Summary: Team #2003

Driven higher by the continuing cost of the War in Iraq and expensive government rescue programs, the United States national debt recently broke the $10 *trillion* mark. Both candidates in the 2008 Presidential Election emphasized their plans to lower the national debt by cutting taxes in conjunction with lowering federal spending. We produced a model to predict national debt from 2009-2017 based on federal receipt and expenditure projections. Our representation consisted of a primary equation for national debt and two secondary formulae which generated the total federal expenditures and receipts from a host of tertiary data and equations. We analyzed the models through three methods: one simplifies all the numbers and equations to a single, clear-cut answer: national debt per capita $\left(\frac{\Psi}{H}\right)$, another puts the debt in context: national debt over GDP $\left(\frac{\Psi}{H}\right)$, and the third utilizes methodology which could be adjusted to fit each person's political preferences. In each model, we estimated the growth rates for spending vs. taxes and made appropriate adjustments for changes in budget proposals for each alternative plan. We also analyzed the robustness of the model by finding the relative sensitivities of each variable.

The first plan that we implemented into our model was the "status quo" based on data from 2004-2007 and projected to 2017. The second policies reflected a widely-supported proposal for change in the American budget system. This plan focused on increasing the tax rates for the top two federal income brackets. It also included many provisions for increased government spending across the board. Our proposal called for universally increasing taxes by 2% and capping health resources spending at 2007 levels. We would offset the latter cost by simultaneously offering gradual privatization of social security. We applied a weighted rating system which could determine the preferred plan for an individual derived from the five flexible variables.

According to our model, the federal debt rose over time under the "status quo" policies. Somewhat surprisingly, the "change" plan showed an even greater increase in national debt. However, our proposal cut the cumulative national debt to $5.46 trillion. Although the national debt per capita and the ratio of national debt to GDP increased for the "status quo" and the "change" plans, both factors decreased significantly under our proposal. In addition, our proposal scored the highest, using the simple multi-attribute rating technique (SMART).

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General Model Variables

The fundamental equation for calculating national debt is $\Omega = E - I + S$ where **Ω** is total national debt, **E** is total federal expenditures, **I** is total federal receipts, also known as income, and **S** is non-budgeted spending. (See Glossary)

The sub-formula for expenditure is $\mathbf{E = D + R_H + R_P + Q_E + \beta}$. These five variables take into account the major areas of federal spending according to the "Fiscal Year 2009" budget published by the Office of Management and Budget (OMB):[1]

1. national defense (**D**) such as general military spending, excluding specific conflicts (e.g. War in Iraq),
2. human resources ($\mathbf{R_H}$), including education, health care, Medicare, income security, social security, and veterans benefits,
3. physical resources ($\mathbf{R_P}$), such as energy, natural resources, transportation, and community/regional development,
4. other ($\mathbf{Q_E}$), including international aid, general research grants, agriculture, and general government costs or allowances, and
5. interest on debt (**β**), which denotes the amount the government spends each year paying off its accumulated national debt.

Annual federal income is modeled by $\mathbf{I = T_I + T_C + T_E + T_W + Q_I}$. Again, these five variables come directly from the "Fiscal Year 2009" budget published by the OMB:[2]

1. Income Taxes ($\mathbf{T_I}$) from individuals,
2. Corporate Taxes ($\mathbf{T_C}$),
3. Excise Taxes ($\mathbf{T_E}$), such as on cigarettes or gasoline,

[1] Historical Tables: Budget of the United States Government: Fiscal Year 2009. (2008). In *The White House*. Retrieved November 22, 2008, from http://www.whitehouse.gov/omb/budget/fy2009/pdf/hist.pdf
[2] ibid.

4. Welfare Taxes ($\mathbf{T_W}$), including social security and payroll taxes, and
5. Other ($\mathbf{Q_I}$), such as estate and gift taxes, customs duties, and Federal Reserve deposits.

Despite sophisticated forecasting models, even the United States government cannot accurately predict every expense. For example, catastrophes, both natural and unnatural, are not factored into the annual budget; rather, the government passes emergency spending bills, such as the recent $700 billion rescue package. We included these non-budgeted spending items in our model as **S**. For each of the plans, while we recognized the unpredictability of the real world, but we assumed **S** was zero for simplicity.

Assumptions

Several key assumptions were made to create a viable model for federal debt. We assumed each plan would be enacted immediately and completely by Congress. Moreover, we decided the tax rates for each bracket would remain constant for each year between 2009 and 2017, and the policy would not change significantly during the model period. In addition, the changes to the tax code would take place instantaneously at the beginning of the fiscal year. Consequently, we could eliminate any uncertainties that occur due to delays tax strategy implementation. All of our models began in 2007 since we did not have complete tax data for the fiscal year 2008. Also, our 2008 predicted figures for debt considerably underestimated the actual debt (~$8.6 trillion vs. >$10.6 trillion) because our value did not include non-budgeted expenses, which have been particularly high this year.

Furthermore, we assumed no significant or unexpected crises would occur during our model time. Although we included a variable, **S,** to account for the unforeseen disasters, we arbitrarily made this value 0, excluding it from our projections because it is too difficult to

predict crises. Therefore, we created significant type II error because the model would treat major catastrophes, such as a hurricane or a terrorist attack, as insignificant and negligible. However, if any such calamities should occur, one could add its effects to the national debt figures of that year in the variable **S**.

Pertaining to taxes, we assumed the Alternative Minimum Tax (AMT) would not be abolished by 2017. Moreover, the population in tax brackets also directly affects the amount of colleted taxes and, indirectly, the national debt. We presumed the average growth rate of households for the past 5 years would accurately project how households will grow for the 2009-2017 time period. For the all models, we assumed the percentage of households in each tax bracket would remain constant. For the sake of simplicity, all households are placed under the tax distinction of married: filling jointly. We supposed all federal expenditures could be described in one of five categories: national defense, human resources, physical resources, other, and interest. In addition, we assumed all federal receipts could be placed into one of the following groups: individual taxes, corporate taxes, welfare taxes, excise taxes, and other. Furthermore, we presumed future GDP, inflation, and the national debt interest rates could be predicted based on previous information. Finally, we supposed that funding for certain programs, like entitlements, could not be changed in the federal budget.

Model Justifications and Sources

For the Gross Domestic Product (GDP), national inflation rate, and national debt interest rate, we computed the future values based on past data. Over the last 50 years, GDP has increased at an average annual rate of 2.70%[3]; the last three full years (i.e. 2005-7) verified this

[3] Clark, M. (2008, July 31). The Losses of the United States Gross Domestic Product. Retrieved November 22, 2008, from http://frontal-lobe.info/gdp_loss.html

trend with GDP growth of 3.2%, 2.9%, and 2.2%, respectively.[4,5] Consequently, we input 2.70% into our representations. For the inflation rate in the model, we found the average inflation over the last eight years (1999-2007)[6] and applied it to the next 10 years. Accordingly, all of our data were adjusted for inflation throughout every model. We found the national debt by year from the Treasury Department[7] and the amount paid towards interest from the Office of Management and Budget from 2004-2007.[8] Then, we calculated the national debt interest rate by dividing the debt paid in a given year over the total national debt ($I_R = \frac{I_{T-1}}{\Psi_{T-1}}$), and applied it at a flat rate over the 10 years of the model. Coincidentally, these two values were the same in our model; however, we have no evidence to prove correlation. Nevertheless, it appears the government pays off the debt interest at approximately the same rate as inflation.

We found data from the previous four years for all our federal income and expenditure variables (see above), excluding the debt interest, individual income tax, and corporate tax, from the "2009 Fiscal Year" report from the OMB[9], a reputable government accounting office. Based on these data, we modeled the current U.S. government policies through 2017. For our second model, we examined an alternative plan from the 2008 Presidential Election, proclaiming change. Although many of these policies were stated vaguely during the campaign, we did find

[4] Real GDP for 2006. (2007, February). In *Bureau of Economic Analysis*. Retrieved November 22, 2008, from http://www.bea.gov/scb/pdf/2007/02%20february/gdp_box.pdf
[5] GDP and the Economy. (2008, February). In *Bureau of Economic Analysis*. Retrieved November 22, 2008, from http://www.bea.gov/scb/pdf/2008/02%20february/0208_gdp_and_econ.pdf
[6] Inflation: Historical. (n.d.). In *Inflationdata.com*. Retrieved November 22, 2008, from http://inflationdata.com/inflation/inflation_rate/historicalinflation.aspx?dsinflation_currentpage=0
[7] *Treasury Direct*. (2008, October 9). Retrieved November 22, 2008, from http://www.treasurydirect.gov/govt/reports/pd/histdebt/histdebt_histo5.htm
[8] Historical Tables: Budget of the United States Government: Fiscal Year 2009. (2008). In *The White House*. Retrieved November 22, 2008, from http://www.whitehouse.gov/omb/budget/fy2009/pdf/hist.pdf
[9] Historical Tables: Budget of the United States Government: Fiscal Year 2009. (2008). In *The White House*. Retrieved November 22, 2008, from http://www.whitehouse.gov/omb/budget/fy2009/pdf/hist.pdf

some numbers from sources, with a variety of biases, on the major issues, including health care, energy, defense, and, most importantly, taxes.[10,11,12,13,14,15,16]

The most difficult section of our model was determining the population spread over the six tax brackets. We researched information about the tax brackets of couples filling jointly[17] and the number of households by income,[18] but the two were incompatible. Therefore, we had to manipulate the data to produce the percentage of households in each tax bracket, which we assumed would remain constant over time. We used $50,000 intervals on the household list and put them into a graph of number of households based on income (See Appendix I**)**. We assumed the mean income of households making over $357,700 was $500,000. Then, we calculated the exponential regression line for the graph, $y = 114604e^{-2E-5x}$, which modeled the information with quite accurately (r^2=0.9874). We computed the approximate number of households in each tax bracket using the integral of the function within each bracket and divided it by the total figure to produce a percentage breakdown of the tax brackets. Unfortunately, the exponential line slightly underestimated the last two tax brackets because it fell too quickly. Therefore, when we

[10] BARACK OBAMA'S COMPREHENSIVE TAX PLAN. (n.d.). In *Barackobama.com*. Retrieved November 22, 2008, from http://www.barackobama.com/pdf/taxes/factsheet_tax_plan_final.pdf
[11] Cole, A. (2008, October 3). Obama Adviser Doesn't Expect Defense Cuts. Retrieved November 22, 2008, from http://online.wsj.com/article/sb122299129356900513.html?mod=googlenews_wsj
[12] Cox News Service. (2008, October 13). How Obama, McCain stand on the issues: Defense Spending. In *Seattle PI*. Retrieved November 22, 2008, from http://seattlepi.nwsource.com/national/382996_issuesbox.html
[13] Fox, M. (2008, November 12). Obama health plan to cost $75 billion: analysis. In *Yahoo News*. Retrieved November 22, 2008, from http://www.barackobama.com/pdf/issues/fiscal/obamapolicy_fiscal.pdf
[14] Obama's Plan for America. (n.d.). In *Barackobama.com*. Retrieved November 22, 2008, from http://www.barackobama.com/pdf/issues/fiscal/obamapolicy_fiscal.pdf
[15] Obama's spending plan. (2008, February 22). In *Washington Times*. Retrieved November 22, 2008, from http://www.washingtontimes.com/news/2008/feb/22/obamas-spending-plan/
[16] Philbin, M. (2008, October 31). CBS Shows Obama Spending Plan $90 Billion in the Red. In *Business & Media Institute*. Retrieved November 22, 2008, from http://www.businessandmedia.org/printer/2008/20081031141410.aspx
[17] Lankford, K. (2006, February 13). How Tax Brackets Work. In *Kiplinger.com*. Retrieved November 22, 2008, from http://www.kiplinger.com/columns/ask/archive/2006/q0213.htm
[18] Household Income Table of Contents. (2007, August 28). In *U.S. Census Bureau*. Retrieved November 22, 2008, from http://pubdb3.census.gov/macro/032007/hhinc/toc.htm

discovered the percentages did not add up to 100, we split the difference, 1.6%, equally between the top two tax groups, which accounted for the discrepancies in the integral.

Separately, we projected the increase in households based upon the changes in the last eight years (2000-2007). We arrived at this quantity by calculating the average increase in households between each year divided by the previous year (ex: $H_R = \frac{H_t - H_{t-1}}{H_{t-1}}$) and averaging these seven numbers. We then applied this value to the last data point (2007) and assumed households would grow at the same average rate for 2009-2017. For the average tax figure, we multiplied the mean of each tax bracket by its corresponding tax rate for each model. Finally, we multiplied the number of households for each year by the average tax rate per bracket.

We employed both the population spread described above and specific tax policies to model the individual income tax over time. Although most people paid the same income taxes for both the "status quo" and "change" models, they differed when it came to the top two tax brackets; there, the "change" plan significantly raised the tax rates. The corporate tax rates were generated by finding the average annual change for 2000-2007 **(**$T_C = \frac{\Sigma \Delta T_C (2000 - 2007)}{7}$**).** We found no significant inconsistencies between these two plans for corporate tax rates for the near future.

Model Descriptions

Model #1: "The Status Quo"

For this model, we assumed the current tax and spending policies would remain more or less constant for the next nine years. This model generated a surplus budget for the first three years. However, by 2010, the plan produced a national deficit, and the cumulative national debt

(CND) increased every year. The "status quo" model would create national debt in excess of $12.2 trillion by 2017. (See Appendix VII)

Model #2: "Change"

In this scenario, we factored in a somewhat significant shift in both the spending and tax policy arenas. Not only would the taxes on the wealthiest individuals go up, but also expenditures would increase considerably in the human resource (health care, education, income security) and physical resource (energy, natural resources) subcategories. The "change" plan manufacture surpluses in the first two years; however, the budget nosedived into billions of dollars of annual deficits. Again, the CND always increased, but under the "change" policies it topped $14.2 trillion in 2017. (See Appendix VIII)

Model #3: Our Plan

To reign in the federal debt, we strove for national surpluses in each of the fiscal years. The foundation of our policy was raising taxes by 2% across the board while simultaneously capping human resources spending at 2007 levels. Through this plan, we achieved our goal of surpluses every year, and we lowered the CND to under $5.5 trillion in 2017. (See Appendix IX)

Analyzing the Models

We evaluated the models in three ways to compare their national consequences better. First, we examined how effectively they reduced overall national debt by calculating the final national debt per capita, $\left(\frac{\Psi}{H}\right)$. This ratio reflects the "neighborhood impact" of national debt because it directly connects the astronomical figures of national debt to individual households. Thus, it takes a difficult-to-grasp, theoretical concept and turns it into a somewhat alarming, tangible number. For the second part, we divided the final CND figure by the final projected

GDP to create a ratio $\left(\frac{\Psi}{G}\right)$ for comparison with previous Presidential administrations. Relating CND to GDP roughly replicates the national effect of each model because it predicts how much debt weighs down on the economy as a whole. Typically, a higher ratio signifies a weak economy, and a lower ratio occurs during a growth period. Finally, we ranked the three models according to our group's simple multi-attribute rating technique , or SMART, responses. This system, explained below, increases the overall value of our analysis because it judges the desirability of the models derived from the individual's tastes.

Currently, the ratio of $\frac{\Psi}{G}$ is at the highest level since 1955 during the Eisenhower administration[19], which is a grave concern when it comes to our economic well-being. The "status quo" plan maintains the policies that have been enacted for the previous four years. According to our representation, this ratio would slightly increase for the first two years before descending again, and by 2017, it would be 67.7%. Although this value would be considerably lower than the post-World War 2 era, nevertheless, it would be far above the ratio during the Johnson, Nixon, Ford, Carter, and Reagan administrations. Consequently, the "status quo" model would fit somewhere between Clinton/Bush Sr. and Truman.[20] In the second model, higher tax rates in the upper brackets created more revenue; nonetheless, it had a significantly higher number of expenditures. The ratio of $\frac{\Psi}{G}$ started at the same rate as the first model, but the end value was much larger as spending rapidly overtook the initial income spurt. The final value for the year 2017 was projected at 78.86%: much higher than the first model and

[19] National Debt Clocks and Savings Clocks. (2008, November 22). In *Zfacts.com*. Retrieved November 23, 2008, from http://zfacts.com/p/461.html

[20] National debt by U.S. presidential terms. (n.d.). In *Wikipedia*. Retrieved November 22, 2008, from http://en.wikipedia.org/wiki/national_debt_by_u.s._presidential_terms

approaching the 80% realm, not seen since Truman's first term.[21] If values were allowed to reach this level the US economy certainly would suffer greatly.

For each of the first two projections, the national debt per capita $\left(\frac{\Psi}{H}\right)$ steadily became more negative over the course of the model, indicating each household was responsible for a larger part of the national debt. In the "status quo" model, the value changed from -72.18 to -91.75 (in thousands of dollars). If we were to consider keeping the same policies for the next nine years, then the economy would continue to worsen while the gross national debt would rise. The figures in the "change" model were similar: -72.14 (2007) escalated to -106.80 (2017). This disparity was much larger than the "status quo" predictor, and it shows this plan would send the country even deeper into debt. These numbers hammer home the impact of our government's spending and tax policies on average U.S. citizens. Most American families would not be able to afford paying the government $91,750 or $106,800 in addition to their projected tax burdens.

The third plan was vastly different from other current policies since it utilized a 2% higher income tax and capped health resources to balance the budget. We compensated for the progressive loss of funding by mandating optional privatization of social security. The ratio of $\frac{\Psi}{G}$ actually decreased during the projected years, and each annual budget contained a surplus. Therefore, the cumulative national debt, Ψ, would shrink from the initial ratio value, 60.06%, to 30.22%. Our estimated value for 2017 would pass Jimmy Carter for the lowest ratio in the history of the US.[22] Likewise, the national debt per capita, $\frac{\Psi}{H}$, decreased from -71.17 to -40.93,

[21] ibid.
[22] ibid.

further mirroring the downward trend of the CND. Both of these indicators generally precede and herald prosperous economic times.

The key difference among these plans is the first two are currently on the political table while the third is hypothetical. Unfortunately, both the "status quo" and the "change" budgets would worsen the economic situation of the government and the country in the near future. Accordingly, we generated the third model which broke sharply with the two authentic fiscal plans. Our model was the only one to actually balance the budget for every year, and it performed best in our SMART analysis when we plugged in our scale.

Simple Multi-attribute Rating Technique (SMART)

SMART is a mathematical tool which rates the characteristics of models on a scale from 1 to 10 based upon a person's preferences; theoretically, such a system evaluates "how ideal" a given model is for the individual.[23] We selected five variables for our SMART calculations: a balanced budget, tax ratios among the income tax brackets, defense spending, non-defense spending, and income to corporate tax ratio. The simple multi-attribute rating technique is especially practical because it allows politicians and citizens from all different viewpoints to see if a budget on paper corresponds to their ideological beliefs. Thus, this model is versatile because it can be adapted to a variety of circumstances. Nevertheless, the SMART model does have some built-in parameters because some policy changes, like lowering corporate taxes to 2% or spending 100% of the budget on non-defense programs, are either economically or politically infeasible (or both). Most legitimate policies would fall closer to the middle: somewhere in the 3 to 7 range. Barring unrealistic weighting, policies outside this series might be difficult or impossible to implement without raising public discontent.

[23] Fülöp, J. (n.d.). Introduction to Decision Making Methods. In *Academic Computing @ Evergreen*. Retrieved November 23, 2008, from http://academic.evergreen.edu/projects/bdei/documents/decisionmakingmethods.pdf

We thought the balanced budget variable was the most important because it was the main objective of the given problem. We decided the ideal budget would be balanced annually, though a surplus would not be unacceptable, and the worst possible one would be a planned deficit of 1 trillion dollars. A balanced budget would receive a score of 10 and a deficit of 1 trillion dollars would receive a 1. Anything falling in-between would be given a scaled score.

The tax ratio, or the tax rate of the highest bracket over the tax rate of the lowest bracket, generally reflects a significant distinction for how an individual wants the tax system to work. A more liberal viewpoint would want this ratio to be a higher number (i.e. wealthier people would pay a higher tax rate than the middle and lower classes), and a more conservative stance would favor a lower number. In our model, a lower tax ratio, closer to 1:1, would be considered positive. We decided that the highest feasible ratio would be 5:1, and the lowest feasible ratio would be 1:1. A ratio of 1:1 would be given a score of 10, and a ratio of 5:1 would be assigned a 1 with all other values scaled in between. We recognize some would disagree with us and state a higher ratio would be better. They would simply flip the scoring system (i.e. the 10 to 5:1 and the 1 to 1:1).

The defense spending and non-defense, or domestic, spending were ratios of their respective budgets to the total discretionary expenditures (these exclude mandatory spending programs, like entitlements, which must be included in the federal budget). Each of these factors would be put on a percentage scale with 100% corresponding to 10 points and 0% given 1 point.

The final variable denoted the ratio between individual income tax receipts and corporate tax intake. This value usually does not fluctuate much; however, we said the maximum value is 10:1 and the minimum is 1:1, we assigned points on a similar scale to the previous ratios.

Someone using our simple multi-attribute rating technique could easily change the weighting structure, and the total score would adjust accordingly. Therefore, the formula could be manipulated to reflect what an individual values most. First, a person assigns values to each weighted category, and those values are totaled up. Each individual weighting is divided by the total to generate the weight ratio. Then, each variable is given a score based on an established scale. This ratio is multiplied by the score for each variable, and the totals for the variables are added together. Our assigned numbers for each category were 95 (for balanced budget), 35 (for tax ratios), 50 (for defense spending), 70 (non-defense spending), and 5 (for income to corporate tax rate). The maximum possible score is 10, and under our weighting system, we awarded a score of 6.414 for model #1, 4.279 for model #2, and 6.842 for model #3 (our projection).

Sensitivity Analysis

For our model, sensitivity was the measurement of how changes in each variable affected the overall national debt. This measurement was crucial in determining what variables could be changed without significantly altering the fundamental model. Our group only used variables that could be manipulated by the government and evaluated their sensitivities based upon percentage changes in the 2007 data. We also assumed that the initial variables could only be manipulated to within 20% of the 2007 data because variables beyond that could not be considered politically viable. Furthermore, sensitivity was one method of assessing the robustness of our model. To make a model applicable in many situations, we had to find how sensitive each variable was.

We calculated the sensitivities using the absolute value of the slope based on national debt over the percent change in each variable. First, we used step sizes of 5% to find all the initial test values within the 80%-120% range of political feasibility. Thus, we were able to

project the national debt for all variable changes, graphed over their percent change. The slopes of the graphs represented the final national debt's sensitivity to each variable.

Income taxes posted the most significant amount of sensitivity because almost half of government receipts come from them. Due to the large number of households taxed, any changes in the income tax would have a considerable ripple effect on our country's debt. National debt was also moderately susceptible to fluctuations in the human resource expenditures. Since programs such as Medicare and Social Security took up approximately 62.72% of the total expenditures from data contained in the *Fiscal Year 2009 Budget* from the Office of Management and Budget, the human resources category conceivable would have a greater sensitivity value than all other categories, except income tax.

Letter to the President

Dear Mr. President,

Based on our observation, calculations, and projections we believe we can give you sound advice on effective economic policy. We created a model based on previous data collected from past budgets and their fluctuations. For our first plan, we assumed values were not going to change, this allowed us to take the past four years data and use it to predict the next eight years. Based on our predictions, the total national debt will climb from $8.429 trillion to $12.239 trillion. The ratio of national debt to GDP will rise from 60.90% to 67.75%. If these trends continue, the United States economy will be severely hindered in the near future. For these reasons, we believe that a major reform in economic policy must be enacted.

Recently, we put a new, widely-supported proposal into our model. The results from this model proved even worse than the current estimations. For this proposal, the national debt would increase from $8.425 trillion in 2007 to $14.247 trillion in 2017. The ratio of national

debt to GDP would increase from 60.87% to 78.86%. The flaw in this plan was the proposed rise in expenditures dwarfed the increases in tax revenue. Consequently, this plan should not go into effect, and a third economic policy plan must be sought.

We created a third option and examined it using the same proven model. This proposal created a surplus in every year through 2017. According to our projections for the next ten years, the total national debt would decrease from $8.312 trillion to $5.460 trillion, and the ratio of national debt to GDP would also drop from 60.06% to 30.22%. Based on these data, our proposal would help lift the U.S. economy from its present downturns. Our plan consists of a universal increase of income tax rates by 2% and a mandate cap on human resource expenditures at current levels. The latter would be offset by gradually privatizing social security.

We also built a weighted ranking system to evaluate these programs against each other based on criteria we felt were significant to managing the United States debt. The weights in this system can change to reflect your political agenda. Under our set of weights, which we believe to reflect commonly-held interests between us, we found our proposed economic policies will result in the highest overall score of 6.842/10. The plan representing status quo had a score of 6.414/10 and the reformed plan had a score of 4.279/10. Therefore, we believe our proposed budget would be the best of the three mentioned for lowering national debt while maintaining non-military spending within viable terms.

Sincerely,

Your Loyal Advisors

Conclusion

In conclusion, our model applied data from the last four years to predict the future national debt for 2009-2017. Based on our model, total debt will rise from $8.429 trillion to $12.239 trillion, and the ratio of national debt to GDP will increase to 67.75% from 60.90%. Assuming these trends hold true, the United States economy will continue to weaken over the next eight years. Therefore, we strongly advise a reform in economic policy.

Furthermore, we applied data from a popular proposal for economic change into our model. This plan called for raising taxes on the top two federal tax brackets, as well as increasing total federal expenditures. However, since tax revenue increased more than expenditures, the national debt still increased. If this budget were to be enacted, it would increase debt from $8.425 trillion to $14.247 trillion. Moreover, the ratio of national debt to GDP would increase from 60.87% to 78.86%. Thus, this proposal should not be carried out, and another alternative plan must be created.

We created a third option and analyzed our budget using the same model. This new plan would create a surplus every year and decrease total federal debt from $8.312 trillion in 2007 to $5.460 trillion in 2017. The ratio of national debt to GDP also would decrease from 60.06% to 30.22%. These declines would have a positive effect on the economy of the United States. This proposal consists of enacting an increase of 2% in all tax brackets. Separately, we would cap human resources spending at 2007 levels while simultaneously allowing optional privatization of social security to defray the loss of revenue.

Another key aspect of our model is a weighted rating system called SMART. This method uses a system of weighted equations based on multiplying weights, set by the user on

each criterion, with the score, designated for each plan, based on how well the plan achieves each standard. The SMART rating for the model of projection based on current data is 6.414 /10 while the widely-supported plan received 4.279 /10. Alternatively, our plan achieved the highest score: 6.842.

Moreover, we analyzed the sensitivity by changing one variable at a time while keeping the others constant and observing the change on the national debt in 2017. Then we graphed the national debt over the percent change to determine the sensitivity of the variable. This sensitivity would allow the users of the model to understand how changing each variable would affect the final national debt relative to the other variables.

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Appendix Section

(All numbers in millions unless otherwise stated)

Glossary

Variable List:

Expenditures

E: Expenditures

D: National Defense

R_H: Human Resources

R_P: Physical Resources

Q_E: Other Expenditures

β: Paying off Interest

Income

I: Income

T_I: Income Taxes

T_C: Corporate Taxes

T_W: Welfare Taxes

T_E: Excise Taxes

Q_R: Other receipts

Others

G: GDP Growth Rate

I_N: Inflation Rate

H: Number of Households

I_R: Interest Rate

I_T: Interest Paid

Ψ: Cumulative National Debt

Acronyms:

GDP = Gross Domestic Product

OMB = Office of Management and Budget

SMART = simple multi-attribute rating technique

AMT= Alternative Minimum Tax

CND = cumulative national debt

Formulae:

$$y = 114604e^{-2E-5x}$$

$$H_R = \frac{H_t - H_{t-1}}{H_{t-1}}$$

H_R = Rate of Housing Increase

$$\Omega = E - I + S$$

$$E = D + R_h + R_p + Q + \beta$$

$$I = T_i + T_c + T_e + T_w + Q_r$$

$$I_R = \frac{I_{T-1}}{\Psi_{T-1}}$$

$$\beta_T = I_R * \Psi_{T-1}$$

$\frac{\Psi}{G}$ = Ratio of National Debt to GDP

$\frac{\Psi}{H}$ = National Debt per Household