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Product Differentiation: Applying Game Theory to Politics

In the November 2014 mid-term elections, Republicans retained control of the House of Representatives and assumed control of the Senate. With this shift of control in the legislative branch, the United States now faces a situation where the legislative branch is controlled by one political party and the executive branch by the other party. An interesting situation has descended upon the U.S. government. Will the voters witness an intensification of partisan politics on Capitol Hill or will the two parties finally decide to work together?

This paper will proceed by briefly discussing some history about politics in the United States. The application of game theory to politics will follow by comparing the world of politics to product differentiation. Next, the rules and structure of the game will be outlined. The (likely) solution to the game will be analyzed and concluding remarks will be provided.

Divided government refers to a situation where one political party controls the presidency and the other party controls at least one house of Congress. In some situations where the other party controls both houses are of particular interest because the president no longer has a house to shield him. With the conclusion of the mid-term elections, President Obama is now forced to face the Republicans head on. However, this situation is not unique to Pres. Obama. In fact, both President Bush and President Clinton encountered this situation for portions of their tenure as president.

For a historical perspective, consider President Clinton's tenure. Pres. Clinton chose to cooperate with the Republican controlled Congress. Major legislative actions were taken during his term such as *The Personal Responsibility and Work Opportunity Reconciliation Act of 1996, Defense of Marriage Act, Balanced Budget Act of 1997,* and *Taxpayer Relief Act of 1997* ("Presidential Key Events" n.d.). All of these laws resulted from bipartisanship – a notion that has since become estranged from the United States government. Under Pres. Clinton and the divided government, the United States federal government actually realized a surplus for the first time in decades ("Bill Clinton" 2009). Perhaps the current government will allow history to repeat itself. However, a more analytical – and game theory related – approach is applicable.

Game theory easily applies to the realm of politics as the two main political parties are constantly battling each other for power and the support of the people. The current immigration situation creates an ideal situation to model. Americans are disgruntled with the current immigration system and are demanding that politicians take action. Pres. Clinton partially addressed the immigration problem with his Republican controlled Congress (Levingston 2002). Will Pres. Obama and the current Republican do the same? Or, more appropriately, is there an incentive for them to do the same?

The topic of product differentiation can be applied to the political world and to the immigration problem. If the voting public is thought of as an ideological spectrum with each voter placed somewhere on the spectrum, the product differentiation game is revealed.

One of the most prominent models regarding product differentiation comes from Harold Hotelling. Hotelling claims that competition through differentiated products results in little to no actual product differentiation. He provides an example using a "linear city" similar to the diagram depicted in Figure 1 of this paper. Hotelling claims that the businesses have no incentive to play the strategy that results in the socially optimal outcome – differentiated product. Instead, Hotelling argues that businesses, especially in a duopoly, have every incentive to deviate from the socially optimal outcome and resort to minimal product differentiation (1929). Hotelling argues that this theory is widely applicable to real situations. Interestingly enough, he applies his theory to politics as well. More over, he remarks, "In politics it is strikingly exemplified" (pg. 54). Moreover, Hotelling wrote, "Each party strives to make its platform as much like the other's as possible. Any radical departure would lose many votes, even though it might lead to stronger commendation of the party by some who would vote for it anyhow" (pg. 54).

Politics has been harshly criticized with claims of bitter partisanship. Joe Heim, a professor of political science at UW – La Crosse, argues that gridlock will be the likely outcome from the 2014-midterm elections (Eckert 2014). However, Hotelling's model predicts an alternative outcome. Høyland and Hansen note this political situation in the European Union. They state, "Politics in the Council is Janus-faced. There is bargaining with identifiable winners and losers, yet the voting records show high levels of agreement" (2014). They identify that the parties attempt to sound highly polarized to their supporters; however, their records indicate a minimal amount of polarization in Europe. Perhaps, this same result will be witnessed between President Obama and the Republican controlled Congress.

Of pressing importance is the immigration situation in the United States. Voters are calling for policy-makers to take action on this hotly debated topic. Keith (2014) claims that immigration policy will test the willingness of President Obama and the Republican controlled Congress to compromise. She claims that this immigration issue will likely divide them. This situation can be modeled using game theory and Keith's claim can be tested to see if there is an incentive for the parties to deviate from her hypothesized outcome.

The rules and structure of the game are as follows. The game in consideration is a sequential game where President Obama moves first. This game has two players and one pseudo-player. The players are President Obama and the Republican legislators. In other words, it is the executive branch and the legislative branch. Chance is a pseudo-player in determining whether or not a bill becomes a law – the further apart the two players' plans are, the less likely a law will be created. Moreover, this is a game of complete information. Republicans know the action that President Obama selects.

Each player has three strategies. The strategies available to President Obama are: propose a liberal plan, propose a compromise, or propose no plan. Republicans can propose a conservative plan, propose a compromise, or propose no plan. Depending on the strategies played, there may be a certain probability, p_i, that a bill becomes a law. Again, the closer the players are to each other, the higher the probability that a law will be created. This assumption is logical since the parties are closer to agreeing on the issue. If both players choose to compromise, a law will be created. If the Republicans do not propose a plan, there is no chance that a law will be created. This is a reasonable assumption since the Republicans now control both houses of the legislative branch and laws originate in Congress as bills. However, if President Obama does not propose a plan and Republicans do, there is still a certain probability that a law is created given the Republicans choose to compromise.

The payoffs are determined by several key elements: whether or not a law is created, who demonstrated leadership, and the partisanship of the proposal. If a law is passed, both President Obama and the Republicans see their approval rates increase by b. Whomever proposes a plan first – in most instances President Obama – will receive a leadership bonus of l. Republicans receive an increase of c if the plan is conservative because they are gaining favorability with the conservatives. Similarly, President Obama receives an increase of d for a liberal proposal. For compromising, the increase in approval is m. In the event that both players compromise, m will be divided evenly between President Obama and the Republicans. Failure to produce a law results in a cost n, where $n > l$, since the voters will see this as failed leadership by both parties.

Further, we can reasonable assume that $d=c$ since both players will see an equivalent increase in approval by their ideological base given they propose an ideologically pleasing plan. Moreover, $m \geq c + d$. To demonstrate that this assumption is logical, recall the product differentiation game or Hotelling's essay (1929). Instead of being differentiated by distance, the players are differentiated by ideology. We will assume a uniform distribution of voters along the political spectrum; however, this assumption may or may not be realistic as the composition of the electorate follows a bimodal distribution with both peaks occurring just off center ("Political Polarization in the American Public" 2014). We will assume for simplicity that the distribution of voters is uniform. In the case where both parties propose an extreme view, $d = 0.5v = c$, where v indicates the number of voters. This conclusion can be easily reached via Figure 1.

Clearly, the Republicans will increase their favorability on the right end of the spectrum and President Obama on the left end of the spectrum. The voters in the middle will split evenly. Thus $d = c = \in(0, 0.5v)$.

Figure 1

In the case that only one of the players proposes a compromise, we have the situation depicted in Figure 2. In this situation, the Republicans will retain their favorability amongst the conservative wing, but will also increase their ratings among voters who lean liberal. Here, Republicans will capture approximately $\left(\frac{2}{3}\right) v$ and President Obama will only have $\left(\frac{1}{3}\right) v$. If both players propose a compromise, then they will evenly split the electorate. The players will then receive a payoff of *m/2*. Thus, $m \in (0.5v, 0.75v)$.

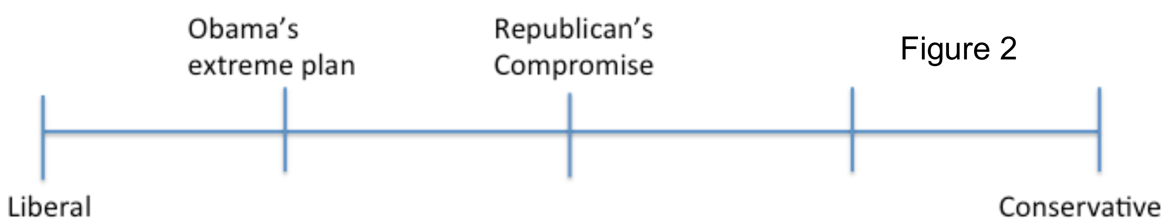
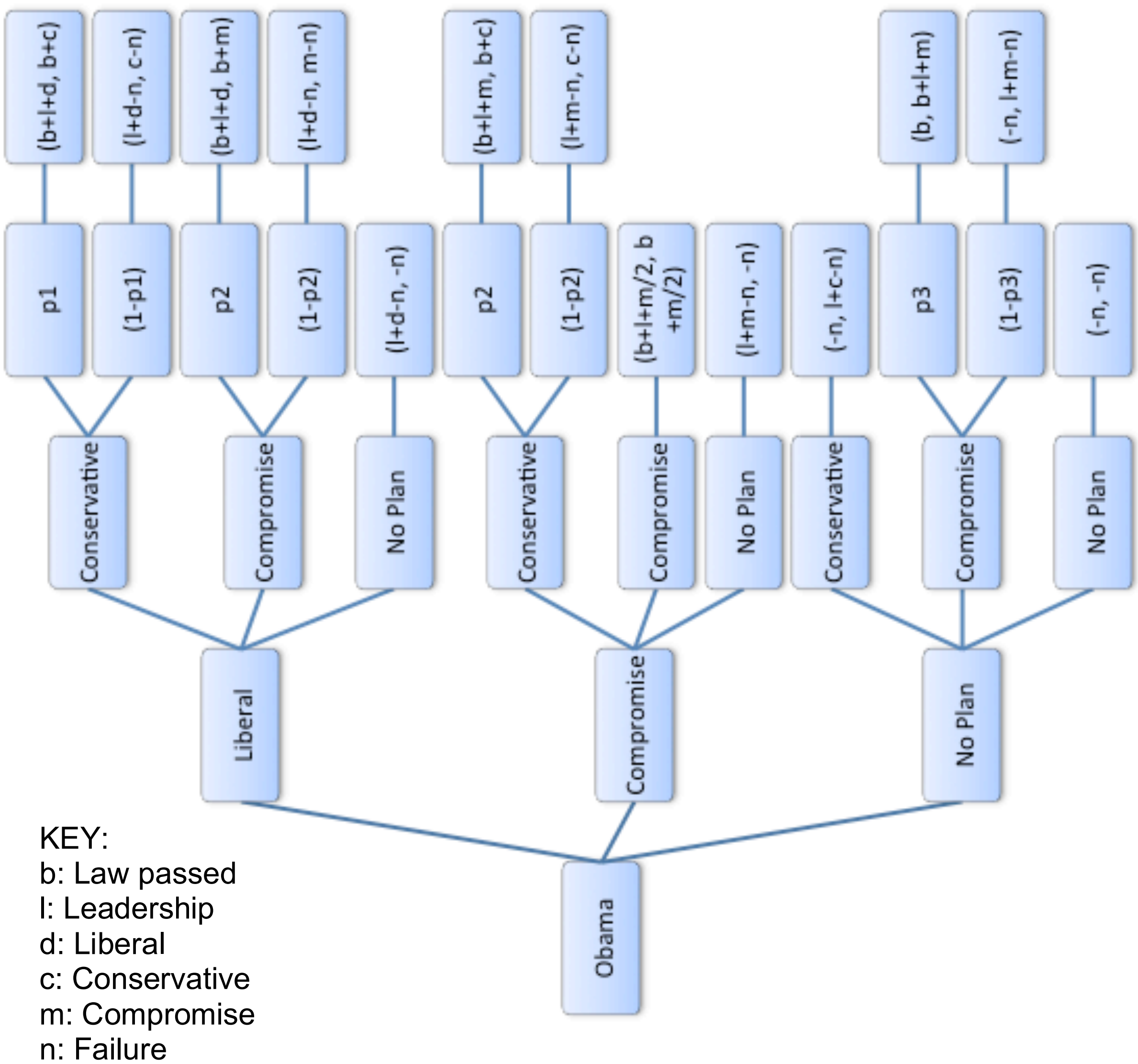
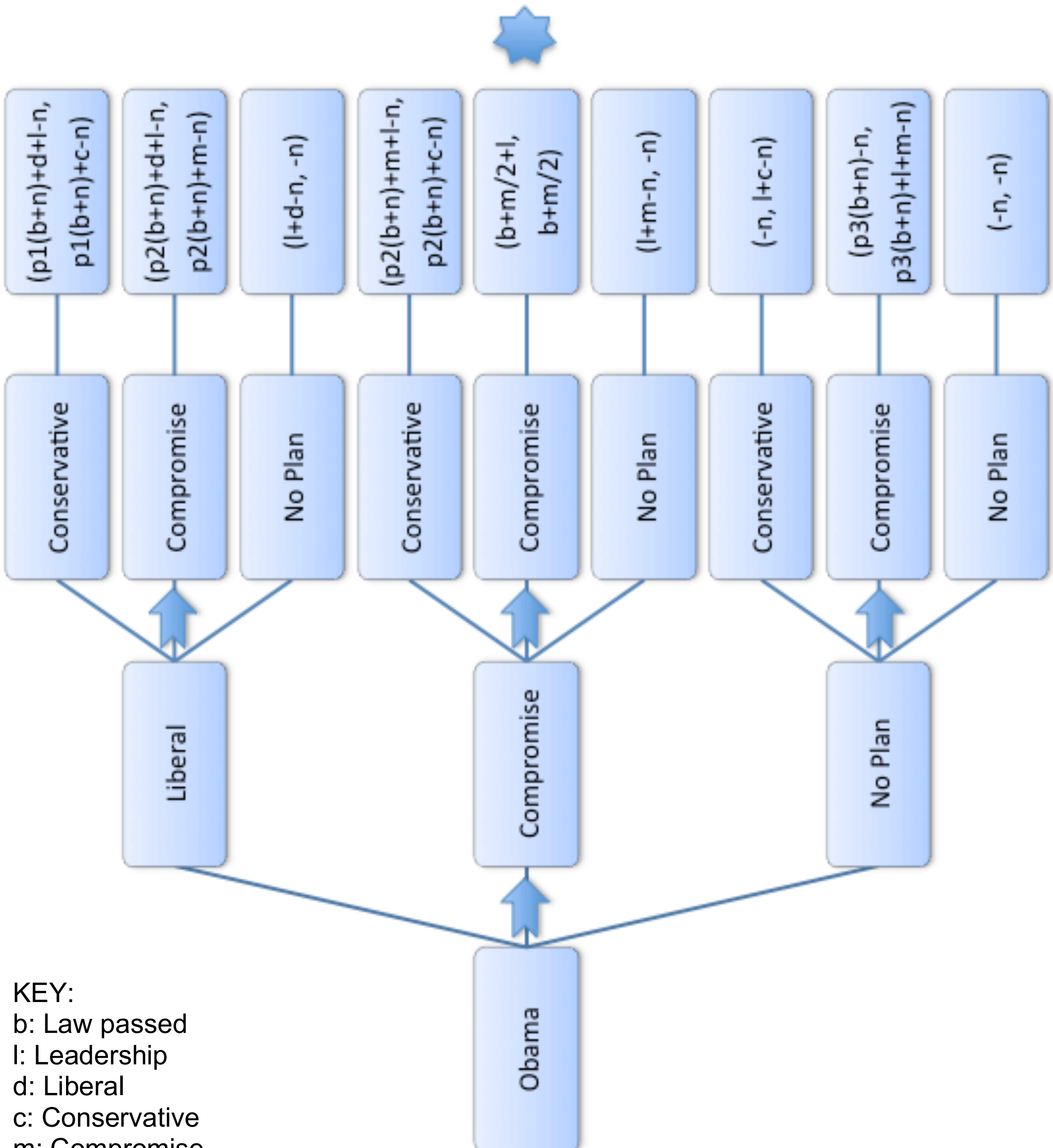


Figure 2

From the previous two cases, we can conclude that $m \geq c + d$. If the more realistic bimodal distribution were used, the upper bound for m would increase further enforcing this inequality. The unsolved extensive form of the game is depicted in Figure 3. The extensive form in Figure 3 includes the chance player and includes the probabilities. Figure 4 is the solved extensive form for this game. In nearly all instances, the payoffs to the players are expected payoffs in Figure 4. The computation of these payoffs is shown in Appendix A.

Figure 3





KEY:
b: Law passed
l: Leadership
d: Liberal
c: Conservative
m: Compromise
n: Failure

As evidence by the extensive form in Figure 4, the Nash Equilibrium is {Compromise, Compromise}. The conclusion is achieved by analyzing the expected payoffs. First, consider the Republican controlled Congress. If Pres. Obama proposes a liberal plan, the best response for Republicans would be to propose a compromise. This is true since $c-n < m-n$ and $p1 < p2$ because if the two players are closer to begin with, the higher the probability that the bill will become a law. The rational used in the *Let's Make a Deal Game* can also be applied. Both parties mutually benefit from a law being created. Thus even if a less Republican law is created, Republicans still prefer it to having no law due to the punishment by the voters being so severe. Therefore, the Republicans prefer {Liberal, Compromise} to {Liberal, Conservative}. Clearly, Republicans prefer {Liberal, Compromise} to {Liberal, No Plan}.

Now consider the case if Pres. Obama proposes a compromise. Since $b + \frac{m}{2} > p2(b + n) + c - n$, Republicans prefer {Compromise, Compromise} to {Compromise, Conservative}. The severe punishment by the voters provides a strong incentive for the politicians to create a new immigration policy. Republicans also clearly prefer {Compromise, Compromise} to {Compromise, No Plan}. Thus, if Pres. Obama proposes a compromise, the Republicans' best response is to compromise.

Lastly consider the case if Pres. Obama proposes no plan. Since $p3(b + n) + l + m - n > l + c - n$, Republicans prefer {No Plan, Compromise} to {No Plan, Conservative}. Republicans also prefer {No Plan, Compromise} to {No Plan, No Plan}. Thus Republicans' best response is to compromise.

From this analysis, "Republicans: always compromise" is part of a sub game perfect Nash Equilibrium and compromising is a dominant strategy for the Republicans.

To determine Pres. Obama's strategy, utilize the fact that Republicans always comprising is part of a sub game perfect Nash Equilibrium. Since $b + \frac{m}{2} + l > p2(b + n) + d + l - n$, Pres. Obama prefers {Compromise, Compromise} to {Liberal, Compromise}. Clearly $b + \frac{m}{2} + l > p3(b + n) - n$; thus Pres. Obama prefers {Compromise, Compromise} to {No Plan, Compromise}. Therefore, the "compromise" is a dominant strategy for President Obama as well.

From this analysis, {Compromise, Compromise} is the sole Nash Equilibrium of this game. The best strategy is for both players to compromise.

Even though the current political atmosphere in the United States is called highly polarized and partisan, economic theory and empirical data seem to suggest otherwise. Høyland and Hansen (2014) showed that despite the partisan talk in Europe, voting records indicate much less division. Hotelling (1929) argues that in a differentiated market, there will be little product differentiation. This idea applies to politics too. The political parties will tend to propose more moderate views as this paper demonstrated through the sequential game.

Game theory predicts that the likely outcome of the immigration crisis will include President Obama and the Republican controlled Congress working together to ensure that a law is passed. In order to accomplish this task, both parties must compromise. Thus, the end situation will demonstrate the poorly differentiated political parties despite the polarizing claims from political pundits. Even with political scientists predicting great divide and government gridlock, economic theory suggests there is little incentive for the parties to remain divided. The incentive is for the leaders to propose solutions to this nation's problems, especially immigration, even if it does mean compromising.

Just weeks before the winter holidays, evidence of this bipartisan spirit has manifested itself. On December 13, the Senate passed a bipartisan bill to fund the government. The $1.1 trillion spending bill passed with a 56 – 40 vote with 31 Democrats, 24 Republicans, and one independent voting for the bill (Hook 2014). This bipartisan effort signals that the two parties may be more willing to work together than political pundits claim and game theory predictions may prevail.

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L

Appendix A

b: bill → law   n: no law, $n > l + b$

l: leadership

d: lib bill   c: conservative $d = c$

$m > c + d$

$$EU_0(L, C) = P_1(b+l+d) + (1-P_1)(l+d-n)$$
$$= P_1(b) + P_1 l + P_1 d + l + d - n - P_1 l - P_1 d + P_1 n$$
$$= P_1(b) + l + d - n + P_1(n)$$
$$= P_1(b+n) + l + d - n$$
$$= P_1(b+n) + d + \overbrace{l-n}^{<0}$$

$$EU_0(L, O) = P_2(b+l+d) + (1-P_2)(l+d-n)$$
$$= P_2 b + P_2 l + P_2 d + l + d - n - P_2 l - P_2 d + P_2 n$$
$$= P_2(b+n) + d + \overbrace{l-n}^{<0}$$

$$EU_0(L, N) = d + l - n$$

$$EU_0(O, C) = P_3(b+l+m) + (1-P_3)(l+m-n)$$
$$= P_3 b + P_3 l + P_3 m + l + m - n - P_3 l - P_3 m + n P_3$$
$$= P_3(b+n) + m + \overbrace{l-n}^{<0}$$

~~Since~~ $P_3 > P_1$ since 2 parties are closer together to start w/ Obama prefer this outcome over {L, C}

$$EU_0(O, O) = P_4 b + P_4 l + P_4\left(\tfrac{m}{2}\right) + (1-P_4)\left(l + \tfrac{m}{2} - n\right)$$
$$= P_4 b + P_4 l + P_4\left(\tfrac{m}{2}\right) + l + \tfrac{m}{2} - n - P_4 l - P_4\left(\tfrac{m}{2}\right) + n P_4$$
$$= P_4(b+n) + \tfrac{m}{2} + \overbrace{l-n}^{<0}$$

$P_4 > P_2$ and $\frac{m}{2} > d$, thus Obama prefers {O, O} and {L, O}

$$EU_0(O, N) = m + l - n$$

Since $m > d$, Obama prefers {O, N} over {L, N}

$$EU_0(N, C) = P_5(b) + (1-P_5)(-n)$$
$$= P_5(b) - n + P_5 n$$
$$= P_5(b+n) - n.$$

Clearly $m + l - n > -n$ and $P_5 \leq P_3$ since Obama would be no more willing to sign a conservative bill into law. Thus he prefers {O, C} to {N, C}

$EU_0(N, \textcircled{Y}) = P_6(b) + (1-P_6)(-n)$

$= P_6 b - n + P_6 n$

$= P_6(b+n) - n$. Clearly $\frac{m}{2} + l - n > -n$ and $P_6 \leq P_4$ since if both $\textcircled{Y}$, the probability it becomes a law is higher than if only Repubs. $\textcircled{Y}$. Thus $\{\textcircled{Y}, L\}$ is preferred over $\{N, \textcircled{Y}\}$

$U(N, N) = -n$. Clearly $l + m - n > -n$ so $\{\textcircled{Y}, n\}$ is preferred over $\{N, N\}$.

$EU_R(L, C) = P_1(b+c) + (1-P_1)(c-n)$

$= P_1 b + P_1 c + c - n - P_1 c + P_1 n$

$= P_1(b+n) + c - n$

$EU_R(L, \textcircled{Y}) = P_2(b+m) + (1-P_2)(m-n)$

$= P_2 b + P_2 m + m - n - P_2 m + P_2 n$

$= P_2(b+n) + m - n$ Since $c - n < m - n$ and $P_2 > P_1$ because if two players are closer to start with the bill is more likely to become law. Thus Repu. prefer $\{L, \textcircled{Y}\}$ over $\{L, C\}$.

$U_R(L, N) = -n$. Clearly $\{L, \textcircled{Y}\}$ is prefered over $\{L, N\}$.

$EU_R(\textcircled{Y}, C) = P_3(b+c) + (1-P_3)(c-n)$

$= P_3 b + P_3 c + c - n - P_3 c + P_3 n$

$= P_3(b+n) + c - n$

$EU_R(\textcircled{Y}, \textcircled{Y}) = P_4(b + \frac{m}{2}) + (1-P_4)(\frac{m}{2} - n)$

$= P_4 b + P_4 \frac{m}{2} + \frac{m}{2} - n - P_4 \frac{m}{2} + P_4 n$

$= P_4(b+n) + \frac{m}{2} - n$. Clearly $P_4 \geq P_3$ and $\frac{m}{2} - n > c - n$ thus $\{\textcircled{Y}, \textcircled{Y}\}$ is prefered over $\{\textcircled{Y}, C\}$.

$U_R(\textcircled{Y}, N) = -n$. Clearly $\{\textcircled{Y}, \textcircled{Y}\}$ is preferred over $\{\textcircled{Y}, N\}$.

$$EU_R(N, C) = p_5(b+l+c) + (1-p_5)(l+c-n)$$

$$= p_5 b + p_5 l + p_5 c + l + c - n - p_5 l - p_5 c + p_5 n$$

$$= p_5(b+n) + l + c - n$$

$$EU_R(N, F) = p_6(b+l+m) + (1-p_6)(l+m-n)$$

$$= p_6 b + p_6 l + p_6 m + l + m - n - p_6 l - p_6 m + p_6 n$$

$$= p_6(b+n) + l + m - n.$$

Clearly $p_6 \geq p_5$ and $l+c-n \leq l+m-n$ so $\{N, F\}$ is preferred.

$U_R(N, N) = -n$. Clearly $\{N, F\}$ is preferred over $\{N, N\}$.