concluded that its most detrimental effect was its identification of the USA as a target for discriminatory trade policy. The Smoot-Hawley Tariff sparked a wave of retaliatory protectionist policies against the USA. The aggressive Chinese government is assumed to behave in the same manner. It will retaliate equally to any tariff placed on Chinese goods, without considering the consequences.

The second type of government is tactical. Only the Chinese government fully understands the extent to which its economy is reliant on export-led growth and the effect that a decline in exports would have. The government will have developed various contingency plans to maintain high exports in the event of a rise in protectionism. This model assumes that the tactical government can manipulate currency in such a way that an increase in tariffs by the USA does not result in a payoff of zero if China opts for free trade. This currency devaluation also allows China to receive a higher payoff than the USA if both opt for free trade.

We also assume that China will be opportunistic and will seek to form trade deals that the USA turns away from. For instance, Trump's plan to withdraw from TPP (if his claims are to be believed) may see China step in to take its place. Japan has stressed that without the absence of the USA from TPP will result in a pivot in the direction of the Chinese alternative: Regional Comprehensive Economic Partnership (RCEP). Not only will this have the effect of increasing China's payoff in both situations where it opts for free trade, but it will also reduce the payoff for the US, as trade is re-allocated to this new partnership. This model, in line with its original version, assumes that both the USA and China will be worse off if they both choose to impose tariffs.



Thus, the payoffs the USA receives vary, depending on whether they interact with the aggressive or tactical China. The USA, however, due to information asymmetries, do not know which type they are interacting with and so rely on probabilities to calculate its expected payoffs. The probability that China is aggressive is 0.4, while the probability that China is tactical is 0.6. These probabilities are determined by Nature, who moves first in this game.

China's optimum strategy for all subgames is (T,T,F,F). The USA is aware of this and can calculate their expected payoffs, given these strategies. The USA's expected payoffs for choosing Tariffs are (2,6) and for Free Trade are (2,4). It follows that they will opt to impose tariffs. This yields a Nash Equilibrium of (T, TTFF). Interestingly, when this game is run as a Bayesian game, the Bayesian Nash Equilibrium is (T,TF). This suggests that the sequential nature of the interaction does not necessarily affect the result.

Extensions and Analysis

The analysis suggests that the threat of China implementing tariffs after the USA has chosen to opt for free trade forces the USA to opt for tariffs in the first instance. It is perhaps pertinent to examine the effect that an agreement put in place to remove this threat would have on the equilibrium outcome. Figure 5 shows that if China cannot choose to implement tariffs after the USA has chosen free trade, the equilibrium then shifts to one of free trade, where both players receive higher payoffs. This emphasizes the important role that the WTO plays in deterring countries, such as the USA, from reneging on its trade agreements and abandoning its position as the leading free trade economy. The same result could equally be achieved through bilateral agreements between nations. If one country breaks its trade agreements, the other countries would retaliate by imposing harsh economic sanctions against that nation in order to prevent repeat incidents.

The analysis shows that tariffs are not the answer; there are other tools that the

USA can use to achieve their economic promises. Arguably the most subtle and most beneficial tool in the long run is the subsidization of domestic research and development. This, not only encourages domestic innovation, but also drives the innovation that would increase the competitiveness of American industry relative to its Chinese counterparts.

Conclusion

This model has sought to provide a deeper understanding of the complexity and uncertainty inherent in the trade decisions facing today's leaders and policymakers. In the strategic interaction between the USA and China, information asymmetries allow the Chinese government to choose to act either aggressively or tactically. The payoffs that the USA receives vary greatly depending on China's type. This analysis highlights the negative effects of protectionism, and, in doing so, the dangers associated with populist politics, in which logical reasoning and empirical analysis no longer provide a basis for policy agendas.

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Appendix

Figure 1:

Basic Simultaneous Game
N=2
S={Tariff (T), Free trade (F)}
For USA: TF > FF > TT > FT
For China: FT > FF > TT > TF

		China T	China F
USA T		**2,2**	5,0
USA F		0,5	4,4

Figure 2:

Sequential Game

SPNE: (T, TT)

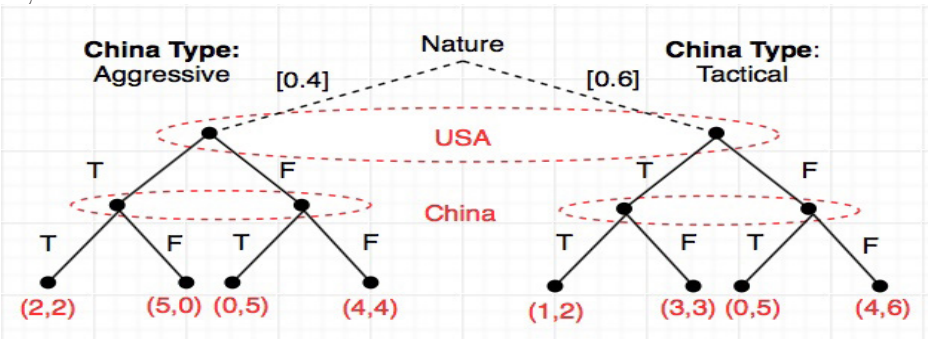
		China TT	China TF	China FT	China FF
USA T		**2,2**	2,2	5,0	5,0
USA F		0,5	4,4	0,5	4,4

Figure 3:

Sequential Game with imperfect information.

Expected payoffs for USA if:
USA plays T: 2*0.4 + 3*0.6 = 2.6
USA plays F: 0*0.4 + 4*0.6 = 2.4

Figure 4:
Bayesian Game



Type I: Retaliatory [1/2]	China	
	T	F

USA	T	2,2	5,0
	F	0,5	4,4

Type II: Opportunistic [1/2]	China	
	T	F

USA	T	1,2	3,3
	F	0,5	4,6

Expected Pay-off for USA	TT	TF	FT	FF
T	1.4	2.6	2.6	3.8
F	0	2.4	1.6	4

BNE (T, TF)

Figure 5:
Sequential Game with threat of China breaking away from agreements first removed. This results in a new NE of (F,T), where if faced with tariffs China will employ tariffs, but given this knowledge the USA will choose free trade resulting in a higher outcome. This is only possible now that the risk associated with the USA choosing free trade initially has been removed.