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THESIS APPROVAL

The abstract and thesis of Hal T. Nelson for the Master of Science in Political Science were presented November 8, 2002, and accepted by the thesis committee and the department.

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ABSTRACT

An abstract of the thesis of Hal T. Nelson for the Master of Science in Political Science presented November 8, 2002.

Title: Presidential Domain: An Exploratory Study of Prospect Theory and US Climate Policy Since 1998.

The Bush administration's decision to abandon the Kyoto Protocol can be explained by prospect theory. The change in federal climate policy between the Clinton and Bush administrations was due to the difference in domain that each president operated under. President Clinton operated under a domain of losses as he associated continued fossil fuel use with future socio-economic and environmental damages from climate change. This domain of losses increased President Clinton's risk tolerances and explains his pursuit of the Kyoto Protocol, an international agreement to limit greenhouse gas emissions. Conversely, President Bush operated under a domain of gains where he did not connect fossil fuel use with future damages, rather with continued economic growth. President Bush's domain of gains reduced his risk tolerance and resulted in his pursuit of fossil fuel intensive economic development policies.

This paper defines the domain that Presidents Clinton and Bush operated under regarding climate change, the independent variable of this analysis. A total of 26 speeches on climate change by these presidents were coded to explicate domain according to two categories of beliefs. The single most salient variable is the decision

makers beliefs about the perceived robustness of the current state of scientific knowledge on climate change. The second most important aspect of these decision makers beliefs revolve around the role of fossil fuels in economic growth.

Once domain has been defined through the cognitive maps and each decision makers corresponding risk tolerance explicated, the dependent variable of policy preferences are analyzed. Two policy options are analyzed; the business as usual (BAU) option associated with the status quo, as well as a climate protection policy that is reflective of the emissions reductions associated with US compliance with Kyoto. These two policy options are evaluated in three case studies; the economy wide costs of compliance with Kyoto targets for greenhouse gas emissions, the public health impacts of greenhouse gas reductions, and finally against a component of the Kyoto Protocol that allows for international trading of permits to emit greenhouse gases.

PRESIDENTIAL DOMAIN: AN EXPLORATORY STUDY OF
PROSPECT THEORY AND US CLIMATE POLICY SINCE 1998

by

HAL T. NELSON

A thesis submitted in partial fulfillment of the
requirements for the degree of

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in
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“He is no wise man that will quit a certainty for an uncertainty.” Samuel Johnson

With these few, simple words Samuel Johnson gracefully stated much of the foundation for public policy decision-making. Human beings are by nature a risk averse lot, preferring the security that comes with the familiarity of the status quo. Empirical studies have demonstrated humans’ penchant for the status quo over alternatives with higher expected outcomes (Kahneman, Knetsch, & Thaler, 1991, Kahneman and Tversky, 1979). Policy makers are not significantly different from other humans in this regard. For public policy to deviate more than incrementally from the current way of doing things requires a synthesis of variables that perceive the status quo as undesirable.

The human tendency to favor the status quo becomes especially important when combined with the fragmented structure of the US political system. The US system of judicial review, the separation of powers, a bicameral legislature, and federalism empower groups and individuals who have vested interests in the status quo to effectively block changes in policy that might adversely affect them. In explaining the basis for what they call the Punctuated Equilibrium Theory, True, Jones & Baumgartner (1999) state,

As opposed to smooth, moderate adjustments to changing circumstances, the conservative nature of the national political system often favors the status quo, thereby making conflict or an extraordinary effort necessary for a major change (p. 98).

While recognizing the primacy of the status quo, this paper takes a different approach to explain the US climate policy process. Instead of operating at a systemic or even institutional level, this analysis proceeds at the individual level of analysis. An individual level of analysis is appropriate for this case study because the units of study are Presidents' Clinton and George W. Bush and their statements and actions on the issue of climate policy. Because of the agenda setting, legislative, and foreign policy decision-making powers of the office, presidential case studies can provide an empirical laboratory for testing individual decision-making theories (McDermott, 1998, Levy, 1997). Rather than theory testing, this analysis utilizes the individual decision-making theory known as prospect theory to explain the difference in policies between the two presidents. Prospect theory can yield important information about presidential decision-making. As McDermott (1998) states

[I]t is worthwhile to investigate the extent to which a decision maker's cognitive biases might affect his choices, and subsequently even his state's behavior, in systematic and predictable ways (35).

The cornerstone of prospect theory is its treatment of the status quo, or domain, as a reference point for decision-making. Domain is an independent variable that affects a person's ability to tolerate risk in their behavior. If a person believes that the status quo is acceptable then he or she is acting under the domain of gains, and will be risk averse in their behavior. Conversely, if the status quo is unacceptable to a decision maker, then he or she is acting under the domain of losses. Under this domain,

individuals are then able to tolerate more risk in supporting policies to alleviate the unacceptable condition.

In addition to considerable empirical support¹, this theory has significant intuitive appeal and can be applied to many policy decisions. One particularly salient example is the Civil War. President Lincoln's anti-slavery platform was the centerpiece of the new Republican Party. The Republican victory in the 1860 presidential election drove the Southern states to secession. Lincoln believed that the status quo of secession of the Southern states was unacceptable on Constitutional grounds (Oates, 1977, p.234). This placed him in the domain of losses and increased his risk tolerance. The policy outcome of this condition was his support for military action to prevent secession of the South. In doing so he risked his own life and the lives of thousands of others.

¹ Daniel Kahneman and Amos Tversky exerted a large part of their considerable energies to empirical study of cognitive decision theories. Theirs and others' empirical studies of cognitive decision theory are included in the following literature review.

1. Introduction

While history is rife with possible applications of prospect theory, this examination concentrates on the slightly more timely issue of federal climate policy. The Bush administration's rejection of the Kyoto Protocol, an international agreement negotiated extensively by the Clinton administration to limit the emission of greenhouse gases, provides us with a rich and timely issue area to study. Climate change has been described as the public policy problem from hell.² This is due to the pervasiveness of fossil fuels throughout the modern economy, the long-term intergenerational nature of the problem, and the redistributive nature of policies to mitigate emissions. Therefore, the benefits of mitigation are long term and dispersed, while the costs are immediate and concentrated.

In addition to the political problems of enacting sagacious climate policies, the complexities of the climate system itself mean that scientists are bound to be divided on how to define the implications of human actions. Therefore, any mitigation policies will be subject to uncertainties about the cost and benefits of the policies. Secondly, climate protection policies are unique in many ways. As such, this paper outlines how prospect theory can explain so much about these environmental and socio-economic policy decisions that are made under conditions of uncertainty with extended temporal elements. Given the short term nature of the political and business cycles, it is important to understand why a society should undertake a greenhouse gas

reduction program under conditions of extreme uncertainty in its cost/benefit analysis and in a situation where many of the benefits from the program are decades away. Hopefully, prospect theory can shed some light on this issue.

After exploring the background of climate change policy, this analysis proceeds by defining the domain that Presidents Clinton and Bush operated under regarding climate change, the independent variable of this analysis. A total of 26 speeches and comments on climate change by these presidents were analyzed to explicate domain, 13 for each president. To operationalize domain, cognitive maps were constructed according to the coding rules explicated by Wrightson (1976). The procedure is to first identify important variables, then to identify which variable is the cause and which is the effect variable, then finally to determine whether the relationship between the variables is positive (+), negative (-), no relationship (0), or indeterminate (?). Thus, the cognitive map is a collection of: *Cause Concept* $\Rightarrow$ *Linkage* $\Rightarrow$ *Effect Concept* for the policy variable under consideration. Because of the timeliness of the issue, the quantity and quality of the information available to the researcher was limited. Past successes in applying prospect theory to foreign policy decision has had the benefit of presidential archives (McDermott 1998, Levy, 1997). In spite of this limitation, the limited amount of information available still yielded rich maps of the domain for each president.

For this analysis, domain is defined according to two categories of beliefs. The single most important variable are the decision makers beliefs about the perceived

² Bill McKibben quoting an “academic analyst” in “Now or Never: What is an Environmentalist to

validity of the current state of scientific knowledge on climate change; science that ties the current fossil fuel based methods of economic growth with irrevocable future environmental and socio-economic changes. The second most important aspect of a decision makers beliefs revolve around the role of fossil fuels in economic growth. The dominant economic growth paradigm is centered around short term economic growth that mandates fossil fuels as a primary input to growth. An “alternative” belief is that economic growth and environmental protection can occur simultaneously.

Once domain has been defined through the cognitive maps and the decision makers corresponding risk tolerance explicated, the dependent variable of policy preferences are analyzed. Two policy options are analyzed; the business as usual (BAU) option associated with the status quo and President Bush, as well as a climate protection policy that is reflective of the emissions reductions associated with US compliance with Kyoto as negotiated by the Clinton administration. These two policy options are evaluated in three case studies; the economy wide costs of compliance with Kyoto targets for greenhouse gas emissions, the public health impacts of greenhouse gas reductions, and finally against a component of Kyoto that allows for international trading of permits to emit greenhouse gases.

A best and a worst case possible outcome for each of the two policies are advanced in order to establish the variance of expected outcomes associated for each policy. The distribution of economy wide costs of compliance for the protection policy are widest under the strong science scenario, representing a risky policy option

that President Clinton preferred under his domain of losses. As a scientific skeptic, President Bush preferred the narrower variance of cost estimates under the BAU. Similarly, the variance of expected outcomes for the emission trading aspect of Kyoto is greater for the protection scenario than for the BAU, a distribution that prospect theory predicts would appeal to President Bush. The final variable examined is the public health component of emissions reductions. The variance of expected outcomes for the protection policy is less than that of the BAU. Prospect theory does not adequately explain why President Bush would not pursue this less risky policy.

In sum, two of the three case studies examined in this analysis include programs for CO₂ abatement that are “risky” compared to the status quo. Given President Bush’s beliefs in the uncertainties associated with climate change science, prospect theory would explain his pursuit of the less risky BAU policy as a function of his belief in the benefits of the status quo. President Clinton, as a climate science adherent, would favor the more risky protection policy as two of three policy variables are more risky than the BAU scenario. Before we can explain the policy change between the two administrations, let us first look at the history of the decision to abandon the Kyoto Protocol.

2. A Change in Climate Policy: President Bush Abandons the Kyoto Protocol

There is evidence that rather than using formal bureaucratic decision-making process in his approach to climate policy, President Bush appears to have acted unilaterally. He opposed the advice given to him by the secretaries of state, treasury, commerce, and the EPA; the agencies that would have administrative authority over implementation of any federal greenhouse gas reduction strategies. However, the position of another key cabinet member, the energy secretary, is unclear. Instead, President Bush sided with Larry Lindsey, his economic advisor, and other conservatives “who continue to question the science behind global warming and think the US should ignore the whole issue”(Dunne, 2001, p. 13).

On March 13, 2001, the President sent a letter to Senators Hagel, Helms, Craig and Roberts that reversed a campaign pledge to regulate CO₂ emissions from US power plants. In doing so, he single handedly rejected the Clinton administration's approach to Kyoto. The administration's decision to officially abandon Kyoto was announced two weeks later by EPA secretary Whitman on March 27th. In April, only after these decisions not to regulate greenhouse gases were made, the administration started holding cabinet level briefings on the economics and science of climate change.

The Bush decision “was made in an appalling vacuum of information” (Rivkin, 2001) and did not represent a classic governmental decision-making approach. According to Allison and Zelikow (1999), outcomes from a governmental model of

decision-making are the result of bargaining games that are formed through competing interests; where a player stands on an issue is dependent on his or her position within the government. Compromise between parties is the inevitable result, and in this case might have manifested itself as a delay to study modifications of Kyoto, a position that was advanced by the EPA, commerce, treasury and state departments. Instead, Bush even rejected the cabinet recommendation to insert moderating language into the letter to the Senators. By refusing to state that the administration opposed CO₂ regulation “at this time” (Dunne, 2001, p. 13), Bush made it appear as if there was not going to be any influence on his decision by the cabinet.

Support for the argument that the President Bush’s decision to abandon Kyoto was largely the result of Presidential discretion and personal initiative could be supported by Bernstein (2000) and Krasner (1972), among others, who have criticized Allison’s models as being too attached to the decision-making process and paying too little attention to the president as an individual. Bernstein argues for “focusing on the president’s personality, values, aspirations, hopes and anxieties, and his background to explain important foreign policy decisions” (p. 162). This analysis responds to these calls for a greater inclusion of individual presidential traits through the cognitive mapping exercise. Prospect theory links traditional rational actor models of decision-making with the actor’s beliefs about the reference point from which they evaluate options.

2.1 Decision-making Literature Review

The rational actor model typically is silent on the role of individual beliefs in decision-making. However, the characteristics of the decision itself are of great importance in any decision theory. The information available to the decision maker categorizes the situation as being performed under conditions of either risk or uncertainty. A situation of risk is one where probabilities of occurrence can be assigned to outcomes, while uncertainty is categorized as a situation where probabilities of occurrence are not possible to assign (Elster, 1986, p. 5).

Policymakers typically face situations of uncertainty where probabilities cannot be assigned to outcomes. For example, legislatures alter policies during conference committees, implementing agencies face cutbacks or barriers to adoption, and evaluation processes that affect policy outcomes, are but a few examples of the conditions of uncertainty that policymakers operate under. Furthermore, policy decisions are made in a dynamic setting, where new alternative are added during the decision process (Mintz, Nehemia, Redd, & Carnes, 1997). In sum, the policy decision-making environment is one of dynamic, often unstructured decisions, made with less than perfect information about both the scope of policy alternatives available and the consequences associated with each alternative.

2.1.1 The Dominant Paradigm?: The Rational Choice Model

Rational choice theorists can possible explain President Bush's decision in March of 2001 to abandon the Kyoto Protocol as a result of subjective expected utility (SEU). SEU posits that decision makers chose options that result in the highest

expected payout according to some subjective utility function. After all, the Kyoto Protocol is an international treaty designed to reduce man made emissions of greenhouse gases, and both the President and Vice President have extensive ties to the fossil fuel industry and believe that an abundant supply of fossil fuels is in the nation's best interest. Furthermore, both individuals come from states where fossil fuels play a major role in the local economies, and were heavily supported in the 2000 election by the fossil fuel industry and other conservative constituencies. A rational actor model could argue that the decision to abandon Kyoto was done in the President's self interests.

Self interests are calculated according to the expected utility principle, which is the basis for the rational choice model of decision-making. The rational model assumes that each decision-maker has a clearly defined set of alternatives (preferences) and these alternatives must be able to be ranked. The economic, physical and logical resources and constraints that define the feasible set are impounded into this set and cease to exist externally (Caparaso, 1992, pp. 129-30). In the neoclassical economic version of rational choice, the actor has gained information on all possible alternatives and will choose the one best value maximizing alternative (Allison, 1999, p. 20). Theorists have relaxed this assumption to include only information whose benefits of collection exceed the costs of doing so (Caparaso, 1992, p. 130). Decision makers will then choose the path with the highest expected utility according to some subjective utility function. Economists have clung to this normative model with tenacity, in spite of overwhelming evidence that humans do not behave the way the

model predicts. Organizational theorists were quick to notice that human behavior in organizations was anything but rational and offered compelling alternatives to the rational choice theory.

Herbert Simon offered the most enduring and quoted alternative to the rational actor model, bounded rationality. Simon held that while intendedly rational, humans operate under a condition of bounded rationality which recognizes the constraints that individuals face in gathering information on alternatives as well as the information processing constraints of individuals. Instead of preparing an exhaustive list of alternatives, individuals only pursue a limited search and select the most familiar alternative, “satisficing” rather than maximizing (Simon, 1976, March & Simon, 1958). Simon makes a cogent argument that decision-making is intendedly rational, however in actuality these constraints result in behavior that is far from rational.

2.1.2 Prospect Theory

Prospect theory (PT) can provide an alternative rival hypotheses to rational choice explanations of presidential behavior. The rational theory of choice is a normative model of idealized decision-making and according to Kahneman and Tversky (1979), does not provide an adequate foundation for a descriptive theory of decision-making. Developed by Amos Tversky, Daniel Kahneman and others over a two decade period, PT “renders rational choice models descriptively vacuous, empirically static, and normatively bankrupt” (McDermott, 1998, pp. 14). PT’s central assertion is that the expected value of a policy is a product of the probability of occurrence adjusted by a probability weighting function and the utility of this outcome

is filtered through a value function (Haas, 2001, p. 247). This value function means that individual utility is based on a reference point where expected outcomes above this point are evaluated as gains, and outcomes below are evaluated as losses, a phenomenon known as “reference dependence”.

Furthermore, notice that the slope of the value function is steeper for losses in

Figure 1: Prospect Theory Value Function

Adapted from Kahneman and Tversky, 1979, p. 200.

This asymmetry means that risk perceptions vary according to domain. PT maintains that individuals might be risk averse when evaluating gains but that they are risk seeking when evaluating losses. Thus, an individual’s perception of risk depends on whether the outcomes are perceived as gains or losses, relative to the starting point and that losses will loom larger than gains. Empirical tests of loss aversion are extensive and robust (Kahneman, et al., 1991). Loss aversion means that the loss of utility of giving up good is larger than the utility of gaining a comparable good and results in an over evaluation of current possessions known as the “endowment effect”. Empirical tests show strong support for this effect (Kahneman and Tversky, 1979, Kahneman, et al., 1991). This loss aversion implies a preference for the status quo, known as the

“status quo bias”, instead of options with the same expected value (Quattrone & Tversky, 1988, pp. 722-4).

The interaction of the asymmetry between gains and losses and the role of the reference point means that altering the framing of a decision can lead to reversals in preferences (Levy, 1997, p. 90). This violates the invariance principle of expected utility theory which states that for rational actors the preference order of outcomes should not vary depending on how their outcomes and probabilities are described. PT offers a means of comparing and predicting behavior across individuals depending on the context of the decision criteria; gains versus losses relative to the reference point, and how and if the assets of decision maker will be affected. Prospect theory is not a prescriptive, normative theory. Rather, it is a prospective theory that is predictively powerful and descriptively accurate (McDermott, 1998, p. 14). The importance of loss aversion and its effects on how an option is framed has profound implications for GHG mitigation policies in the US.

3. Background

Carbon dioxide (CO₂) is seemingly a very innocuous gas. Human beings exhale it with every breath and it has been a by-product of civilization since humans lit their first campfire. But as demand for electricity and transportation increase in an industrializing society grows, so do emissions of carbon dioxide. Carbon from beneath the earth's surface in the form of oil, coal and gas is burned by industrial and consumer activities and released into the common pool resource known as the biosphere. Global greenhouse gas emissions are over six billion tons of carbon a year and this increase in the amount of atmospheric gases results in more of the sun's energy being trapped within the atmosphere rather than being radiated back into space. The US is responsible for about one fourth of global anthropogenic greenhouse gas emissions. If the U.S. were to reduce its greenhouse gas output to something near its Kyoto commitment under Clinton, it will need to reduce its annual carbon dioxide output by approximately 562 million tons of carbon by 2010 (Bernow, et al, 1999).

The magnitude of the cuts necessary to meet Kyoto highlight the changes in climate policy between the two administrations. For the purposes of this analysis, policy change will be defined in three areas. The first policy is the abandonment of Kyoto by President Bush. The Clinton administration negotiated and supported the treaty, but ratification was jeopardized by a unanimous 1997 Senate resolution opposing any international agreement that exempted developing countries from mandatory emissions reductions. Secondly, is regulation of the electricity policy. The

Bush administration's Clean Skies Initiative is widely regarded as a continuation of the status quo, essentially allowing unlimited emissions in the future (Pianin, 2002). In addition, the Bush administration is attempting to roll back regulation of retrofits of old coal plants that were grandfathered into the Clean Air Act Amendments, creating conditions for even cheaper and dirtier fossil fuel sources of electricity. The EPA under the Clinton administration had been pursuing coal fired electricity generators that retrofitted old plants with new equipment yet avoided the emission requirements of new plants. Also, the administration has rolled back Clinton's higher standards for air conditioners, has tried to relax the Army Corp of Engineer's mountaintop coal mining rules, reversed a campaign pledge to regulate CO₂ emissions from power plants, and increased the number of voluntary as opposed to mandatory programs for CO₂ reductions. The final dissimilarity between the two administrations is in transportation policy. Clinton claimed to be in favor of tighter CAFÉ' standards for fuel efficiency while Bush has not supported this policy. These three broad issue areas would comprise a national climate protection policy to reduce GHG emissions.

3.1 Climate Policy Architecture and Implementation

These policies would most likely be supplemented by a national emissions trading regime that has been examined in some detail in the *Airlie Carbon Trading Papers* and Hargrave (1998, 2000). These papers were developed by the "Greenhouse Gas Emissions Trading Braintrust" assembled by the Center for Clean Air Policy which is a group of high level representatives from industry, environmental organizations, state and federal governments and academia. The *Airlie Papers*

explicate policy considerations surrounding the design and implementation of a carbon allowance regime.

According to the Airlie Papers, two broad types of policy options exist for an economy wide carbon trading regime. The first type is an “upstream” approach under a cap and trade regime where allowances to emit greenhouse gases are allocated or auctioned at the level of the primary fuel producers; petroleum refineries, oil importers, gas pipelines and processors. These producers would be required to possess allowances representing one ton (or metric tonne) of greenhouse gas emissions of their products. Low carbon fuel producers such as gas processors would have to hold fewer allowances per unit of sales than would petroleum or coal fuel processors. Their excess allowances could be sold to firms requiring more carbon allowances, thus reducing the relative price of low carbon fuels.

The second policy option is a “downstream” approach which requires all users of fossil fuels to surrender allowances to emit GHGs. With about 380,000 manufacturing sites across the country and millions of cars and houses, using a strictly downstream approach is considered impractical. However, large downstream sources such as electric power generators are relatively few in number (2500), stationary, and these units could be monitored relatively easily. Combining a downstream approach for electricity generators, and perhaps large industrial sources, with an upstream approach for the rest of the economy has been dubbed a “hybrid” approach and is considered the most likely form for a GHG emissions trading regime to be implemented in the US.

Domestic Opposition

It is due to the magnitude of the US emissions reductions associated with fossil fuel combustion that makes the Kyoto Protocol unique among international treaties. Domestic reductions in fossil fuel use would impact a large portion of the US economy and radically affect the current energy infrastructure and industry. As much as international relations scholars like to assume states are unitary, rational actors at the negotiating table, experienced diplomats argue otherwise (Strauss, 1987). As Putnam (1988) argues, international negotiations involve the satisfaction of two sets of interests; domestic political and economic constituencies must be satisfied, as well as maintaining key international relationships through negotiations.

Putnam notes that both levels need to be heeded by decision-makers as long as their countries remain interdependent. Interdependence is an often-used term but needs a working definition. Snyder and Diesing (1977) define it as “the parties are dependent on each other for the preservation or realization of important values” (p. 170). One goal of this analysis is to explicate how the Bush administration did not share the same values as that of the other industrialized nations. As we define the domain that the Bush administration operates under, two variables should become clear: 1) the administration questions the existence and severity of global warming, and 2) that fossil fuels are perceived as too important to economic growth to regulate.

The US rejection of Kyoto is not unique among OECD countries. Australia has also indicated that it will not ratify the treaty and the Canadian government is having trouble overcoming opposition from energy intensive industries and fossil fuel

extractive regions. Climate policy is difficult to enact because of the characteristics of the issue area. The combination of the ambiguous scientific nature of this problem, along with the magnitude of the use of the polluting input continues to hamper progressive climate policy implementation globally. Comparing these scientific and economic aspects of Kyoto to the Montreal Protocol on ozone depleting substances can provide an illustration of these phenomena.

3.2 Comparison of the Kyoto Protocol to the Montreal Protocol

As early as the mid 1970's, the scientific community was aware that the ozone layer was diminishing. By the early 1980's, the combination of regulatory action and voluntary industry activities had reduced the production of ozone depleting substances (CFCs) by about 20% from their peak of a decade earlier. The initial target of a 50% reduction of these substances under the Montreal Protocol was increased to a total production ban (by industrialized nations) in the final 1986 agreement after a NASA expedition brought back definitive proof of a hole in the ozone layer (Bryner, 1997, pp. 29-34).

The contrast of the “smoking gun” hole in the ozone layer to the gradual and quasi-attributable effects of global climate change couldn't be starker. While not a simple problem, the complexity of the ozone hole pales in comparison to the intricacies of climatology. Since the Bush administration abandoned the Kyoto Protocol, 2000 people have died in monsoon floods in Asia, the Chinese government has announce that it will spend billions to halt desertification outside Beijing, Europe has seen the worst floods in centuries, two huge chunks of the Antarctic Ice sheet have

calved off, the worst forest fires in history have devastated the Western US, bark beetles have killed pine trees worth billions of dollars in Alaska and the Northwest, and the West Nile virus has killed and terrified vulnerable residents across this country. All of these events are consistent with what the climate models predict for global warming.³ However, none of these events can be definitively attributed to the one-degree rise in global temperatures that we have experienced. Alternative rival hypothesis abound for each of these complex phenomena. As Jasonoff (1993) states;

When it comes to studying the causes of complex environmental problems, there is almost always more than one way to skin the scientific cat. And these choices are not themselves scientific. They're deeply social, cultural, and ethical (p. 155).

This inability to define a clear scientific link between these tragic events and our warmer world is preventing the environmental community from moving the climate change issue to the forefront of the US policy agenda.

If the lack of a smoking gun is preventing policy action, so to is the importance of fossil fuels as economic inputs compared to CFCs under the Montreal Protocol. CFCs and their replacements are used primarily in refrigeration and some manufacturing processes which limits their penetration in the economy to a relatively small industry. Contrast this with fossil fuels; the coal, oil, and gas industries combined are a trillion dollar a year industry. When combined with the automotive industry it becomes apparent that a modern economy's very foundation is fossil fuels.

³ See the US National Assessment by the US Global Change Research Program at <http://www.usgcrp.gov/usgcrp/nacc/default.htm>

Not only does the discrepancy between the economic goods under regulation in the two treaties become apparent, there exists substantial differences in the availability of substitute goods. The US refrigeration industry signed onto Montreal after they had discovered a cost effective substitute to CFCs. The fact that the US industry that would be regulated under the treaty developed a new product, when European CFC manufacturers had not, is commonly viewed as a major explanatory variable for US support of the Treaty under the Reagan administration (Bryner, 1997, p. 33). However, cost effective substitutes for fossil fuels are not readily available. While electricity generated from wind turbines can be competitive with new fossil fuel generation, it is available as a generation resource only in certain parts of the US. No new sources of electricity can compete with old coal plants whose equipment has been fully depreciated, giving it a major cost advantage. Only energy efficiency and conservation can compete with old coal as a source of “new” generation (Nelson, 2002). In the transportation sector the availability of cost effective substitutes for the internal combustion engine are bleak. Thus, Kyoto suffers in comparison with the Montreal Protocol again, this time because of differences in the availability of commercialized cost effective substitutes.

The final disparity between these two international environmental agreements has to do with the effects on state sovereignty from ratification. Remember that the Reagan administration was not concerned about US ability to comply with Montreal’s required reductions of CFCs because of the existence of CFC substitutes. However, only a few ardent environmentalists have argued that US compliance with Kyoto

would be easy. Therefore, at the time of the its abandonment of Kyoto it is possible that the Bush administration believed that if the US had ratified Kyoto and then was not able to meet its targets it would have been liable for potentially unlimited financial liability under Article 18 of the Kyoto Protocol. Article 18 is a rather vague paragraph that defers compliance criteria to future meetings. Subsequently, the Conference of the Parties to the Protocol decided that excess emissions from the first period ending 2008-2012 would have to be made up in the next compliance period, plus a 30% penalty.⁴ This is not a light sentence, but neither is it the death penalty as the benefits of electricity standards and investments in new technologies for clean energy and transportation in the first compliance period would be reaping emissions reductions benefits in the next period.

While this paper is not expressly concerned with the effects of Kyoto compliance on US sovereignty, this is clearly an important issue that needs to be analyzed in future research. This analysis cannot rule out that these concerns did not materially impact the administration's decision on the issue. A risk averse administration operating under the domain of gains is certainly not going to experiment with potentially expensive and invasive international treaties if it does not believe the threat posed by climate change is significant. However, in many ways the concern about national sovereignty complement the two variables under examination in this paper. If, as this paper maintains, the risk averse Bush administration quit the Kyoto process because compliance required too many risky policies then the sovereignty issue would be similarly risky to the emissions trading and economic

⁴ <http://unfccc.int/issues/comp.html>

policies associated with ratification and compliance. This paper does not explicitly consider sovereignty due to a lack of publicly available data from the administration on the issue. Nor does the sovereignty problem lend itself to a cost-benefit analysis and estimates of the variance of expected outcomes, the favored methodology for the more quantifiable policies under examination.

4. Prospect Theory Analysis of Domain

The goal in delineating the discrepancies between the Montreal and Kyoto Protocols is to help define important variables in the political economy of climate policy. The differences in both scientific certainty of the underlying phenomenon as well as the availability of cost effective substitute goods explains much of the differences in outcomes between the two treaties. Because of the importance of these factors they will be used to define domain in this analysis. For us to understand the shift in policy from the Clinton to the Bush administration, we need to contrast the two administrations' views on the issue of global climate change with the goal of delineating the type of domain each administration believed itself to be under. Once we have assessed the domain, the independent variable, we can explain and predict the subsequent riskiness of the dependent variable of the options that each administration pursued.

Thus, for this analysis domain is defined in two categories. First, we need to explicate each decision maker's beliefs about the role of fossil fuels in the US economy. Second, each President's statements on the science of climate change are considered as each decision maker's beliefs about the robustness of the science and the long-term threat posed to society by climate change determines the domain that the individual operates under. Other categories of belief elements were considered and then excluded due to methodological reasons. For example, it is tempting to include the beliefs of each president on the regulation of the economy. However, this belief

also reflects a subsequent policy preference. Domain and the risk tolerance of subsequent policy alternatives need to be evaluated independently to avoid tautological reasoning (McDermott, 1998). By delineating each man's beliefs only about science and fossil fuels, this type of circular reasoning can hopefully be avoided.

It is difficult to overstate the importance of fossil fuels to modern economies. Daniel Yergin, with a gift for understatement claims, "...[P]etroleum remains the motivating force of industrial society and the lifeblood of the civilization that it helped create" (1992, p. 779). This is especially true in the US where the regulatory environment is especially friendly to fossil fuel consumption. Figure 2 shows that the price of unleaded gas in the US is less than one half that of other industrialized countries (retail petrol prices for India and China are not available), primarily because of low energy taxes. Because of the low cost of fossil fuels as an economic input, the US relies on these sources of cheap energy, and their corresponding greenhouse gas emissions. The average American is responsible for double the CO₂ emissions of their European counterpart, and 20 times that of an Indian citizen.

The entire US socio-economic structure has benefited from cheap fossil fuels. In fact, cheap fossil fuels might even be considered a part of American cultural "mythology"; Route 66, cruising, huge dream homes, muscle cars, and SUVs are mostly viewed as positives for mainstream American culture and each requires a source of cheap energy. The status quo consists of low energy taxes, low-cost imported oil, and cheap domestic coal. These regulatory choices have provided cheap energy inputs and therefore the status quo is viewed favorably. In

Figure 2: Comparative Fuel Cost and Emissions Data (source: IEA, 2002)

prospect theory terms, this is important because states that benefit under current conditions will be in a gains frame (Berjekian, 1997, p. 792). One of the assumptions of this paper is that, *ceteris paribus*, the US has benefited from the status quo of low cost energy inputs as a reference point and is therefore in the domain of gains as the default condition.

In social science terms, the status quo would be defined as the dominant social paradigm. For the mainstream consumer society of the US this paradigm could be considered “frontier economics” which is characteristic of the unlimited resources of a society with an open frontier (Porter and Brown, 1991, p. 27). The foundation of this societal view is fundamentally exclusionist, in that it excludes human beings from the laws of nature. It is based on the assumptions of neoclassical economics; markets allocate scarce resources most efficiently, and that there is an infinite supply of natural resources as well as sinks to dispose of human waste. Human beings can avoid resource depletion by allowing the price of scarce resources to rise until technology

can supply substitute goods. Similarly, waste disposal is something to be considered *ex post facto*.

However, this dominant social paradigm has come under attack by an “alternative” view. Sustainable economic development recognizes that the current system does not impound the externalities into prices of goods and services, nor does it protect public goods such the atmosphere, rivers and oceans. It is not a coincidence that the vanguard of this alternative paradigm is “alternative” energy; biofuels and renewables that minimize the long-term negative externalities and damage to the commons. A cornerstone of this paradigm is its call for long term decision-making. Dubbed intergenerational equity, it is the concern that the current generation’s economic policies will jeopardize the ability of future generations to increase their standard of living because of either polluted common areas or depleted resources. Sustainable development’s concern for future generations and for the global commons is what distinguishes it from the status quo and the exclusionist paradigm. The difference between Presidents Clinton and Bush is how each viewed this reference point of the status quo. Perceptions of their reference point is a function of each individual’s ideology and beliefs and how it affects their ability to assimilate new information that might conflict with existing beliefs, preferences and policies.

4.1 Elite Ideology and Beliefs

Explicating a definition of elite political ideology has challenged scholars for years. Putnam (1971) has defined it as some identifiable characteristics or set of characteristics of political actors; a small set of explicable principles that guide an

individual's thinking and behavior in a wide variety of situations. Kritzer (1978), following Converse (1964), operationalizes ideology as the stable, highly structured interrelationships among belief elements or attitudes (groups of belief elements) of elites. Kritzer's model composed of belief elements and their interrelationships utilized survey questions to measure ideology. For this analysis a different data gathering model needs to be used, given the lack of access to administration officials. Instead, this paper utilizes Axelrod's (1976) cognitive mapping model consisting of concepts and causal beliefs. Confusing terminology aside, Axelrod's concepts act as variables akin to belief elements, while causal beliefs are the relationships between variables.

A total of 26 speeches dealing with climate change were analyzed to explicate domain, 13 for each president. To operationalize domain cognitive maps were constructed according to the coding rules explicated by Wrightson (1976). The procedure is to first identify important variables, then to identify which variable is the cause and which is the effect variable, then determine whether the relationship between the variables is positive (+), negative (-), no relationship (0), or indeterminate (?). Thus, the cognitive map is a collection of: *Cause Concept* $\Rightarrow$ *Linkage* $\Rightarrow$ *Effect Concept* for the policy variable under consideration. The appendix contains a full description of the methodology employed in this analysis.

4.2 Analysis: Comparison of Presidential Belief Systems

This paper argues that the two most important aspects of a climate policy decision makers' domains are his beliefs about the state of the science of climate

change, as well as beliefs about the role of fossil fuels in economic growth. Most importantly, the science is what links the emission of greenhouse gases from the burning of fossil fuels with the negative consequences of climate warming: sea level rise, more extreme weather events such as hurricanes, increased droughts and flooding, human health problems from the increase in vector born diseases such as malaria, hantavirus and W. Nile virus, etc. In climate policy decision-making, it is science that is the link between the antecedent path of greenhouse gas emissions and the consequence path of global warming. "Science, not aroused by public opinion or economic interest groups, has been the prime political mover behind most global environmental issues." (Rosenbaum, 1998, p. 344). Peer reviewed science may be the closest thing to an "objective" source of information that is available to a policy maker.

The Intergovernmental Panel on Climate Change (IPCC) is comprised of 2500 scientists and represents the largest peer reviewed scientific effort in history. In 1995 the IPCC stated that "The balance of evidence suggests a discernible human influence on global climate" and in 2001 concluded, "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.." (IPCC, 2001, p.10). The IPCC projects that the coming century will bring temperature increase of 1.4 to 5.8 degrees Celsius, barring significant changes in consumer and industrial behavior. Yet, in spite of the billions of dollars of scientific research, the earth's climatic system is undoubtedly one of the most complex systems to understand. While the IPCC believes that part of the .6 degree Celsius warming of

the last century is due to anthropogenic activity and not due to natural variation, uncertainties still exist regarding the magnitude of the changes and the role of cloud formations in future warming.

The Bush administration revealed its views about the state of the science when it asked the National Research Council of the National Academy of Sciences to review the IPCC reports. In addition to identifying areas of certainties and uncertainties in the science, the White House was also concerned that there was a bias between the full IPCC reports which are approximately 1,000 pages, and the 20 page summaries for policy makers. Climate skeptics have argued that the scientists of IPCC were displaying scare tactics to make the public and policy makers believe that the problem was worse than the science says it was.

The National Research Council (2001b) squelched these rumors, stating “no changes were made [in the SPM] without the consent of the convening lead authors and that most changes that did occur lacked significant impact” (p. 23). On the issue of uncertainties, the NAS notes, “The changes observed over the last several decades are likely mostly due to human activities, but we cannot rule out that some significant part of these changes is also a reflection of natural variability” (p. 1).

Given this brief synopsis of climate science, let us turn to each president’s stated beliefs about climate change. The contrast in the stated beliefs by the two presidents about climate science could not be more polarized. President Bush stated that he believes that climate policy initiative should be based on “sound science” and has described the scientific community as having “differing opinions” and the state of

climate science as “uncertain” and possessing an “incomplete state of knowledge”.

The interpretation of these comments is that since the science is uncertain and policies should be based on “sound” science, only limited action should be undertaken until the science improves.

In contrast, President Clinton argues that the scientific evidence is “not all that controversial”, rather he argued on November 11, 2000, the evidence is “clear that this projected warming threatens serious harm to our environment and to our economy. It could mean more flooding, more droughts, more extreme weather, and a serious disruption in water supplies.” Clinton nearly always listed the forecasted negative impacts of a warmer climate and used the word “risk” and “threat” repeatedly. In other talks he clearly defines the linkage between fossil fuel use, greenhouse gas emissions and climate change, links that President Bush has not explicitly made in this collection of statements. As close as Bush got to linking this antecedent to a consequence path was on January 18, 2001 when he acknowledged that “human activities are a significant factor in climate change, and that climate change is likely to have many negative impacts on our environment and society.”⁵ President Bush never mentions what those negative impacts are; flooding, droughts, and other predicted consequences are not included in any of his statements available to this researcher.

Figures 3 and 4 provide cognitive maps for Presidents Clinton and Bush respectively. The differences in their beliefs about the state of the science are

The second way that this paper defines domain are the decision makers' beliefs about the role of fossil fuels in the economy. Fossil fuels have been responsible for historical patterns of industrialization and economic growth, otherwise known as the status quo. Clinton's map shows a neutral relationship between fossil fuel use (thick line in the center of Figure 3) while Bush believes in a strong positive relationship between the two. This central belief affects the relationship of many other belief elements. Bush's statements are centered around the concept that environmental protection will come after, or as a result of economic growth and increased wealth. His belief is manifest as positive relationship *from* economic growth to environmental protection. In contrast, Clinton's belief that environmental protection and investment in renewable resources would cause economic growth is manifest as a positive relationship between the two as well. However, the direction of the linkage between these two concepts is different for each decision maker, indicating opposite antecedent and consequence paths. President Bush's beliefs don't include the fact that, according to the science, any future economic growth using historical types of energy consumption will lead to environmental degradation, not protection. His aforementioned inability to connect economic growth using fossil fuels and their corresponding GHGs with global warming is central to explaining Bush's domain.

Figure 4: Cognitive Map of President Bush

In his statements, President Bush repeatedly suggests two things: a belief that technology will be able to solve the problem of global warming, and that this will happen at some time in the future. Remember that these are two elements of the exclusionist paradigm. As an example, on February 21, 2002 he put it this way, “wise [economic] growth is something that happens in the future.” This approach is reminiscent of an old Brazilian saying, “Brazil is the country of the future, and always will be.” Without a timeline for action, or agreed on adaptive management triggers for policy action to offset environmental problems, the dominant paradigm relies on the human penchant of being resistant to change for its continued supremacy.

This discrepancy between the two presidents in their perception of temporal elements is critical. After all, the conceptualization of time is one of the paramount differences between the dominant paradigm and the alternative one that this analysis argues each president represents. Sustainable economic development has been defined as “development that meets the needs of the present without compromising the ability of future generations to meet their needs” (World Commission of Environment and Development, 1987). Under this paradigm, policy makers must explicitly consider the future. The status quo relies on maximizing returns in the current period, without explicit consideration of future income or conditions.

At the end of nearly every one of Clinton’s comments was a request to consider our children when considering climate policy and this is impounded in his cognitive map as the negative relationship between fossil fuels and the future costs of climate change. President Bush’s statements show little regard for the future and therefore his cognitive map indicates an uncertain relationship between fossil fuel use and future costs.

These two maps contrast the two individual differences in beliefs about the robustness of climate science as well as the role of fossil fuels in the economy. These two cognitive maps have been developed in order to advance the theory that each decision maker operated under differing domains. When comparing the domains of these two men, there are four important factors to consider. First, in prospect theory terms, President Bush conceptually would have been operating along the value function in the upper right quadrant of the hypothetical value function in Figure 1.

Conversely, President Clinton's domain would have been along the line in the lower left section. Secondly, prospect theory allows for an individual's expectations to help define their domain. While in many cases, expected gains or losses from potential alternatives are evaluated against the reference point of the status quo, it is also possible that gains or losses are compared relative to an expectation or aspiration level that differs from the status quo. Kahneman and Tversky (1979) use the example of an entrepreneur that is experiencing a business downturn with greater success than his competitors. He might evaluate a small loss as a gain, as opposed to the expected larger loss (p. 286). In this case, Clinton's expectation would have been that the gains from business as usual development are overwhelmed by the future costs from a changing climate, putting him in the domain of losses.

The third factor to consider is that comparing the domain of two such disparate individuals as Presidents Clinton and Bush is difficult from a methodological standpoint. Such a comparison is enhanced by a benchmark to compare each of them against. Berejekian (1992, 1997) proposes a "social frame" which he defines as "the perception that participation in the existing socio-structural arrangement implies either gains or losses" (p. 792). Perhaps for this analysis, the term "policy frame" might be more appropriate. This policy frame would include our two primary variables; the role of fossil fuels in economic growth as well as views about the robustness of climate science. Clinton's policy frame led him to believe that current conditions were unacceptable and negative consequences would result from a continuation of the

status quo. In contrast, President Bush did not share these beliefs and thus associated the status quo with continued gains.

The final factor to contemplate is how Clinton's beliefs about the policy frame changed sometime prior to 1998. His current beliefs differ from what this paper argues is the default condition of business as usual fossil fuel development. While an explication of his beliefs over time is beyond the limitations this paper, President Clinton would have had to have impounded into his belief system new information such as the 1990 and 1995 IPCC reports as well as significant developments in renewable energy and conservation. This new information could cause a renormalization of his reference point from the gains previously associated with the status quo to losses from a continuation of it. Prospect theory predicts that there will be a time lag in this renormalization from gains to losses. Remember that the "endowment effect" holds that people will overvalue what they currently hold (including beliefs), which will lead to resistance to change. Additionally, loss aversion predicts that it might take longer for people to renormalize their reference point to include losses. Thus, one explanation for the differences in beliefs between the two presidents, is that President Clinton renormalized more quickly than President Bush in the face of new information. The limitations of prospect theory in addressing why one decision maker might renormalize more quickly than another is addressed in the final section. Given these differences in domain between decision makers, the next section explicates the subsequent riskiness of each President's policy preferences.

5. Prospect Theory Analysis of Risk Tolerance

The previous section defined the domains in which each administration operated under. According to prospect theory, if the Bush administration is in the domain of gains as this paper argues, then risk aversion leads to policy changes that are at most incremental. In contrast, meaningful policy change occurs when policymakers are placed in the domains of losses, increasing their risk tolerances and opening up new policy alternatives. The cognitive map for President Clinton maintains that he was operating under the domain of losses. The decision makers operating under this domain should have been risk seeking in its efforts to implement climate protections policies.

Clinton, given his belief in the robustness of the science should then argue for economic development founded on lesser polluting sources of energy. As prospect theory tells us, any policies to move away from the status quo will only be undertaken by those operating under a domain of losses that believe that the status quo is unacceptable.

For this analysis then, risk tolerance is the dependent variable, and it is evaluated in terms of the variance of expected outcomes. If the best and worst outcomes of A are better than the best and worst outcomes of B then A is the more rational choice:

Using this strategy, it becomes possible to compare policies in term of variance in outcomes values without having to precisely determine a decision makers

subjective probabilities, and without having to risk tautology in the definition of risk. (McDermott, 1998, p. 40).

This analysis ranks the distribution of outcomes for three of the most important aspects of a climate protection policy: the economy wide costs, a mechanism that allows polluters to trade permits to pollute, and finally the public health aspects of greenhouse gas reductions.

5.1 Climate Policy Scenarios: Business-as-Usual vs. Protection

For federal climate policy, an increase in risk tolerance equates to abandoning the status quo of business-as-usual (BAU) and adopting plans to first stop increases of GHG's and then to actually reduce emissions. This will be called the climate protection scenario, which contrasts with the risk averse BAU scenario. Some key components of a climate protection policy in the transport sector include: the strengthening of Corporate Average Fuel Economy (CAFÉ) standards, tax credits for the purchase of efficient cars and trucks, the increased use of biofuels, and federal investment in large-scale mass transit. For the electricity sector, mitigation policies usually focus on a national standard for the use of renewable sources of electricity, a transition from coal to gas fired sources of electricity as an interim stage towards renewables, a tax on the carbon content of fuels used to make electricity (with revenues used to reduce payroll taxes), and tighter building codes and appliance energy standards. This paper examines the policy options open to any administration as "ideal types" that are either the BAU case or the climate protection case. Analyzing

the two scenarios as ideal types allows for intellectual clarity on the relative merits of each.

This section analyzes three policy case studies using cost-benefit analyses. By examining the expected variance of positive and negative returns of three policy scenarios, we are able to understand both the Clinton and Bush administrations' approach to climate policy. Because of the complex nature of the scientific issues involved and the reliance of modern economies on fossil fuels, this analysis looks at the economy wide costs and benefits of Kyoto under the domain of both the climate science adherent and the scientific skeptic. Second, is an analysis of the emissions trading component of Kyoto as well as the mechanism known as joint implementation that allows industrialized countries to develop and receive credit for emissions reductions projects undertaken in lesser developed countries (LDCs). The final policy area analyzed in this paper is public health and the externalities associated with fossil fuel sources of energy.

5.1.1 Economy-Wide Cost Of Kyoto Compliance

The variance of outcomes for the status quo (BAU) is easy to determine in the short run for those policy makers operating under a domain of gains and with skepticism towards climate science. The best outcome is a continuation of the economic growth that relies on cheap fossil fuel inputs. The worst outcome would be a hugely expensive program that ultimately would be unnecessary if global warming doesn't pose significant socio-economic risks. Recent efforts to model the costs of compliance with the Kyoto Protocol have utilized computer models called computable

general equilibrium (CGE) models. These models are composed of at least two modules that utilize either top-down and/or bottom-up approaches. Top-down models describe economic behavior based on statistical and theoretical approaches, and provide a look at the economy as a whole, based on analysis of the principal economic sectors impacted by primary energy use. Top-down analyses use the independent variables of GDP growth, population, prices, and investment levels as inputs, along with price changes due to carbon constraints, and try to determine how price effects, income effects, investment effects and structural and technical change will affect the dependent variable, demand for energy use and its corresponding CO₂ emissions (IEA, 1998).

Bottom-up models incorporate technological and engineering data and principals, including market penetration and technology cost data, to model economic activity in key energy intensive subsectors of the economy, transportation, residential, commercial and industrial. The forecasted demand for energy use, along with its CO₂ emissions are the dependent variables. In equilibrium models the relationship between markets is captured through the market clearing process. A change in the price of one fuel will affect the price of other fuels. The market will have said to clear when the model sets prices for all markets so that demand equals supply (Petonsk, Dudek & Goffman, 1998, p. 140).

Top Down Models

In its assessment of six CGE models, the EIA attempted to reconcile the differences between estimated costs of compliance with the Protocol that ranged from

\$221 to \$348 in 2010 and \$147 to \$360 in 2020. Carbon permit prices are per metric ton in 1996 dollars without annex 1 trading, sinks and offsets (EIA, 1999). The dramatic differences in price between the models are due to differing assumptions regarding the models' variables.

- Assumptions regarding baseline (reference) GDP estimates and GDP growth rates: estimates that are relatively high will increase the carbon reduction requirements and corresponding marginal costs.
- Similarly, assumptions about the amount of lead-time decision makers have to implement the climate policy significantly affect abatement costs. If the model begins compliance in 1990, it could understate adjustment costs.
- Assumptions about nuclear power plant retirement and relicensing: if no nuclear plants are retired by 2020 about 40 million metric tons of carbon (MMTC) would be avoided.
- The model's assumptions about the timing and costs of the transition process for labor and capital given compliance with Kyoto. Assuming immediate factor substitution will understate the costs.
- The model's sophistication in dis-aggregating technology that might affect energy efficiency and structural changes in the economy; the existence and/or extent of "no-regrets" policies.

- The assumed price elasticities of demand by consumers of energy. Higher assumed elasticities enable consumers to respond quickly to changes in prices.

As one can see from these assumptions, small differences can result in large variations in estimated carbon allowance prices. The different models exhibit wide variance in compliance costs when projected over time. The models that emphasize technological change show the highest carbon prices early in implementation which are followed by declining prices. Non technology focused models show the highest prices later as technology improvements do not meet demand requirements. The highest costs of compliance are generated with these simplistic top-down models that operate under the assumption that restrictions (price increases) on energy as an economic input will translate automatically as lost GDP. This assumption discounts human ingenuity, technological improvements and our ability to adapt to price increases. Therefore, these models assume that any opportunities for cost effective energy savings have already been exploited since energy markets are fully competitive. “No regrets” saving opportunities are minimal under these models.⁶

Bottom Up and Hybrid Models

The arguments for zero cost compliance with the Protocol comes from demand side advocates who argue that micro-economic assumptions regarding individual and firm behavior are too pessimistic and therefore top down models suffer from a lack of

⁶ Skeptics who argue that the global warming problem is not serious enough to warrant more aggressive mitigation strategies usually reference the top-down, econometric models that show the highest costs of compliance with Kyoto, as we shall analyze later in this paper, to justify their “negative cost” policies.

realism. Top down models assume that producers and consumers are rational and well informed which will ensure that all possible cost saving actions are taken. However, when individuals exhibit “bounded rationality” they will make economic decisions that are not optimal, resulting in disequilibrium between competitive supply and demand forces. The difficulties in obtaining a global optimization that encompasses the entire opportunity set a decision maker faces have been expanded upon in Herbert A. Simon’s seminal work *Models of Bounded Rationality* (1997).

In addition to questioning the perfect rationality of economic actors, some scholars have raised objections to the assumption of perfect information and other assumptions of a free market. Lovins (1997) poses certain “obstacles” to the market capitalizing on all neutral and negative cost energy savings opportunities:

- Capital misallocation: in choosing capital allocations between energy generation and conservation, retail decision makers require a payback period of several years whereas utilities’ make capital investments based on a 20-30 year project lifespan. This discrepancy makes us invest in generation rather than efficiency. Similarly, investments are made according to first cost basis rather than life-cycle costs. The contractor who offers the lowest bid usually gets the contract, and often times the lowest bid doesn’t include low loss wires which provide an annual rate of return of 169%.

Ironically, these models that they reference assume that negative cost options don’t exist because they would have already been exploited.

- **Organizational failures:** energy savings for a department in one year might lead to a budget cut by management for the next year.
- **Regulatory failures:** Many states reward regulated utilities for selling more energy and penalize them for reducing retail customer's bills. The fact that declining block rates exist is evidence of perverse regulatory incentives.
- **Informational failures:** Not knowing something is possible prevents us from doing it. Standby power usage for home entertainment systems in the US consumes about 5,000 MW continuously, yet consumers and manufacturers don't realize the standby feature is available w/ 80-95% less power through a change in the equipment design.
- **Perverse Incentives:** The owner of rental property does not have any incentive to implement even negative cost efficiency improvements when his/her tenants pay all the utility bills.
- **False or absent price signals:** The US subsidized the energy supply industry between \$21-36 billion in 1989. Removing subsidies will let the market determine the equilibrium price and decrease demand for the higher efficiency items.

Lovins argues that the actual market and the theoretical free market are so disparate that comparisons are problematic. According to him, the aforementioned barriers are costing the American economy about \$300 billion a year and that compliance with Kyoto could be achieved with a net gain to the economy.

Hybrid models that integrate bottom up and top down models do assume the existence of “no-regrets policies and the existence of market barriers for energy efficiency. A nice feature of these models is their ability to test the effects of theoretical policy cases in the “real world”. To quantify their theories, the World Wildlife Fund recently chartered a study that utilized the DOE/EIA National Energy Modeling System (NEMS) and the Argonne National Lab Long-Run Industrial Energy Forecasting (LIEF) model to model four primary sectors of the economy; the building sector, the industrial sector, the electricity supply industry, and the transportation sector. They find that net savings in energy costs would average \$46 billion per year if Kyoto was met and that wage and cost benefits would increase by about \$27 billion accompanied by a net increase in 900,000 jobs. The electricity supply industry would meet its target by implementing a 10% renewable portfolio standard (RPS), a requirement for co-firing of bio-mass in coal plants, and a cap and trade system for CO₂ (to 70% of BAU levels), NO_x and fine particulates (Bernow, et al. pp. 9-10).

The disparities in forecasts for compliance costs between the top down models of the fossil fuel industries and the models of the environmental research institutes have been examined in some detail. Goodstein (2001) following Repetto and Austin (1997) argues that four assumptions drive the differences in cost estimates,

- How flexible and innovative is the American economy?
- Will some emissions reductions be achieved through joint implementation?
- What happens to carbon tax or allowance revenues?

- What direct or indirect benefits are achieved from climate protection? (p. 145)

The answers to these four questions explain up to 80% of the differences. So which estimate should the policy maker believe? History might provide a clue. Goodstein provides data on how compliance costs have differed from predicted cost estimates for other environmental regimes. In thirteen cases the actual costs never exceed predicted costs. In fact, overestimation of predicted costs ranged from 41% for CFCs to 2300% for surface mining. Furthermore, the \$350,000 per plant estimate for benzene mitigation was actually done at no cost resulting in an infinite overestimation of original cost estimates.

In addition to energy savings, another economic benefit from a sagacious climate regime could be increased employment in high technology sectors of the economy. If coal prices rise to reflect anywhere near their true externalities, then the coal dependent sector of the ESI will experience a net loss of employment. Most microeconomic models show a net gain in jobs the abatement sector: smokestack scrubbers, lighting, weatherizing, fuel cells, solar and wind manufacturers will all experience a net increase in employment. The enhanced productivity and added value of a solar power technician or home weatherization installer versus a coal miner could also contribute to macro economic gains.

Congressional delegates from coal mining states often use job losses in this sector to oppose carbon taxes as there are about 50,000 coal mining jobs in the U.S. Yet, a recent report by the National Renewable Energy Lab shows that in 1996 the

solar photovoltaic industry employed 15,000 people in high paying jobs, while the biomass power generation industry employs more than 66,000 workers (NREL, 1999). The clean power sector would reap huge benefits from a carbon regime, but employers and employees are not as well mobilized politically and are more decentralized geographically than the fossil fuel sector which hinders efforts to successfully press for an energy transformation.

To reconcile the expected variances for economy wide costs for the science and no science scenarios boils down to the decision makers beliefs on the range of expected outcomes: the costs associated with no protection, and the costs associated with protection. For the skeptic that believes the warming trends that the Earth is currently experiencing are only natural occurring variation, and that climate change poses as many benefits as costs (enhanced agricultural yields) then the worst outcome is investing in expensive climate protection equipment and technology that is unnecessary. For the scientific adherent, the socioeconomic costs of the worst outcome associated with climate change far outweighs the potential costs of abatement. Unfortunately, calculating the indirect costs of climate change are much more difficult due to the uncertainty inherent in modeling the complexity of the Earth's climate and the effects of climate change on socio-economic activity. The effect of this uncertainty in estimating costs on individual decision-making will be addressed in the final section.

Estimating the costs and benefits of the best-case scenario according to domain of the adherent and the skeptic are also more problematic for the protection case than

for the BAU. For the risk adverse Bush administration operating under the domain of gains, there is risk in departing from the known universe of the status quo. Under this domain, the US policies of low cost fossil fuels will provide the best possible outcome. This administration references the top-down econometric models that forecast the highest costs for climate protection. Thus, for Bush the distribution for best outcomes would be BAU then protection, and the distribution for worst outcomes would again be BAU then protection. Table 1 presents a graphical representation of the variance of these policy scenarios.

For the risk seeking Clinton administration operating under the domain of losses, the best possible outcome could have been viewed as increased economic growth and environmental protection. On the worst case side, the severe costs of climate change left unchecked under the BAU would offer the worst outcome. Thus, the distribution for best outcomes would be protection then BAU, and the distribution for worst outcomes would again be protection then BAU. For the strong science adherent, since the protection policy has a more favorable best and worst outcome it is clearly preferable.

5.1.2 Flexible Implementation Mechanisms

As discussed in the preceding section, the cost estimates for the protection scenario depend on the assumptions and methodologies employed. One key assumption of the protection scenario is the availability of GHG emissions trading between states, as well as letting the industrialized countries receive credit for projects undertaken on their behalf in developing countries. This section evaluates the

variance of expected outcomes for two mechanisms of the Kyoto Protocol known as emissions trading and joint implementation. This analyses finds that the variance associated with the best and worst outcomes from these mechanisms is much greater than the BAU model, reducing the likelihood that risk averse decision makers would pursue them.

Emissions Trading

Under Kyoto, states can reduce emissions in any way they choose; traditional command-and-control (CAC) methods such as taxes on the carbon content of fuels or setting emissions limits on industrial activities. Another approach to emission reduction is through an innovative market technique known as emissions trading. Emissions trading (ET) programs require each state to set a national emissions target for GHGs, as was done at Kyoto, and then break down total emissions by each economic sector. Players in each sector are then allocated their “share” of emissions; low emitters can store their right to pollute or sell it to high emitters either domestic or international.

Some rich polluters that would use one of these types of policy frameworks, namely the U.S. and other English speaking states, are suffering from sticker shock while contemplating reducing greenhouse gas emissions an average of 5%. These states are looking for ways to cut the bill for compliance with their emissions targets. The Kyoto Protocol includes an emissions permit trading component, mainly at the insistence of the Clinton administration, which believed that trading can drastically reduce the costs of mitigation of pollutants. The U.S. has a long experience with

emissions trading and is a firm believer in utilizing economic instruments to reduce the costs associated with environmental regulation.

The U.S. Acid Rain program is generally considered the model for emissions trading under the Protocol. The political environment became favorable for the initiation of this program because of the problems with acid rain falling in the Northeastern U.S. and Canada from coal-fired utility and industrial plants in the Midwest and on the East Coast. Under a so-called cap and trade model, the U.S. set a target for its sulfur dioxide emissions. The EPA allocated emissions allowances amongst power generators and qualifying industrial plants. These participants were allocated allowances according to a complex formula based on historical emissions. Firms were then able to emit up to their limit, buy credits to emit past their limit from other participants, store credits, or sell unused credits. This program allowed industries to comply with sulfur dioxide emissions requirements for \$100 per ton compared with initial estimates of \$400-1,000 per ton (Swift, 1998).

Proponents of economic incentives such as ET schemes consistently point to two components responsible for their economic successes. Most importantly, permit trading allows operators to profit from what economists call gains-from-trade. In this case, a firm with a high marginal cost (cost of one additional unit) of abatement can pay a firm with a lower marginal cost of abatement to reduce emissions which would count as a reduction for the high cost emitter. A typical example in the Acid Rain program would be a utility that instead of purchasing expensive abatement equipment for a quick fix, bought cheap credits from a low emitter and invested the difference in

the cost between the two alternatives. Over time this provides firms with capital to invest in new technologies or in fuel switching that will provide more long-term efficiency (Petsonk, et al, 1998, p. 5). The total allocation of allowable emissions will then decrease over time, forcing firms to increase efficiency or to pay stiff penalties on excess pollutants.

The other economic advantage of market mechanisms is that it allows operators to utilize their entrepreneurial skills in pursuit of pollution abatement. Rather than static taxes on inputs or limits on emissions, competition and innovation help defray costs and invite operators to employ their own ideas to maximize emissions reductions, the excess allowances can then be sold in the marketplace. Inherent in a multi-year cap and trade program is a mechanism for temporal and geographic flexibility, suitable for emissions such as sulfur dioxide and carbon dioxide that have long environmental lifetimes and spread over large areas. Temporal and geographical flexibility would allow a utility to “bank” low emissions during a warm winter to offset the high emission encountered in a later cold winter. Similarly, during a drought a low emitting hydro-powered utility would have unused credits with which to offset energy supplied by a high emitting coal utility that is on the same energy grid.

Under one model’s prediction these market mechanisms enable the cost of compliance to fall dramatically under the protection scenario. With no trading, marginal abatement per ton ranges from \$139 to \$304 for the US and the EU respectively. With global emissions trading marginal abatement costs fall to \$24/ton resulting in costs falling 73% to 92% of the original estimates (Pew, 1999).

Apparently, the best outcome between the BAU and the protection scenario would be for a well designed program to bring substantial climate benefits for annex 1 countries at a modest cost. However, significant monitoring and verification problems exist with emissions trading schemes, as well as with joint implementation of reduction projects. For this reason, the discussion of the worst outcomes for ET will be conjoined with the following evaluation of negative possible outcomes from joint implementation.

Joint Implementation

The authors of the Framework Convention on Climate Change recognized the potential problems in including developing countries into the regime. Not only do many developing countries lack the capital, technology and human skills to implement reductions on a systematic basis, they also lack the systems of governance necessary to participate. This lack of regulatory ability and the decentralized nature of production in some LDCs (such as township and village enterprises in China) makes it difficult for developing nations to participate in the regime directly. Until these states are able to 'beef up' their regulatory, legal and monitoring infrastructure they would not be viable players in a regime that relies on the uniformity and enforcement of global regulations. In an effort to appeal to the self-interests of LDCs, a strategy was introduced for the joint implementation (JI) of projects to reduce GHG emissions between developed and developing countries. It allows countries with higher abatement costs to invest in cheaper emission reduction projects in other countries and

to receive credits in return for the joint project. As with any regulatory mechanism it has its strengths and weaknesses.

The most obvious of its strengths are the similarities to the economic benefits of the ET program as it provides actors with temporal and geographical flexibility in their economic decision-making. Participants can choose the time and place of their reduction programs. Proponents argue that the polluters with the lowest marginal cost of abatement are found in developing countries given their older technology. The OECD estimates that the costs of energy sector emissions abatement vary by a factor of about 20 across regions (OECD, 1996, p. 11). This aspect, coupled with the relatively greater purchasing power of developed countries makes this argument particularly strong. For example, given the strength of the English pound against the Indian Rupee, a British utility (the investor) could purchase and install a scrubber on an Indian coal-fired utility (the host) much more cheaply than a scrubber on an English plant. Similarly, the decrease in CO₂ would be much greater given the greater efficiency of the modern English plant versus the older Indian plant. The potential benefits from the reduction of *global* GHGs through this mechanism of the treaty cannot be overestimated.

Another potential advantage of JI is it contains a potentially important mechanism for obtaining private capital to finance emissions abatement projects around the world. The difficulty in getting developed governments to give aid for LDC emissions reductions has been discussed previously. Instead of Western governments resisting the principle of additionality, private business could form

transnational links that would result in potentially huge transfers of capital from North to South. One model estimates that financial transfers from the OECD to developing countries would rise from \$3.6 billion in 1995 to \$118 billion by 2020 (OECD, 1996).

Inherent in these transnational links is another advantage of JI, an assumption of a transfer of technology that the West would bring to LDCs. In fact, the Clean Development Mechanism (CDM) of the Protocol, of which JI is a component, is designed to facilitate technology transfers of environmentally sound technologies that are publicly owned. Western technology could be used to develop long-term sustainable development mechanisms in these developing countries.

Finally, the CDM mechanism is designed to create carbon storage sinks as well as emissions abatement. Carbon storage sinks are created by preserving forests (primarily tropical forests) that otherwise would be harvested or destroyed. These sinks then draw in atmospheric CO₂ and store it as biomass. Carbon sinks are much less expensive than many direct emissions reduction measures (Harvey and Bush, 1997).

The Disadvantages of Joint Implementation: Measurement and Accountability

Despite the strengths of this mechanism it also suffers some severe drawbacks, as can be predicted from the carbon storage clause. How is the carbon sink's value to be calculated and who is going to calculate it? Both the investing and receiving nations have the incentive to overstate the sink or the reduction amount. Again, third parties in the form of IGOs or NGO's would need to be involved in the calculation of credits. The emissions reductions from energy conversion schemes such as switching

from coal to gas are relatively easy to calculate based on known emissions, but sink values are much more complex. The mediator must be convinced that the sink to be “saved” would otherwise have been razed before the negotiations about credits can begin. The credits allowed are the difference between the baseline and the abatement target. The baseline is the level of emissions that would have occurred in the absence of the abatement effort, while the target is another subjective figure about what happens after the abatement begins. The uncertainty and delays in the process will raise transaction costs exponentially and could make the program unworkable.

A comparison of the success components for JI with the permit trading system components yields big question marks for both measurement and accountability, especially in regards to carbon sink projects. A thorough and ingenious method of public monitoring and enforcement would need to be devised in order to provide accountability and transparency for the system. Given the potentially high transaction costs, the fungibility of the system could also be questioned. If the JI project were modified by eliminating the carbon sink provision, it would be much more viable.

While sinks are problematic, the JI mechanism is a viable method of technology transfer and has the ability to attract capital to the LDCs, potentially making it a very effective mechanism of the Protocol. The JI mechanism within the Protocol can effectively provide side payments in the form of technology and capital that lower transaction costs and compliance costs for participants and makes participation in the regime more attractive to non-Annex I members. Carbon sink rules

need to be carefully delineated in order for this subcomponent to be viable on a large scale.

In spite of the favorable potential outcomes associated with ET and JI under the protection scenario, very unfavorable outcomes are also possible. Emissions projects undertaken in any country and involving large sums of money can be prone to government appropriation, corruption, and misrepresentation, but the perception is that malfeasance is more likely to occur in LDCs. The very nature of project based reductions makes them difficult to implement on a large scale. In addition to the problems inherent in projects involving carbon sinks, these mechanisms represent transfers of wealth between the industrialized and the developing world. Given the potential problems involved, the protection scenario should rate both the best and worst possible outcomes. Thus, the distribution for best outcomes would be protection then BAU, and the distribution for worst outcomes would be BAU then protection, as presented in Table 1. The variance of outcomes for the protection scenario are wider than for the BAU scenario. For the risk averse Bush administration, prospect theory predicts that the less risky policy option of the BAU would be chosen. For the Clinton administration operating under the domain of losses, the more risky protection scenario would be preferred.

5.1.3 Public Health

The final case study involves the differences in expected outcomes from the BAU and the protection policies in regards to public health. Under the protection scenario, improvements in public health are forecasted due to less air born pollutants

from fossil fuel combustion in the transport and electricity sectors. The highly respected Working Group on Public Health and Fossil Fuel Combustion released a report in 1997 that forecasted an additional eight million deaths could occur worldwide by allowing the business-as-usual (BAU) scenario rather than their climate policy scenario between 2000 and 2020.⁷ Over 80% of these “avoidable deaths” would occur in developing nations and the balance of approximately 1.6 million in OECD countries. They estimate that in the US alone, in 2020 the “avoidable deaths” under the BAU model would equal the deaths in 1995 due to liver disease or human immunodeficiency disease.

Benefits from GHG abatement that reduce the incidence of chronic morbidity and mortality are posed as central to the public health argument. With improved air quality citizens suffering from asthma, allergies, respiratory ailments and heart disease would experience health benefits. Similarly, the protection policy could result in fewer heat related deaths among primarily poor, urban residents. Unlike other benefits associated with the protection scenario, the positive externalities associated with reduced fossil fuel usage accrue in the short term. Therefore, the temporal disconnect between expenditure and receipt of social benefits is not so large as with other aspects of climate policy, making immediate action easier to achieve given the short time frame of most citizens and policy makers. Also, public health benefits from GHG mitigation will likely accrue more in certain regions and localities than in others.

⁷ Their climate policy model is a 15% reduction in 1990 levels by 2010 for the developed countries and a 10% reduction compared to BAU for developing countries, a rather ambitious policy but not impossible.

One huge public health benefit from a GHG mitigation regime would be the reduction of these “conventional” pollutants from coal-fired electricity generation: sulfur dioxide (SO₂), nitrogen oxide (NO_x), particulate matter and mercury. Estimates of ancillary benefits to the U.S. for GHG reduction range from \$2.88 to \$300 per ton of carbon reduction, with a general agreed guideline of being approximately 30% of the carbon allowance price (Burtraw and Toman, 1998, p. 6). The U.S. health care sector consumes about 14% of GDP, and improvements in public health from reduced fossil fuel use could represent an opportunity to shift these expenditures to more productive uses.

How best then to deal with public health from an expected return standpoint? Consider the argument for the protection case to have the highest expected return. As fossil fuel usage is curtailed using cost effective means, airborne pollutants are reduced making the downwind citizens healthier, thus more productive and adding to economic output. The protection policy does not have the worst outcome, that estimate is reserved for the BAU. As the US population continues to increase, under BAU the fossil fuel based transportation infrastructure will be augmented. Similarly electricity use from coal and gas will increase, and the net result is the population is becoming negatively impacted by the health externalities associated with fossil fuel usage.

Thus, according to this scenario, the distribution for best outcomes would be protection then BAU, and the distribution for worst outcomes would again be protection then BAU. Given this distribution of expected outcomes, prospect theory

would hold that the risk averse Bush administration would favor the protection scenario with its more favorable relative expected outcomes. Similarly, the risk seeking Clinton administration would also favor the protection scenario because of the more favorable relative outcomes. However, in addition to abandoning Kyoto the Bush administration is currently attempting to roll back air pollution standards for older coal plants, the New Source Review which would favor the BAU. So it would appear that there is a disconnect between what prospect theory predicts for the public health and what is actually being done by the risk averse administration which is pursuing increased energy supplies. Axelrod (1976) calls this problem the decision-making problem. Given that we have two policy variables, public health or energy supplies (which is inexorably linked to economic growth), which one should be enacted and which subsumed? The Bush administration apparently has decided on increased energy supplies over improvements in public health. For the public health case study, according to the way that domain has been operationalized and risk tolerance defined, apparently prospect theory cannot adequately explain the behavior of the Bush administration.

5.2 Case Study Synthesis

Table 1 summarizes the differences in the two administrations' understanding of their domain and how this translates into the dependent variable of policy preferences. The results indicate that prospect theory, as we have defined domain, adequately explains President Clinton's behavior on climate policy. Clinton operated under the domain of losses and as a strong science adherent believed that the worst

possible outcome was the damage from climate change associated with continued fossil fuel usage. His beliefs about the availability of cost effective substitutes for fossil fuels, including renewable energy and energy efficiency measures, resulted in his belief that the best possible outcome was associated with the protection scenario. The emissions trading component on the Kyoto Protocol and the protection scenario has been shown to be more risky as its distribution of expected outcomes is greater than that of the BAU scenario. The greater risk of the protection scenario was appealing to President Clinton who operated under the domain of losses. The public health benefits also were preferred by Clinton according to how we have delineated the expected outcomes.

Table 1: Summary of Variance of Case Study Outcomes

Expected Return	Economy Wide Costs: Weak Science	Economy Wide Costs: Strong Science	Emissions Trading & Joint Implementation	Public Health Benefits
Best	BAU	PROTECT	PROTECT	PROTECT
	PROTECT	BAU	BAU	BAU
	BAU	PROTECT	BAU	PROTECT
Worst	PROTECT	BAU	PROTECT	BAU

Note: each policy scenario must have a best and worst outcome.

According to both expected utility theory and prospect theory these public health benefits should have been pursued by President Bush. That they were not pursued most likely means that there are other variables that need to be included in the analysis. Certainly the Bush administration's ties to the fossil fuel industry is one that could be incorporated into future studies. However, President Bush's beliefs about the uncertainties of climate science do explain his rejection of Kyoto on economic

grounds. Since the science is what links the status quo with negative outcomes, disbelief should result in a continuation of the status quo associated with the BAU scenario. Table 1 suggests that the BAU with its higher expected payoffs would be selected by the weak science adherent. Similarly, this work shows that a risk averse President Bush would have rejected the Kyoto Protocol and its associated emissions trading component because of the greater variance of expected outcomes associated with it.

6. Conclusion

This paper has explicated the domain of Presidents Bush and Clinton as the independent variable that can explain climate policy choices made by each administration. Given that fossil fuels are an essential input to modern economies, having access to cheap sources of these fuels, *ceteris paribus*, puts national policy makers in the domain of gains. This paper argues that the Bush administration still operates under this domain of gains while the Clinton administration was in a domain of losses because of its belief in climate change science that predicts major environmental and socio economic damages if fossil fuel use is not curtailed in the coming decades.

This paper argues that the disparities in the two administrations regarding environmental protection and economic growth are due to the strength of each administrations beliefs in the robustness of climate science. This research indicates that Bush identifies the state of climate science as uncertain. Associated with this disbelief is the notion that the status quo is satisfactory, and that the risks associated with BAU are not as great as the risks associated with Kyoto, putting the Bush administration squarely in the domain of gains and subsequent risk aversion in policy preferences. Clinton's comments, on the other hand, show a man with a much greater belief in the robustness of the science and the negative consequences of the status quo. Therefore, the Clinton operated under the domain of losses and risk acceptance in policy choices.

Using prospect theory, we can see how under the domain of gains the Bush administration's decision to abandon the Kyoto process, a treaty negotiated by the Clinton administration, is consistent with its other energy policies. Energy efficiency and conservation measures have been subsumed to increased energy supplies. In other words, a continuation of the status quo. In contrast, the mandatory reductions of GHGs under Kyoto represented a risky and an untested departure from the domain of gains that the Bush administration operates under.

This paper has examined in detail the complexity of the economic models that estimate the costs associated with Kyoto compliance. These models assumptions regarding the flexibility of the US economy, how carbon tax revenues are used, and the ability of US polluters to receive credit for international emissions reductions projects are the major drivers for the widely varying cost estimates. Furthermore, the cognitive map developed for President Bush doesn't indicate any explicit recognition of jobs created by the adoption of the Protocol. Bush's stated belief is that environmental protection inevitably sacrifices economic growth, and that it must come as a result of economic growth. This stands in stark contrast with the cognitive map developed for President Clinton who appears to believe that environmental protection and economic growth can be synonymous, and that there are jobs to be created by reducing emissions.

Theoretical And Policy Implications

President Clinton's beliefs in the adverse affects of the status quo and the ability for economic growth to occur through alternative means are representative of

change in paradigm from the dominant one to an alternative one. Then this change needs to be the focus of studies that enable us to understand how and why it occurred. Prospect theory posits that there are anomalies in decision makers' processes that affect their behavior. The implications of the endowment effect, loss aversion and status quo bias are of major importance to climate policy that is made under conditions of uncertainty.

As we have examined, the default domain is the status quo. But over time the reference point moves to an adaptation point that reflects the new status quo. Science is the rose colored lens that drives the shift in domain. However, during that shift things are still evaluated relative to the old status quo. The weighting function of prospect theory predicts that people weigh the possibility of losses more heavily than they do the prospect of equally large gains. "Loss aversion suggests that the lag will last longer in adjusting to losses than to gains" (McDermott, 1998, p. 42). In climate policy terms, this means that individuals are going to resist recognizing that the status quo is leading to large future damages from climate change. This is fundamentally a shift from a domain of gains to a domain of losses, or in other words a change in domain from the dominant paradigm to the alternative paradigm. This change will lead to an increase in risk tolerance and subsequently more risky policy choices.

In addition to predicting delays in policies reflective of a new paradigm, PT also holds implications for a carbon tax. Since the dawn of civilization, tax collectors and the paying of taxes has always been unpopular. Tax issues were at the heart of The American Revolution, Shay's Rebellion, and the Reagan revolution and are

certainly prominent today in the fiscally challenged state and local environments. From a prospect theory standpoint, taxes are an anathema to individual decision makers. Since individuals are loss averse and any future tax implies losses, cognitive biases negatively affect policy platforms that advocate new taxes. (Tversky and Kahneman, 1988, p. 176). Loss aversion and the issue of how taxes and new regulations are presented to those who would be impacted by them is another issue that prospect theory has a great deal to speak about. Prospect theory posits that individuals will tend to choose an option framed as a gain relative to the status quo, but with a lower expected return than another option framed as a loss (Quattrone and Tversky, 1988). This loss aversion implies that any future effort to impose a carbon tax needs to be offset by income tax rebates so that the new policies are neutral relevant to the reference point of the status quo.

In addition to implications for policy enactment, the status quo bias of prospect theory also helps to explain the dichotomy in the US between what is called the precautionary principle and delayed action on irreversible environmental problems. The precautionary principle argues that polluters should prove *a priori* that their emissions will not damage the environment, accompanied by procedures for monitoring and assessment (Porter and Brown, 1991). However, prospect theory would argue against the implementation of a systematic precautionary principle for industrial and consumer activity if such measures are not part of the status quo. Thus their adoption would be hindered until the status quo is found to lead to losses.

Akin to the status quo bias is an anomaly known as the endowment effect.

Individuals' tend to value the items that they currently possess more than substitute goods of similar or greater value. Empirical tests of the endowment effect are robust (Kahneman, et al, 1991). This discrepancy between willingness to pay and willingness to accept means that selling prices are prone to exceed buying prices, sometimes by double the amount. The implications of the endowment effect for climate policy literally means that policies to reduce fossil fuel consumption will need to create an incentive structure that makes clean energy and fuel efficiency cost only half as much as current fossil fuel based option. Not only do cultural factors favor consumption of large amounts of fossil fuels, but prospect theory is telling policymakers that it will be difficult to get people out of their SUVs and other gas guzzlers and into hybrids.

The implications of prospect theory for climate change do not end with the anomalies of the status quo bias, the endowment effect and loss aversion. Additionally, an assumption of prospect theory is that decision makers are boundedly rational, in that there exist limits to their information processing skills. This bounded rationality has serious implications for climate policy enactment. For example, research indicates that the Earth's climate in the past has experienced abrupt climate shifts of 10-20 degrees Fahrenheit in the short span of several decades. In the past, these non-linear changes in the climate most likely resulted from the cumulative effects of solar radiation or even shifts in the earth's axis. The NRC concludes that mankind's emissions of GHGs could have the same effect on the delicate climate balance. The net effect of these changes was to change entire ecosystems and raise or lower sea level by 20 or more feet. These

climatic changes undoubtedly had dire impacts on previous civilizations, and in spite of current technology and the economic diversification associated with modern society, such a dramatic climate shift would also devastate our civilization. Climatologists are loathe to assign exact probabilities to such an occurrence but they do say that there is a “non zero” chance of such an abrupt climate change occurring within the next century. In fact, the NRC (2001b) claims,

“Available evidence suggest that abrupt climate changes are not only possible but likely in the future, potentially with large impacts on ecosystems and societies (v). Prospect theory holds predictions for people’s evaluation of such extremely low (and extremely high) probabilities. The simplification process of the editing phase of prospect theory (which occurs prior to the evaluation stage) implies rounding of probabilities or outcomes. Because of limited abilities to understand extreme probabilities, extremely unlikely probabilities could be disregarded and highly likely probabilities might be rounded up to near certainty. At other times extremely low probabilities might be treated as near certainty (as in lotteries), and correspondingly high probabilities might be underweighted (Kahneman and Tversky, 1979, pp. 282-3). Empirical doubt aside, policies to regulate pollutants whose effects are permanent need to explicitly incorporate the probability of these non linear events, something that has not been in the discourse thus far. This lack of policy consideration is possibly due to the rounding bias associated with cognitive processes.

Strengths and Weaknesses of a Prospect Theory Analysis of Climate Policy

While PT provides ample explanations and predictions for the enactment of

climate policy, it is limited in its theoretical foundations. PT primarily addresses the evaluation step of decision-making, it doesn't address screening function. Following rational choice theory, decision makers under PT are assumed to evaluate policy alternatives relative to their domain, and it is this domain, as well as how the options are framed, that determines outcomes. Yet, many alternative policies might not even be considered due to biases in the decision makers information processing abilities that rule out possible alternatives before they can be evaluated.

Beach and Mitchell (1998) consider this an adoption decision, that is divided into screening and choice decisions. Candidate plans are screened according to their compatibility with the decision maker's principles and goals (p. 14). Prospect theory's roots in rational choice decision theory rules out the inclusion of values in decision-making. According to this line of reasoning, if President Bush believes that environmental regulations hamper economic growth, then any alternative that requires additional regulation would not be considered. Since Kyoto would require a new set of such policies, it was not ever a viable policy alternative. Given Bush's quick abandonment of Kyoto, it is likely that he did not seriously consider it as a policy alternative.

President Bush's withdrawal from the Kyoto process can be explained by prospect theory if he did not believe that climate change represents a real threat to the US. His cognitive map shows disbelief about the state of climate science. Yet, this disbelief is in direct conflict with the peer-reviewed science of the IPCC and his own NAS summary. In this case, the IPCC and NAS reports represent "new" information

about the externalities associated with the business as usual policies of economic growth. Yet, this new information apparently has not been internalized by President Bush who clings to existing beliefs about development. Psychologists have dubbed such phenomena irrational belief persistence and argue that existing beliefs (status quo) are resistant to counterevidence that would criticize them. Reviewing empirical studies, Baron (1994) concludes that humans “hold on to our beliefs without sufficient regard to the evidence against them or the lack of evidence in their favor” (p. 281). While prospect theory doesn’t incorporate *all* the biases of decision-making, it can explain why some decisions are preferred over others. Choosing risky policy options is more likely when decision-makers are placed in the domain of losses. This paper has argued that science is the engine that can tear people away from the anchor of the status quo. A belief that economic development can occur with less polluting sources of energy is also critical for increased risk tolerance to pursue new policies. The comparisons presented here between Presidents Bush and Clinton provide us with a critical understanding of some of the important issues involved in the complicated field of climate policy.

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Appendix: Methodology

To construct the two cognitive maps official documents from 1998 to 2002 were accessed from the weekly compilation of presidential documents at <http://www.access.gpo.gov/nara/nara003.html>, as well as the official repository for the 2000 Presidential debates at <http://debates.org/pages/debhis2000.html#oct3>. The one debate where Bush spoke about climate change prior to his becoming president was chosen for two reasons. One, the number of Bush statements on climate change is limited. Table 1 indicates that these two sources of information surrendered only 13 observations for each decision maker. Second, this source was included because the Presidential debate was only three months prior to his decision to abandon Kyoto. As explicated in section 2, Bush's decision employed considerable independence from his cabinet's recommendations and was done without the benefit of cabinet level briefings on the issues, indicating he was likely operating under similar beliefs as during the debate.

The search statement "global warming" OR "climate change" was used to summon appropriate documents. Search results composed of joint statements between US Presidents and other foreign leaders were not included in the analysis due to the possible confounding effects of being drafted by other authors. Similarly, budget statements and other search results that did not yield substantive information about the speaker's beliefs regarding climate change were excluded as well. The search results of the compilation yielded a large sample frame consisting primarily of similar irrelevant documents. The selection of all the appropriate documents from President

Bush yielded twelve documents from his presidency, thirteen total counting the debate.

Interviews and debates accounted for eight of thirteen statements for President Bush and the balance were prepared remarks. Although twelve of thirteen remarks by President Clinton appear to have been prepared, his penchant for impromptu comments and the rambling nature of many of his “prepared” statements makes it likely that these statements were adlibbed. The concern here is to be able to draw credible inferences from the data. If Clinton’s prepared statements are not representative of his beliefs then there will be biases in the cognitive map for him. Future research efforts that have more resources available could benefit from other data sources.

The selection process for President Clinton targeted an equal number of observations to facilitate comparability with President Bush’s beliefs. While the sample frame was again large, only 4-5 of the top scoring search results that yielded the most information regarding his beliefs were selected. The analysis only included documents back to 1998 as the Kyoto Protocol was negotiated late in 1997.

Appendix Table 1: Source of Documents for Cognitive Maps

President	Year	Selected
Bush	2002	3
Bush	2001	9
Bush	2000	1
Clinton	2000	5
Clinton	1999	4
Clinton	1998	4
Total		26

The cognitive maps were constructed according to the coding rules explicated by Wrightson (1976). The procedure is to first identify important variables, then to identify which variable is the cause and which is the effect variable, then determine whether the relationship between the variables is positive (+), negative (-), no relationship (0), or indeterminate (?). In sum the cognitive map is a collection of: *Cause Concept* $\Rightarrow$ *Linkage* $\Rightarrow$ *Effect Concept* for the policy variable under consideration.