A Game Theoretical Analysis of the U.S.-Mexican Suspension Agreement

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Authorization to Submit Thesis

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Abstract

The goals of this thesis are to a) develop a graphical and mathematical analysis of the welfare effects of the Suspension Agreement for the United States and Mexico, b) create a game theoretical representation the U.S.-Mexican tomato dispute, c) develop a mathematical model depicting a particular Nash equilibrium of the game, and d) derive the sustainability conditions for cooperative trade agreements in politically varying environments.

Chapter two displays the effects on producer and consumer surplus for the United States and Mexico from the Suspension agreement, as well as the statics of these two components.

Chapter three develops an extensive form representation of the game revealing the subgame-perfect Nash equilibria.

Chapter four represents a particular equilibrium of the previous chapter in mathematical form. The effects of exogenous shocks to the model are discussed as well.

Chapter five utilizes the framework provided in the previous two chapters to develop the sustainability conditions of cooperative trade agreements. The conditions are tested with and without third party mediating institutions.

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CHAPTER 1: Introduction and Thesis Overview

1.1 The U.S.-Mexican Tomato Dispute

Mexico and the United States have been disputing their bilateral tomato trade agreements for decades. The most recent developments in these disputes began in 1996, shortly after the signing of NAFTA. U.S. tomato producers – mainly in Florida – petitioned to the United States Department of Commerce (USDOC) claiming Mexico was dumping tomatoes, or selling tomatoes below fair market value, in the U.S. market (Gunter et al., 2001). The United States began to investigate the matter and did find evidence of dumping, however, dumping was not proven to cause material harm to the United States overall, an additional requirement needed for trade retaliation (VanSickle, 2003). Before the issue was formally resolved, the United States suspended the investigation after negotiations with Mexico lead to what appeared to be a mutually agreed upon trade policy. The policy, known as the Suspension Agreement, instituted a price floor on imported Mexican tomatoes. Accordingly, the Suspension Agreement is a minimum price agreement.

This agreement was modified over the years to include multiple categories of tomatoes, each with a distinct price, and seasonal variations in price. The largest modification occurred in 2013, when further contention from certain U.S. producers resulted in the renegotiation of the Suspension Agreement, achieving a higher minimum price. Shortly thereafter, Floridian producers, still unsatisfied with the new agreement, began petitioning again to reopen the investigation (Kosse et al., 2014).

The continued disputes, threats, resolutions, defections, negotiations, and renewals of tomato trade agreements between the United States and Mexico lay a ripe playing field for game theoretical analysis. With our time line beginning at the signing of NAFTA, the first contribution of this thesis is to clearly understand and model this trade problem. Doing so requires a review of the foundations developed previously in the literature, as well as an understanding of the welfare effects of the Suspension Agreement.

1.2 Bilateral Cooperative Trade Agreements in Game Theory

The instability of trade agreements is extensively covered in the literature. The seminal work of Johnson (1953) introduces the idea of a nation choosing an optimal tariff, taking into account the incentives of the opposing nation. The equilibrium reached by the two nations is referred to later in the literature as Nash equilibrium tariffs (NET).

While nations can agree to adjust their trade policy to that which is mutually beneficial, this solution is usually unstable. The reason is that each nation likely has an incentive to deviate to a policy which unilaterally increases its welfare. Friedman (1971) develops a strategy to prevent this deviation, known today as the "grim-trigger" strategy, wherein players threaten each other to implement mutually harmful policies if either player deviates from the cooperative trade agreement. This strategy only works in intertemporal, or "supergames," as it would be impossible to punish a player if only one period exists. Riezman (1982) formalizes this single-period dilemma, concluding that cooperative trade agreements in single-period games are unsustainable.

Klimenko et al. (2008) question the validity of grim-trigger tactics even in supergames. They argue that the lack of a third party mediator, referred to as a dispute settling institution (DSI), in bilateral tariff reduction agreements precludes their stability. This occurs because nations expect to renegotiate following deviation, which will reinstitute the cooperative trade agreement. As a result, no punishment is expected. This effectively removes grim-trigger effects, thus nations have no incentive to uphold the agreement. The only remaining stable solution is for both nations to default to NET[1].

All of the aforementioned research measures welfare via traditional methods. We refer to this approach as the traditional welfare (TW) approach. TW utilizes consumer surplus (CS), producers surplus (PS), and tariff revenues (TR) as the means for determining a nation's welfare. However, because nations many times behave in ways contradictory to the theories posited by TW methodology, economists have developed a new arena of models, known as the

[1]They assume a standard two country, two good framework with symmetric tastes and preferences. Countries aim to maximize joint welfare and equally split the surplus relative to Nash Equilibrium tariffs.

political economy models, which attempt to take into account the political bias of policy makers due to lobbying, campaign contributions, etc. The Stigler-Peltzman model provides a clear picture of this idea. In this model, politically biased policy makers attempt to maximize political support – in the form of industry contributions – and constituent support. Grossman and Helpman (1994) develop a much more explicit representation of the problem, wherein policy makers aim to maximize campaign contributions and TW.

Mentioning political economy models is important, because the idea that free trade is the joint welfare maximizing policy of a bilateral trade agreement falls apart in a politically-biased atmosphere. The second contribution of this thesis, then, is to display this fact, specifically within the U.S.-Mexican tomato dispute.

1.3 Thesis Overview

This thesis views the current Suspension Agreement as a Nash equilibrium of the tomato trade "game" between the United States and Mexico, with the game starting at NAFTA. It then goes on to argue that the continual changes to the Suspension Agreement should be seen not as the instability of a cooperative trade agreement, but as adjustments to the Nash equilibrium, due to exogenous changes in the motives of one or both nations.

To achieve these goals, Chapter 2 examines the TW effects of a minimum price policy, Chapter 3 derives the Nash equilibrium trade policy from an extensive form representation of the game, and Chapter 4 provides a mathematical representation of the Nash equilibrium to show its response to exogenous shocks.

Lastly, given the strong evidence provided by Kosse et al., (2014) that the U.S.-Mexican tomato dispute exists within a politically biased atmosphere. Chapter 5 applies the DSI methodology of Klimenko et al. (2008) to this atmosphere. The results argue that the application of a DSI will not help to sustain cooperative trade agreements when political bias is at play.

CHAPTER 2: Overview of Minimum Price Welfare Effects

2.1 Traditional Welfare Analysis

Utilizing CS, PS, and TR, this section develops an understanding of the TW effects from a minimum price policy, both on the importing nation instituting the price and the exporting nation facing the price. Refer to Figure 1. The left panel depicts the U.S. market for tomatoes. Price P^{AU} is where U.S. domestic demand, D^U, equals U.S. domestic supply, S^U, a situation also known as autarky. All prices below P^{AU} result in U.S. domestic demand exceeding U.S. domestic supply. For example, at price P^M domestic demand is Q^{DUM} while domestic supply is Q^{SUM}. The difference $Q^{DUM} - Q^{SUM}$, also given by line segment *bc*, represents the excess demand for the United States. This excess demand is then plotted to create the excess demand curve, ED^U, in the middle panel depicting the world market. Line segment *bc* is thus equivalent to qr. Accordingly, ED^U is equal to the difference between D^U and S^U at prices P^{AU} and below.

The right panel depicts the Mexican market for tomatoes. Price P^{AM} results in autarky for Mexico as its domestic demand, D^M, equals its domestic supply, S^M. All prices above P^{AM} result in Mexico's domestic supply exceeding its domestic demand. For example, at price $P^{M'}$domestic supply is $Q^{SM'}$ while domestic demand is $Q^{DM'}$. The difference $Q^{SM'} - Q^{DM'}$, also given by the line segment *np*, represents the excess supply for Mexico. This excess supply is then plotted to create the excess supply curve, ES^M, in the middle panel. Line segment *np* is thus equivalent to st. Accordingly, ES^M is equal to the difference between S^M and D^M at prices P^{AM} and above.

The point where $ED^U = ES^M = Q^*$ occurs at price P^*, the world equilibrium price. Our analysis begins here at P^*, beginning in 1994. Under the Suspension Agreement the United States places a minimum price, P^M, on all imports of tomatoes from Mexico (prices P^e and P^{e2} are ignored for now). As a result, U.S. tomato imports drop from Q^* to Q'. Mexico's response to this reduction in import demand is found by connecting U.S. excess demand and Mexican excess supply at quantity Q' via line segment rt. The resulting price is

$P^{M'}$, or the “new Mexican domestic price”. Understandably, a price drop from P^* to $P^{M'}$ results in a reduction in Mexican output from Q^{SM^*} to $Q^{SM'}$ and an increase in Mexican domestic demand from $Q^{DM^*}$to $Q^{DM'}$, bringing Mexico closer to autarky. Based on this process, prices above P^M will result in new Mexican domestic prices below $P^{M'}$, and prices below P^M, but above P^*, will result in new Mexican domestic prices above $P^{M'}$. The larger the minimum price, the lower the new Mexican domestic price.

Looking at the welfare changes resulting from the Suspension Agreement, U.S. PS increases by area $abed$. U.S. CS declines by area $acfd$. The result is a final net loss of $bcfe$. Mexican PS drops by area $gkpm$ and Mexican CS increases by area $ghnm$. The net of these two effects is a loss of $hkpn$, a loss referred to as the “Mexican TW loss.” Mexico, however, also receives rents on its exported quantity equal to $\left[\left(P^M - P^{M'}\right) * Q'\right]$, equivalent to $xvpn$, or $qrts$ in the middle panel. Whether or not $qrts$ is greater than the Mexican TW loss $hkpn$ is ambiguous, and thus, the final net welfare of Mexico is ambiguous.

2.2 Traditional Welfare Statics

Important to our analysis is to study the behavior of CS and PS changes for both nations. For the United States, a negatively sloped demand curve means that all marginal price increases will result in marginal CS losses which are themselves decreasing. To illustrate this, examine example minimum prices $P^e = \left[P^M - P^*\right] \ / \ 2$ and $P^{e2} = \left[P^M + \left(P^M - P^e\right)\right]$ to see that the areas $ijfd$, $acji$, and $i'j'ca$ representing the marginal CS losses resulting from movements $P^* \to P^e \to P^M \to P^{e2}$, respectively, are decreasing. Inversely, a positively sloped supply curve means that the marginal PS gains $ie'ed$, $abe'i$, and $i'b'ba$ resulting from movements $P^* \to P^e \to P^M \to P^{e2}$, respectively, are increasing.

Before illustrating the situation for Mexico, first note that Mexico can exist in one of two possible situations. In the first situation rents accrued by Mexican producers on the exported quantity do not overcompensate for the Mexican TW loss, as described in Chapter 2, thus unweighted TW is maximized at free trade. This situation is referred to as the insufficient case. In the second situation, referred to as the sufficient case, rents do overcompensate up to a certain minimum price, thus unweighted TW is maximized at a price above free trade.

To illustrate the effects on TW given the insufficient case, first note the example prices', P^e and P^{e2}, creation of new Mexican domestic prices $P^{e'}$ and $P^{e2'}$, respectively. Accordingly, the movements $P^* \rightarrow P^e \rightarrow P^M \rightarrow P^{e2}$ for the United States result in new Mexican domestic price movements $P^* \rightarrow P^{e'} \rightarrow P^{M'} \rightarrow P^{e2'}$. Additionally, linear supply and demand curves dictate that the equal distance of P^*, P^e, P^M, and P^{e2} imply the equal distance of P^*, $P^{e'}$, $P^{M'}$, and $P^{e2'}$. Given their equal distance, $P^* \rightarrow P^{e'} \rightarrow P^{M'} \rightarrow P^{e2'}$can be viewed as marginal changes. A negatively sloped demand curve means that the marginal CS gains $ghh'g'$, $g'h'nm$, and $mnn'm'$ resulting from movements $P^* \rightarrow P^{e'} \rightarrow P^{M'} \rightarrow P^{e2'}$, respectively, are increasing.

Inversely, a positively sloped supply curve means that the marginal PS losses $gkk'g'$, $g'k'pm$, and $mpp'm'$ resulting from movements $P^* \rightarrow P^{e'} \rightarrow P^{M'} \rightarrow P^{e2'}$, respectively, are decreasing[2]. The increasing rents Mexico receives on its exported quantity adds positive welfare to Mexican PS, cementing this property.

Respective to free trade, these characteristics imply that, for the United States

$$\frac{\partial PS}{\partial P^m} > 0\ ,\ \frac{\partial^2 PS}{\partial P^{m^2}} > 0 \tag{1}$$

$$\frac{\partial CS}{\partial P^m} < 0\ ,\ \frac{\partial^2 CS}{\partial P^{m^2}} > 0. \tag{2}$$

For Mexico,

$$\frac{\partial PS}{\partial P^m} < 0\ ,\ \frac{\partial^2 PS}{\partial P^{m^2}} > 0 \tag{3}$$

[2]In the case of supply and demand curves convex to the origin, P* , $P^{e'}$, $P^{M'}$, and $P^{e2'}$ would not be equidistant. Instead, $P^*P^{e'} < P^{e'}P^{M'} < P^{M'}P^{e2'}$. These growing distances imply increasing heights of Mexican PS losses (gg' < g'm < mm'). Increasing heights may theoretically offset the loss in width, however we assume these growths in height are negligible given the greater losses in width. CS is unaffected by this possibility.

$$\frac{\partial CS}{\partial P^m} > 0 \,, \; \frac{\partial^2 CS}{\partial P^{m^2}} > 0, \tag{4}$$

where PS, CS, and P^m represent producer surplus, consumer surplus, and the minimum price, respectively. These statics have very important implications to be addressed in Chapter 4.

Given the sufficient case, none of these statics change; rather, the only change occurs in the magnitude of Mexican PS respective to Mexican CS.

The U.S. net loss $bcfe$ provides no incentive for it to advocate for a minimum price policy. Mexico similarly does not benefit from a minimum price policy unless the rents it receives on its exported quantity over compensate for the Mexican TW loss. In the case of the U.S.-Mexican tomato dispute, however, a minimum price *was* implemented implying there are other factors at play, which are explained in Chapter 4.

The next step is to understand the incentive structure of both nations within this dispute. Doing so a) illuminates the counterintuitive nature of the Suspension Agreement from the perspective of the United States as well as possibly Mexico and b) provides the basis for discussing why, and under what conditions, moving from NAFTA to the Suspension Agreement may be seen as a preferred action.

CHAPTER 3: Game Representation of the U.S.-Mexican Tomato Dispute

3.1 Extensive Form Outline

To begin the analysis, this thesis first presents the possible decisions within the game and then derives the subgame-perfect Nash equilibria.

To start, both nations are enrolled within the cooperative trade agreement. For the U.S.-Mexican tomato dispute this agreement is represented by NAFTA. The United States (u) and Mexico (m) are receiving joint maximizing welfares d_u and d_m, respectively, from NAFTA. h_u and h_m represent the payoffs to the United States and Mexico, respectively, from NET. Welfare is valued alphabetically: a > b > c ... > d, etc., however a_u does not have to equal a_m; payoffs are not symmetrically restricted for reasons to be discussed later in the section. Payoffs are also intertemporal, implying that d_u, for example, represents the combined welfare in current and discounted future periods resulting from NAFTA for the United States. Welfare is measured traditionally using CS, PS, and TR[3]; no political motivations are reflected in the payoffs themselves. Figure 2 depicts the game.

Given that Mexico is the dominant exporter, it is very unlikely it will dispute this agreement, thus the United States is given the first move. To begin, nature chooses the condition of the United States: aggressive or passive. Their condition is unknown to Mexico. Mexico itself does not need to receive an explicit condition, as will soon be discovered. The United States then decides either to dispute the agreement or maintain it, denoted as "dispute" and "hold," respectively. Given a dispute, Mexico has the opportunity to negotiate and come to a new agreement, or refute negotiation. If it refutes negotiation both nations will either move to NET or back to NAFTA, depending on the condition of the United States.

As noted, Klimenko et al. (2008) derive that, given a bilateral agreement, a dispute is inevitable. The key to their result is that predicted renegotiation removes grim trigger effects from the model. This thesis takes a different approach. We maintain that a dispute can lead to renegotiation, however, renegotiation does not have to lead to the joint welfare maximizing

[3]TR is not applicable in the Suspension Agreement as there are no tariffs to collect revenues on.

agreement. Instead, nations are willing to renegotiate to any agreement so long as the payoff to both nations is greater than what they would each receive under NET. It is for this reason that there is no symmetrical payoff restriction. In Figure 2, these payoffs are represented by the B category, outlined in green, red, and yellow. Our approach also differs in that renegotiation may actually lead to a semi-stable Nash equilibrium, as our results will indicate.

The reasoning behind this approach is that, while history has shown free-trade agreements to be difficult to accomplish and to sustain, their very existence reflects the desire of nations to move away from NET and expand their trade presence; so long as the projected payoffs are greater than NET, nations will attempt to implement trade agreements. Additionally, working bilateral trade agreements do exist such as the Canada-U.S. Trade Agreement (CUSTA), thus not all bilateral agreements are doomed to fail.

Both nations have the ability to foresee these payoffs prior to the negotiation itself. The question then arises as to why a nation would dispute any agreement when, within the TW sense, it is harmful to do so. Motivations for this seemingly counterintuitive action will be explained in the next chapter.

An aggressive United States follows the mentality mentioned previously and is willing to dispute so long as it foresees a resulting payoff greater than what it would receive under NET. A passive United States, however, is only willing to dispute if it foresees a resulting payoff greater than or equal to its NAFTA payoff. In Figure 2, the possible payoffs falling within this latter category are labeled B_S. Given that NAFTA is the joint welfare maximizing agreement, this would imply Mexico's welfare must fall.

As shown, the United States will only issue a dispute if it foresees the appropriate payoff. There is always a chance, however, that negotiation will fail or be refuted by Mexico. If this occurs, an aggressive United States will initiate a tariff war[4] resulting in NET. Although Mexico theoretically has the choice of whether or not to respond to this initiation with its own tariffs, we assume it responds for two reasons: a) given the relatively massive amount of trade

[4]Within the real negotiations between the two countries, these threats of initiation manifested as the threat of imposing anti-dumping duties – immensely high tariffs on Mexican tomatoes (VanSickle 2003).

between the two nations, they are both likely "large countries" relative to each other, as outlined by Houck (1986), in at least one good. Accordingly, there exists the very real possibility that Mexico retaliates by setting an optimal response tariff on at least one other U.S. good. Optimal tariffs may produce positive welfare offsetting some of the loss Mexico incurs from the anti-dumping duties on tomatoes it now faces. The result, outlined in Riezman (1982), is that Mexico chooses to respond and both nations ultimately move to NET. b) No response by Mexico would mean the United States would not be punished for its tariff placement. As mentioned earlier, the United States, recognizing no punishment, continually deviates from any agreement to optimize its welfare unilaterally, thus no tariff agreement is sustainable. Mexico, recognizing this entire series of events, responds by moving immediately to NET.

A passive United States, however, will not initiate a tariff war and will instead wish to revert to NAFTA, a request which Mexico, as we will soon discover, will comply with.

As shown, the condition of the United States does not predetermine its decision; both an aggressive and a passive United States can issue a dispute or maintain NAFTA, depending on the expected payoffs. However, its condition is signaled to Mexico by its choice of whether or not to dispute. Disputing signals to Mexico that the United States is aggressive. Holding, conversely, signals the United States is passive. After receiving the signal, Mexico has the option to either refute any negotiation with the United States, or to negotiate.

As mentioned earlier, Mexico does not receive an explicit condition. This occurs because its response is not subject to its condition. To understand why, let us examine the situation from Mexico's point of view. Given a dispute, Mexico now views the United States as aggressive; it believes failed negotiation will result in NET. Accordingly, it negotiates to avoid a worse payoff. If, however, the United States is actually passive, failed negotiation will result in the United States wishing to move back to NAFTA. Mexico now has two options: it can comply with this request and move back to NAFTA, which maximizes its payoff from a TW standpoint, or it can refute the request and both nations move to NET. Recognizing the options, Mexico complies with the request to move back to NAFTA.

3.2 Payoff Structure

Given a dispute by the United States and negotiation by Mexico, the possible payoffs can be categorized into four groups: W, B, S, and M. W consists of the United States and Mexico receiving payoffs less than or equal to h_u and h_m, respectively. This implies both nations are fairing equally if not worse than they would be under NET. B consists of the United States and Mexico receiving payoffs greater than h_u and h_m, respectively. S consists of the United States receiving a payoff greater than h_u, while Mexico receives a payoff less than or equal to h_m. M consists of Mexico receiving a payoff greater than h_m, while the United States receives a payoff less than or equal to h_u. W, S, and M are immediately excluded as possibilities, because either one or both nations are at least as good disregarding negotiation and moving to NET[5]. Accordingly, the case where both nations gain, B, is the only payoff scenario where negotiation may take place.

B payoffs can be split into four sub categories: B_W, B_B, B_S, and B_M. B_W consists of the United States and Mexico receiving payoffs less than or equal to d_u and d_m, respectively. This implies both nations are fairing equally if not worse than they would be under NAFTA, but are still better off compared to NET. B_B consists of the United States and Mexico receiving payoffs greater than d_u and d_m, respectively. Given that NAFTA is the joint maximizing agreement, B_B is impossible. B_S consists of the United States receiving a payoff greater than d_u, while Mexico receives a payoff less than or equal to d_m. B_M consists of Mexico receiving a payoff greater than d_m, while the United States receives a payoff less than or equal to d_u.

As a final note, all the welfares in Figure 2 after the start of the game occur in period t + 1. This means that the possibility of a current period gain is eliminated. This assumption is in line with the realistic situation of the current tomato dispute. Given deviation by one nation, the response of the other will be almost instantaneous such that any possible gains are negligible.

[5]In the case where a nation receives equal payoffs from negotiation and NET, we assume it refutes negotiation.

3.3 Nash Equilibria

It is now possible to derive the subgame-perfect Nash equilibria, presented in Table 1. The columns represent the payoffs from negotiation. To reiterate, both nations can foresee these payoffs prior to negotiation itself. The rows refer to the condition of the United States.

Examining Figure 2, all possible actions are denoted by lines. Thick colored lines denote how a nation will behave given that it foresees a negotiation payoff of the same color. For example, the expected negotiation payoffs less than or equal to NET for either country are outlined in purple. Due to the aforementioned conditions, both nations have no incentive to negotiate and subsequently the United States decides to hold. As a result, the line denoting "hold" is also colored purple[6]. Double lined boxes refer to subgame-perfect Nash equilibria given an aggressive United States and triple lined boxes refer to the subgame-perfect Nash equilibria of a passive United States.

Out of the six unique scenarios there exist two Nash equilibria: $\{hold\}$ and $\{Dispute, Negotiate\}$. $\{hold\}$ refers to the United States remaining compliant with NAFTA, thus no welfare changes occur. $\{Dispute, Negotiate\}$ refers the United States disputing NAFTA and Mexico willing to negotiate to come to another more stable agreement. Let us examine each of the six scenarios.

Given an aggressive United States and the knowledge that negotiation will yield payoffs less than or equal to NET payoffs for the United States and/or Mexico, denoted by {(Aggressive U.S.) | (W, M, S)}, the United States will remain compliant with NAFTA and not dispute the agreement. The United States and Mexico both know negotiation will lead to at least one of them receiving a payoff less than or equal to what they would receive under NET, thus there is no incentive to negotiate and any attempts to negotiate will fail. With the United States being aggressive, failed negotiation leads to NET. Accordingly, the United States does not dispute the agreement.

[6] If for any reason the United States does not behave rationally and chooses to dispute, extensive form representation procedure dictates that the subsequent action by Mexico be highlighted as well. For this reason, Mexico choosing to refute negotiation and move to a tariff war is also highlighted in purple. This same principle applies to all situations within the game.

Given {(Passive U.S.) | (W, M, S)}, the United States will hold and not dispute the agreement for the same reason. This time, however, the equilibrium is stronger because a passive United States requires its payoff from negotiation to be greater than what it currently receives under NAFTA, as oppose to solely NET. Given that a passive United States will return to NAFTA if negotiation fails, it now has no incentive to dispute the agreement.

Given {(Aggressive U.S.) | (B_W, B_M)} the United States will dispute the agreement, because it knows failed negotiation results in NET, but it foresees negotiation resulting in a payoff greater than that of NET for itself as well as Mexico. Issuing a dispute flags itself as aggressive. Mexico, foreseeing its own negotiation payoff greater than its payoff from NET, chooses to negotiate to avoid what it believes to be the alternative of NET.

Given {(Passive U.S.) | (B_W, B_M)} the United States does not dispute the agreement, because it knows a) negotiation will lead to a payoff for itself less than or equal to its payoff from NAFTA and b) failed negotiation will result in moving back to NAFTA. Accordingly, it has no incentive to dispute the agreement.

Given {(Aggressive U.S.) | (B_S)} the United States will dispute the agreement because {(Aggressive U.S.) | (B_S)} is a subset of {(Aggressive U.S.) | (B_W, B_M)}; an aggressive United States only requires negotiation payoffs to be greater than the payoffs from NET for both nations. Accordingly, any payoff above that of NET, including B_S, B_W, and B_M, fulfills the same conditions and thus leads to the same outcome.

Given {(Passive U.S.) | (B_S)} the United States will dispute the agreement, because it knows negotiation will yield a payoff greater than its current payoff from NAFTA. Issuing a dispute flags itself as aggressive so Mexico, foreseeing its own negotiation payoff greater than its payoff from NET, chooses to negotiate to avoid what it believes to be the alternative of NET.

Interestingly, while the United States, in some cases, cares about its specific payoff relative to both NET and NAFTA, Mexico only cares about its payoff relative to NET. This is because Mexico sees the dispute as a signal of an aggressive United States and accordingly believes refusing to negotiate will lead to NET, although this may not actually be the case. Its only concern, then, is to avoid NET if at all possible. Another interesting point is that NET itself is not a Nash equilibrium of the game.

Given the failure to uphold NAFTA, as well as the continued negotiations over the years, let us put the equilibrium $\{hold\}$ on hold and focus on the equilibrium $\{Dispute, \ Negotiate\}$. The next chapter develops a mathematical representation of this equilibrium. Through the lens of the extensive form presented here, this mathematical representation can be viewed as the result of the negotiation taking place within $\{Dispute, \ Negotiate\}$. Chapter 4 also provides evidence as to why the United States may choose $\{Dispute, \ Negotiate\}$ given B_W or B_M; i.e., why United States may choose to leave NAFTA and receive a potentially worse payoff.

CHAPTER 4: Mathematical Representation of the Nash Equilibrium

4.1 Motivations

As shown previously, the equilibrium $\{Dispute, \ Negotiate\}$ occurs in three cases: {(Aggressive U.S.) | (B_W, B_M)}, {(Aggressive U.S.) | (B_S)}, and {(Passive U.S.) | (B_S)}. Interestingly, the first case provides a payoff to the United States that may be worse than its payoff from NAFTA. There would seem, then, to be no reason why the United States would dispute NAFTA knowing its welfare may drop as a result. To help understand the motivations behind actions such as these, economists have developed a new arena of models, known as the political economy models.

Political economy models consist of two main components: a proxy for the political influence on policy makers' decisions, and a proxy for the welfare of the nation as a whole. The goal is to capture the effect of politically biased policy makers, which may result in counterintuitive actions. Some models, such as the pioneering Stigler-Peltzman model, assume the welfare component consists only of consumers, labeled "consumer antagonism," while the producer influence component is proxied by industry profits. Other models, such as the seminal Grossman and Helpman (1994) model, comprise national welfare using TW, while the producer influence component is proxied by campaign contributions[7].

Factoring in political bias, the United States may perceive the Nash equilibrium $\{Dispute, \ Negotiate\}$ as providing greater welfare for itself than what it would receive under NAFTA, even if its TW payoff is less than its TW payoff from NAFTA. Political bias can then be seen as the willingness to lose TW; the greater the political bias, the more loss in TW is accepted. However, Chapter 3 established that the largest amount of TW loss accepted by an aggressive United States is that which would result in it receiving a payoff marginally above its payoff from NET. Since a passive United States is not willing to lose TW, being passive can then be seen as being politically neutral; there is no political bias affecting the decision making process.

[7]Because campaign contributions are miniscule compared to the loss in overall TW, TW is weighted to diminish its value in order to allow any price movement to occur.

To achieve a maximum, these models must have an objective function which falls into one of three cases, referred to as the standard case, the rising case, and the falling case. The standard case, most commonly presented in economics, occurs when the marginal losses of the function are increasing, while the marginal gains are decreasing. The rising case occurs when both the marginal gains and marginal losses are increasing, but the marginal gains are increasing at a relatively slower rate. The falling case occurs when both the marginal gains and the marginal losses are decreasing, but the marginal gains are decreasing at a relatively faster rate.

The Stigler-Peltzman framework falls within the standard case, assuming marginally increasing consumer antagonism and marginally decreasing industry profits. Their assumption of increasing consumer antagonism is a key assumption as will be discovered shortly. Hillman (1982) expands upon this model, examining the effects of a change in world price, but the assumption of increasing losses and decreasing gains holds. Grossman and Helpman (1994) do not explicitly state increasing losses to national welfare, however, it is implied by the indifference curves in their model. They similarly do not specify the assumption of marginally decreasing gains in political support; however, given that a firm with monopoly power has a profit maximizing price, the assumption is still likely, because price increases will provide marginally decreasing gains in profits to the firm leaving marginally fewer dollars for them to contribute.

Adopting these properties of marginally increasing harm to national welfare and marginally decreasing gains to political support, the first contribution of our model will be to explicitly display these properties. Doing so is important, because TW losses, excluding tariff revenues, are *decreasing*, rather than increasing, as derived in Chapter 2. To understand why this is a problem, refer to Figure 1 again. Note the net loss $e'jfe$ from the first marginal price increase $P^* \to P^e$. In order for any price movement to occur, a weight, X, must be placed on campaign contributions[8], C_1, to make C_1 greater than or equal to area $e'jfe$[9]. Assume the value of X is such that $(X * C_1) = e'jfe$ and thus price movement occurs. The next marginal price movement $P^e \rightarrow P^M$ creates a net loss $bcje' < e'jfe$. Unless campaign contributions fall to a new level, C_2, such that $\frac{C_2}{C_1} < \frac{bcje'}{e'jfe}$, the same weight X justifies the next price increase. This cycle continues until the price moves to autarky. These results imply that once industry can influence the government to marginally increase the price, the same level of influence is enough to continue to do so until autarky is achieved, which is an unreasonable conclusion. The core problem is that unless C_1 falls to a value less than or equal to C_2, creating a situation of the falling case, the objective function does not contain a maximum.

It is still possible that TW losses are increasing when tariff revenues are factored in, but only under very specific circumstances. Tariff revenues, themselves marginally decreasing in price, must drop at a fast enough rate in order to allow overall TW losses to be increasing. For example, consider a marginal price increase leading to a PS gain of 50, a CS loss of 100, and tariff revenues of 20. The net loss is 30. Now assume a further price increase. PS gains, as derived, must be greater; for example, 55. CS losses, as derived, must be smaller; for example, 95. Net loss before tariff revenues is now 40. Tariff revenues, by definition of a maximum, must decrease to, for example, 15. Overall net loss is 25, which is less than 30. In order for the TW loss to have grown, tariff revenues must decrease to below 10. This would make net loss greater than 30 and thus TW losses would be increasing. In the case of a minimum price agreement, however, there are no tariff revenues to potentially change the results.

The previous example stresses the importance of ensuring that welfare losses dominate political influence to produce a maximum for the objective function. Given the theories proposed in the Stigler-Peltzman framework, as well as the nature of the U.S.-Mexican tomato dispute, we believe the government recognizes national welfare losses to be increasing. This leaves either the standard case or the rising case as the means to achieving a maximum.

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[8]The weight can, of course, be placed on the national welfare component instead.

[9]In the case where $(X * C_1)$ = e'jfe, where the government is indifferent to increasing the price, we assume they do.

To ensure this maximum, certain factors of welfare aside from TW must be taken into account. In the literature, these factors include what is referred to as "consumer antagonism" or "voter dissatisfaction," which represent both the indirect and intangible harm (the combination of which is referred to in this thesis simply as indirect harm) consumers and producers feel when they are displaced from a level of welfare as a result of a price change. In the explicit models such as that of Grossman and Helpman, however, these factors are not actually specified. Instead, the same TW components are used to measure welfare.

To clarify, surplus for consumers is equal to the difference between the utility derived from a good, expressed as the willingness to pay, and the money spent on it. For producers, surplus is equal to the difference between the marginal cost of a product, expressed as the willingness to sell, and the actual sale price. Measuring welfare using this method suffers from a few problems.

First, while the increasing value consumers place on its consumption, as it falls, is reflected by the negatively sloped demand curve, CS itself does not take this increasing value into account. Instead, it only takes into account the change in price and the number of units affected. Using Figure 1 to illustrate, consider two marginal price movements: $P^* \rightarrow P^e$ and $P^e \rightarrow P^M$. The CS losses are $ijfd$ and $acji$, respectively. Using CS as the proxy alone implies $ijfd > acji$; the loss shrunk. The problem is that this method implies the areas $i\delta\beta d$ and $ac\delta i$ are valued equally. It is more intuitive, however, to value $ac\delta i$ greater than $i\delta\beta d$ because the loss $ac\delta i$ occurs after $i\delta\beta d$; as prices rise, the existing surplus is continually depleted and the consumer has to continually divert the surplus from other utility generating allocations. Given the law of diminishing marginal utility, the first diversion of surplus causes less harm than the second[10]. This additional harm, which makes the overall welfare loss

[10] It can be argued that a specific situation can occur wherein harm does not grow. In this situation, the consumer uses his or her surplus to buy only one unit of a diverse range of normal goods, of equal price, each providing a uniform level of utility. If we assume, however, that goods are not uniform in utility and that consumers use their surplus to purchase those goods providing the highest level of utility first, followed by the next highest, etc., the situation of increasing harm still applies.

represented by $i\delta\beta d$ less than that of $ac\delta i$, is the indirect welfare loss. Accordingly, each area has two components of welfare: surplus and indirect.

Second, there is also the effect of the loss in consumption itself. The surplus losses from consumption loss, equivalent to μf for the first marginal increase and δj for the second, are assumed to be equal, because their representative areas $cj\delta$ and $jf\mu$, respectively, are equal. In reality, the welfare of units δj are greater than that of μf, because the consumer is willing to pay more for the additional units δj than they are for μf.

The only remaining welfare to be accounted for is $\delta j\mu\beta$. In order for the overall welfare loss from the marginal price movement $P^e \rightarrow P^M$ to be greater than that of $P^* \rightarrow P^e$, the inequality $\left[\overbrace{ac\delta i - i\delta\beta d}^{>0}\right] + \left[\overbrace{cj\delta - jf\mu}^{>0}\right] > \delta j\mu\beta$ must hold. Given the two positive values on the left hand side and their combined magnitude relative to the right hand side, it is reasonable to assume the inequality holds.

To implement these non-TW factors, while maintaining the long held CS and PS as proxies for welfare, our objective function will be modified in a few ways. First, variables representing producer and consumer indirect welfare are incorporated into the welfare function. Second, following Grossman and Helpman, we necessarily weight the components of the objective function in order to allow price movement to occur. With these two modifications, welfare is no longer represented by PS and CS; rather, it is represented by a combination of surplus, satisfaction, and political appeal. When discussing the mechanisms of the TW model, this thesis will refer to the components as PS and CS. When discussing the current model, however, the components will be referred to as "producer welfare" and "consumer welfare."

The objective function itself follows the standard two component framework. Our political influence component is a weighted producer welfare, where producer welfare is the combination of PS and producer indirect welfare. The weight is endogenized on campaign contributions. Our national welfare component is consumer welfare, comprising of CS and consumer indirect welfare.

While other models may combine producer and consumer welfare together for the national welfare component and use campaign contributions as the political influence component, we choose not to, because although contributions affect the decision making process, the contributions themselves are infinitesimally small compared to the losses in TW. To illustrate, Kosse (2015) estimates the TW effects of the 2013 modifications to the Suspension Agreement, relative to free trade. Results show that the United States suffers a loss of approximately 85 million dollars per year in TW, contrasted with an annual gain in total campaign contributions and lobbying of roughly one million. This miniscule relation also serves as an argument against detracting contributions from consumer and/or producer welfare. Therefore, contributions do not take away from contributor welfare, as they are negligible when compared with the return on welfare they provide.

Conversely, contributions are not negligible relative to the government. They provide a relatively large source of income for government officials. Consequently, our model applies campaign contributions implicitly as a deciding factor in the preference given to producers relative to consumers by the government, a preference manifest as the weight.

A second reason for not including government welfare is that, given that the Suspension Agreement implies no tariff revenues, overall government welfare is negligible compared to the welfare of producers and consumers. As a result, our model more closely follows the Stigler-Peltzman approach, using a certain measure of producer welfare as the proxy for the political influence component.

Each nation is first modeled in isolation, a process which ignores the effects of the other nation; i.e., when discussing Mexico, the United States has no say in policy and vice versa. The two models are then combined to create the full model and correct for this unrealistic assumption; however, isolated modeling is still important, as it reveals the desires of each nation. To begin, nation i imports the good with the minimum price and nation j exports the good. Policy makers in nations i and j aim to maximize their respective welfare.

4.2 Modeling the Importing Nation

The objective function is

$$\left[\alpha_i \begin{pmatrix} C_i^P \left(P^m , \Omega_i \left(Q_i^P \left(P^m\right)\right) \right. , \\ C_i^C \left(P^m , \Theta_i \left(Q_i^C \left(P^m\right)\right)\right. \end{pmatrix}\right] W_i^P \left(P^m , \Omega_i \left(Q_i^P \left(P^m\right)\right) \right)$$
$$+ W_i^C \left(P^m , \Theta_i \left(Q_i^C \left(P^m\right)\right)\right), \tag{5}$$

where P^m is the minimum price. W_i^P and W_i^C represent producer and consumer welfare, respectively. Welfare is a function of two components. The first component, denoted by P^m, reflects the TW effects – producer surplus for W_i^P and consumer surplus for W_i^C – at P^m. The second component, denoted by Ω for producers and Θ for consumers, reflects the level of indirect welfare at P^m. Ω and Θ are measured in terms of loss; i.e., $\frac{\partial W^P}{\partial \Omega} < 0$ and $\frac{\partial W^C}{\partial \Theta} < 0$. Indirect welfare is measured as a function of Q. For producers, the term is denoted Q_i^P and is equivalent to the loss in quantity produced at P^m relative to free trade. For consumers, the term is denoted Q_i^C and is equivalent to the loss in quantity consumed at P^m relative to free trade. This implies that prices above free trade result in $-\,Q_i^P$, or $\frac{\partial Q_i^P}{\partial P^m} < 0$, or a gain in quantity produced. Consequently, $\frac{\partial Q_i^C}{\partial P^m} > 0$; prices above free trade result in a loss in quantity consumed. To illustrate in Figure 1, a minimum price of P^M means Q_i^C is equal to $Q^{DU^*} - Q^{DUM}$ and Q_i^P is equal to $Q^{SU^*} - Q^{SUM}$. $Q\ (P^m)$ reflects the fact that the quantity gained or lost, relative to free trade, is a function of the minimum price.

α, the weight placed producer welfare, is endogenized on the campaign contributions of those in support of price increases, C^P, and those against it, C^C. In the case of the U.S.-Mexican tomato dispute, C^P can be thought of as contributions from associations, such as the Florida Tomato Growers Exchange, in support of higher prices, while C^C can be thought of as contributions from tomato processors, such as Wal-Mart, who are against price hikes. Contributions are of two types: lobbying and direct contributions. Direct contributions are in support of a policy currently in place, while lobbying occurs in attempt to change a policy currently in place. Effects on direct contributions coming from the current policy are denoted by P^m, while effects coming from lobbying are reflected by the level of indirect welfare loss, Ω and Θ, as they are the result of dissatisfaction and the subsequent desire of achieving a change in policy. Following the insight of Mitra (1999), we have endogenized lobbying; however, instead of endogenizing on the equality of asset ownership, we endogenize on the level of political satisfaction, as it is a likely root cause for changes in asset ownership. The intuition behind this reasoning is that individuals can be sparked into political action through their dissatisfaction. This action may manifest as boycotts, union formations, and advocating for legislation which regulates monopoly power, all aimed at equalizing asset ownership.

Important to note is that, in the same way quantity demanded differs from demand itself (in that it is a function of price), each term in (5) can be affected endogenously – from P^m – but also exogenously. For example, a bill may be passed removing campaign contribution caps from industry. This may raise C_i^P when no price change has occurred. Similarly, a change in tastes and preferences can reduce overall demand, lowering W_i^C when no price changed has occurred. Another example posited by Mitra (1999) is in elected officials' changing appetites for campaign contributions. It is for these potential exogenous changes that α is stated explicitly in (5); if it were not exogenously affected it would simply be inserted into the welfare function of producers.

Taking the FOC of (5)

$$\begin{aligned}
&\left(\left[\overbrace{\frac{\partial \alpha_i}{\partial C_i^P}}^{+,\,\le 0} * \overbrace{\frac{\partial C_i^P}{\partial P^m}}^{+,\,-} \right] + \left[\overbrace{\frac{\partial \alpha_i}{\partial C_i^P}}^{+,\,\le 0} * \overbrace{\frac{\partial C_i^P}{\partial \Omega_i}}^{+,\,+} * \overbrace{\frac{\partial \Omega_i}{\partial Q_i^P}}^{+,\,+} * \overbrace{\frac{\partial Q_i^P}{\partial P^m}}^{-,\,\sim} \right] \right. \\
&\left. + \left[\overbrace{\frac{\partial \alpha_i}{\partial C_i^C}}^{-,\,\ge 0} * \overbrace{\frac{\partial C_i^C}{\partial P^m}}^{-,\,-} \right] + \left[\overbrace{\frac{\partial \alpha_i}{\partial C_i^C}}^{-,\,\ge 0} * \overbrace{\frac{\partial C_i^C}{\partial \Theta_i}}^{+,\,+} * \overbrace{\frac{\partial \Theta_i}{\partial Q_i^C}}^{+,\,+} * \overbrace{\frac{\partial Q_i^C}{\partial P^m}}^{+,\,\sim} \right] \right) W_i^P\left(P^m,\, \Omega_i\left(Q^P\left(P^m\right)\right) \right) \\
&+ \left(\left[\overbrace{\frac{\partial W_i^P}{\partial P^m}}^{+,\,+} \right] + \left[\overbrace{\frac{\partial W_i^P}{\partial \Omega_i}}^{-,\,-} * \overbrace{\frac{\partial \Omega_i}{\partial Q_i^P}}^{+,\,+} * \overbrace{\frac{\partial Q_i^P}{\partial P^m}}^{+,\,\sim} \right] \right) \alpha_i \begin{pmatrix} C_i^P\left(P^m,\, \Omega_i\left(Q_i^P\left(P^m\right)\right)\right), \\ C_i^C\left(P^m,\, \Theta_i\left(Q_i^C\left(P^m\right)\right)\right) \end{pmatrix} \\
&= -\left(\left[\overbrace{\frac{\partial W_i^C}{\partial P^m}}^{-,\,+} \right] + \left[\overbrace{\frac{\partial W_i^C}{\partial \Theta_i}}^{-,\,-} * \overbrace{\frac{\partial \Theta_i}{\partial Q_i^C}}^{+,\,+} * \overbrace{\frac{\partial Q_i^C}{\partial P^m}}^{+,\,\sim} \right] \right). \qquad (6)
\end{aligned}$$

For each term in (6), the first sign above the term reflects the value of the term itself. The second sign reflects the derivative of the term, where positive indicates concave up, and negative indicates concave down. To understand both of these elements for all the terms in (6), the behavior of Θ and Ω must be known. As derived earlier, indirect harm accrues at an increasing rate, meaning $\frac{\partial \Omega_i}{\partial Q_i^P}$, $\frac{\partial^2 \Omega_i}{\partial Q_i^P}$, $\frac{\partial \Theta_i}{\partial Q_i^C}$, and $\frac{\partial^2 \Theta_i}{\partial Q_i^C}$ are all positive and $\frac{\partial W_i^P}{\partial \Omega_i}$, $\frac{\partial^2 W_i^P}{\partial \Omega_i^2}$, $\frac{\partial W_i^C}{\partial \Theta_i}$, and $\frac{\partial^2 W_i^C}{\partial \Theta_i^2}$, are all negative. These characteristics are denoted in (6) by $\overbrace{\frac{\partial \Omega_i}{\partial Q_i^P}}^{+,\,+}$, $\overbrace{\frac{\partial \Theta_i}{\partial Q_i^C}}^{+,\,+}$, $\overbrace{\frac{\partial W_i^P}{\partial \Omega_i}}^{-,\,-}$, and $\overbrace{\frac{\partial W_i^C}{\partial \Theta_i}}^{-,\,-}$.

By the definition of Q_i^P and Q_i^C, $\overbrace{\frac{\partial Q_i^P}{\partial P^m}}^{-,\,\sim}$ and $\overbrace{\frac{\partial Q_i^C}{\partial P^m}}^{+,\,\sim}$, where "~" implies that the derivative of the term will depend on whether the supply and demand curves are linear, concave to the origin, or convex to the origin. In the case of supply and demand curves convex to the origin, the derivative for both terms will be negative. However, given that the change in quantity will be miniscule for marginal movements, the slowing of growth of Ω or Θ due to this situation is assumed to be dominated by the increasing growth of $\overbrace{\frac{\partial \Omega_i}{\partial Q_i^P}}^{+,+}$ and $\overbrace{\frac{\partial \Theta_i}{\partial Q_i^C}}^{+,+}$. For PS and CS effects, (1) and (2) imply $\overbrace{\frac{\partial W_i^P}{\partial P^m}}^{+,+}$ and $\overbrace{\frac{\partial W_i^C}{\partial P^m}}^{-,+}$.

Examining α, the model assumes that marginally increasing indirect harm results in marginally increasing political activism; i.e., individuals push harder for their interests, as their distress grows, at an increasing rate, implying $\overbrace{\frac{\partial C_i^P}{\partial \Omega}}^{+,+}$ and $\overbrace{\frac{\partial C_i^C}{\partial \Theta}}^{+,+}$. However, contributions resulting from support of existing policies are assumed to be decreasing, as in the Stigler-Peltzman model, implying $\overbrace{\frac{\partial C_i^P}{\partial P^m}}^{+,-}$ and $\overbrace{\frac{\partial C_i^C}{\partial P^m}}^{-,-}$. Lastly, the government receives contributions and in turn allocates preference in the form of weight to the contributing player, implying $\overbrace{\frac{\partial \alpha_i}{\partial C_i^P}}^{+,\,\leq 0}$ and $\overbrace{\frac{\partial \alpha_i}{\partial C_i^C}}^{-,\,\geq 0}$, where ≤ 0 and ≥ 0 imply that the derivative of these terms contains a linear limit; i.e., increasing marginal preference from campaign dollars is unlikely.

The proper evidence now exists to display marginally increasing harm to national welfare and marginally decreasing gains to political support, leading to a maximum. This maximum likely occurs by the standard case. To understand how, refer to the previous breakdown of indirect welfare, which showed the likelihood of marginally increasing indirect harm, $\overbrace{\frac{\partial W_i^C}{\partial \Theta_i}}^{-,-}$, dominating the marginally decreasing CS loss, $\overbrace{\frac{\partial W_i^C}{\partial P^m}}^{-,+}$. The result (excluding the effects from α_i) is $\overbrace{\frac{dW_i^C}{dP^m}}^{-,-}$, or increasing marginal loss of consumer welfare. For producers, a price decrease will result in all the same effects, thus a price increase will produce $\overbrace{\frac{dW_i^P}{dP^m}}^{+,-}$. Together, $\overbrace{\frac{dW_i^C}{dP^m}}^{-,-}$

and $\overbrace{\frac{dW_i^P}{dP^m}}^{+,-}$ lead toward the standard case, however the final answer requires the knowledge of $\frac{d\alpha_i}{dP^m}$.

$\frac{d\alpha_i}{dP^m}$ is ultimately ambiguous, as it depends on the specific nature of each government, however its exact value is not pertinent for our analysis; rather, there are only two necessary conditions placed on α_i. 1) For the first marginal price increase up from free trade, $\left(\alpha_i * \Delta W_i^P\right) \geq \left|\Delta W_i^C\right|$. This must hold to allow price movement. 2) If $\frac{d\alpha_i}{dP^m} \geq 0$, then for any marginal price increase $P^1 \rightarrow P^2$, $\Delta\alpha_i \leq \frac{|W_i^C(P^2)|}{W_i^P(P^2)} - \frac{W|_i^C(P^1)|}{W_i^P(P^1)}$, otherwise, price movements would be justified all the way to autarky. Accordingly, condition 2 ensures $\overbrace{\frac{d\left(\alpha_i W_i^P\right)}{dP^m}}^{+,-}$. Together, $\overbrace{\frac{d\left(\alpha_i W_i^P\right)}{dP^m}}^{+,-}$ and $\overbrace{\frac{dW_i^C}{dP^m}}^{-,-}$ define the standard case.

With the maximum derived, the next objective is to link the objective function with the Nash equilibrium $\{Dispute, \ Negotiate\}$. Doing so requires an understanding of the effects of exogenous and endogenous changes in (6). Rearranging (6), with simplified notation, produces

$$\overbrace{\frac{dW_i^P}{dP^m}}^{+,-} = -\frac{1}{\alpha_i}\left[\overbrace{\frac{dW_i^C}{dP^m}}^{-,-} + \overbrace{\frac{da_i}{dP^m}}^{\sim\ ,\ l_U} * \ W_i^P\right], \tag{7}$$

where l_U reflects the effect of condition 2 being placed on α_i. All endogenous effects are taken into account within (7); that is, this equality cannot and will not change from endogenous affects, because, by definition, it has already taken any potential welfare increasing changes into account. The resulting equilibrium P^m in (7) is thus the negotiated minimum price within $\{Dispute, \ Negotiate\}$. Consequently, the drivers changing this equilibrium must be exogenous changes.

4.3 Evidence of Exogenous Shocks

Figure 3 presents an example of what an exogenous shock may manifest as in reality. The Florida Tomato Exchange, whose motto is “We are growers, all for one and one for all,” (Florida Growers, 2016) spent no lobbying money from 2004 to 2007. Their lobbying over the next six years, however, averaged $35,000. The Florida Farm Bureau, whose mission is to "increase the net income of farmers and ranchers, and to improve the quality of rural life," (Florida Bureau, 2016) followed a similar pattern, beginning to lobby in 2008, averaging about $80,000 over the next six years.

The Florida Fruit and Vegetable Association, whose mission is to "enhance the business and competitive environment for producing and marketing fruits, vegetables and other crops," (FFVA, 2016) averaged $42,500 in annual spending from 2004 to 2007. Their average over the next six years increased to over $44,000, with annual spending peaking at $90,000 in 2013.

There is evidence, then, that a shift affecting lobbying spending has taken place around 2008. If this has occurred then a similar shift should also be seen by the opponents of tomato price hikes. These would include tomato processors and value stores who are consistently attempting to lower their costs of production. Figure 4 indeed reveals a similar shift taking place, however, the diversity within these organizations prevents an exact knowledge of what proportion of lobbying dollars were specifically directed towards the Suspension Agreement.

Following a shock of this type, an exogenous increase may occur in α_i, destabilizing (7) and resulting in

$$\frac{\overbrace{dW_i^P}^{+,\,-}}{dP^m} < -\frac{1}{\alpha_i}\left[\frac{\overbrace{dW_i^C}^{-,\,-}}{dP^m} + \frac{\overbrace{da_i}^{\sim\;,\;l_U}}{dP^m} * W_i^P\right], \tag{8}$$

wherein P^m will increase until (7) is achieved again.

While the recent changes to the Suspension Agreement may be seen as the manifestation of an unstable cooperative trade agreement, we argue the cooperative trade agreement should be seen as NAFTA, and has deteriorated – with respect to tomatoes – long ago, leading to the Suspension Agreement, or what this thesis views as the Nash equilibrium. Our model implies that the changes within the Suspension Agreement are, then, manifestations of adjustments of a pre-existing Nash equilibrium to exogenous changes within one or both nations. Up until this point, however, changes within Mexico's attributes, as well as its overall effects on negotiation, have not been taken into account. While Mexico does not affect any of the terms in (5), where (5) represents the interests of the United States, it does have a say in the overall decision; (5) does not represent the complete picture. However, developing this picture requires an understanding of Mexico's interests, it being the exporting nation.

4.4 Modeling the Exporting Nation

The objective function is

$$\left[\alpha_j \begin{pmatrix} C_j^P\left(P^m, \Omega_j\left(Q_j^P\left(P^m\right)\right)\right), \\ C_j^C\left(P^m, \Theta_j\left(Q_j^C\left(P^m\right)\right)\right) \end{pmatrix}\right] W_j^P\left(P^m, \Omega_j\left(Q_j^P\left(P^m\right)\right)\right)$$
$$+ W_j^C\left(P^m, \Theta_j\left(Q_j^C\left(P^m\right)\right)\right), \tag{9}$$

where the terminology is all the same, but is referring to nation j, the exporting nation.

Just as the statics of (9) will not differ at the free-trade price regardless of whether Mexico is in the sufficient case or insufficient case, the FOC of (9) is also unaffected. This is because (9)'s behavior is identical at the welfare maximizing price, whatever that price may be.

The FOC is

$$
\begin{aligned}
&\left(\begin{array}{l} \left[\overbrace{\frac{\partial \alpha_j}{\partial C_j^P}}^{+,\, \le 0} * \overbrace{\frac{\partial C_j^P}{\partial P^m}}^{-,\, -} \right] + \left[\overbrace{\frac{\partial \alpha_j}{\partial C_j^P}}^{+,\, \le 0} * \overbrace{\frac{\partial C_j^P}{\partial \Omega_j}}^{+,\, +} * \overbrace{\frac{\partial \Omega_j}{\partial Q_j^P}}^{+,\, +} * \overbrace{\frac{\partial Q_j^P}{\partial P^m}}^{+,\, \sim} \right] \\ + \left[\overbrace{\frac{\partial \alpha_j}{\partial C_j^C}}^{-,\, \ge 0} * \overbrace{\frac{\partial C_j^C}{\partial P^m}}^{+,\, -} \right] + \left[\overbrace{\frac{\partial \alpha_j}{\partial C_j^C}}^{-,\, \ge 0} * \overbrace{\frac{\partial C_j^C}{\partial \Theta_j}}^{+,\, +} * \overbrace{\frac{\partial \Theta_j}{\partial Q_j^C}}^{+,\, +} * \overbrace{\frac{\partial Q_j^C}{\partial P^m}}^{-,\, \sim} \right] \end{array} \right) W_j^P \left(P^m,\, \Omega_j \left(Q^P \left(P^m \right) \right) \right) \\
&+ \left(\left[\overbrace{\frac{\partial W_j^P}{\partial P^m}}^{-,\, +} \right] + \left[\overbrace{\frac{\partial W_j^P}{\partial \Omega_j}}^{-,\, -} * \overbrace{\frac{\partial \Omega_j}{\partial Q_j^P}}^{+,\, +} * \overbrace{\frac{\partial Q_j^P}{\partial P^m}}^{+,\, \sim} \right] \right) \alpha_j \left(\begin{array}{l} C_j^P \left(P^m,\, \Omega_j \left(Q_j^P \left(P^m \right) \right) \right), \\ C_j^C \left(P^m,\, \Theta_j \left(Q_j^C \left(P^m \right) \right) \right) \end{array} \right) \\
&= - \left(\left[\overbrace{\frac{\partial W_j^C}{\partial P^m}}^{+,\, +} \right] + \left[\overbrace{\frac{\partial W_j^C}{\partial \Theta_j}}^{-,\, -} * \overbrace{\frac{\partial \Theta_j}{\partial Q_j^C}}^{+,\, +} * \overbrace{\frac{\partial Q_j^C}{\partial P^m}}^{+,\, \sim} \right] \right). \qquad (10)
\end{aligned}
$$

$\overbrace{\frac{\partial \alpha_j}{\partial C_j^P}}^{+,\, \le 0}$, $\overbrace{\frac{\partial C_j^P}{\partial \Omega_j}}^{+,\, +}$, $\overbrace{\frac{\partial \Omega_j}{\partial Q_j^P}}^{+,\, +}$, $\overbrace{\frac{\partial \alpha_j}{\partial C_j^C}}^{-,\, \ge 0}$, $\overbrace{\frac{\partial C_j^C}{\partial \Theta_j}}^{+,\, +}$, $\overbrace{\frac{\partial \Theta_j}{\partial Q_j^C}}^{+,\, +}$, $\overbrace{\frac{\partial W_j^P}{\partial \Omega_j}}^{-,\, -}$, and $\overbrace{\frac{\partial W_j^C}{\partial \Theta_j}}^{-,\, -}$ are identical to (6). The remaining six terms differ in comparison to (6): $\overbrace{\frac{\partial C_j^P}{\partial P^m}}^{-,\, -}$ and $\overbrace{\frac{\partial C_j^C}{\partial P^m}}^{+,\, -}$, because a higher minimum price creates a lower new Mexican domestic price, harming Mexican producers and benefiting Mexican consumers. The derivatives are for the same reasons as in (6). $\overbrace{\frac{\partial Q_j^P}{\partial P^m}}^{+,\, \sim}$ and $\overbrace{\frac{\partial Q_j^C}{\partial P^m}}^{-,\, \sim}$, because a higher minimum price creates a loss in quantity for Mexican producers, implying a positive Q_j^P, and a gain in quantity for Mexican consumers, implying a negative Q_j^C. The derivatives are ambiguous for the same reasons as in (6). For PS and CS effects, (3) and (4) imply $\overbrace{\frac{\partial W_j^P}{\partial P^m}}^{-,\, +}$, and $\overbrace{\frac{\partial W_j^C}{\partial P^m}}^{+,\, +}$. An additional reason for $\overbrace{\frac{\partial W_j^P}{\partial P^m}}^{-,\, +}$ is that the increasing rents Mexico receives on exports from increases in the minimum price cement the term’s upward concavity.

Lastly, just as in the case of the United States, indirect harm is assumed to dominate TW loss to create $\overbrace{\frac{dW_j^P}{dP^m}}^{-,-}$ and $\overbrace{\frac{dW_j^C}{dP^m}}^{+,-}$.

$\frac{da_j}{dP^m}$ is ambiguous as in (6) and is subject to two conditions similar to those of $\frac{da_i}{dP^m}$. 1) For the first marginal price increase up from free trade, $\left(\alpha_j * \left|\Delta W_j^P\right|\right) \leq \Delta W_i^C$. This must hold to allow price movement. 2) If $\frac{da_j}{dP^m} \leq 0$, then for any marginal price increase $P^1 \rightarrow P^2$, $\left|\Delta\alpha_j\right| \leq \frac{\left|W_j^P(P^2)\right|}{W_j^C(P^2)} - \frac{\left|W_j^P(P^1)\right|}{W_j^C(P^1)}$, otherwise, price movements would be justified all the way to autarky. These conditions ensure $\overbrace{\frac{d\left(\alpha_j W_j^P\right)}{dP^m}}^{-,-}$.

Rearranging (10) with simple notation

$$\overbrace{\frac{dW_j^C}{dP^m}}^{+,-} = -\left[\overbrace{\frac{d\alpha_j}{dP^m}}^{\sim,\,l_M} W_j^P + \overbrace{\frac{dW_j^P}{dP^m}}^{-,-}\alpha_j\right], \tag{11}$$

where l_M reflects the effect of condition 2 being placed on α_j.

To increase the minimum price, an exogenous change, such as a drop in α_j, must occur to create

$$\overbrace{\frac{dW_j^C}{dP^m}}^{+,-} > -\left[\overbrace{\frac{da_j}{dP^m}}^{\sim,\,l_M} W_j^P + \overbrace{\frac{dW_j^P}{dP^m}}^{-,-}\alpha_j\right], \tag{12}$$

wherein P^m would rise until (11) is achieved again.

4.5 The Full Model

Up until this point Mexico and the United States have been examined in isolation, each unaffected by the other. The reality is that neither nation is the sole decider in the matter. The simple solution to correct for the fact that both nations have to negotiate and have weight in the decision is to combine (5) and (9) to create the full model. In simple notation, it is as follows

$$\alpha_i W_i^P + W_i^C + \alpha_j W_j^P + W_j^C. \tag{13}$$

Maximizing joint welfare, combined with the possibility of asymmetric payoffs – $\left[\alpha_i W_i^P + W_i^C\right] \neq \left[\alpha_j W_j^P + W_j^C\right]$ – gives (13) a simple yet useful property; each nation's portion of overall welfare becomes its weight in the decision making process. While previous research maximizes joint welfare because transfers are assumed to occur (which upholds the symmetric payoff restriction), our full model maximizes joint welfare to allow each nation's welfare to act as its weight in the decision making process; the greater the magnitude of a nation's welfare, respective to the other, the more the price will be adjusted in its favor. The FOC of (13) is

$$\overbrace{\overbrace{\frac{\overbrace{d\left(\alpha_i W_i^P\right)}^{+\,,\,-}}{dP^m}}\underbrace{\alpha_i \overbrace{\frac{dW_i^P}{dP^m}}^{+\,,\,-} + \overbrace{\frac{d\alpha_i}{dP^m}}^{\sim\,,\,l_U} W_i^P} + \overbrace{\frac{dW_j^C}{dP^m}}^{+\,,\,-}}^{+\,,\,-} = -\overbrace{\left[\overbrace{\frac{dW_i^C}{dP^m}}^{-\,,\,-} + \underbrace{\alpha_j \overbrace{\frac{dW_j^P}{dP^m}}^{-\,,\,-} + \overbrace{\frac{d\alpha_j}{dP^m}}^{\sim\,,\,l_M} W_j^P}_{\frac{\overbrace{d\left(\alpha_j W_j^P\right)}^{-\,,\,-}}{dP^m}}\right]}^{-\,,\,-}, \qquad (14)$$

where the terms are arranged such that all components increasing in P^m are on the left side and all components decreasing in P^m are on the right. All the terms in (14) have been derived previously. As a result, all the intuitions about the effects of exogenous changes within any one of these four components are realized. For example, an increase in α_i pushes the equilibrium price of (14) in the direction which favors those whose welfare is attached to α_i; in this case, U.S. producers. The difference between (14) and (6), however, is that the added harm to Mexico in (14), as oppose to the harm solely to U.S. consumers in (6), implies that, for an equivalent price increase to occur, the exogenous increase in α_i must be greater in (14) that it would need to be in (6) to make up for the additional harm. (14), then, naturally captures the weight of each nation by its respective welfare.

With the Nash equilibrium modeled, we can now discover what conditions are necessary to uphold a cooperative free trade agreement. Following the methodology of Klimenko et al. (2008), the next chapter first examines these conditions without a DSI to see if a cooperative trade agreement is sustainable bilaterally. Next, a DSI is implemented into the model to note any meaningful results and useful implications.

CHAPTER 5: Modeling the DSI in a Politically Biased Atmosphere

5.1 Differences between TW and Politically Biased Frameworks

This section applies the sustainability conditions for a DSI mediated cooperative trade agreement, developed by Klimenko et al. (2008). While they derive their results within a TW framework, this thesis necessarily extends the methodology to a political economy framework; i.e., (5), (9), and (13). The necessity for doing so results from key differences between the two frameworks.

In the TW framework nations are punished by the DSI by having to move to NET until the dispute is resolved, however, Chapter 3 derived that the Nash equilibria of the current game do not include NET; instead, nations either maintain the agreement or move to the specific equilibrium $\{Dispute,\ Negotiate\}$, which is actually favored over the cooperative trade equilibrium. The reason for this difference is that in the TW framework, joint welfare is maximized at free trade. This is not true in the political economy framework, where nations willingly advocate for trade barriers as a result of political influence in both nations. This means that the DSI must make nations agree to something they actually do not want to do, which may make it impossible for the DSI to mediate an agreement. At the very least, DSI tactics must be appropriately altered.

For context, the DSI originally has two tools to sustain cooperative trade agreements. The first tool is to settle the dispute with delay and have both nations receive their respective Nash solution welfare, which are NET payoffs in the TW framework, until the dispute is resolved with probability p. The second tool is to apply this delay tactic with the addition of forcing the disputing nation to pay a penalty as a prerequisite to reinstating the cooperative trade agreement.

There are also key differences between tariff policy and minimum price policy, which must be taken into account. First, neither nation has the ability to unilaterally change the price in a minimum price agreement. The only way for either nation to defect is of course to set a policy it can solely control, such as a tariff, import quota, etc. Together, the framework differences and policy differences are combined to create an appropriate adaptation of the game.

5.2 Representation with no DSI

For simplicity, we denote $W_i\left(P^m, \Omega_i\left(Q_i^P\left(P^m\right)\right)\right)$ as $W(P^m)$, $\alpha_i\left(C_i^P\left(P^m, \Omega_i\left(Q_i^P\left(P^m\right)\right)\right), C_i^C\left(P^m, \Theta_i\left(Q_i^C\left(P^m\right)\right)\right)\right)$ as $\alpha_i(P^m)$, etc.

Nation i: the United States

$$\overbrace{\alpha_i\left(P^f\right)W_i^P\left(P^f\right)+W_i^C\left(P^f\right)}^{A} + \frac{\delta}{1-\delta}\left[\overbrace{\alpha_i\left(P^f\right)W_i^P\left(P^f\right)+W_i^C\left(P^f\right)}^{A}\right]$$

$$\geq \overbrace{\alpha_i\left(P^f\right)W_i^P\left(P^f\right)+W_i^C\left(P^f\right)}^{A} + \frac{\delta}{1-\delta}\left[\overbrace{\alpha_i\left(P^N\right)W_i^P\left(P^N\right)+W_i^C\left(P^N\right)}^{D}\right], \quad (15)$$

where A and D are labels for ease. A represents the payoff from the cooperative trade agreement; NAFTA. D is the payoff to the United States from the Nash solution, either $\{hold\}$ or $\{Dispute,\ Negotiate\}$; i.e., the solution to (14). P^N refers to the price satisfying (14).

(15) represents the situation for the United States without a DSI. The current period gain on both sides of (15) is A because there is no within period gain from defecting. Accordingly, (15) can be simplified to $A \geq D$, an inequality that depends on the value of D. The possible outcomes of (15) can then be separated into three groups.

The first group consists of the outcomes where (15) is satisfied, and $P^N > P^f$; there is political bias. Referring to Figure 2, these outcomes occur when the foreseen payoffs – the results of (13) – are W, S, and M under an aggressive United States, and W, S, M, B_M, and B_W under a passive United States. In these cases, the losses in welfare from disputing are so great that even a politically biased government is not willing to suffer them, as mentioned in Chapter 4. In terms of (15), this is seen as the negotiation payoff, D, being less than the cooperative payoff, A. Accordingly, satisfying (15) in this case is equivalent to the Nash equilibrium $\{hold\}$.

The second group consists of a single outcome where (14) is satisfied by $P^m = P^f$, thus $P^N = P^f$. This implies there is no political bias meaning the TW framework is essentially in effect. As a result, $D = A$ and (15) is satisfied. This case is most similar to the framework of Klimenko et al. (2008) in that negotiation leads back to the TW maximizing agreement, however, according to the framework developed in Chapter 3, this negotiation outcome of NAFTA is stable even without a DSI, under the proper conditions.

The third group consists of the cases where (15) is not satisfied, and $P^N > P^f$; i.e., there is political bias. In this group, $D - A > 0$ and represents the preference of $\{Dispute,\ Negotiate\}$ over the free-trade agreement. $D > A$ is the mathematical result of the framework difference mentioned earlier; i.e., nations may actually gain from the Nash equilibrium in the political economy framework as oppose to being harmed by it in the TW framework. Because $D > A$, (15) is only satisfied at P^N; i.e., $\{Dispute,\ Negotiate\}$ ensues and thus the cooperative trade agreement, A, is the Nash solution, D. Now both sides of (15) are equal and the inequality is satisfied.

Mexico's situation is not applicable here, because it is unaware of the condition of the United States. Therefore, it does not know what its own deviation will lead to. Additionally, its consistent compliance with the United States throughout the dispute supports the assertions made in Chapter 3 that it will not initiate any dispute on its own. Instead, it will wait for the United States to make its move and respond accordingly.

5.3 Representation with DSI

With a DSI utilizing delay, (15) becomes

$$A + \frac{\delta}{1-\delta}(A) \geq A + \frac{\delta}{1-\delta}\left[p(A) + (1-p)(D)\right], \tag{16}$$

which also simplifies to $A \geq D$, thus a DSI utilizing delay as a tactic has no effect.

With a DSI utilizing delay with the addition of penalizing the defecting nation by an amount Π, (15) becomes

$$A + \frac{\delta}{1-\delta}(A) \geq A + \frac{\delta}{1-\delta}\left[p(A-\Pi) + (1-p)(D)\right], \tag{17}$$

which simplifies to

$$A \geq Ap - \Pi p + D - Dp$$

$$A(1-p) \geq -\Pi p + D(1-p)$$

$$\Pi p \geq (1-p)[D-A]$$

$$\Pi \geq \frac{(1-p)}{p}[D-A] = \Pi^{*}.$$

The penalty has to be at least as great as the discounted value of the gain from moving to the Nash solution, however, if the penalty does fulfill this condition, the defecting nation is still better off ignoring the DSI because $A + \frac{\delta}{1-\delta}A \leq A + \frac{\delta}{1-\delta}D$. Consequently, a DSI utilizing the delay-plus-penalty tactic is ineffective against politically biased nations favoring trade barriers, so long as DSI compliance is voluntary. However, if a nation is in debt with the DSI, then the DSI may have the ability to enforce (17) with a penalty $\Pi \geq \Pi^{*}$. The penalty may come in the form of interest rate manipulation, loan refusals, etc.

As is now evident, political bias alters the effectiveness of a DSI in mediating cooperative trade agreements. It does so by changing the incentives of nations to that which is beyond the control of the DSI; specifically, nations may change from desiring lower trade barriers to higher ones. These higher trade barriers used to be a tool yielded by the DSI as a threat to enforce lower trade barriers. With political bias, however, high barriers may no longer be seen as a threat; rather, they may be desired. Desiring these high barriers removes the enforcing power the DSI once yielded.

CHAPTER 6: Thesis Implications and Conclusions

6.1 Concluding Remarks

This thesis develops a game theoretical analysis of the U.S.-Mexican tomato dispute in both politically neutral and politically biased environments. The process provides evidence as to why a nation may implement a trade policy which may not appear to be in its best interest.

The game reveals Nash equilibria which are heavily dependent on the political environment. We then model the most relevant equilibrium mathematically to understand how it may change to exogenous shocks. The Suspension Agreement, an agreement placing a minimum price by the United States on imported Mexican tomatoes, resulting from the dispute, is one of the possible manifestations of this equilibrium. Our argument is that the continued modifications to the Suspension Agreement are manifestations not of a failed recurrent cooperative trade agreement, but of adjustments to this Nash equilibrium as a result of these exogenous shocks.

Chapter 2 develops a graphical and mathematical understanding of the welfare effects of the Suspension Agreement on the United States and Mexico. Welfare is measured traditionally using producer surplus, consumer surplus, and tariff revenues. The results show that the United States loses overall welfare, but Mexico may gain in overall welfare. Mexico's welfare depends on the value of the rents it receives on its exported quantity.

Chapter 2 also examines the statics of producer surplus and consumer surplus for both nations. The results show that, for the United States, producer surplus gains are marginally increasing and consumer surplus losses are marginally decreasing (in absolute value), from increases in the minimum price. For Mexico, producer surplus losses are marginally decreasing (in absolute value) and consumer surplus gains are marginally increasing, from increases in the minimum price. The fact that surplus losses are marginally shrinking in absolute value for both nations poses a key problem as it may not allow the objective functions developed previously in the literature to achieve a maximum. This problem is addressed and corrected for in Chapter 4.

Chapter 3 develops an extensive form representation of the U.S.-Mexican tomato dispute, beginning at NAFTA. The game reveals two subgame-perfect Nash equilibria. One consists of no dispute being issued and NAFTA remaining in place. The second consists of a dispute taking place and both nations subsequently negotiating a more stable agreement.

Chapter 4 develops a model of the second Nash solution, depicting the negotiation process. The model begins by displaying the selfish interests of both nations, and then combines those interests to create the full model, which reveals a surprisingly simple characteristic. Maximizing the nations' joint welfare allows each nation's welfare to act as its weight in the decision making process. This of course assumes no symmetrical payoff restrictions, the reasons for which are described in Chapter 3. As a result, the larger a nation's welfare, the more the price will move in its favor.

The final chapter combines the analysis of the previous two chapters to develop the sustainability conditions for cooperative trade agreements with and without DSI mediation, a framework developed by Klimenko et al., (2008). Our results show that cooperative trade agreements are in fact sustainable, even without a DSI, under the proper conditions. Adding a DSI does not produce any effect on mediation unless penalties are used and DSI compliance is compulsory. The reasoning behind these results are the consequence of key framework differences, which are explained in Chapter 3 and Chapter 5. One difference important to mention here is that the reality of a single period gain from defecting is unlikely given how quickly each nation responds to threats by the other. Removing the possibility of this gain has significant impacts on sustainability conditions.

The main argument of this thesis is that the continued modifications to the Suspension Agreement should not be seen as the manifestation of a failed cooperative trade agreement requiring DSI intervention; rather, the cooperative trade agreement was NAFTA, and has deteriorated long ago. The Suspension Agreement, in turn, may actually be the Nash equilibrium result of negotiations taking place between the United States and Mexico following the deterioration of NAFTA. Its continued modifications are more likely manifestations of adjustments of this Nash equilibrium as a result of exogenous shocks occurring in one or both nations.

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Table 1: Subgame-Perfect Nash Equilibria

	W, M, S	B_W, B_M	B_S
Aggressive U.S.	$\{hold\}$	$\{Dispute, Negotiate\}$	$\{Dispute, Negotiate\}$
Passive U.S.	$\{hold\}$	$\{hold\}$	$\{Dispute, Negotiate\}$

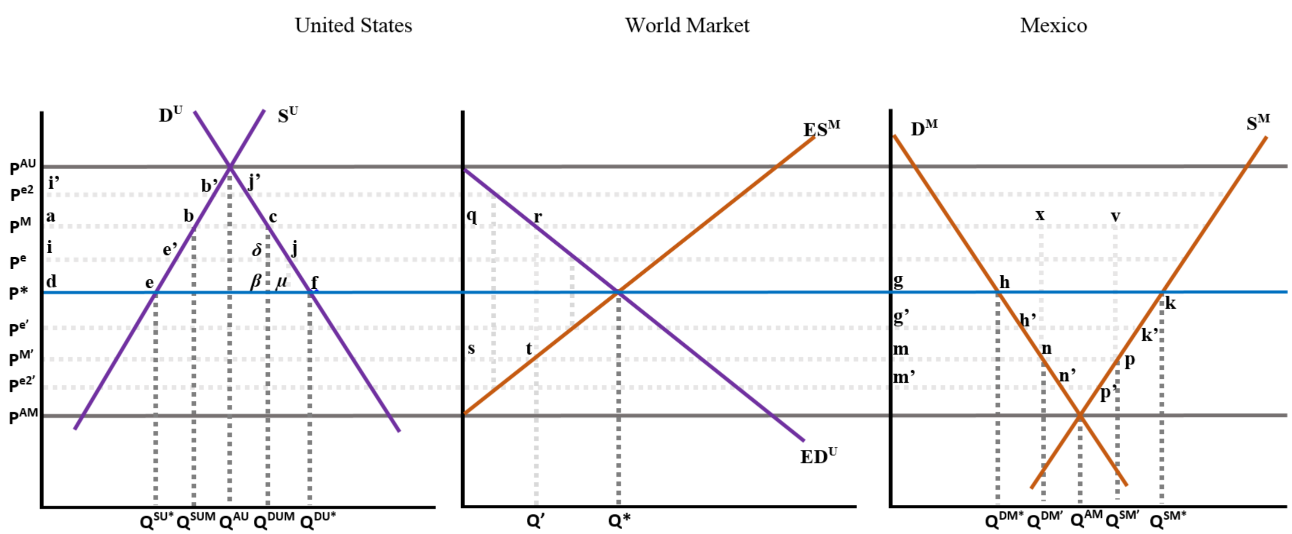


Figure 1: Traditional Welfare Effects of a Minimum Price Policy with the United States as the Importer and Mexico as the Exporter

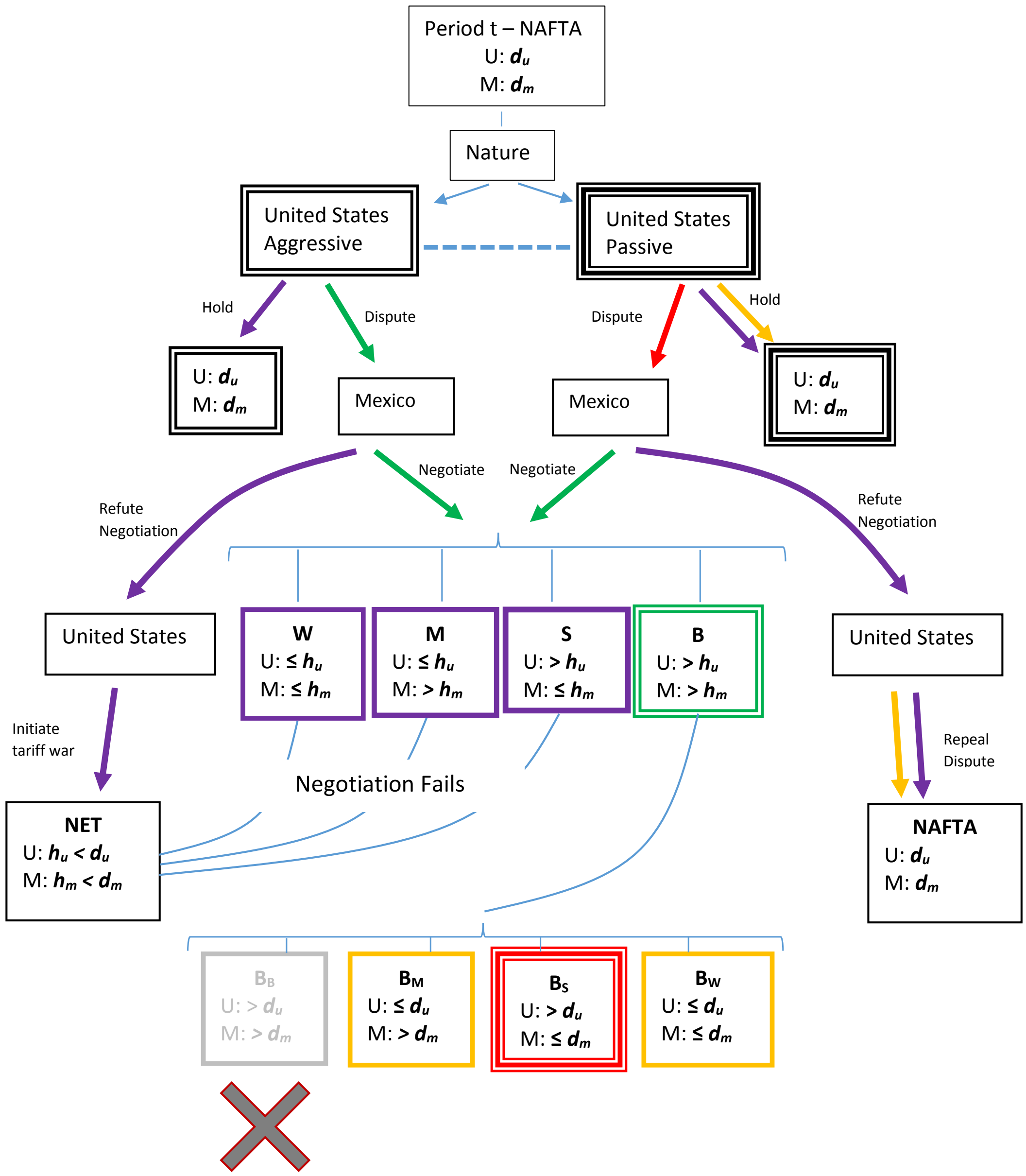
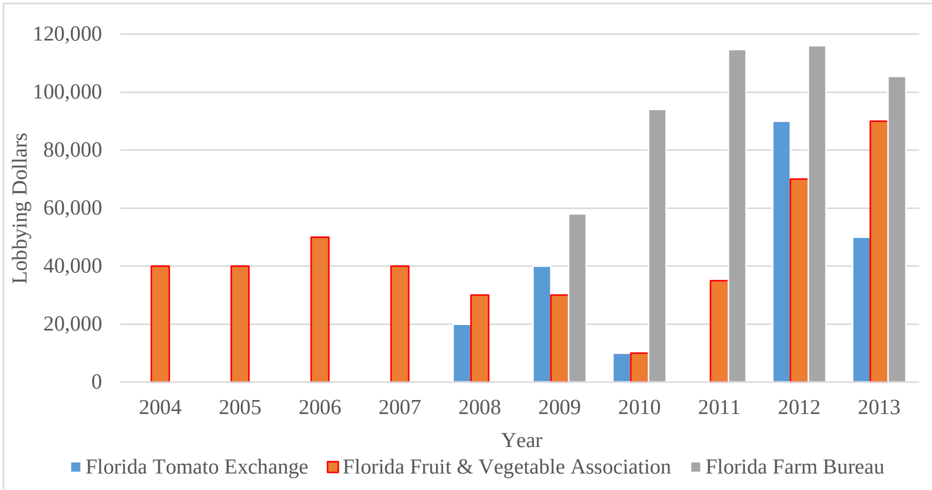
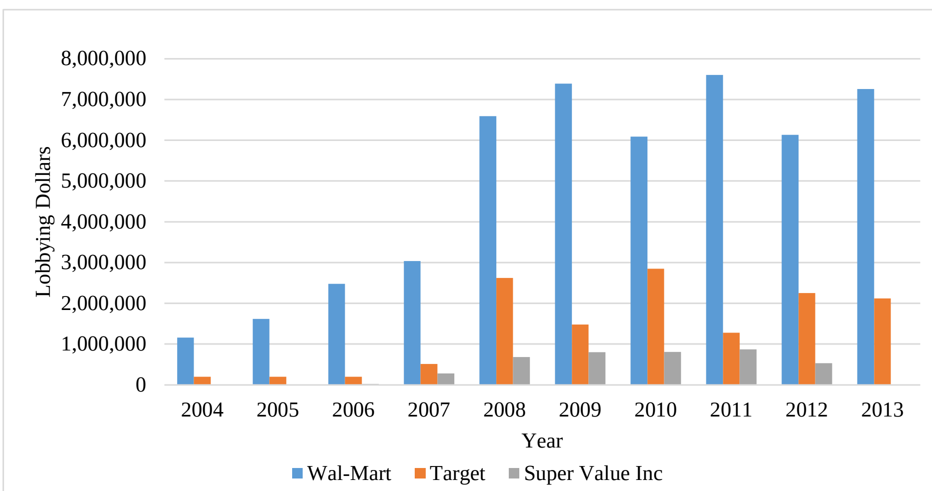


Figure 2: Extensive Form Representation of the U.S.-Mexican Tomato Dispute, NAFTA Onward



Source: OpenSecrets (2016)

Figure 3: Lobbying Spending by Price Hike Advocates, 2004-2013



Source: OpenSecrets (2016)

Figure 4: Lobbying Spending by Price Hike Opponents, 2004-2013