THOMAZ TEODOROVICZ

ENVIRONMENTAL BENEFIT-COST ANALYSIS IN THE US: RISK-BASED REGULATION AND THE ROLE OF THE NATIONAL CENTER FOR ENVIRONMENTAL ECONOMICS

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Dissertação apresentada como requisito parcial à obtenção do grau de Mestre em Políticas Públicas, no Programa de Pós-Graduação em Políticas Públicas, da Universidade Federal do Paraná.

Orientador: Prof. Dr. Victor Manoel Pelaez Alvarez

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TERMO DE APROVAÇÃO

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Dissertação aprovada como requisito parcial para obtenção do grau de Mestre no Curso de Pós-Graduação em Políticas Públicas, Universidade Federal do Paraná, pela seguinte banca examinadora:

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“[...] a forma realmente significativa de educação do pensamento que deveríamos obter num lugar como este não tem relação com a capacidade de pensar, e sim com aquilo em que escolhemos pensar”.

“Se tiverem a certeza automática de que conhecem a realidade e sabem quem, e o quê realmente importa – se preferirem operar na configuração padrão, então vocês, assim como eu, provavelmente farão vista grossa a possibilidades que não são inúteis nem irritantes. Todavia, se tiverem aprendido a prestar atenção de verdade, saberão que existem outras opções”.

Isto é Água (David Foster Wallace)

RESUMO

O desenvolvimento do marco regulatório ambiental dos EUA começou a ficar em evidência a partir da criação da *Environmental Protection Agency* (EPA) em 1970, agência responsável por estabelecer regulações de emissão de poluentes e determinar o uso de tecnologias para seu controle. Contudo, a partir de meados da década de 1970, em um ambiente político-econômico marcado pela crise energética e voltado à priorização da produtividade e do desempenho econômico, um ferramental específico tornou-se proeminente no processo de avaliação a respeito de regulações (tanto gerais como ambientais): a análise custo-benefício (ACB). A ACB foi introduzida nos EUA, por meio de uma série de *Executive Orders* (EO) emitidas pelo poder executivo estadunidense, especialmente a partir do governo Reagan, sob o argumento de proporcionar uma análise regulatória consistente, objetiva, neutra e em sintonia com o desenvolvimento econômico. A ACB foi mantida e reforçada em governos subsequentes, institucionalizando-se como uma peça obrigatória na pré-avaliação do impacto econômico de novas regulações. Enquanto os principais argumentos para a adoção da ACB estão ligados à defesa de sua objetividade teórica e à busca de eficiência, o conhecimento para sua efetiva prática na regulação ambiental é concentrado em um grupo de economistas ligados à área da economia ambiental. Esses especialistas utilizam ferramentas econométricas para simular preços artificiais dos “bens naturais”, de modo a precificar e comparar custos e benefícios das regulações e políticas ambientais. O objetivo deste trabalho é realizar uma análise crítica da ACB ambiental, a partir da experiência da sua implantação na EPA. Mais especificamente, o trabalho analisa o modo pelo qual o departamento de economistas especializados em economia ambiental e ACB da EPA (*National Center for Environmental Economics* - NCEE) influencia o processo decisório da agência. Verifica-se que os praticantes de ACB ambiental formam uma comunidade epistêmica responsável por defender a aplicação política desta prática. Entretanto, outra corrente, composta por representantes do meio acadêmico e por *policy-makers* com passagem pela EPA, apresenta críticas multidisciplinares. Estes questionam os fundamentos da metodologia adotada, ao assumir pressupostos que envolvem significativo grau de subjetividade. Por fim, observou-se que a NCEE não está inserida formalmente no processo regulatório da EPA. Entrevistas conduzidas na EPA revelaram que a ação da NCEE é restrita por legislações que impedem a aplicação da ACB ambiental em regulações ambientais específicas. Entretanto, ao realizar pesquisas independentes, promover seminários e workshops e desenvolver manuais técnicos, a NCEE busca a sua legitimidade, tanto ao nível interno da agência, quanto ao nível externo, ao conectar-se com especialistas da comunidade acadêmica e de outros órgãos de governo.

Palavras-chave: Análise Custo-Benefício, Regulação de Risco, Comunidade Epistêmica; Regulação Ambiental; NCEE.

ABSTRACT

The creation of the Environmental Protection Agency (EPA) in 1970, a federal regulatory agency focused on environmental protection and restoration, was a cornerstone in the development of US environmental policy and a landmark of the the US environmentalist movement. However, in the mid-1970s, as a result of the energy crisis, the US political and economic agenda shifted towards greater concern over productivity and economic performance. In such context, a particular economic tool for evaluating new economic and environmental regulations gained prominence in the US regulatory process: the benefit-cost analysis (BCA). The US executive branch issued a series of Executive Orders and gradually introduced BCA in the regulatory system, reaching its acumen during the Reagan Presidency, on the grounds that BCA would not only provide a consistent, neutral, and objective regulatory analysis, but also be aligned with economic development and recovery. Subsequent Administrations maintained and reinforced BCA's role in the regulatory process, institutionalizing it as a mandatory stage for *ex ante* regulatory analysis. While the main arguments defending BCA defends its theoretical objectivity and the necessity of efficient policies, its practice to environmental regulations, what we call "environmental BCA", depends on a group of economists specialized in the field of environmental economics. These experts rely on econometric tools to estimate artificial prices of "environmental goods", thus assigning a monetary value to environmental regulation's benefits and making them comparable to regulatory costs. This work aims to critically analyze environmental BCA, particularly based on the US experience and on its implementation at EPA. More specifically, we analyze how the National Center for Environmental Economics (NCEE), a particular department within EPA mainly composed of economists experts in environmental economics and BCA, might influence the agency's regulatory process. It was verified that environmental BCA's practitioners share characteristics of an epistemic community, which is responsible for defending such practice in the policy arena. However, an opposing group of academics and policy-makers fosters multidisciplinary criticisms regarding BCA's subjective assumptions and methods. Finally, we observed that NCEE is not formally included in EPA's regulatory process. Interviews conducted at EPA revealed that NCEE's activities are restricted by legislative mandates impeding the application of environmental BCA for particular environmental regulations. However, by fostering independent research, promoting seminars and workshops, and developing technical guidelines, NCEE seeks internal and external legitimacy, connecting itself to experts from the academic community and other governmental agencies.

Keywords: Benefit-Cost Analysis, Risk-Based Regulation, Epistemic Community; Environmental Regulation; NCEE.

LIST OF ACRONYMS

ADP	–	Action Development Process
BCA	–	Benefit-Cost Analysis
CEQ	–	Council on Environmental Quality
COWPS	–	Council on Wage & Price Stability
EC	–	Epistemic Community
EIS	–	Environmental Impact Statement
EO	–	Executive Order
EPA	–	Environmental Protection Agency
NAS	–	National Academy of Sciences
NCEE	–	National Center for Environmental Economics
NIRA	–	National Industrial Recovery Act
NPM	–	New Public Management
NPRM	–	Notice of Proposed Rulemaking
NPV	–	Net Present Value
OECD	–	Organization for Economic Co-operation and Development
OIRA	–	Office of Information and Regulatory Affairs
OMB	–	Office of Management and Budget
OP	–	Office of Policy
RARG	–	Regulatory Analysis and Review Group
RBR	–	Risk-Based Regulation
RIA	–	Regulatory Impact Analysis
TEV	–	Total Economic Value
VSL	–	Value of Statistical Life
WTA	–	Willingness to Accept
WTP	–	Willingness to Pay

SUMMARY

1 INTRODUCTION

On January 19, 2001, the final day of the Clinton Presidency, the Environmental Protection Agency (EPA) approved a new health and safety standard for US public water systems. In accordance with the 1996 Safe Drinking Water Act, EPA had finalized a new rule reducing the maximum allowable level of arsenic in drinking water from a limit of 50 micrograms per liter (μg/L) to 10 (μg/L). Arsenic is a toxic substance which causes several health risks to humans, as increased risk of getting cancer and developing some deleterious cardiovascular, pulmonary, neurological, and endocrine effects, as well as others health predicaments (SUNSTEIN, 2002a). As such, the rationale behind reducing the levels of arsenic in drinking water was to mitigate mortality and morbidity risks to human health, thus improving people's quality of life. However, not long after being announced, the arsenic rule became the center of a heated academic and political debate, as the Bush Administration rescinded it and subject it to another battery of political and technical scrutiny in which scholars, policymakers, and scientists were divided regarding the rule's desirability. Notwithstanding, if reducing health risks is a beneficial and socially desirable goal, then why has the arsenic rule caused so much controversy? To answer that question, we must understand the fundamental inquiry dividing arsenic rule's proponents and critics: did the expected benefits of reducing levels of arsenic in drinking water outweigh the expected costs of implementation?

The case of the arsenic rule illustrates one controversial topic that has lingered in the US regulatory policy since the 1970s, especially in the field of environmental, health, and safety regulations. Whereas costs are usually expressed in monetary figures and thus relatively straightforward to measure, benefits deriving from these so-called "social regulations" do not have direct monetary equivalents, as they represent the saving of wild species, environmental preservation, avoiding illness and, ultimately, death. If at a first glance to compare any project or policy's benefits to its corresponding costs seems sensible, this logic begs the question of how should the analyst compare benefits and costs from different natures.

Economists have proposed a particular answer for evaluating public policies and comparing social impacts of different natures: (social) benefit-cost analysis (BCA). Derived from the new welfare economics, BCA assigns monetary values for

both regulatory costs and benefits, including environmental, health and safety benefits, thus establishing a common *numéraire* to evaluate the merits of several policy alternatives. After both costs and benefits are monetized, they are discounted to present values, allowing the analyst to make conclusions about a regulatory endeavor's desirability.

BCA has been in the spotlight since the 1980s, when President Reagan issued an Executive Order mandating that all federal executive agencies, including regulatory agencies, submitted all significant regulations to a benefit-cost test, and approved only those presenting net monetized benefits. BCA's proponents have defended that such practice would enhance regulatory rationality and grant consistency and efficiency to US regulatory policy. Ever since, subsequent Presidencies, including Clinton and Obama Administrations, have legitimized BCA's role within a context of regulating risks to society, even though qualifying that quantitative analysis should be supported by qualitative considerations.

BCA's particular application to analyze environmental regulations is what we will henceforth refer as "environmental BCA". Economists have developed intricate techniques to monetize both costs and benefits from environmental policy, thus associating the environmental BCA's practice to a set of idiosyncratic methods to assign prices to non-monetized goods, as reducing health risks, protecting endangered species, and promoting a less-polluted environmental. Therefore, environmental BCA is a practice whose claim fall upon a group of specialists with not only shared sets of technical frameworks, methodological guidelines, but also common interpretations of reality, and a normative belief that environmental BCA is an important input for "rational" regulatory policy.

Even though BCA has been frequently associated with "rational" decisions, it relies on a narrower concept of neoclassical economic rationality, which gained strength with the ascent of a "risk-based' thinking regarding the State's regulatory role. As a result, whereas environmental economists heralds the advantages of fostering environmental BCA, scholars from differing backgrounds have composed an opposing group, exposing environmental BCA's multidisciplinary limitations. Coming from different fields as environmental law, environmental science and political economy, this group has criticized several aspects of environmental BCA's usefulness as an evaluation standard for environmental policy.

As the US government has sought a more “rational” and efficient regulatory policy, environmental BCA gained strength in the country’s environmental regulatory process. As a reflex, since the 1970s EPA has organized several in-house economic groups or departments, leading to the creation, in 2000, of the National Center for Environmental Economics (NCEE). NCEE is a group located in EPA Office of Policy and majorly comprised by PhD economists specialized in environmental economics and BCA. Amongst its duties, NCEE provides consultancy and develops studies supporting the Agency’s environmental BCA.

BCA’s practice has spread in OECD where its usage has been defended as a regulatory “gold-standard” that should be the benchmark for conducting Regulatory Impact Analysis (RIA). Recently, Brazil has initiated an attempt to incorporate RIA within its regulatory process, thus emerged the possibility of inserting BCA within the national regulatory process. However, if environmental BCA has fostered controversies regarding its advantages and limitations, its actual application and influence on the regulatory process still needs to be analyzed in order to subsidize policy decisions regarding the manner and overall desirability of inserting environmental BCA as a mechanism to evaluate environmental policies. The objective of this Master’s Thesis is to present a critical analysis of environmental BCA, focusing on the US experience and particularly on how NCEE, a group of specialists in environmental economics and BCA, might influence EPA’s environmental regulations.

In this work, we employed a multi-step methodology. First, we used Eisner’s (2000) framework of US regulatory regimes to bolster a broad historical review contextualizing how environmental BCA rose as a relevant political and economic issue in the US regulatory system. An extensive literature review supported a characterization of environmental BCA’s idiosyncratic features, as well as its defenses and limitations. We used Haas (1992) concept of “epistemic community” to argue that environmental BCA’s is a technical knowledge whose claim fall upon a particular group of specialists in environmental economics. Finally, we used information collected during a summer internship at NCEE, held on August/2014, to analyze this center’s activities within EPA and its role on the agency’s regulatory process. During the internship, we conducted 11 semi-structured interviews to identify NCEE’s activities and potential influence within EPA’s regulatory process. The second assignment while at NCEE was to structure and collect data regarding

NCEE's activities in order to analyze their structural characteristics and prominent fields of actions.

We have structured this work in five sections, besides this introduction. First, we present the synchronic process that lead to the emergence of environmental regulation in US, and was followed by the ascent of BCA's application as an *ex ante* tool for regulatory analysis. Second, we present the theoretical concepts supporting our research: i) the concept of risk-based regulation; ii) the "Risk-Based Regulation Policy Cycle", as a multi-disciplinary framework to map the regulatory process; and iii) the "epistemic community" framework. The following section reviews environmental BCA's theoretical foundations and argues that its practice is associated with a network of specialists with shared values, interpretations of reality, notions of validity, and policy enterprise, thus characterizing an epistemic community. Then, we present environmental BCA's multidisciplinary limitations and criticisms. In the fifth section, we apply the risk-based regulation policy cycle to analyze how NCEE, a potential branch of the environmental BCA epistemic community, might influence several steps within EPA's regulatory process. The final section presents our final remarks and conclusions.

2 BCA AND US ENVIRONMENTAL REGULATION

The year 1970 marked an important landmark of the American environmentalist movement: the creation of the Environmental Protection Agency (EPA). Established as an independent regulatory agency, EPA's statutory goals related to the mitigation of health and environmental hazards and fostering environmental preservation and restoration, formalizing the dawn of a new environmental regulatory framework. However, EPA's creation and the subsequent development environmental legislations must be interpreted as events embedded in a broader process, which confronts public policy making and regulatory change to economic, political and social variables. This section's presents the development of US environmental regulation according to three historic periods: i) the expansion of industrial capitalism and the "golden years", from 1940 to 1960; ii) the ascent of social regulation and of the environmentalist cause, from 1960 to the early 1970s; and iii) the rise of an efficiency-oriented regulatory regime responsible for incorporating BCA as a tool for ex ante economic analysis within US's regulatory system, which reached its acumen in the Reagan Administration.

2.1 ECONOMIC AND INDUSTRIAL GROWTH IN THE POST-WAR

Between the 1929 crash and the middle of the 1960s, US witnessed a growing preoccupation with economic recovery and growth. The post-financial crisis economic scenario was catastrophic. According to the Bureau of Economic Analysis (BEA, 2014), from 1929 to 1933, the US Gross Domestic Product (GDP) had shrunk from about US$ 100 billion to US$ 56 billion, even without accounting for inflation.

In an attempt to rebuild the US economy, President Frank D. Roosevelt enacted the New Deal, a series of domestic governmental policies issued between 1933 and 1397 whose main target was to support national industry. In this period, both public and private sector had prioritized increasing productivity and private capital' earnings as means to stimulate the economy. The White House adopted several economic interventions with a clear political goal: to restore and strengthen

the national economy by granting incentives and protecting the industrial sector. Government intervention was crucial to support national industry's recovery, thus setting an associative regime between government and industrial group in which policies and regulations were designed targeting the assistance to the national industry, thus favoring the regulated industrial groups (EISNER, 2000).

Roosevelt's New Deal guided most of the US pre-World War II economic policy. In his acceptance speech, in 1932, Roosevelt emphasized the connection between industrial stagnation, decline in commerce, poverty, unemployment, and the reduction of social welfare. As a response to such negative social background, he reaffirmed federal government's fundamental responsibility of providing overall social welfare, and inasmuch, policies would be enacted to promote it (ROOSEVELT, 1932).

Signed in July 1933, the National Industrial Recovery Act (NIRA) was a first measure indicating a major political concern with industrial recovery. In its first paragraph, a national emergency scenario, comprised of high unemployment and industrial disorganization, undermined Americans people's standard of living and harmed the general welfare. To revert such dismal outlook, NIRA stated several potential government policies, as removing obstacles to private industry, to promote industrial reorganization, to eliminate unfair competition practices, to promote the fullest possible utilization of present industrial capacity, to increase consumption of industrial and agricultural goods, and to rehabilitate American industry. (USA, 1933). As a result, Eisner (2000) argues that NIRA created a system of self-industrial regulation, monitored by the government, which:

> [...] authorized trade associations or industrial groups to establish codes of fair conduct, subject to the approval of the president. [...] The codes were exempt from the antitrust laws, and thus agreements that maintained artificially high prices in order to fight deflation were allowed. **The Roosevelt administration erected a system of industrial planning in which power was vested in corporations and their representative organizations.** (p. 83, emphasis added)

After the II World War, US industry had continued to be assisted by the federal government. While NIRA measures had withstood, national industry profited as the government adopted actions to regulate aggregate demand and a strong purchase policy aimed at military goods. Between the 1940s and the 1970s, major companies grew in absolute and relative terms: in 1975, the 200 largest industrial

companies in the US (1% of US industry) employer 40% of the total labor and concentrated 60% of the net income from the industrial sector. (GALBRAITH, 1982).

Parallel to industry's stabilization and growth, government's spending in the private sector had also created specific opportunities to incentivize technological change. Productivity rose as industries started to absorb new technologies (as introducing computers produced by IBM in their manufacturing and administrative processes). Beyond adopting technologies developed externally, as large corporations increased their profits, they simultaneously accumulated capital developed sufficient financial conditions to establish internal research and development laboratories. The process of internalizing the innovative process led to the entry of new products on the market and growth of technology-intensive (e.g. chemical, oil, automobile, war, and aviation) industries (GRAHAM, 2010).

During the associative regime, a combination of high industry productivity gains and increase of the consumption capacity of the US population made the period between the decades of 1950 and 1960 to be known as the "golden years". US annual average productivity rates rose from 1.5% (1929-1939) to 2.5 - 3% (KRUGMAN, 1992). Between 1945 and 1969, GDP grew 211%, going from a little over US$ 2 trillion and reaching US$ 4.3 trillion (BEA, 2014)[1]. However, if the "Golden years" were marked by economic and industrial growth, the rise in personal income awoke new social and environmental demands and values.

2.2 THE ASCENT OF ENVIRONMENTAL REGULATION

Besides industrial and economic recovery and affluence, USA witnessed, during the "golden years", a growing concern regarding the deleterious environmental and social effects resulting from industrial production, and with it, environmental values gained strength across the country. As a result, a new "societary regulatory regime" ascended, marked by the creation of new "social regulations" addressing topics as health and safety concerns, and especially important for this work, environmental protection. This section presents the ascent of environmental

[1] Base year: 2005. In nominal terms, GDP grew from 223 to 984 billions of dollars in the same period. (BEA, 2014).

regulation in the US as the result of a social demand for environmental policies especially during the 1960s, culminating in the creation of a federal regulatory agency responsible for environmental protection, preservation and restoration: the Environmental Protection Agency (EPA).

2.2.1 Industrial production's deleterious effects and the demand for social protection

Beyond economic prosperity and unprecedented income levels, US industrial recovery brought along with it several collateral and deleterious social effects. An increasing pressure over natural resources and its consequential environmental damages, became unsustainable and reinforced the need for a new wave of environmental protection (MITCHELLl, 1984). There were three main sources of human pressure over the environment: i) post-war economic and population growth associated with new consumption habits; ii) higher levels of industrial production; and iii) an intensification of the urbanization process (LEWIS, 1985; WISMAN, 1985; HAYS, 2000).

Between 1940 and 1960, the *baby boom* phenomenon lead to the inversion of the American age pyramid as the birth rate grew 26% and the share of people with 15 years or less passed from 50 to 62% (GROVE and HETZEL, 1968).[2] In addition, the average population growth rate doubled compared to the pre-war period (1930-1940) and the post-war period (1947-1957), going from 1 to 2% per year. In absolute terms, US population grew from 140 to 180 billion people from 1945 to 1960 (USA, 2000). Rising consumption rates accompanied US population growth in the golden years. As a result, industrial production increased to match higher demand levels, boosting not only the exploitation of natural resources, but also the emission of polluting discharges and waste production, thus becoming an environmental concern (EHRLICH, 1968; HAYS, 2000).

While the US government adopted a successful strategy to recover the domestic economy based on incentives to industrial production, such strategy also presented two main harmful environmental side effects. First, industrial expansion

[2] Between 1940 and 1960 the birth rate passed on from 19 to 24 births per 1000 of a population in a years (GROVE and HETZEL, 1968).

was intrinsically associated with scale production achieved through long production chains, which depended on the capacity to transport and distribute raw material, intermediate product, and final product across the country. This need for broad supply chains materialized itself in demand for new railways and roads, means of transportation mainly dependent on the burn of fossil fuels, thus resulting in increasing discharges of air pollutants.[3] Secondly, industrial recovery intensified the extraction of natural resources and production of domestic, agricultural (pesticides), and industrial waste production (WISMAN, 1985; LEWIS, 1988).[4]

Simultaneously to environmental pressures, the economic affluence achieved during the "Golden Years" propitiated conditions supporting an emergent demand for stronger environmental protection. Politically, as the urgency for achieving economic stability and industrial recovery lessened with the economic growth of the 1950s and 1960s, new public policies addressing new social goals, as combating poverty, and fostering health and environmental protection, paved their way in the political arena (HOBSBAWN, 2008). Also, successive increases in real income dislocated social attention from material production to quality of life (VISCUSI, HARRINGTON JR. and VERNON, 2005).[5] Environmental protection emerged as a new social value associated with the concern over human and environmental health, ecosystem stability and environmental aesthetic value.

The 1960s witnessed several events alerting the population of the several environmental hazards that had to be addressed, reinforcing social demand for governmental action. The Torrey Canyon oil spill incident in the United Kingdom, caused by the wreckage the supertanker SS *Torrey Canyon*, in 1967, and the Cuyahoga river fire, one of the most polluted river in US, in 1969, provide only a few examples of the natural disasters which drew social awareness to the environmentalist cause (EISNER, WORSHAM and RINGQUIST, 2006). Several authors also emphasized the crucial role of Rachel Carson's *Silent Spring* (CARSON, 1962), a book published in 1962, capturing public attention to the growing

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[3] Between 1930 and 1970, annual carbon monoxide discharged rose from 82 to 101 bullion of kilograms. Of these, a share of 74% originated from means of transportation as automobiles and airplanes, and 9% from industrial processes (EPA, 1991).

[4] From 1940 to 1960, emission of particulates from industrial processes increased 43% in the period 1930-1970, from 8.7 to 12.5 teragrams (10^{12} grams) per year (EPA, 1991).

[5] Viscusi, Harrington Jr. e Vernon (2005) characterize "environmental quality" as a normal good whose demand is positively correlated with income.

usage of pesticides and synthetic chemicals and the resulting long term deleterious effects these substances may cause to human health and to the ecosystem. [6]

In such context a growing awareness and urge for public policies addressing environmental preservation and protection emerged. While a public pool conducted in 1965 showed that 17% of the respondents judged environmental policy to be a national priority, in 1970 this number rose to 53% (DUNLAP, 1995 *apud* EISNER, WORSHAM and RINGQUIST, 2006).

Eisner (2000) argues that social pressure was of paramount importance to the passing of an “associative” to a new “societary” regulatory regime.” While the first was market by regulatory actions whose final objective was to recover the US economy between the 1929 crash and the II World War, the latter essentially marked the rise of the new types of “social regulation.”

To tackle the hazards derived from the increasing industrial production and to appease popular pressure for public measures, the US government had incentive to internalize decisions regarding production activities that were previously in the hands of private agents (EISNER, 2000). Government imposed minimal production requirements upon private parties on the spheres of information availability, work and consumer safety, and pollutant discharges (TABB, 1980). Such imposition characterized the “social regulations” as several governmental-imposed restrictions limiting the productive actions and decision of the economic agents with the intent of preventing, and compensating for, the social damages generated by unrestricted productive activities and market functioning. As such, policy makers perceived a general “public interest” when fostering social regulations (OGUS, 2002; SAGGAR, 2008). The Organization for Economic Cooperation and Development (OECD) reinforces such functional interpretation and accepts the public role of mitigating the negative impacts of unrestricted private economic activities in its definition of social regulation:

[6] See Wisman (1985); Lewis (1988); Williams (1993); Eisner, Worsham and Ringquist (2006); and Kraft (2011).

> Social regulations protect public interests such as health, safety, the environment, and social cohesion. The economic effects of social regulations may be secondary concerns or even unexpected, but can be substantial. (OECD, 1997, p. 6)

Especially since the beginning of the 1970s, the creation of several new regulatory agencies, as the Occupational Safety and Health Administration (1972), responsible for regulating work safety conditions, the Consumer Product Safety Commission (1972), defending consumer safety, and the Highway Traffic Safety Administration (1974), addressing traffic coordination, marked the societary regime (EISNER, 2000). Beyond, actions taken during the Reagan Administration (1969-1974) portrayed both social and political concern regarding industrial production's harmful environmental effects. In special, 1969 and 1970 marked the beginning of a revolution of US environmental policy.

The first event materializing the insertion of environmental protection in the political agenda was the *National Environmental Policy Act of 1969* (NEPA), enacted by the Congress. This legislative effort's objective was:

> To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality. (USA, 1970)

NEPA's section 101 recognized the negative environmental impacts derived from population growth, urbanization, industrial expansion, and emergence of new technologies. It also emphasized the necessity for achieving and maintaining not only harmony between the current society and the environment, but also **ensuring a productive coexistence and environmental conditions for future generations**.

NEPA introduced two major institutional innovations in the realm of US environmental policy: a requirement of conducting and presenting an Environmental Impact Statement (EIS) for all federal actions and the creation of the Council of Environmental Quality (CEQ). Adopting the EIS was a pioneering step as it mandated that federal agencies had to present reports summarizing the environmental impacts of their proposed actions, forcing them to address, or at least be aware of the potential environmental hazards of their policies. EIS was multidisciplinary by nature, as quantifiable and non-quantifiable benefits had to be

identified, avoiding an exclusive “economicist” approach or emphasis on a specific type of environmental effect. Following, to the CEQ was granted a consultancy task of assisting the executive and legislative powers on matters related with the national environmental policy. CEQ became an information source for recommending environmental actions and concern to be prioritized and incorporated in the political agenda as their main tasks were to gather data, to conduct research, and to evaluate policies and their respective environmental impacts.

In a short period, the federal government both acknowledged the existence of an environmental problem and assumed a role as the central agent responsible for tackling it. In February, 1970, only two months after NEPA’s publication, President Nixon sent a to the Congress a letter entitled *Special Message to the Congress on Environmental Quality*” (NIXON, 1970b). In it, Nixon presented a program with 37 proposals, categorized in five main themes,[7] addressing environmental protection against industrial and human actions. Nixon underscored that natural resources exploitation and exploration, industrial disregard for environmental protection *vis-à-vis* economic profits, and the consequential polluting behavior and environmental hazards had intensified and extended during the previous century. Since municipal and state-level institutions were not capable to cope with these problems, an effective action called for a joint action between people and companies, whilst vigorously led by the federal government. Society had to face environmental protection as a shared social challenge that “[...] summons our energy, our ingenuity and our conscience in **a cause as fundamental as life itself**” (p. 6, emphasis added).

Promoted by a joint effort of Senator Gaylord Nelson (Democratic Party) and an environmentalist organization guided by Denis Hayes, environmental concern took the form of a social manifest. Together, Nelson and Hayes sponsored an announce in the New York Times calling citizens to participate in several manifests in support of the environmentalist cause, which would happen all across the country on April’s 22nd, 1970, an event called the “Earth Day”. The proposal as a success, as the following description of the New York manifest illustrates:

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[7] Water pollution, air pollution, waste management, parks and recreation, organization for governmental action.

> [...] in New York City [...] for two hours, Fifth Avenue was closed to traffic between 14th Street and 59th Street, bringing midtown Manhattan to a virtual standstill. One innovative group of demonstrators grabbed attention by dragging a net filled with dead fish down the thoroughfare, shouting to passersby, “This could be you!” Later in the day, a rally filled Union Square to overflowing as Mayor Lindsay [...] spoke from a raised platform looking out over a sea of smiling faces. (LEWIS, 1990)

On this day, more than 20 million people participated in a pro environmentalist cause event, corroborating how environmental values had effectively joined the political agenda at the time (LEWIS, 1985).

2.2.2 The creation of the Environmental Protection Agency

As the socio-political environment pledged more governmental action in environmental matters, a new solution came with a greater institutional innovation in US environmental policy: the creation of a unified federal agency responsible for environmental regulation, the Environmental Protection Agency (EPA). EPA’s creation was not, however, an insulated effort, but rather the product of reorganization in the executive sphere whose origin was in the early days of the Nixon Administration. In 1969, little after being inaugurated as President, Nixon summoned Roy L. Ash to organize and create the *President's Advisory Council on Executive Organization*, also known as the *Ash Council*.[8] The Council’s mission was to conduct a general review of the federal structure’s organization and propose reforms to alleviate overlapping jurisdictions between government departments, increasing public efficiency on matters as crime and international drug trafficking; study of atmospheric conditions; national social programs; and the focus of this work, environmental regulation (FG 250, 2014).

In 1970, the Ash Council issued a report to the President addressing US environmental regulation, in which it emphasized and recommended the creation of a strong and unified federal regulatory agency. The *Reorganization Plan No. 3* stressed that only involving and reorganizing the federal sphere would make the government able to protect, develop, and improve US environmental conditions, as

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[8] The Ash Council was created in April 15th, 1969.

well as increase and propagate knowledge regarding natural resources. The document revealed that several departments, within distinct federal agencies, were in charge of conducting and analyzing EIS as well as had the task of minimizing environmental damages, each associated with a particular polluting vehicle (e.g., air pollution, water pollution, waste management). The absence of a unified structure aimed at environmental protection resulted in legal overlaps, inefficiency, and disregard for ecosystem's intrinsic complexity, singularity and interconnectedness.[9] To tackle such deficiencies, the government proposed the creation of a strong, unified and independent federal agency in charge of US environmental regulation, the EPA (NIXON, 1970a).

In July 1970, under the shadow of the International Earth Day, Nixon submitted the *Reorganization Plan No. 3* for Congress' approval. In December of the same year, EPA initiated its activities. EPA had four main objectives: i) to establish and apply environmental standards; ii) to conduct research, acquire information, and recommend public actions concerning the environment; iii) to offer technical assistance to other public and private spheres on environmental protection and pollution abatement; and iv) to support the President and the CEQ on the development and recommendation of national environmental policies. EPA's role would soon be crucial both indirectly, when assisting CEQ on the creation of a environmental agenda, and directly by issuing and supervising national environmental regulations (NIXON, 1970a).

Notwithstanding EPA's creation being a response to the strengthening of environmental values, it certainly was attached to political interests. In 1969, the democrat senator Edmund S. Muskie, at the time leading the *Air and Water Pollution Subcommittee* in the US Senate, was a potential candidate for the Democratic Party at the forthcoming presidential election in 1972. Thus, Muskie was in a privileged position to incorporate the environmentalist cause in his speech to gain political support. Nixon – a republican president fearing that the Democratic Party would appropriate the environmentalist movement – used EPA's creation to empty the opposition political agenda (EISNER, 2000). Not only the President himself, but also the first EPA Administrator, William D. Ruckelshaus, when inquired about the motives that led Nixon to create the agency, stated that the President had not created the

[9] "[...] the environment must be perceived as a single, interrelated system. Present assignments of departmental responsibilities do no reflect this interrelatedness" (Nixon, 1970a).

agency due to an affinity with environmental values. To Ruckelshaus, public pressure and outrage regarding environmental hazards were the reasons pushing the executive power to establish EPA. Nixon did not act because he resonated with environmental causes, but rather because he had no other politically available option (RUCKELSHAUS, 1993).

EPA derived from the union of 15 pre-existing departments which were formerly disperse in 12 different public agencies. Ruckelshaus, EPA first Administrator, signed the *EPA Order 1110.2*, in December 4th, 1970, a document delineating EPA's first formal structure (EPA, 1970). Under the Agency's Administrator – nominated by the President – there were nine federal offices, each with its own individual attributions and responsibilities: office of the administrator, regulatory planning and management, standards, enforcement and legal support, research and monitoring, and five thematic offices (air pollution, water pollution, pesticide and chemicals, radiation, and solid wastes).[10] Besides these departments, ten regional offices were in charge of developing, enforcing, and monitoring national programs in state and regional levels. [11]

Despite initial difficulties resulting from the agency's initial structural arrangement,[12] the emergence of a unified federal regulatory agency responsible for environmental protection and preservation presented several advantages:

1) to increase overall research capacity in the several lines of actions;
2) to allow greater capability to collect data and set environmental standards;
3) to diminish jurisdictional conflict between former decentralized public agencies responsible for fostering environmental policy; and
4) to promote efficiency and to minimize economic advantages of those firms which ignored the deleterious environmental impacts of their productive activities (NIXON, 1970a).

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[10] EPA's nine initial offices were: Office of the Administrator; Assistant Administrator for Planning and Management; Assistant Administrator (for Standards and enforcement) and General Council; Assistant Administrator for Research and Monitoring; Water Quality Office; Air Pollution Control Office; Pesticides Office; Radiation Office; Solid Wastes Office.

[11] Section 5.2 presents EPA's current organizational structure.

[12] As EPA was formed by transferring already existing bodies from other federal agencies to a single agency, intra-agency conflicts was not rare as each unit could had inherited diametrically opposite purposes. Ruckelshaus (1988) and Williams (1993) exemplified this concern by describing the initial experience on pesticide regulation. While the EPA's responsibility was to protect the environment and human health, the department responsible for pesticide regulation came from the US Department of Agriculture, which focused agricultural efficiency and productivity rather than the harmful aspects of the environment.

Besides, a strong federal agency mitigated a weakness of decentralized environmental policies, reducing the political and economic disparity between public agencies and regulated industries:

> The belief was that the states had enough interest and infrastructure to enforce these laws. If they also had this ‘gorilla in the closet’--that is, the federal government, which could assume control if the state authorities proved too weak or inept to curb local polluters--the states would be far more effective. That's the theory. **Prior to EPA, there was no federal oversight. There was no ‘gorilla in the closet’. Absent that, it was very hard to get widespread compliance.** (RUCKELSHAUS, 1993, emphasis added)

Throughout the 1970s, EPA’s legislative mandate grew swiftly. Chart 1 presents the main legislation enacted between 1970 and 1977 under EPA’s responsibility. The growth of the pool of environmental regulations which had to be enacted, enforced, and monitored by EPA demanded increases in the agency’s financial resources and workforce. Whereas in 1971 EPA had a budget of US$ 1.2 billion and employed 5,744 people, in 1979 these numbers reached US$ 5.4 billions and 12,160 employees (EPA, 2014b).

Legislation	Year	Brief Description
Clean Air Act Amendments	1970	EPA must establish primary and secundar air quality and vehicle discharges standards; states must develop implementation plan and schedule.
Resources Recovery Act[1]	1970	Establishment of a program for the development of new waste management systems.
Federal Water Polution Control Act Amendments	1972	Establishment of federal objectives related with water quality and the development of a system of permissions to discharges of polluting substances.
Federal Environmental Pesticide Control Act	1972	Register requirement for all pesticides commercialized in the US.
Noise Control Act	1972	Granted authority to the federal government to define standards limiting commercial sources' noise pollution.
Marine Protection Act	1972	Regulated waste dump in the oceans and coastal waters.
Energy Supply and Environmental Coordination Act[2]	1974	Clean Air Act Amendment extending the deadline for automakers to comply with new discharge levels and national air quality standards set by the Clean Air Act.
Safe Drinking Water Act	1974	Authorized the federal government to esbalish safety standards for the quality of potable water.
Toxic Substances Control Act	1976	Authorized previous tests of chemicals and banning or regulating the production, sale or use of chemical by the EPA.
Resources Conservation and Recovery Act	1976	Requested that EPA set rules defining accurate procedures for treatment, storage, disposal, transportation and disposal of hazardous waste.
Clean Air Act Amendments	1977	Clean Air Act Amendment delaying, again, the deadline for automakers to comply with new discharge levels and national air quality standards set by the Clean Air Act.
Clean Water Act Amendments	1977	Clean Water Act Amendment extending the deadline for industry and cities to achieve treatment standards. Defined national standards for industrial pretreatment.

Chart 1 – Main US environmental legislations enacted by EPA: 1970-1977
Source: Adapted from Vig and Kraft (1984)
[1] Initially under the jurisdiction of the Department of Health, Education and Welfare.
[2] Jointly implemented by EPA and the Federal Energy Administration.

The period between 1960 and the beginning of the 1970s marked the ascent of environmental values *vis-à-vis* the predominant economic preoccupation during the immediate post-war years, resulting in the rise of a societary regulatory regime in the US. Policies aiming environmental preservation, protection, and restauration, including others “social” regulations addressing aspects as worker safety, consumer health, and, ultimately, promotion of quality of life were at the core of this new regime. Vig and Kraft (1984) summarize US environmental policy during this period

> The environmental policies of the last decade […] were based on a deep conviction that various types of industrial and business activity must be regulated by laws forcing companies to adopt new technologies and processes to clean up pollution emissions by specified dates. It was recognized that this would impose other economic and social costs, but that such a trade-off would have to be made in the long-term interest of preserving human health and environmental integrity. (p. 6)

2.3 THE EFFICIENCY REGIME AND THE RISE OF BENEFIT-COST ANALYSIS WITHIN THE REGULATORY PROCESS

Besides being a crucial event in the ascent of the societary regime, EPA’s creation in 1970 represented how environmental and social values had swiftly joined the political agenda throughout the 1960s. However, not long after the agency opened it doors, environmental values began to be restricted in the US. The US economy in the 1970s was rife with instability and turbulences, as the oil embargo unfolded in the Middle East, and the domestic economy suffered with high inflation rates, sluggish production growth and increasingly higher external competition. As a result, policy objectives were yet again, as witnessed after the 1929 crass, focused on economic conditions.

The adoption of regulatory oversight mechanisms in the US, emphasizing economic efficiency in regulatory actions, was a central characteristic supporting the passage from a societary to a new efficiency regulatory regime. This subsection presents the process through which economic values replaces social values as the core of the US regulatory system, culminating in the insertion, fostered by the Reagan Administration, and subsequent maintenance, throughout the following

Presidents, of a particular economic practice as a prerequisite in the process for issuing new regulations, the BCA.

2.3.1 Economic instability and criticisms to the societary regime

If sequential periods of economic growth underscore public preference for environmental protections, when political conflicts oppose environmentalism with economic welfare, as during generalized crisis, environmental values are also undermined (KRAFT, 2011). Similar to the growing environmental awareness of the 1960s, the reclaim of efficiency as a central target to be pursued by US regulatory policy were a result of a synchronic process where sequential events constructed an environment rife with concern regarding productive and economic performance.

Sunstein (2002a) argued that environmentalist advances in the societary regime resulted in regulations intending to correct environmental problems, long neglected since US industrial growth. By focusing on issuing rules addressing environmental hazards *per se*, Sunstein notes that regulators neglected both social and private compliance costs, and overestimated how fast could agents' adequate their actions. Hahn (1994) underscores the growing administrative and compliance regulatory costs, which doubled between 1972 and 1979, reaching US$ 63 billion (in 1990 dollars), and passing from representing 0.9% of US GDP to the level of 1.5% of the US GDP.

Also related with growing regulatory burden, but reinforced by the 1973 and 1979 oil embargos, US macroeconomic conditions in the 1970s deteriorated. Figure 1 illustrates that since 1970, US inflation and unemployment rates ascended whereas productivity growth leveled off around 1971-1973, facing a sharp decline in 1974, immediately after the first oil embargo. The feeble economic performance was responsible for reclaiming efficiency as a central political goal. In the regulatory arena, this was especially important an argument condemning the set of regulatory "burdens" imposed during the societary regime precluded economic development and undermined industrial productivity.

Effectively, private industrial groups were the greatest opponents of the new social regulations issued in the previous decade. Bolstered by US weak

macroeconomic performance, industrialists propagated the notion that regulatory agencies usually overestimated the pace of “green”, less polluting, technological change, underestimated private costs and technical difficulties in complying with new environmental standards, and ultimately created economic rigidities which should be blamed for the country’s growing unemployment and inflation rates (EISNER, 2000; 2007). Moreover, industrialists blamed declining productivity growth rates on regulatory costs, as new rules displaced resources from potentially productive ends to non-productive uses – compliance costs -, fostering economic inefficiency. Another variant of this argument stated that high regulatory costs not only retrieved resources from productive ends, but they also blocked new investments in research and development (R&D), undermining the development of more efficient products and means of production (HAYS, 1987). Seeking technical and academic support, companies funded conservative think tanks (as the Heritage Foundation, the American Enterprise Institute, and the Cato Institute) to challenge agencies’ regulatory analysis, as well as to create an academic lobby exalting how an excessive and growing regulatory body led to rigidities and adverse economic impacts (EISNER, 2000; 2007).

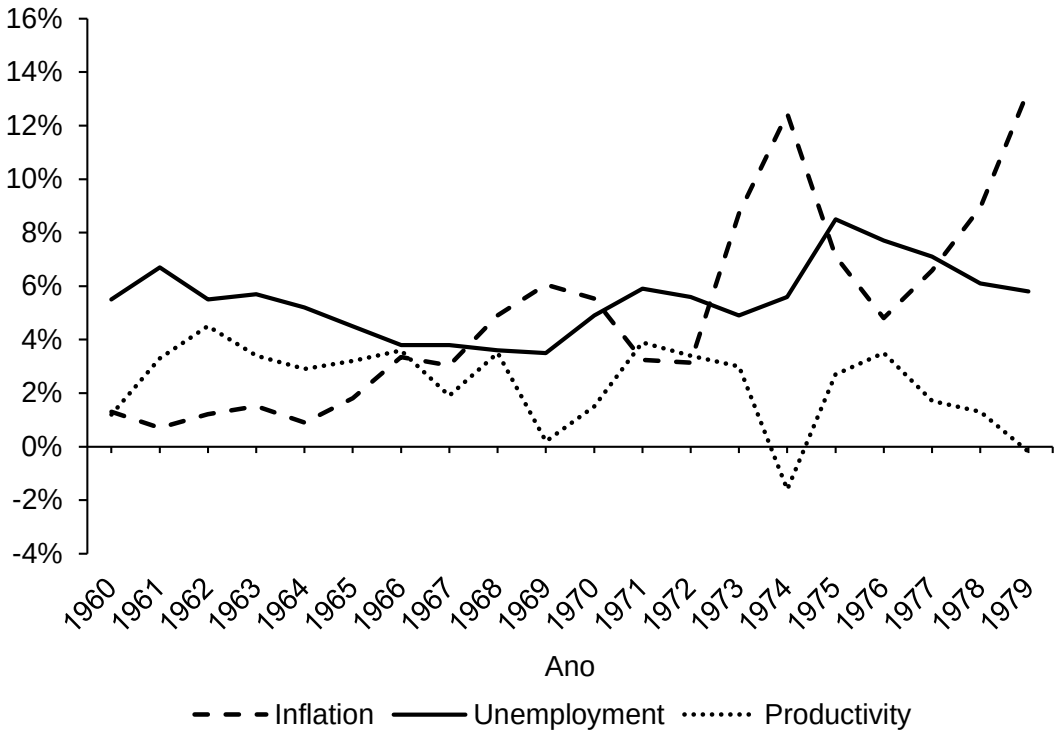

Figure 1 – US annual rates of inflation, unemployment, and productivity growth (non-agricultural): 1960-1979
Source: own elaboration based on data retrieved from the Bureau of Labor Statistics’ website (BLS, 2014)

Besides promoting ideas favorable to deregulation, private groups organized a political movement to increase their involvement in the policy arena by creation the so-called *political action committees* to channel resources and contribution to pro-business political campaigns (HAYS, 1987; EISNER, 2000; KRAFT, 2011).[13] Finally, attempts to block new regulation through court challenges filed by the regulated industries delayed even more final compliance to more stringent environmental standards (VIG; KRAFT, 1984).[14] Hays (1987) describes how industrialists attacked new regulatory costs and defended less stringent environmental rules:

> Business groups complained about additional costs; they used their own economic analyses and those of their consultants to demonstrate that proposed regulatory actions would have severe economic consequences. Such analyses often persuaded the EPA to modify both the level of standards and the rate of implementation. Hence, there arose a contest between the EPA and the regulated industry as to whose economic analyses would prevail. (p. 371)

Throughout the 1970s, beyond industrialist-sponsored criticism, several academic researches questioned the legitimacy of US regulatory policy, especially due to the rise of the concept of *regulatory failure* and the *private interest theory of regulation* (VIG; KRAFT, 1984; EISNER, 2000; 2007). Cutler and Johnson (1975) first proposed the concept of regulatory failure as a criticism to strictly “technical” decisions supporting regulatory policy. They argued that independent regulatory agencies would produce socially flawed regulations if left without any oversight mechanism. To assume that regulatory agencies acted only based on strict “technical” analyses would by naïve once it disregarded the complexity of all concurring social and economic values inherently embedded in public policy decisions. Thus, a regulatory failure occurs “when an agency has not done what elected officials would have done had they exercised the power conferred on them by virtue of their ultimate political responsibility” (p. 1399).

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[13] In 1980, private business and commercial associations comprised 62% of all political committees, controlling a share of 59% of all political contributions originated from this this source (EISNER, 2000).
[14] The consecutive Clean Air Amendments (1974 and 1977), delaying automaker’s compliance deadline are, perhaps, the best example of industrialist’s concern regarding regulatory costs.

In addition to the idea of regulatory failure, George J. Stigler's influential article *The Theory of Economic Regulation* (1971) reinforced the regulatory policy's legitimacy crisis.[15] Stigler criticized the traditional interpretation that regulatory intervention ultimately aimed at enhancing social welfare by addressing market failures (see section 4), and instead argued that regulator policy was a governmental instrument to redistribute income in favor of private interest groups. Ultimately, new legislation could favor interest groups in four ways: i) erecting barriers to entry; ii) promoting direct subsidies; iii) imposing regulatory costs to potential competitors; and iv) controlling industry prices and setting them in an above-competitive levels, assuring extraordinary profits. Supported by the assumptions of rational and self-interested individuals, Stigler defended the existence of a "regulatory market" in which regulators traded favorable regulations in exchange for political and financial support from private interest groups. Industry would then demand biased regulations, and "capture" the regulatory agency. Hence, this regulatory policy would promote private rather than social welfare. [16]

2.3.2 The origins of economic analysis and regulatory oversight in the US regulatory system

Macroeconomic instability, political mobilization of private interest groups for deregulation, and dissemination of the notions of regulatory failure and capture were central to the rise of a new efficiency regulatory regime in US. Eisner (2000) listed four main characteristics of such regime: i) growing demand for supporting regulatory decisions through economic analysis; ii) centralization of regulatory authority in the executive power; iii) using market as benchmark for government actions; and iv) concern with compliance costs and necessity to quantify and compare regulatory costs and benefits. Throughout the 1970s, US government gradually incorporated

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[15] Stigler's *The Theory of Economic Regulation* was cited by more than 9000 academic works (1971-2014), according to the Google Scholar database. In addition, Stigler is an Economic Nobel laureate (1982) for his work on the study of industrial organization, market functioning, and causes and effects of public regulations.

[16] Stigler's work gave birth to the private interest theory of regulation, or the Chicago theory of regulation. Among its most prominent works, we find Posner (1974), Peltzman (1976) and Becker (1983).

these features in the regulatory flow through a crucial novelty of the efficiency regime, an executive oversight mechanism for regulatory decisions.

EPA brought, along with its creation, a concern regarding excessive regulatory costs. Remarkably influenced by such perception and heralding efficiency as political target, Nixon, Ford, and Carter Administrations started a movement towards constructing an executive regulatory oversight mechanism and inserting economic analysis within the process of issuing new regulations (KRAFT; VIG, 1984; WEIDENBAUM, 1997; SUNSTEIN, 2002a; VISCUSI, HARRINGTON JR.; VERNON, 2005).

Nixon Administration (1969-1974)

The Nixon Administration took the first step towards greater White House participation in the regulatory process, especially through the leadership of the Office of Management and Budget (OMB).[17] Tozzi (2011) underscored how the growing concern regarding regulatory costs, after NEPA's approval and EPA's creation, incentivized the creation of a government group to study public actions affecting variables associated with the nation's quality of life, the Quality of Life Committee. One of such committee's propositions materialized in the establishment of a "quality-of-life review process", under OMB's responsibility, whose goal was to assure that regulatory decisions incorporated sound economic weighing of benefit and costs.

In October 1971, George P. Schultz, then heading OMB, sent an official Memoranda to regulatory agencies and executive departments establishing OMB's preliminary regulatory and/or policy analysis process for those policies which: significantly impacted other agencies/departments' programs; imposed "significant" or net costs on non-federal sectors; and/or increased demand for federal resources. Federal actions meeting such requirements had to be submitted for OMB's review, and the responsible agency/department should sent a summary briefly describing the

[17] OMB is an executive office under the executive power whose goal are: public budget development and execution; management and oversight of federal agencies; coordination and review of all significant Federal regulations by executive agencies; legislative clearance and coordination; assist the issuance of Executive Orders and Presidential Memoranda and their distribution to agency heads and officials (OMB, 2014).

regulatory/policy actions, as well as the expected costs and benefits, the considered alternatives, and arguments supporting the preferred options. This document should be sent to OMB 30 days prior to the action/regulation publication in the Federal Register (SCHULTZ, 1971).

Although incipient, this first executive regulatory oversight was crucial to establish OMB's role as the leading office responsible for coordinating US federal regulatory agencies, as well as interagency, actions and avoiding jurisdictional overlaps (SUNSTEIN, 2002a; VISCUSI, HARRINGTON JR.; VERNON, 2005). However, economic review remained an informal process as it did not mandated regulatory agencies to adjust their actions according to OMB's analysis, even if net costs or OMB deemed regulatory impacts were excessive. Effectively, OMB's enforcement was rather limited whilst it assumed less of an oversight and more of a consulting role, as regulatory agencies could simply disregard OMB's comments in the final regulatory text (WEIDENBAUM, 1997).

Ford Administration (1974-1977)

The Ford Administration continued the initiative started during the Nixon's mandate, maintaining OMB's interagency review process for avoiding regulatory duplicity. Ford assumed the presidency after Nixon had resigned in August, 1974, just one year after the first oil embargo. Amidst an inflationary pressure due to the energy crisis, Ford's first regulatory reform came about in the same month as he was sworn President; he created the Council on Wage and Price Stability (COWPS). COWPS' main function was to oversee private actions and review governmental programs that could accelerate domestic inflation, so as to determine and minimize their inflationary impacts (EISNER, 2000).

On November 1974, the White House issued a crucial document regarding regulatory oversight: the Executive Order (EO) 11821. EO 11821 formalized a regulatory oversight process whose core was the requirement of an *Inflation Impact Statement* for major proposals for legislation, and for the promulgation of regulations and rules by any executive branch agency. From then on, all executive department and federal regulatory agencies should analyze "significant" actions' impact on four

particular areas: i) costs imposed upon consumers, government, and the private sector; ii) impact on private and public productivity; iii) impact on national competitiveness; and iv) influence on supply of “relevant” products and/or services. In addition, EO 11281 established a new mechanism for joint action between OMB and COWPS. While the latter was in charge of analyzing inflationary impacts, the former would participate earlier in the regulatory process and define the criteria defining a “significant” public project, thus indicating which action would require the submission of an inflationary impact statements (USA, 1974).[18] In December 1976, Ford went a step further and signed the EO 11949 (USA, 1976), which replaced the inflationary impact statement by an *Economic Impact Statement*, emphasizing that policy makers should not only consider inflationary, but rather full economic impacts when selecting policies and projects.

Despite an early concern regarding formal economic considerations and a regulatory oversight mechanism led by executive agencies, Viscusi (1992b) and Viscusi, Harrington Jr. and Vernon (2005) defend that OMB and COWPS’ regulatory review was basically *pro forma* and non-binding. Even if an executive department or federal regulatory agency presented impact statements for their significant projects or regulations and OMB and/or COWPS signaled the proposals should be altered to diminish economic or inflationary negative impacts, neither of them could actually block the proposal.

Carter Administration (1977-1981)

Not only maintaining the trend of increasingly executive oversight, the Carter Administration strengthened the regulatory review process through two prominent actions: creating the *Regulatory Analysis and Review Group* (RARG) and signing the EO 12044 (USA, 1978) – replacing EO 11949, both in 1978. Representatives from several government bodies, as the Council of Economic Advisors, OMB, a myriad executive departments related with agriculture, trade, education, energy, treasure,

[18] According to Eisner (2000), “significant” proposals were those generating costs superior to US$ 100 millions and/or undermined national productivity, the job market, energy consumption, or supply of relevant products or services.

transportation, heath, and even EPA itself, were called to assume chairs on RARG. This new group's function was to supervise agencies' regulatory schedule and agenda and to conduct studies for selected regulatory proposals, which would later be submitted to COWPS and further incorporated in the proposal's overall economic analysis. As such, RARG complemented the preexisting executive oversight structure, acting alongside OMB and COWPS (VISCUSI, 1992b).

By replacing EO 11949 by EO 12044, Carter formalized a new regulatory oversight process. While the new EO mandated federal regulatory agencies had the obligation to issue economic impact analysis for all regulatory actions likely to result in annual costs of over US$ 100 million dollars or which imposed "significant" impacts on market prices or costs borne by industries, governmental agencies, or specific geographic regions, it incorporated an institutional innovation regarding impact analysis. In the regulatory impact statement, agencies had to not only present the expected economic impacts, but also to show that "*alternative approaches have been considered and the least burdensome of the acceptable alternatives has been chosen*" (USA, 1978). These lines introduced the practice of *Cost-Efficiency Analysis* in the US regulatory process. Once a regulatory purpose was defined, the agency had to assure that the selected action was the least burdensome option from all considered alternatives, and thus would not impose unnecessary costs to the economy, to individuals, and/or to private or public organizations (EISNER, 2000).

Although the regulatory reform efforts of Presidents Ford and Carter encouraged agencies to weigh costs and benefits of proposed regulation, the economic standard applied by the oversight mechanism remained advisory in nature and economic impacts were not systematically considered during the design of regulation or during the process of writing and approving regulatory statutes (WEIDENBAUM, 1997). However, even a non-binding executive oversight indicated the passage from a regulatory regime formerly primarily focused on mitigating social and environmental hazards, to other heralding greater concern with regulator costs, policies' economic impacts and, ultimately, efficiency.

2.3.3 *Reagonomics*: regulatory reform and the ascent of BCA

The efficiency regime reached its pulpit in the Reagan Administration (1981-1989), whose economic policy had in regulatory reform one of its main pillars. In spite of following a growing executive participation in the regulatory process, as well as several measures seeking to recover the US economy after the 1970s' first oil embargo, US economic indicators remained pessimistic and sluggish until the beginning the next decade. In 1980, US macroeconomic environment suffered from a two-digit inflation rate, falling growth and productivity rates, fierce competition from external companies in both domestic and international markets, and an undesirably high unemployment rate – higher than that witnessed in 1973. The poor economic conditions were better illustrated by the *misery index*, sum of inflation and unemployment rates, which suffered a 47% increase between 1973 and 1980 (Table 1 illustrates US poor economic indicators for this period).

Table 1 - Evolution of economic indicators: 1973-1980

	Annual rate (%)							
	1973	1974	1975	1976	1977	1978	1979	1980
Inflation	8.7	12.5	7.1	4.8	6.6	8.9	13.4	12.3
Unemployment	4.9	5.6	8.5	7.7	7.1	6.1	5.8	7.1
Misery Index	13.6	18.1	15.6	12.5	13.7	15.0	19.2	19.4
Productivity (growth)	3.0	-1.6	2.7	3.5	1.7	1.3	-0.2	-0.1
GDP (growth)	2.7	-3.5	2.0	6.3	4.4	3.7	-1.5	-3.1

Source: own elaboration based on data retrieved from the Bureau of Labor Statistics' website (BLS, 2014)

Amidst turbulent economic times, the 1980's presidential election, electing the republican candidate Ronald Reagan, represented a change of hearts regarding government's duty before society. Not only economic policy swerved to a more orthodox interpretation, with high interest rates and cutbacks on public spending, but the Reagan Administration also fostered major regulatory reforms and deregulations,

marking the peak of the efficiency regime, whose implications and effects lingered and are perceptible even in US current regulatory system.

On January 20th 1981, the Republican Party expressed their intent, in case they won the election, of pursuing an administration focused on an "essential" objective: to recover US economic health.[19] Reagan reaffirmed the prevalence of economic goals in his speech accepting the presidential nomination by the Republican Party:

> First, we must overcome something the present administration has cooked up: a new and altogether indigestible economic stew, one part inflation, one part high unemployment, one part recessions, one part runaway taxes, one part deficit spending and seasoned by an energy crisis. It's an economic stew that has turned the national stomach. (REAGAN, 1980)

In the early 1980s, if economic growth and search for efficiency were the most essential goals pursued by the government, "other" objectives were merely "desirable" (REAGAN, 1980). The Reagan Administration's economic program reflected the preponderance of economic objectives *vis-à-vis* those social concerns embedded in the 1960s societary regime. Reagan's economic policy was mainly supporter by the theoretical underpinnings of supply-side economics, being later called *Reagonomics*. Whilst stimulating private productive and supply capacities by fostering free-market was one of the fundamental elements behind Reagonomics, government actions were subject to the assumptions that regulatory policy and business/industry taxation were shackles imposed on private initiative, hampering national economic performance. Following, stagflation and economic instability resulted from indulgent public spending, high taxes, and unnecessarily strict and costly regulations. Ultimately, government intervention was the economic "villain" precluding entrepreneurial activity and the source of US economic malaise. Thus, the proposed solution was simply to reduce the "regulatory burden" and liberalize the markets (USA, 1982; BLANCHARD, 1987; DAY, 1989).

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[19] "At home, our economy careens, whiplashed from one extreme to another. Earlier this year, inflation skyrocketed to its highest levels in more than a century; weeks later, the economy plummeted, suffering its steepest slide on record. Prices escalate at more than 10 percent a year. More than eight million people seek employment. Manufacturing plants lie idle across the country. The hopes and aspirations of our people are being smothered. […]Our foremost goal here at home is simple: economic growth and full employment without inflation" (PLATFORMS, 1980).

Once the administration declared economic recovery was its political focus, and that supply-side economics would support federal economic policy, deregulation and regulatory reform were central pieces of a strategy to favor private investment. Both Republican Party and the President (PLATFORMS, 1980; REAGAN, 1980; 1981a; b; USA, 1982) argued that US “regulatory web”, built during the last two decades, engendered several negative economic impacts on the level of US$ 100 billion, but with potential to reach US$ 500 billion throughout the 1980s (BRATLETT, 1984).

Regulatory compliance costs were blamed for causing inflation: as regulations increased average production costs, they would be passed along the production chain to final consumers. In addition, low productivity and low economic growth have also been interpreted as resulting from an excessive regulatory regime for two reasons. First, regulatory costs "diverted" resources from productive sectors to non-productive ends, pulling the economy out of its optimum equilibrium point. Second, by allocating resources to regulatory compliance, firms reduced their stock of capital available for investment in R&D, preventing technological innovation and efficiency gains. The combination of high inflation, low productivity and discouragement of private, productive, investment indirectly lead to increasing unemployment. Finally, the administration argued that several social regulations issued on the previous decade lacked solid technical foundations while disregarded efficiency concerns and their respective economic impact on several US economic sectors. Instead, strict regulation was deemed as the result of biased and subjective political decision, which only imposed excessive burdens upon the industrial sector. Deregulating the economy was then defended as a necessary mean for the end of reestablishing the national economy and enhance “social welfare” (HAYS, 1987; EISNER, 2000; HAYS, 2000).

Conservative business groups found in Reagan a candidate favorable to their claim for market liberalization and less regulatory requirements. Andrews (1984) found that regulatory matters divided the business community in two groups (especially regarding environmental rules). While a first group, comprised of companies that had already invested resources to comply with new environmental standards, supported the maintenance of the new levels, those companies that failed to comply or had yet to adapt their productive processes represented an opposing group defending deregulation in order to avoid incurring in extra regulatory costs. In

spite of their differences regarding already issued regulation, the business community was unified around a clear claim: regulatory reform – whether to reduce the issuance of new regulations or to effectively reverse the already existent pool of regulatory requirements.

Prechel (2012) analyzed the deregulatory business lobby anti-environmental regulations in the energy sector. As energy companies were unfavorable to the implementation of the Clean Air Act on the 1970s and 1980s, they took advantage of the successive 1973 and 1979 oil embargos (1973 and 1979) and the US sluggish economic performance to argue that excessive regulatory costs were the cause of poor macroeconomic and productivity indicators. In addition, Viscusi (1992b) illustrated the strength of the automobile industrial lobby during the Reagan Administration, as a deregulatory package approved in 1981 not only softened (or completely eliminated) proposed polluting discharge thresholds set in the Clean Air Act, but also delayed the deadline for industrial compliance for those standards which were still valid.

Industrial pressure and focus on economic conditions were at the core of the economic program presented, in February 1981 by the President to US Congress (REAGAN, 1981a). Entitled *America's New Beginning*, Reagan's economic program advocated a parallelism between economic growth, free market, small government intervention, and strengthening of the private sector, as depicted by the program's four pillars:

1) reducing individual and corporate income tax in order to incentivize saving, investment, and economic growth;
2) a new commitment to a conservative, and strict, monetary policy to contain inflationary pressure;
3) budget reform to cut federal spending, except for spending on national defense; and
4) an extensive regulatory reform and deregulatory program to "emancipate" the private sector.

The Reagan Administration enforced the first two pillars by raising interest rates and promoted a massive tax reform, fostering several ulterior economic studies regarding their effectiveness (BLANCHARD, 1987; DAY, 1989; VISCUSI, 1992b). More importantly to this work's subject is how Reagonomics' changed US regulatory environment, with measures mostly pertaining to the third and fourth pillars.

Meanwhile regulatory agencies were subject to, as what Eisner (2007) described, “draconian” budget cuts, and their workforce was severely reduced. Moreover, Reagan led a regulatory reform process structures around the idea of inserting economic rationality in US regulatory system.

Budget cuts during the Reagan Administration addressed not only regulatory agencies, but most federal public agencies (a total of 83 federal programs suffered cuts), with the exception of military and social security spending (DAY, 1989). However, the impact on regulatory agencies was substantial. Weidenbaum (1997) shows that regulatory agencies’ workforce fell, between 1980 and 1985, from 121 791 to 102 192 employees (16% reduction). Only for social regulations, this represented a reduction of over 16 thousand employees.

Specifically addressing US environmental regulation and EPA, Kraft (1984) argues that the agency became a vulnerable target amid government focus on economic recovery. Bratlett (1984), Kraft and Vig (1984), Vig (1984), Hays (1987), and Eisner (2007) represent only some of the work supporting the hypothesis that the Reagan Administration adopted a strategy to disable EPA’s regulatory capabilities by imposing drastic budgets cuts and placing ideologically biased presidential (or easily controlled) appointees in strategic position in the agency. In the first years of the Reagan Administration, between 1980 and 1983, EPA lost 1/5 of its workforce (from 13,078 to 10,832 employees), and has its nominal budget reduced from US$ 4.7 billion to US$ 3.9 billion, which represented a real loss of more than 30% after adjusting for inflation (EPA, 2014b). Considering only those resources invested on R&D activities, which are the foundations for improving existent and promoting new environmental regulations, the agency’s real budget was cut in half between 1981 and 1984, indicating the unwillingness to initiate new environmental initiatives (BRATLETT, 1984).

Regarding the strategically designed occupation of policy positions within the agency, the presidential nomination of Anne Gorsuch as EPA Administrator only exemplified the approximation between the regulatory framework and the ideology of supply-side economics. In her period leading EPA (1981-1983), Gorsuch implemented a political agenda comprised of 5 main objectives:

1) “providing a better scientific foundation for agency decision-making;
2) the institution of regulatory reform measures to assist in supporting the President’s economic recovery program;

3) the elimination of backlogs and delays in many of the Agency's major programs;
4) strengthening of the Federal-State-local relationships to support the President's New Federalism program; and
5) improved management and budget reduction measures at all levels of the Agency" (GORSUCH, 1983, p. 332).

These pillars set by Gorsuch exemplified how EPA's actions were bound to an economic, instead of environmental, mission. Moreover, they were incompatible as while proposing to increase scientific studies and their quality to support EPA's rulemaking, it also fostered general budget cuts, including funds for R&D (as described above) (ANDREWS, 1984). Overall, EPA's demoralization in the beginning of the 1980s not only incorporated those criticism fostered by private business groups and scholars from the supply-side economics paradigm, but it was also supported by EPA Administrator herself.

Although the budget cuts affected EPA's regulatory activities, the fourth pillar of the economic plan of Reagan, regulatory reform, is crucial for understanding US current regulatory practice. On January 22nd 1981, only two days after the start of his first mandate, Reagan arranged the *Presidential Task Force on Regulatory Relief* (Task Force) Headed by the vice-president, George Bush, this Task Force aimed to review both existing and proposed regulations to determine whether they would generate social net benefits. After assembling the Task Force, Reagan froze the issuance of new regulation for a 60-day period so as the group could analyze the proposals. Comments, reviews, and alterations recommended by the Task force should be then incorporated in the regulation's final text, in a manner as to avoid excessively burden US industry (EISNER, 2007). Throughout its activities (January 1981 – August 1983), the Task Force analyzed 119 regulations, of which 76 were either eliminated or suffered alterations (ANDREWS, 1984).

On February 17th 1981, less than one month after creating the Task Force, Reagan took his most prominent effort towards regulatory reform, influencing US regulatory system throughout the years to come, by signing EO 12291 (USA, 1981). This EO was the major pivot marking the passage from societary to an efficiency regulatory regime by proclaiming that "regulatory action shall not be undertaken unless the potential benefits to society from the regulation outweigh the potential costs to society"; and that "regulatory objectives shall be chosen to maximize the net

benefits to society". To enforce the formal comparison between costs and benefits and the maximization of net benefits as a regulatory goal, EO 12291 required that all federal agencies, including EPA, should prepare Regulatory Impact Analysis (RIA) for all significant regulations. Additionally, agencies should submit all proposed and final regulations, and their corresponding RIAs, for OMB's analysis, review, and approval, transforming OMB's oversight, in the past advisory in nature, into a mandatory passage point in the regulatory process.[20] EO 12291 explicitly listed which information should a proper RIA contain:

> 1) A descriptions of the potential benefits of the rule, including any beneficial effects that cannot be quantified in monetary terms, and the identification of those likely to receive the benefits;
> 2) A description of the potential costs of the rule, including any adverse effects that cannot be quantified in monetary terms, and the identification of those likely to bear the costs;
> 3) A determination of the potential net benefits of the rule, including an evaluation of effects that cannot be quantified in monetary terms;
> 4) A description of alternative approaches that could substantially achieve the same regulatory goal at lower cost, together with an analysis of this potential benefit and costs and a brief explanation of the legal reasons why such alternative, if proposed, could not be adopted; and
> 5) Unless covered by the description required under paragraph (4) of this subsection, an explanation of any legal reasons why the rule cannot be based on the requirements set forth in section 2 of this Order (USA, 1981).

Thereby, EO 12291 required that, through the practice of RIA, agencies conducted a BCA supporting the merits of proposed regulations according to strict economic and efficiency criteria. Reagan extinguished the former COWPS and RARG, granting OMB's Office of Information and Regulatory Affairs (OIRA), an OMB department created on 1980, full jurisdiction for regulatory review, including analyzing BCA's for proposed and final regulation. Executive oversight intensified as proposed and final regulations, along with their corresponding BCA's, had to be submitted for OIRA review 60 days before publishing a notification of proposed regulation in the Federal Register, and 20 days before publishing the final rule. Within these periods,

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[20] The threshold for defining a "significant" regulation were I) having an expected annual economic impacts equal of higher than US$ 100 million; or ii) resulting in relevant increase in costs or prices to consumers, individual industries, federal, state, or local governments, or geographic regions; and iii) engendering "significant adverse effects" on competition, employment, investment, productivity, innovation, or competitiveness of domestic industries in relation to their foreign competitors (USA, 1981). Despite the attempts to create threshold limiting what would characterize a "significant regulation, Eisner (2007) argues that such criteria were inherently subjective by incorporating terms as "significant effects" or "relevant" increases in costs or prices.

OIRA reviewed the rule's expected economic impacts, commented and suggested necessary reviews under the prerogative of blocking and/or suspending the regulatory process for the proposed regulation unless a consensus was negotiated between OMB and the regulatory agency (EISNER, 2000). OMB's attributions were later increased during the Reagan Administration as EO 12498, issued on 1985, required agencies to submit to OMB's review an annual proposed regulatory agenda, containing an overview of the agency's regulatory policies, goals, and objectives for the program year (USA, 1985).

It did not take long for EO 12291 to generate heated debates regarding BCA's merits, especially when applied to social regulations. On one side, one group argued that it was impossible for BCA to accurately analyze policies with explicit social intent, as their goals were clearly non-economic. Moreover, to monetize environmental, health, safety and social benefits, and assume the final figures represented the actual benefits derived from the proposed actions, would be both impossible and immoral. [21] On the other side, proponents of EO 12291 judged BCA was a necessary step towards increasing social welfare. George Bush, then US vice-president, argued that such action was part of a reform process aimed at reducing the regulatory burden, which hampered national productivity and employment conditions. James P. Carty and Jerry J. Jasinowski, respectively Regulatory Manager and Head-Economist of the National Association of Manufacturers, supported EO 12291 based on the argument that stringent regulation had a depressive economic effect, and that executive oversight and BCA would promote "reasonable" regulatory choices by minimizing unnecessary private costs and, consequently, increasing the funds available for productive investments. Murray Weindebaum, head of the *Council of Economic Advisors,* saw BCA as an obvious necessity that would lead to better regulatory decisions by allowing efficienct resource management (FARNSWORTH, 1981a; b; SCHABECOFF, 1981).

Within EPA, Gorsuch's agenda (1983) incorporated BCA as a tool to improve regulatory decisions' objectiveness and pragmatism. Thus, BCA's prominence implied that economic rationality and allocative efficiency were now primordial regulatory goal, as also sustained by the President:

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[21] See section 4 for a more detailed review of both defenses and criticisms addressing BCA, especially when applied to evaluate environmental regulations.

> **The motive for incorporating benefit-cost analysis into the regulatory decision-making process is to achieve a more efficient allocation of government resources by subjecting the public sector to the same type of efficiency tests used in the private sector.** [...] The aim of requiring agencies to perform benefit-cost analysis is to make the regulatory process more efficient and to eliminate regulatory actions that, on balance, generate more costs than benefits. (USA, 1982, emphasis added)

As such, in the beginning of his period in the White House, adopting economic recovery as his crucial political objective, President Reagan pursued a pro-market economic recovery and promoted a major regulatory reform and deregulation program, designed according to theoretical concepts and interpretations originating from the supply-side economics, which heralded the importance of economics efficiency (VIG, 1984). If regulatory burdens were blamed for sluggish macro and micro economic conditions, the demand for weighing regulatory impacts led to the rise of OMB as head of a stricter regulatory oversight process and, more importantly, to the ascent of BCA as a mandatory *ex ante* practice within US regulatory process. These actions represented the peak of the efficiency regulatory regime, and their impacts linger until the present.

2.3.4 BCA's continuity and legitimization as a regulatory practice in US

Throughout the 1980s and beginning of the 1990s, as US economic recovered and became more stable, EO 12291 was still the central document structuring the US regulatory process, including the oversight process headed by OMB. At first, EO 12291 emerged as a result of the perceived urgency for economic recovery and productivity growth and enforced BCA as a tool to prevent excessive regulation that hampered national economic growth. However, after the US economy had stabilized, such defense gave room to a new, and more profound, set of arguments. If BCA proponents still heralded the importance of reducing excessive costs and increasing regulatory rationality, such effort was not to restore economic health, but rather to allow a rational management of the risks incurred by society. This rationale was especially important in the fields of social regulation, once the idea of regulating and diminishing risks to human safety and to ecosystem stability is behind the issuance of environmental, health, worker/consumer safety regulations.

With the intent of rationalizing the regulatory process and addressing the most important risks, BCA, as was argued, would consistently prioritize regulatory activities, based on their capacity to reduce risks *vis-à-vis* the corresponding costs, by monetizing and weighing regulatory benefits and costs. In a world with limited public and private limited resources, this would grant efficiency to the regulatory process.

> If some regulations show a much lower cost per life saved or accident avoided than others, adoption of the more cost-effective ones would save more lives for a given level or risk-reduction costs. Regulatory actions with the highest expected net gains should be undertaken first, leading to consistency in cost-effectiveness across regulations. (USA, 1987)

> Government regulation can reduce some risks significantly, but it can also reduce productivity, personal income, and individual choice. Risks ordinarly cannot be controlled without cost. The resources used to reduce them are not available for alternative improvements in safety or well-being. When government regulates, makes public expenditures, or require private expenditures to reduce risk, the cost of these actions should be weighed against their likely benefits. It is not possible to eliminate all hazards to safety and health, nor is it desirable for the government to attempt to reduce risks that could be controlled in less costly ways. (USA, 1987)

Even though the discourse defending BCA had changed, concern regarding “excessively burdensome” environmental regulations withstood in the twelve years of Republican control of the White House (1981-1992). The return of a Democrat government to the White House, with Bill Clinton’s election in 1993, created an expectation regarding a regulatory reform that would prioritize environmental and social aspects and grant less weight to concerns with private costs - expectation also reinforced by the vice-president Al Gore, a recognized advocate of environmental causes. However, Clinton’s legacy was that of preoccupation about efficiency and private costs rather than environmental and social goals (EISNER, 2000; 2007).

On September 30th 1993, Clinton signed EO 12866, revoking EO 12291 and established a new regulatory oversight process, headed by OIRA, but maintaining the central features present in EO 12291. Hahn (2000), Sunstein (2002a), and Hahn and Dudley (2007) sustain that Clinton both endorsed BCA as a mechanism for ex ante regulatory analysis and maintained OIRA’s powers to block the publication of new regulations. Notwithstanding, EO 12866 proposed a more flexible reliance on economic analysis. First, whereas EO 12291 explicitly mandated that quantified and monetized benefits should outweigh costs, thus enforcing a “hard” BCA, EO 12866

used the more subjective term that benefits should "justify" costs. Besides, EO 12866 declared a new interpretation of how BCA should be used by regulatory agencies, sponsoring a "soft" BCA, which should not only use economic and quantitative information, but also incorporate qualitative and distributive discussions for promoting new regulatory endeavors.

> Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantity, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefit (including potential economic, environmental, public health and safety, and other advantages; distributive impact; and equity), unless a statute requires another regulatory approach (USA, 1993)

Since then, the US regulatory system has not witnessed any drastic changes and EO 12866 has withstood as its basis regarding regulatory oversight, RIA, and BCA. The Obama Administration has recently reinforced the importance of "soft" BCA and RIA by issuing EO's 13563 (January, 18th 2011) and 13579 (July, 11th 2011) (USA, 2011a; b). The former reaffirms the importance of weighing both regulatory quantitative and qualitative costs and benefits, but adds that executive regulatory agencies should address matters as human dignity and moral and ethical aspects of proposed regulations.[22] The latter expands the requirements set on EO 13563 to all federal independent agencies. [23]

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[22] The definition of "executive agencies" is found in US Code, title 44, chapter 35, sub-chapter I, section 3502 (1):
"[...] the term "agency" means any executive department, military department, Government corporation, Government controlled corporation, or other establishment in the executive branch of the Government (including the Executive Office of the President), or any independent regulatory agency, but does not include—
(A) the Government Accountability Office;
(B) Federal Election Commission;
(C) the governments of the District of Columbia and of the territories and possessions of the United States, and their various subdivisions; or
(D) Government-owned contractor-operated facilities, including laboratories engaged in national defense research and production activities".

[23] The definition of "independent agency" is found in US Code, title 44, chapter 35, sub-chapter I, section 3502 (5):

> Executive Order 13563 of January 18, 2011, ‘‘Improving Regulation and Regulatory Review,’’ directed to executive agencies, was meant to produce a regulatory system that protects ‘‘public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation.’’ Independent regulatory agencies, no less than executive agencies, should promote that goal (USA, 2011b, p. 41587)

BCA’s resilience and ascending relevance within the US regulatory system made Sunstein (2002b) heralds the transformation of US in a “Cost-Benefit State”. Chart 1 summarizes the evolution of the several economic tools that have been incorporated in US regulatory process from the Reagan to the Obama Administration.

Having initiated in US, the practice of regulatory oversight and RIA have spread worldwide, mostly incorporated by OECD countries. In fact, OECD has played an important role as a diffusor of both regulatory oversight and RIA, exalting their value as a regulatory best practice (OECD, 1997; 2002; 2008a; b; 2009). Although issuing a RIA does not necessarily imply that a BCA must be developed, as several different methodologies for assessing regulatory impacts exist,[24] OECD characterizes BCA as a regulatory “gold standard” that should be applied when assessing regulatory impacts (OECD, 2002, p. 108; 2009, p. 75). Effectively, if the US was the first country to adopt a formal regulatory oversight process and RIA practice in 1971, by instituting the Quality of Life Review, in 2006 there were more than 36 OECD and European countries that had already adopted RIAs within their respective regulatory processes (DE FRANCESCO, 2012).[25]

“[...] the term “independent regulatory agency” means the Board of Governors of the Federal Reserve System, the Commodity Futures Trading Commission, the Consumer Product Safety Commission, the Federal Communications Commission, the Federal Deposit Insurance Corporation, the Federal Energy Regulatory Commission, the Federal Housing Finance Agency, the Federal Maritime Commission, the Federal Trade Commission, the Interstate Commerce Commission, the Mine Enforcement Safety and Health Review Commission, the National Labor Relations Board, the Nuclear Regulatory Commission, the Occupational Safety and Health Review Commission, the Postal Regulatory Commission, the Securities and Exchange Commission, the Bureau of Consumer Financial Protection, the Office of Financial Research, Office of the Controller of the Currency, and any other similar agency designated by statute as a Federal independent regulatory agency or commission”.

[24] Amongst the other methods we find: trade-off analysis, risk-risk analysis, cost-efficiency analysis, multi-criteria analysis, fiscal impact analysis, and break-even analysis. See Salgado and Borges (2010) and OECD (2008a; 2009).

[25] In 2007, the Brazilian government has initiated na attempt to incorporate the practice of RIA within its regulatory agencies by creating the *Programa Nacional de Capacitação e Desenvolvimento Regulatório Nacional* (Programme for Strengthening the Institutional Capacity for Regulatory Management).

Regulatory Impact Analysis (RIA)	Administration (Year)	Document	Description
Quality of Life Review	Nixon (1971)	OMB's Memoranda	Oversight with advisory nature. Present summary of alternatives considered, likely economic impacts.
Inflationary Impact Statement	Ford (1974)	EO 11821	Oversight with advisory nature. Mainly concerned with the relation between regulatory costs and inflation.
Economic Impact Statement	Ford (1976)	EO 11949	Oversight with advisory nature. Expanded regulatory analysis' focus from inflation to economic impact.
Cost-Efficiency Analysis	Carter (1978)	EO 12044	Oversight with advisory nature. Once a regulatory goal was set, agencies should select the most efficient alternative, minimizing costs.
"Hard" BCA	Reagan (1981)	EO 12291	Oversight with binding nature. Necessity to monetize and weigh costs and benefits, and show that regulatory actions presented net benefits.
"Soft" BCA	Clinton (12866)	EO 12866	Oversight with binding nature. Analysis should incorporate both quantitative and qualitative analysis, encompassing monetized impacts and discussing distributive impacts and equity.
"Soft" BCA	Obama (2011)	EOs 13563 and 13579	Oversight with binding nature. Maintains a soft BCA while emphasizing need to analyze moral, ethical, and human dignity aspects.

Chart 2 – Evolution of economic analysis required by US regulatory process
Source: own elaboration

Figure 2 closes this section by presenting a timeline organizing the historical process which passed from the affluent "Golden Years", to the ascent of the societary regulatory regime in the 1960s, and later return of economic values with the passage to the efficiency regime, especially during the Reagan Administration, whose influence still affect current regulatory policy. In this process, BCA became a legitimate practice for ex ante regulatory analysis in US while marking the passage from a regulatory framework mainly concerned with social values to other in which economic and efficiency considerations are at the core of regulatory policy.

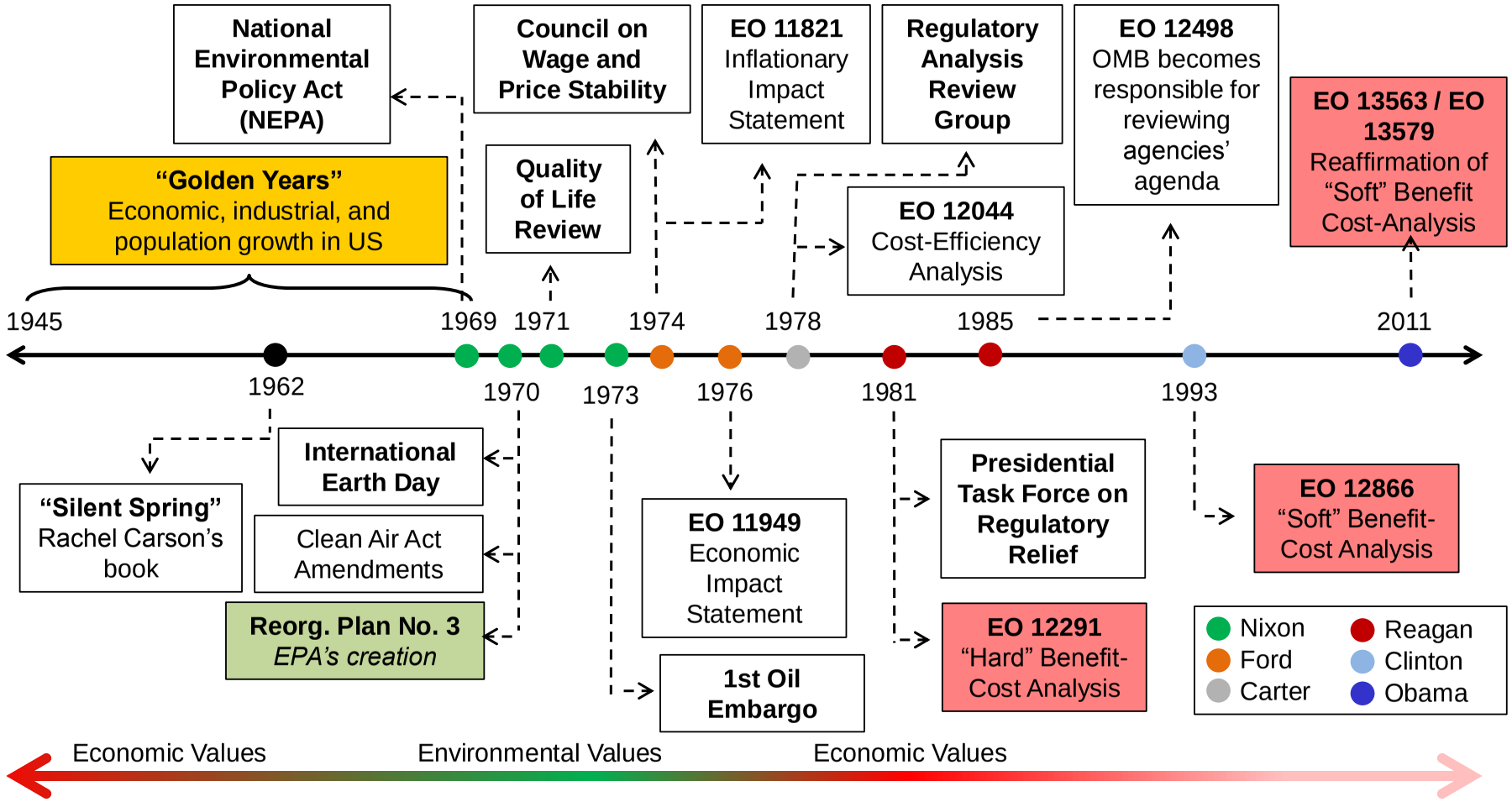

Figure 2 - Timeline: rise of environmental regulation and ascent of BCA within US regulatory process: 1945-2011
Source: own elaboration

3 RISK-BASED REGULATION, POLICY-CYCLE, AND EPISTEMIC COMMUNITIES

During the 1960s, an increasing social awareness about the detrimental social and environmental impacts caused by American industrial growth resulted in the constitution of new regulatory agencies whose objective was to protect health, safety, and environmental conditions. However, as the energy crisis burst in the early 1970s, declining private sector productivity and rising inflation/unemployment rates elevated economic values once again to the top of the political agenda. As businesses complaints regarding high compliance costs and the imposition of a "regulatory straitjacket", which hampered national productivity and innovativeness, took over the political scenario, regulatory relief and reform became political priorities. Amidst political and economic pressures, the US witnessed BCA's ascension in the regulatory arena, first with Reagan's EO 12.291, mandating that regulatory agencies could only issue new "major" regulations if they presented net monetized benefits and creating an oversight process lead by OMB, and later through Clinton's EO 12.866, which further legitimized BCA as an *ex ante* regulatory analytical tool.

Following this brief historic background, this section presents the main theoretical concepts that will support our work. We propose that BCA, when used to assess environmental regulations' impacts, is not only intrinsically embedded in a "risk-based" framework bolstered by the idea of "rationality", but also a practice whose pillars are in consonance with the values and interpretations held by a specific network of specialists. The first sub-section briefly discusses the concept of "risk-based regulation" (RBR) as the bridge linking regulatory purposes to a systematized decision-making process. Next, we present the "RBR Policy Cycle" as a multi-disciplinary framework to map where specific advocacy or technical groups might influence the regulatory process. This section closes with a summary of the "epistemic community" (EC) framework, supporting a scrutiny of how the practice of environmental BCA is inherently associated with a network of specialists with shared values, interpretations of reality, notions of validity, and policy enterprise. When combined with the RBR Policy Cycle, the EC framework allows a study of the role played by a group of specialists in environmental economics and BCA within EPA regulatory process.

3.1 RISK-BASED REGULATION: SEEKING REGULATORY RATIONALITY

The cornerstone questions supporting BCA's application as a tool for *ex ante* regulatory analysis are: what should the government's duty be when acting as a regulatory agent? In addition, through which mechanisms and manner should policymakers pursue such duty? RBR emerged as an answer to these questions. Regulators should address and diminish pervasive "risks" incurred by society through "rational" and evidence-based decisions regarding when and how to enforce regulatory actions. Thus, RBR's foundation lies on two fundamental concepts: "risk" and "rationality".

The conceptualization of "risk" within a regulatory framework, especially in the US, gained the spotlight during the Reagan Administration, as exemplified by the 1987 Annual Economic Report (USA, 1987). In this document, the President underscored government concern about actions that posed risk imposed upon society. More specifically, Reagan addressed the mitigation of "personal risks", that is, health and/or safety hazards to which individuals are voluntarily of involuntarily subject when making day-to-day decisions (such as traveling by airplane or car, smoking a cigar, and engaging in dangerous recreational activities), or that are bestowed upon them by third parties.[26] Even if some risks were more associated with individual action and choice and are beyond government control, as one's choice not to smoke reduces the likelihood of developing lung cancer, others would call for regulatory actions aimed at increasing safety and reducing risk.[27]

Academics and policy-makers have also recognized that risk could also embrace negative outcomes related with environmental hazards (VISCUSI, 1992A; SUNSTEIN, 2002A; VISCUSI, HARRINGTON JR. E VERNON, 2005). If ecological balance is assumed as of paramount importance to human life on earth and, if left

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[26] The document presented data regarding the rates of accidental deaths by cause and rates of home and work related deaths due to accidents to exemply "risk". A decline in the frequency of these two indicators would illustrate diminishing risks related with the respective causes of death (p. 180).

[27] The document specified three social arrangements for diminishing risks: i) the market which offer safety-related products as private insurances or safer products, thus respecting consumer choice; ii) the legal and judicial system, which would protect the integrity of market transactions; and lastly iii) government regulation may be warranted, for Reagan, in the presence of unattended market failures (p. 182).

alone, private agents are prone to overuse natural resources[28] or cause detrimental environmental imbalances, then government should have a role of mitigating risks associated with environmental hazards as deforestation, extinction of some species, and the emission of toxic pollutants.

Initially, then, "regulating risks" was strongly linked with health, safety, and environmental regulations. Notwithstanding, Fisher (2010) elucidates that "risk" cannot be trivially and solely associated with such social regulations. As a matter of policy, she argues, a varied set of governmental actions, including but not limited to social regulation, has applied this concept.[29] From financial disasters to global climate change and national security, several topics join the political agenda and then support new public policies whose goals are to mitigate uncertain adverse outcomes. The success of such-and-such public policy is, by nature, inherently risky in the sense that it could fail to achieve its pre-determined goals. Risk is then ubiquitous in the policy arena and its definition for regulatory purposes should not limit itself to environmental and human hazards. As such, Wiener (2010) proposes a better definition:

> Risk is generally understood as the combination of the probability and consequences of an adverse outcome. Risk is therefore ubiquitous. It encompasses both highly publicized exotic events such as pandemic flu, SARS, BSE (mad cow disease), terrorist attacks, financial collapse, and global climate change; and more mundane routine events that generate less publicity but that inflict tragically heavy losses, such as cancer, heart disease, diabetes, malaria, and traffic accidents.

If policy-makers have embraced "risk-reduction" as a socially desirable goal since the 1980s, such process cannot be detached from a parallel movement towards an increasingly "rationalization" of public and regulatory actions. US regulatory reform and relief were not singular events, but rather illustrated a worldwide "regulatory crisis" in the 1980s/1990s whose foundations were in accusing regulatory costs of "burdening" industry and causing generalized inefficiency and ineffectiveness in their operation. Not only US, but also UK, Australia, and OECD countries suffered pressure for government's parsimony, objectivity, and

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[28] The tendency to overuse and deplete natural resources has been named the "tragedy of the commons". See the Hardin (1968).

[29] Fisher elicits three distinctive forms through which government has applied the term "risk" when setting course of actions: i) public sector management reform; ii) subject matter of several regulatory actions, such as financial and social regulations; and iii) enforcement and criminal justice.

transparency when investing in new public policies or issuing regulations, leading to a change in government's actions that began to be referred as "New Public Management" (NPM) (HUTTER, 2005).

According to Hood (1991), NPM had seven crucial components:

i) Professional management in the public-sector;

ii) Stress on private-sector styles of management practice;

iii) Adoption of explicit standards and measures of performance;

iv) Greater emphasis on output controls;

v) Stress on greater discipline and parsimony in resource use;

vi) Shift to disaggregation of units in the public sector; and

vii) Shift to greater competition in the public sector (p. 4-5).

Through these, NPM fostered a specific notion of rationality which, when combined with the concept of risk, shaped RBR's core.

Within NPM, "rationality" involves four features: objectivity, neutrality, efficiency, and consistency. Behind the defense of professionalized management, explicit criteria for actions and performance measures is the urge for objective and "neutral" regulatory decisions. High compliance costs and the perception that political discretion biased the process of issuing new rules led to a legitimacy crisis regarding regulatory actions[30] and the call for a more accountable and pragmatic regulatory process, ultimately leading to the rise of technocrats within regulatory agencies. To adopt quantitative methods, standards and thresholds as subsidies to regulatory decisions strategically surrounded regulators with a veil of "science-bounded" pragmatism and neutrality that awarded political defense and a badge of objectivity and legitimacy to regulatory agencies (BLACK, 2010). As such, to incorporate specialists' judgments in policy decisions was a mandatory condition for achieving "good" regulations, epitomizing the rational-instrumental model of public administration, which portrays the public agency as an agent of the legislature entrusted to carry out a series of finite tasks with as little discretion as possible through the usage of analytical methodologies (FISHER, 2010).[31]

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[30] The roots of such thoughts are in the "private interest theory of regulation". For a summary, see Stigler (1971), Posner (1974), and den Hertog (2010) .

[31] According to Fisher (2010), the rational-instrumental model constrasts with a deliberative-constitutive model, which considers public administration as inherently political, flexible, and discretionary.

To control for potential outputs when addressing risks is, however, a difficult task even for specialists. Risk is ubiquitous and pervasive in our society. Whether crossing a street, making financial transactions or implementing public policies all actions are subject to some risk or uncertainty regarding its effectiveness or its possible negative outcomes.[32] Moreover, Wiener (2010, p. 138) points out an intrinsic *interconnectedness* associated with risks incurred by society. For example: if a regulatory agent decides to ban one specific pharmaceutical due to possible negative side-effects associated with its consumption, this could force patients to start treatments with new drugs whose side-effects might be more severe or even block access to a "substitute" and more expensive medicine. A "risk-free" environment would be virtually unattainable due to an environment rife with trade-offs: every attempt to mitigate one risk would engender another (smaller or higher) risk. Given the multitude of fields impacted by regulatory actions (such as economic production, health hazards, and environmental impacts), rational decisions would have to take into account multi-disciplinary trade-offs in order to study and analyze regulatory options and outputs.

One specific trade-off that has received both academic and political prominence is between risk-cost trade-offs (MORRALL III, 1986; VISCUSI, 1992a). Behind this trade-off lies the question: "how much is society willing to pay to reduce a marginal reduction in a specified risk?" In other words, considering all achievable goals (e.g. economic growth or investments in R&D), given a limited pool of resources, is it worthy to mitigate one specific risk *vis-à-vis* all alternative endings? Regarding this matter, In the 1987 Economic Report of the President, the Council of Economics Advisors (USA, 1987, P. 207) stated

> Government regulation can reduce some risks significantly, but it can also reduce productivity, personal income, and individual choice. Risks ordinarily cannot be controlled without cost. The resources used to reduce them are not available for alternative improvements in safety or well-being. […] It is not possible to eliminate all hazards to safety and health, nor is it desirable for the government to attempt to reduce risks that could be controlled in less costly ways.

[32] To ease further comprehension, measurable uncertaintites, that is, those to which we can attribute a quantified point-probability or probability-range will be referred as "risk", leaving the term "uncertainty" to those cases in which the frequency distribution of a specific event cannot be measured.

This means that since risk is an ever-present condition, when choosing how and when to issue new regulations government should do so in the most efficient manner, that is, using the least possible amount of resources. Moreover, regulators should aim to reduce risks only when the expected benefits from mitigating them outweigh the associated costs. This guideline would then limit administrative power by enforcing an effective deployment of scarce resources towards efficient regulatory outcomes (BLACK, 2010).

Technical/scientific assessments and controlling outputs through trade-off analysis and concerns for efficiency then grants regulators a uniform framework for decision-making. Accordingly, Morrall III (1986) defends “smart regulations” based on a priority setting capable of allocating resources to those regulatory actions which mitigates greater risks at lower costs (cost-effective regulations). Uniformity then allows regulators to set “rational” and consistent priorities: not only regulatory agencies, but also congress and other governmental agencies would be able to develop a ranking from the most to the least desirable regulation by abiding to explicit quantitative standards and methods (GRAHAM, 1996).

“Risk” and “rationality” then provide the foundations for the concept of RBR. If on the one hand government seeks risk-reduction through regulatory actions, on the other hand, decisions should be politically unbiased, evidence-based, efficient, and consistent among one another, i.e. rational decisions. Considering these assumptions, the term RBR has embraced a very broad range of approaches, ranging from either a broad framework or a much loosely concept connected with some specific *ad hoc* scenarios (HUTTER, 2005). OECD (2008b) has systematized four different meanings in order to present a coherent definition behind RBR:

> **First, regulation** of risks to society, which has a long history and extended scope in areas such as **environmental protection or health and safety regulations**: here risks are identified, their level is assessed, a decision is taken as to how much risk reduction is needed, and a piece of legislation is introduced accordingly. Second, a loose collection of approaches which regulators adopt and express in terms of risk, including their own management system. Third, in banking and insurance in particular, regulators rely on the risk models that firms use internally to set their capital requirements. Fourth, **in a broader regulatory context, it means a systematized decision-making frameworks and procedures that prioritize regulatory activities and deploy supervisory resources** – in particular, those of inspection and enforcement – based on an assessment of the risks that firms pose to the regulator’s objectives. (p. 3, emphasis added)

Especially the first and fourth definitions then provide an interesting connection between environmental regulation and RBR: it arises from normative aspects addressing not only the issue of *what* government's objective should be, but also *how* policy-makers ought to pursue it. Environmental protection is both politically and socially desirable, impinging to government the role of sanctioning and regulating actions that threaten or pose risks to the environment. Notwithstanding, since environmental protection is not the sole goal pursued by society, these regulations must follow a systematized process capable of rationally prioritizing actions.

This work does not address government's objective regarding environmental protection, instead focusing on the process through which such goal is pursued. With that in mind, the next section presents the systematized decision-making framework behind RBR, providing a roadmap to position BCA within the regulatory process concerning environmental regulation in the US.

3.2 THE RISK-BASED REGULATION POLICY CYCLE

RBR multidisciplinary nature invokes different kinds of expertise. Drawing on the broad concept of risk, RBR receives inputs from both "hard" sciences (as chemistry, physics, epidemiology, and biology) and "soft" sciences (as economics, psychology, political science, law, and public policy). Although specific methods and processes for regulating risks vary across agencies, across countries, and over time,[33] Wiener (2010) suggests that many governmental agencies generally follow a common RBR policy cycle.[34] This cycle involves the seven following components:

i) Risk Identification
ii) Risk Assessment
iii) Risk Management

[33] Graham (2006) summarizes RBR systems from distinct countries and regulatory agencies.
[34] The RBR Policy Cycle should not be mistaken by the broad definition of "Risk Analysis" as defined by the Society for Risk Analysis (SRA). According to their definition, Risk Analysis comprises "risk assessment, risk characterization, risk communication, risk management, and policy relating to risk, in the context of risks of concern to individuals, to public- and private-sector organizations, and to society at a local, regional, national, or global level". (Sra, 2013). Whereas the later presents "risk analysis" as a field of study, the former is an application of the policy cycle (Kingdon
, 1984) to the study of regulatory policy.

iv) Regulatory Review

v) Implementation & Enforcement

vi) Coping and

vii) Evaluation

Black (2010, p. 6-7) argues that, in principle, the foundation of any RBR is the risks on which it focuses. Since regulators face a multitude of risks, and are restricted by a limited amount of financial, political, and human resources, they must be selective on which risks they wish to focus. Hence, the primary step in RBR involves the identification of those risks subject to regulatory actions and within the regulatory agenda. Three usual motives explain why a specific risk might join the regulatory agenda. First, the starting point for every RBR is the regulator's statutory objectives. The US EPA, for instance, is subject to several broad legislative mandates determining the fields in which the agency holds competence regarding water quality, air pollution, land usage, human health, among others. Thus, studies on these fields of action may uncover new risks to the agency's statutory goals and then provoke new regulations. Secondly, public perceptions and expectations can play and important part in identifying new risks. Unexpected events, such as a sudden and broad contamination from a specific toxin or a well-publicized ecological disaster, might cause a strong public reaction and create social pressure for further study and regulations regarding another set off risks that was not previously within the regulatory agenda. Finally, the amount of available data can have a significant impact on which risks to focus on. Only risks that regulators are aware off can induce actions. Without sufficient information to assess the risk, it would make little sense to issue regulations.[35] In addition to statutory objectives, public perception, and data availability, Sunstein (2002a) presents a fourth reason as to why risks enter the regulatory agenda: not only public pressure, but also private pressures might engender regulatory actions, whether by capturing regulatory agents, sheer political pressure, or by manipulating the media and social awareness.

Once a risk joins the regulatory agenda, RBR attempts to forecast the likelihood of adverse consequences through a "risk assessment". Although this

[35] This notion contrasts with the "precautionary principle" sponsored by many environmentalists, in which regulations should be issued even in the presence of uncertainty (Ashford, 2007).

inquiry differs based on the type of risk,[36] it usually relies on quantitative evidence-based studies to examine the potential adverse outcomes of a specific action. As such, ever since the US National Academy of Sciences (NAS) published its "Redbook" (NAS, 1983), in which NAS tried to establish guidelines to improve consistency across US regulatory agencies, risk assessment has been deemed as a scientific endeavor distinct from the political process of risk management (p. 2). Risk assessment then would represent a "pragmatic", "objective" and "neutral" component of RBR, whose nature was exempt from value judgments and results only portrayed evidence-based results. Accordingly, Goldstein (1996) argued that following guidelines when issuing risk indicators is valuable to "free" them from political bias, rendering "political" decisions to other components of RBR. Risk assessment has recently become a standard step in the regulatory process of several countries other than US, with special prominence in the EU (WIENER, 2010).

After assessing a risk, regulators must decide what to do about it. This is where "risk management" steps in. Risk management proposes at least two questions: "how much prevention is warranted?" and "how to accomplish such prevention?" While the first tries to determine the optimum level of regulation, the later addresses instrument choice. Black (2010, p. 190-3) underscores the importance of setting "risk-tolerance". Risk-tolerance is the determination of the type and extent of risks that the regulatory agency is prepared to tolerate. Usually, this tolerance is constrained by political and cost considerations, which make risk management intrinsically political and subject to judgment values.[37]

Although several approaches to assessing "how much" have been proposed and used throughout the world,[38] ever since Reagan's EO 12291, continuing with Clinton's EO 12866, comparing compliance costs to benefits from reducing the targeted risk, usually by the practice of BCA, has been US' standard practice to determine the optimum level of regulation. BCA`s influence in US led Sunstein

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[36] Morbidity risks, mortality risks, and environmental risks are just few of the several risks a risk assessor must tackle when issuing public policies.

[37] "Whatever their policy, and whatever their legislative framework, risk-based regulation requires regulators to take risks. This is extremely challenging for a regulatory organisation. They have to choose which risks or levels of risk are they not prepared to devote the bulk of their resources to preventing. […] In practice, the political context is determinative. The higher the political salience of a sector or risk, the less will be the regulators' tolerance of failure in that particular area." (Black, 2010, p. 193).

[38] Cost-effectiveness analysis risk-risk analysis, break-even analysis, and multi-criteria analysis. For more are only some of them. For details, see OECD (2009, p. 73-81).

(2002c) to herald the era of a “cost-benefit state”. However, BCA is not applied to all RBR in the US, especially because some federal statutes and legislative mandates preclude its application for some risks (WIENER, 2010).[39] Even so, this practice has gained worldwide strength throughout the last decade since OECD elevated it as a “gold standard” for assessing regulatory impacts (OECD, 2002; 2009).

Regulators must also determine “how” to prevent the targeted risk by defining the appropriate regulatory instrument to be imposed. Regulatory intervention options are numerous and can act at various points in the production chain. Conduct, price, quantity, information requirements, technology, market-based regulations are only but few requirements susceptible regulatory discretion. Choosing between them is not an easy task, once different outcomes may arise on several instances as environmental protection, economic damage, or consumer safety (WIENER, 2010).

Risk assessment and management have faced criticism regarding their inability to account for uncertainty (POLLAK, 1995) and risk-interconnectedness (WIENER, 2010). However, the relationship between these two components has given room to reflections about scientific neutrality and regulatory decisions. Although NAS’s “Red Book” secluded risk assessment from risk management, claiming the first would be a pragmatic study that would only support regulatory political decisions regarding when and how to regulate, commentators have contested such seggregation. Robinson and Levy (2011) exposes the necessity for a revolving door between risk assessment and management: not only the first supports the later, but also when risk assessors become aware of what type of information policy-makers’ demand and the political-legislative restraints for regulatory actions, risk assessment can focus on useful information for better risk magement. NAS has later recognized this complementarity in a later publication named *Science and Decisions* (2009). Although reaffirming that previously favored political options should not bias risk assessments, NAS conceded that previous planning and ongoing exchange of information between risk-managers and assessors are beneficial for RBR, especially to determine which type of information and form of presentation might be best useful for regulating risks.

As agencies allocate resources and efforts towards more complex analyses and regulations, it makes intuitive sense to have mechanisms of accountability and to

[39] For instance, Section 109 of the Clean Air Act mandates that US EPA must not consider costs when determining national ambient air quality standards.

assure transparency for regulatory decisions. This is the *raison d'être* of the next RBR cycle component, "Regulatory Review". As long as regulations can arise from either laudable goals (risk reduction) or objectionable influences (political capture), their impact cannot be assumed to always enhance social welfare. As such, regulatory decisions are subject to different layers of scrutiny from several interested parties. If regulatory review does not assures that final decisions are optimum, it grants accountability and transparency to the reasons why such-and-such regulations were issued. When a formal regulatory oversight body is established, it may possess different forms (executive, legislative, judiciary, peer-review, and democratic participiption), and powers as:

i) Commenting on, and assisting in improving, agency's analysis;
ii) Constraining agency action when analysis is deemed inadequate;
iii) Blocking new regulations when agency fails to provide sufficient information to justify regulatory action;
iv) Calling on agencies to review existing regulation;
v) Screening possible fields for regulatory action; and
vi) Fostering transparency by reporting analysis conducted during both risk assessment and management. (WIENER, 2013, P. 124-6)

Disregarding regulatory rationale and mechanisms, effective RBR implies implementation and enforcement. Instruments and institutions to assure regulatory compliance have been a broadly discussed theme, though they will not be further explored here given this works' objective. After any regulation is enforced, regulators must adjust regulations, coping for uncertainties that were not foreseen on *ex ante* analyses, such as unpredictable disasters that shifted the conditions on which risk had been first assessed. The last, and yet crucial, component of effective RBR is to monitor the *ex post* regulatory impacts and performance. Has the regulation achieved its goals? Is it possible to enhance regulatory efficiency? Do policies actually work? It is by assessing "real-word" impacts that new risks might become salient to regulatory actions, agency fallibility is screened and new, effective, regulatory mechanisms are designed (WIENER, 2010).

Figure 3 summarizes this section with an illustration of the RBR policy cycle.

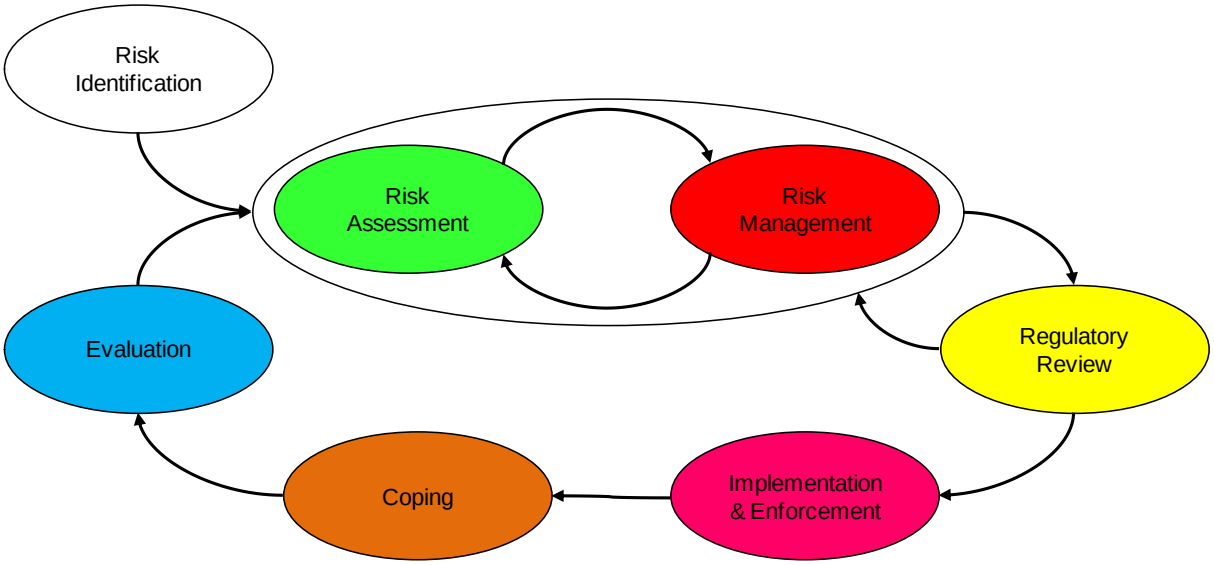

Figure 3 - The Risk-Based Regulation Policy Cycle
Source: Elaborated based on Wiener (2010).

3.3 EPISTEMIC COMMUNITIES AND THE POLITICAL INFLUENCE OF SPECIALISTS

As RBR is multi-disciplinary by nature, blending information and knowledge from several fields of expertise across the Policy Cycle, the regulatory process seldom involves analyses and specialists from several scientific and technical backgrounds. New pesticide regulations, for instance, depends on the assessments made by toxicologists, epidemiologists, ecologists, to name of few of the specialists responsible for assessing the health and environmental impacts of chemicals and toxic substances. Engineers are called forth to analyze the technical characteristics of specific technologies and/or machineries that might be enforced by a regulatory body in order to mitigate occupational risks. Moreover, economists provide consultancy to most regulators as competitiveness, employment, efficiency, regulatory costs and benefits receive weigh in the regulatory process. Ultimately, while policy issues becomes increasingly complex within a society marked by a fast-paced scientific and technological change, policymakers must seek specialists from several disciplines for guidance and assistance for developing public policies and making decisions regarding complex problems. The concept of “epistemic

community" emerged to examine how groups and networks of specialists have become potentially influential political actors within policymaking.

Although the epistemic community framework aims to understand the interplay between scientific knowledge and policymaking, its roots lies outside political science and are, instead, on the fields of the history and sociology of science. First, Kuhn (2009) argued that establishing standard scientific methods and patterns of reference and training future scientists through them was crucial to create a "scientific community", a network of peers with shared language and prone to achieve similar professional judgments, thus fostering an intersubjective scientific consensus and then legitimize their scientific work. Following, Holzner (1968) and Holzner and Marx (1979) first used the term "epistemic community" to characterize groups of scientists which applied the same scientific methods searching "scientific truths". These communities not only presented the same language and technical specialization, but its members also shared cognitive systems, as they used similar systems of interpretation to frame reality and scientific issues. Finally, to understand the impact of technological change on an international scenario, Ruggie (1975) built a bridge between international policy and a germinal idea of epistemic community by using the foucauldian concept of *episteme*.[40] Technological change, he argued, had created an inherent tension between scientific and political knowledge. Since politicians lacked the specialized knowledge to analyze policy actions related to technology, this task would fall upon specialists. These specialists, however, were not disperse, but rather were embedded in a common *episteme*, i.e. a network of scientists with the same symbols, expectations and interpretation of reality. Ruggie thus set the stage to the analysis of scientific groups within policymaking.

In 1992, Peter Haas organized a special edition of the journal *International Organization,* which gathered 10 articles to formally introduce and exemplify the concept of "Epistemic Communities" within the realm of political science and international relations. Haas (1992) was troubled by how policymakers could arrive at sensible decisions given the increasing complexity of technical and political issues in a context marked by globalization and technological change. Such factors created

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[40] Foucault (2008) used the concept of episteme to reference the set of relations between historically contextualized scientific, epistemological and discursive practices. As such, instead of representing a formalized "knowledge" *per se*, e*pisteme* is a condition of the scientific discourse that limits science by subjecting it to period-specific sets of practices, methods, language and expectations.

great uncertainty as to what the social and political outcomes of governmental actions would be, potentially paralyzing policymaking. However, Haas observed that international policy converged even in complex and uncertain areas as nuclear material and environmental issues, which seemed to him inexplicable by institutional or interest group analysis. Alternatively, he proposed a different variable to solve the puzzle of how international policy converged even in complex matters: the political influence of “ideas” advocated by “epistemic communities”.

Haas conceptualized epistemic community as a network of professionals whose recognized expertise and competence in a particular domain grants them authoritative claim to policy-relevant knowledge within that domain. While such network is not constrained by geographic boundaries, nor it necessarily consists of professionals with the same disciplinary background, such professionals share four pillars that connect them:

> (1) a shared set of normative and principled beliefs, which provide a value-based rationale for the social action of community members; (2) shared causal beliefs, which are derived from their analysis of practices leading or contributing to a central set of problems in their domains and which then serve as the basis for elucidating the multiple linkages between possible policy actions and desired outcomes; (3) shared notions of validity – that is, intersubjective, internally defined criteria for weighing and validating knowledge in the domain of their expertise; and (4) a common policy enterprise – that is, a set of common practices associated with a set of problems to which their professional competence is directed, presumably out of the conviction that human welfare will be enhanced as a consequence. (Haas, 1992, p. 3).

By sharing a set of normative and principled beliefs, causal beliefs, notions of validity, and a common policy enterprise, a network of specialists evidences not only a common scientific framework, but also socio-political convictions. The unique feature that distinguishes epistemic communities from other policy networks or interest groups within politics and policy-making is the combination of truth tests and common causal beliefs that are used to legitimize policy-advices (HAAS, 2001; DUNLOP, 2010). On the one hand, when confronted with complex social and technical issues, policymakers would seek advice from epistemic communities to elucidate causal chains, establish political options, forecast likely results, and ultimately legitimize their actions by using scientific rationality. The epistemic community, on the other hand, is capable of framing complex questions through common perceived causal relations and validity tests (HAAS, 1992). In doing so,

Dunlop (2000) and Haas (2008) underscore that it is a scientific knowledge's adherence to reality that grants authority to an epistemic community, but rather the socially perceived credibility of such knowledge. Credibility depends, however, on the same network of specialists that creates the epistemic community once the process of awarding scientific validity lies on peer-acceptance and shared communications channels and cognitive and symbolic frameworks (e.g. peer-review, thematic journals, and acceptance of specific research methods). As such, an epistemic community is responsible to intersubjectively validate and legitimize its own knowledge and recommendations.

To understand the political influence and role of a specific epistemic community implies, however, an understanding of its idiosyncratic characteristics. First, internal cohesion is the strength of the ties linking specialists from the epistemic community to one another. These ties represent the existence of shared professional norms, the existence of communication channels,[41] a shared academic and professional background, and more importantly, the existence of a scientific consensus within the epistemic community. The closer the members are to one another in both professional opinions and academic backgrounds, the more cohesive the epistemic community is and the less challenged it may be by external forces or policymakers (CROSS, 2010).[42]

Though cohesiveness is important, Verdun (1999) argues that not all epistemic community members hold the same political power. By studying the role of economists in the Delors Committee, Verdun[43] found that such epistemic community presented an internal hierarchy in which, even if economists shared the same macroeconomic background and theoretical foundations, only some economists actively presented ideas and options.

Peer consensus and cohesion does not necessarily lead to stoic relations. Epistemic communities are evolving networks that are rebuilt constantly and thus

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[41] E.g. Preferred journals where to publish their findings, frequent meetings and encounters, and academic/professional conferences.

[42] Cross (2010) compared two different epistemic communities related with safety policies in the European Union, the Civilian Crisis Management Committee and the European Union Military Committee. She evidenced that experienced high-ranking officials with shared language, systematic thinking and professional background form the first, whereas the latter, which unites, members from the civilian society (with different backgrounds and experience), rendering its decisions more likely to be challenged.

[43] The Delors Committee was responsible for proposing the creation of the European common currency.

have to be observed through a dynamic perspective. Not only the knowledge itself might be marginally or even radically changed in both short and long term, but scientific consensus is not automatic, but rather the result of a lengthy process (DUNLOP, 2012).

The field of expertise in itself might be a powerful tool to enhance an epistemic community's political influence. As Haas (1992; 2008) and Cross (2013) have argued, although "soft sciences" specialists indeed constitute epistemic communities, policy topics related to the "hard sciences" are, at principle, more subject to epistemic communities' influence. Since policymakers usually lack comprehension on the field as toxicology, epidemiology, biochemistry, and others, as well as do not possess technical skills on such matters, they become subject to specialists' advice and explanations to frame policy issues.

Even when an epistemic community is cohesive and stable throughout time, its hierarchy and internal structure are known, and it holds a "legitimized monopoly" over a specific knowledge, several other political and external features are crucial determinants of its ability to sway policymaking. On a first note, Haas (1992) reinforced that epistemic communities' influence rose in a context in which technological change and uncertainty regarding policy impact overwhelmed policymakers, thus elevating specialists to a position in which their need was necessary in the policy arena. The more complex and uncertain political environmental is, the more political influence an epistemic community might possess, this is especially true for sensitive topics such as the emergence of drastic innovations whose health and environmental impacts are unknown and policies with economic impacts during a sudden economic crisis.

Another aspect emphasized by Haas (1992), Zito (2001) and Cross (2013) is an epistemic community's institutionalization. If subsequent policies are framed through the lenses of a specific epistemic community, such "policy pool" institutionalizes a pattern of action within the government. A path-dependence situation is created, which at the same time reaffirms the power of the existing community and also blocks the entrance and influence of groups of experts with different normative and causal beliefs, notions of validity and policy enterprise. Epistemic communities capable of joining the process of developing public policy on early stages, especially when aimed at new problems, incur thus in first-move advantages and are more likely to influence the policy outcome.

Since the legitimization of epistemic community comes from their monopoly and authoritative claim for a specific policy-relevant knowledge, Haas (1992), and subsequently Cross (2013), initially proposed that being perceived as a neutral and "external" group granted specialists political power. Once technical knowledge is deemed neutral, a representation/simplification of reality, science would become detached from political debates thus more easily accepted by any political party.

However, as Dunlop (2000; 2009; 2010) argues, such interpretation assumes that politicians and policymakers are only passive actors who wish to "learn" from specialists. Instead, they should be perceived as active components of the policy process even in complex issues, as they hold political preferences and have autonomy within the political process. On the one hand, specialist and politician are embedded in a continuous "give-and-take" learning process, where the first learns how to navigate the intricate tides of the policy world, and the latter absorbs technical terms and knowledge for future policies. On the other hand, it is possible that politicians actually seek epistemic communities to reinforce their previously established positions, using technical knowledge as a rhetorical tool.

Dunlop (2010) observes that epistemic communities are not bounded to emerge from academia alone, but rather could be created by government entities, whether through public funding for private research or even by public research centers. Moreover, epistemic communities must be politically articulated, meaning it must have access to policymakers in order to exert any political influence (ZITO, 2001). When studying the capital flow sections within the Bretton Woods Agreement, Chwieroth (2007) observed that several economists, who were deemed as technicians, seldom had political preferences and defended them within the discussions, acting as "technopoles": specialists who also presented skills to influence policymaking.

Whereas the literature has studied epistemic communities from a myriad of fields of expertise,[44] the next section will discuss how the concept of epistemic community might provide a fruitful framework to study environmental benefit-cost analysis, a technical tool used by a group of economists for analyzing the desirability of environmental policy.

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[44] See Dunlop (2012) for how academics have uses the concept of epistemic community for several distinct disciplines as public administration, international relations, and business economics.

4 A COMMENT ON ENVIRONMENTAL BENEFIT-COST ANALYSIS: PRINCIPLES, EPISTEMIC COMMUNITY, AND MULTIDISCIPLINARY LIMITATIONS

This section addresses three complementary objectives. First, to summarize the economic theory and technical guiding principles supporting environmental BCA. Next, we present the main arguments supporting its application as a tool for analyzing the desirability of environmental regulations, arguing that both technical application and political defense of environmental BCA is the work of an epistemic community seeking "rational" policymaking within the RBR Policy Cycle framework. The section closes with a review of environmental BCA's multidisciplinary limitations as a mechanism for *ex ante* analysis of new environmental rules and standards.

4.1 PRINCIPLES OF BENEFIT-COST ANALYSIS AND ITS APPLICATION TO ENVIRONMENTAL REGULATION

To clarify environmental BCA's assumptions and characteristics, this subsection addresses, first, how the search for rational policymaking associates itself with BCA's foundations and guiding principles. Next, we present the main stages involved in performing BCA, emphasizing its application for environmental policy.[45] These stages are: i) setting a baseline and establishing regulatory alternatives; ii) analyzing costs; iii) analyzing benefits; iv) discounting future benefits and costs; and v) comparing and selecting alternative policies.

[45] We rely on EPA's Guidelines for Preparing Economic Analysis (EPA, 2010) and, when judged necessary, on complementary literature.

4.1.1 Rational choice, BCA's foundations and guiding principles

BCA uses a notion of rationality rooted in the neoclassical definition of "rational choice". Rationality assumes that individuals have stable, complete and transitive[46] hierarchy of preferences, but whose actions and choices are limited by exogenous constraints (budget restriction, set of potential actions, legislation, among others). Given these conditions, a "rational" agent would maximize welfare by, within his possibilities, choosing an optimal bundle of actions (AMADAE, 2007; OPPENHEIMER, 2012). Consequently, rationality implies a welfare-maximizing agent who first anticipates and calculates the expected costs, benefits, and payoffs of each course of action for later select his/her preferred option (SCOTT, 2000).

By applying BCA as an instrument for analyzing and pre-selecting policies, government and public agencies emulate this neoclassical rationality. BCA's fundamental objective is to analyze, select, and approve the implementation and enforcement of the best public project, given a pre-determined set of alternatives (DONAHUE, 1980).[47] Under a budget constraint and limited public resources, BCA addresses the question of economic efficiency when policymakers face different political/social goals. Assuming a benevolent government,[48] rational choice rests upon measuring and weighing the costs and benefits of all policy options (including a no-policy scenario) for then pursuing the welfare-maximizing alternative (FUGUITT E WILCOX, 1999). Incorporating BCA as a regular practice in policymaking has become attractive due to the underlying judgment that it is minimally reasonable that a government should be frugal and sensible when managing public funds, only investing (limited) public resources on policies whose total benefits exceed total costs (VISCUSI, HARRINGTON JR. E VERNON, 2005). As such, BCA closely relates with the ascent of RBR as "rational choice" and pragmatic regulations are among the central pillars of the latter.

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[46] If an action a1 is strictly preferred to other a2, and a2 is strictly preferred to a3, transitivity would guarantee that a1 must also be strictly preferred to a3.

[47] Here, we only consider BCA as a tool for analyzing public BCA, which is also called "social BCA". When applied for private projects, a "private BCA" follows a distinct logic, in which what matters is maximizing profit rather than social welfare.

[48] A benevolent government assumes policymakers who policies to improve social welfare rather than improve one's private welfare.

Nevertheless, a holistic study listing, quantifying and/or qualitatively comparing costs and benefits is not enough to assure rational public choice under such framework. Since several policies' impacts, goals, and outcomes differ in nature,[49] without a more generally applicable rule for selecting public policy, policymakers would ultimately either become paralyzed or rest policy choice upon value judgments. BCA attempts to provide such general rule by monetizing all expected costs and benefits, thus providing a common *numéraire* for consistently comparing, ranking, and prioritizing alternative policy options.

Teodorovicz and Pelaez (2014) show that, though BCA has evolved across time as result of heated academic debates, it is intrinsically attached to a utilitarian philosophy rooted in Bentham's writings (1952; 1989). Adopting the aggregation of individual utility as the measure of social welfare, monetary figures and prices would serve as the best quantifiable proxy for socially desirable policies.[50]

Current BCA draws on the new welfare economics and the public interest theory of regulation.[51] Whilst a perfectly competitive market would maximize economic welfare, measured by the traditional concepts of consumer and producer's surpluses,[52] the conditions for such result to be achieved are usually absent in the real world. The presence of market failures, namely market power, asymmetric information, public goods, and externalities, generate socially undesirable and inefficient outcomes.[53] As a result, regulatory intervention becomes legitimate, as it compensates for market failures, approximating real-world outcomes from those observed in perfectly competitive markets, thus promoting economic welfare.

BCA attempts to measure and assure that such regulatory intervention actually produces net economic welfare improvements. Specifically, the presence of

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[49] This is especially the case for environmental policies, whose benefits might range from saving forests, saving different species, granting health improvements, or even saving human lives. Comparing such plethora of benefits without establishing a common unity of measure would increase policy discretion, as decisions would rest upon value judgments.

[50] See also Adler and Posner (2006) for a review of BCA history.

[51] See Viscusi, Harrington Jr. and Vernon (2005) and Den Hertog (2010) for a summary on the public interest theory of regulation and the new welfare economics.

[52] It is not the aim of this paper to review the theory behind new welfare economics and the justification for regulation. For a review, see Appendix A of EPA's Guidelines for Preparing Economic Analysis (EPA, 2014e).

[53] OMB's Circular A-4 (OMB, 2003) states that when issuing regulations, federal agencies must first present a "need for federal regulatory action" by indicating the observed market/institutional failure and its corresponding causes. In the absence of such market failure, federal agencies may also justify regulatory intervention if such aims at fostering other desirable social and political purposes, as secure personal freedom, promote democratic aspirations, and protect private property (p. 5).

externalities is the most likely market failure generating environmental damages and supporting the need for environmental regulations. Externalities occur when markets do not account for the benefits or harms of one individual's decision on another individual's well-being. In case the latter individual is benefitted, this represent a positive externality, while in case (s)he is harmed, it would represent a negative externality. Environmental hazards, as particulate emission, oil spills, or polluting drinking water, usually presents negative externalities as they often harm uninvolved third parties, thus justifying regulatory intervention (EPA, 2014e).[54]

Pearce, Atkinson and Mourato (2006) summarize BCA's theoretical foundations. First, individual preferences are to be taken as the source of value. To state than an individual's well-being, welfare or utility is higher in state A than in state B is to say that such individual prefers A to B (according to his/her hierarchy of preferences). Second, preferences are measured by a willingness to pay (WTP) for a benefit or a willingness to accept a compensation for a cost (willingness to accept - WTA). "WTP is the maximum amount of money and individual would voluntarily pay to obtain and improvement. WTA is the least amount of money an individual would accept to forego the improvement" (EPA, 2010a, p. 7-7).[55] As WTP and WTA are monetary figures, they would actually represent either the benefit or cost of a specific policy. Third, it is assumed that individual's preferences can be aggregated in its monetary form (WTP or WTA) so that social benefit is simply the sum of all individual's benefits and social cost is the sum of all individual's social costs.[56] Fourth, when costs and benefits accrue on different periods, the general rule is that future costs and benefits have lower weight than the same occurring closer to the present.[57] Fifth, if beneficiaries from a change/policy can hypothetically compensate

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[54] Coase (1960) has a seminal paper in which he exposes the relation between well-defined property rights and the concept of externality. An externality would only justify a regulatory intervention in the presence of well-defined property rights, because externalities would be *per se* a violation of such rights, whether the right to run business or to enjoy a pollution-free environment.

[55] Assume that an individual's welfare/utility in an initial state E_0 and with an initial income Y0 is $U_0(Y_0, E_0)$. If a specific policy (such as an environmental regulation) would alter the state from E0 to E_1, the new individual's welfare/utility level would be defined as $U_1(Y_0, E_1)$. U_1 can be either lower, equal, or higher than U_0. If $U_1 = U_0$ for all individuals, such policy would present no economic welfare increase. However, if some individuals are well-off in E_1, i.e. $U_1 > U_0$, WTP is defined as the maximum monetary amount which such individuals would be willing to pay in order to pass from E_0 to E_1, so that $U_0(Y_0 – WTP, E_1) = U_0(Y_0, E_0)$. Similarly, when $U_1 < U_0$, WTA is the least monetary amount which one individual who is harmed by a policy requires as a compensation to maintain its own welfare/utility level in the presence of E_1, i.e. $U_0(Y + WTA, E_1) = U_0(Y_0, E_0)$.

[56] These three initial foundations exemplifies BCA's relation with a utilitarian philosophy.

[57] This is related with the practice of discounting, which will be further explores in section 4.1.5.

the losers from a change/policy, presenting at least some net gains left over, BCA would conclude that such change/policy is warranted. This decision rule supporting BCA is known as the Kaldor-Hicks (KH) compensation test, or simply, the KH principle (KH).

The KH principle relates with the concept of Pareto improvement. As proposed by Pareto (1996), a Pareto improvement represents a situation in which a specific change in *status quo* leads to an improvement in the welfare of at least one person while maintaining all people at least as well-off as they were prior to the change/policy. In other words, while no one is harmed by such action, at least one person is better off after the change. Thus, any policy leading to a Pareto improvement would be desirable and politically defendable. However, to use this rationale as a strict policy criteria would also be unfeasible, since government actions ubiquitously benefit some groups while harming others.

Adapting the idea of a Pareto improvement for real world application, Kaldor (1939) and Hicks (1939; 1940) proposed the adoption of a "potential Pareto improvement" as a decision rule for government actions which became known as the KH principle. If, on the one hand, it is impossible to guarantee that no individual in society will be harmed by a policy action, on the other hand, if the benefits awarded to the "winners" are greater than the costs incurred by the "losers", a Pareto improvement would be achievable through income distribution. Net benefits could be redistributed so that beneficiaries would still be better off after the policy (though in a worse condition in comparison with a no-redistribution scenario) and the losers would receive an amount sufficient for them to remain at least as well off as they were prior to the policy. However, as decision criteria, such redistribution is only hypothetical and potential. Once government promotes a broad array of policies, distributive concerns would negate each other, on average (PREST; TURVEY, 1965). As such, the KH principle dictates that any policy whose benefits outweigh should be approved.[58]

Brent (2007) further explains that BCA draws on few value judgments associated with the concept of Pareto improvement. First, it is based on an

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[58] BCA's decision rule is also represented by the formula: $\sum_{i,t}(B_{i,t} - C_{i,t}).(1+s)^{-t} > 0$, in which B and C are the monetized benefits and costs, respectively, for the i-th individual in the t-th period, and s is the discount rate used to represent that present impacts are given more weight than future impacts.

individualistic conception of social welfare, one that assumes that to increase social welfare, one must first make individuals better off (embodied in practice that social benefits and costs are the aggregation of individuals WTPs and WTAs). Non-economic causes of welfare are ignored once BCA is associated with a utilitarian philosophy, using money figures as proxies to represent individual and social welfare. Finally, the idea of consumer (or individual) sovereignty reigns within a BCA thinking, assuming that individuals are the best judge of their own welfare.

While BCA has evolved supported by utilitarian and economic thinking, the translation of policy impacts to a common monetary unity has granted a mean to standardize analyses and to compare several projects with benefits and costs with different natures. By adopting a KH principle as a common decision rule, BCA seeks to rationalize and legitimize policy actions. Next, we introduce the basic steps of developing a comprehensive BCA to analyze environmental policies.

4.1.2 Setting the baseline

The starting point for conducting an economic analysis of the potential benefits and costs of a proposed regulation is to define the baseline, a reference point reflecting the world without the proposed regulation. “A baseline is defined as the best assessment of the world absent the proposed regulation or policy action” (EPA, 2010a, p. 5-1). Its importance lies on the fact that all costs and benefits of a proposed regulation are calculated as the difference between a world with the policy (policy scenario) and other absent of the proposed regulatory policy (baseline).

A proper baseline should incorporate assumptions about exogenous changes in the economy that may affect relevant benefits and costs. OMB’s Circular A-4 (OMB, 2003a) lists four potential factors requiring considerations when setting a baseline: i) evolution of the market; changes in exogenous factors affecting expected benefit and costs; iii) changes in regulations promulgated by the agency or

government entities; and iv) the degree of compliance promulgated by regulated entities with the regulation.[59]

Commonly, multiple baseline scenarios are needed when it is impossible to have a clear, or at least consistent, image of how exogenous variables will vary in the future. Since baseline setting rests upon an attempt to forecast future conditions, though econometric techniques are used to estimate some idea of how agents' behavior and exogenous variables will be in the future, its inherent uncertainty ultimately makes it dependent on analyst's assumptions. Similarly, multiple policy scenarios are also necessary because BCA must compare different regulatory alternatives when searching for the most efficient manner to achieve a pre-determined goal. Though this work does not encompass the broad economic literature regarding regulatory design, one should be aware that BCA should address different regulatory mechanisms, whether command-and-control, informational, or market mechanisms.[60]

EPA (2010) draws few guidelines for setting a proper baseline. First, the analyst has to specify the current and future state of relevant economic and environmental variables involved in the proposed regulation. Second, he/she should outline the required parameters deemed relevant for the analysis. The analyst should clarify the reasons why such-and-such variables were included while others were not considered in the baseline, granting a certain degree of accountability. Third, only those aspects likely to have a greater impact on final analysis should be considered, especially if resources are limited and parameters are uncertain. Fourth, all assumptions should be clearly specified in the report. Fifth and sixth: the "starting" and "ending" point of the baseline and policy scenario, as well as the rationale for defining them, must be clearly stated. This is especially important because it is common that environmental benefits will only accrue after several years after the

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[59] EPA (2010), more specifically, recommends the consideration of demographic change, future economic activity, changes in consumer behavior, technological change, compliance rates, multiple rules and behavioral responses as examples of basic variables that should be considered when developing a proper baseline.

[60] Economists have fostered and usually favored the so-called "economic mechanisms", which either attempts at directly taxing polluting activities or creating a private market for "rights to pollute" in order to enhance the effectiveness at which resources, including pollution, are allocated in society (also called market mechanisms). The Sulfur Dioxide Cap-and-Trade program, created under the title IV of the 1990 Clear Air Act Amendments, exemplifies this last by creating a market for rights to release SO2 particulates, thus allowing private agents to buy, sell and bank unused rights to cover future SO2 emissions. See also Hahn (2000) for a summary on economic instruments for environmental regulation.

issuance of any regulation, thus a misspecification may result in disregarding several economic benefits that would be captured by adopting a longer time frame. Seventh, the analyst should clarify which aspects of the baseline specification are uncertain, rendering a qualitative discussion regarding how such uncertainties might affect an analysis' outcome. Finally, eighth, all baseline assumptions should be consistently applied for all analyses for the proposed regulation. If the underlying assumptions change from scenario to scenario, the economic outcomes are not comparable among themselves since they were calculated in "different worlds".

4.1.3 Cost Analysis

The estimation of costs is often portrayed as being relatively straightforward and, at first glance, relatively easier to quantify and estimate in economic terms when compared to benefits resulting from environmental policy (which will be discussed in the next section). However, while "costing" might appear to be a mere accounting exercise, in fact, it presents several intriguing features deserving explanation in order to comprehend the reasoning behind the estimations used in environmental BCA (PEARCE; ATKINSON; MOURATO, 2006).

The first challenge is to identify an appropriate measure of cost for the particular application of analyzing whether government policies have social merits. For that, instead of a common "private cost", which would encompass new expenditures and foregone income associated with the abidance to new regulatory standards, a most comprehensive measure of the costs of a regulation is "social cost". Social Costs represent the total burden a regulation will impose on the economy as measured by the sum of all opportunity costs incurred as a result of the regulation. As such, instead of considering only firm's compliance costs, it encompasses the value lost to society of all the goods and services that will not be produced and consumed, in the present, as a result from firms reallocating resources away from production activities and towards pollution abatement. Additionally, future

consumption losses derived from reduced capital investment must also be added to the estimation of regulatory costs (EPA, 2010a)[61].

The analysis of regulatory costs usually employs one of two analytical frameworks: partial equilibrium models and general equilibrium models. Partial equilibrium models are usually used to assess social costs from regulations whose effects are confined primarily to a single market or small number of markets, assuming that effects on all other markets are minimal and irrelevant. Based on the theoretical framework of the new welfare economics, Figure 4 represents the measure corresponding to a regulation's social cost as associated with regulatory impacts on the outcome of a competitive market. The intersection (A) between supply (S0) and demand (DD) curves prior to any regulatory intervention determines the equilibrium price (P0) and quantity (Q0), as well as the corresponding economic welfare. Economic welfare measured by summing consumer and producer surpluses, which are represented by the area of the triangle AFP0 and ADP0, respectively. Thus, total economic welfare would be AFP0 + ADP0 (area ADF).

In such a market, the imposition of a new (environmental) regulation would displace/raise firm's production costs, as each unit of output would now be more costly due to new expenditures associated with compliance to regulatory standards. The supply curve (S0) would suffer and upward shift, passing from S0 to S1. In this scenario, the new equilibrium price and quantity would be P1 and Q1, respectively. It is easy to notice that the new level of economic welfare level is the area of the triangle BEF (sum of new consumer and producer surpluses). Since ADF < BEF, the difference ADF – BEF would represent the total social costs of a regulation and would be subdivided in two portions: i) compliance costs (area of the polygon BCDE); and ii) deadweight losses (area of the triangle ABC).

This brief explanation shows that, in a competitive market, regulatory costs are equal to the sum of the compliance costs and deadweight losses. However, since real world markets are rarely perfectly competitive, firms would react differently when facing new regulatory standards, and cost analysis should reflect and incorporate the actual market structure.

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[61] Though EPA's Guidelines present several additional concepts of costs that are not derived from economic theory, they are usually used to describe, rather than measure, the effects of a regulation. These are: explicit and implicit costs, direct and indirect costs, private and public sector costs, incremental costs, compliance costs, capital costs, operating and maintenance costs, industry costs, transactions costs, government regulatory costs, transitional costs and distributional costs.

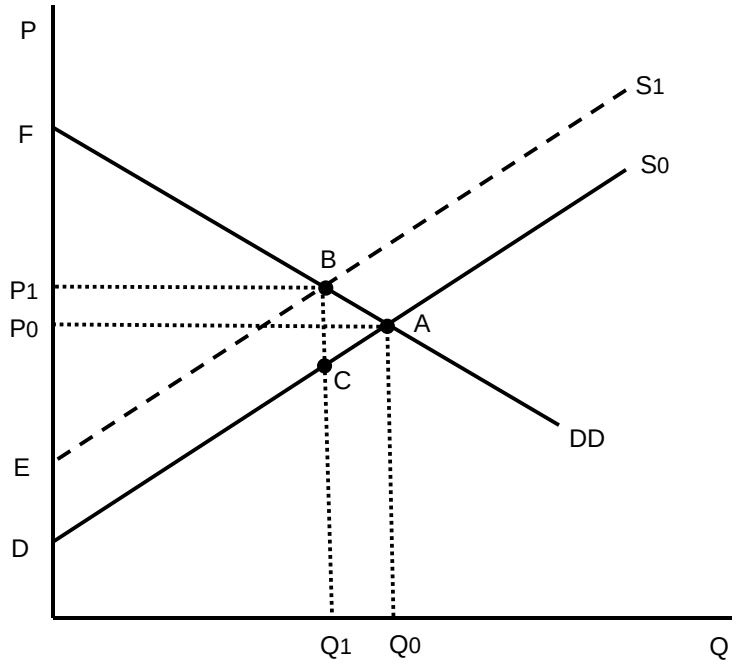

Figure 4 - Effect of regulation on a competitive market
Source: adapted from EPA (2010)

In some cases, however, the imposition of an environmental regulation will have significant effects in several markets beyond those directly subject to the new rule. For instance, a new rule controlling the emissions from the electric utility sector may increase the price of electricity, which is an intermediate good present in the production chain of almost every sector in a modern economy. In such cases when the number of affected markets grows, a general equilibrium model would be needed to capture the linkages between markets across the entire economy.

General equilibrium models are built around the assumption that, at least for some discrete and defined period of time, an economy can be characterized by several interconnected markets and in which a set of equilibrium conditions in which supply equals demand in all markets (EPA, 2010).[62] To solve general equilibrium models, analysts use computable general equilibrium (CGE) models. CGE models combines an input-output matrix, describing transactions between a wide range of economic sectors, with a set of assumptions regarding the economic behavior of households, firms and government in order to uncover the impact of environmental regulation on the national economy (PEARCE; ATKINSON; MOURATO, 2006). In

[62] Mathematically, in and economy with "n" markets, if P_i, S_i and DD_i represent price, supply and demand of the i-th market, respectively, a general equilibrium model tries to find a solution to the following equation system: $S_i(P_1, P_2, \ldots, P_i, \ldots, P_n)$, $DD_i(P_1, P_2, \ldots, P_i, \ldots, P_n)$ adopting a set of equilibrium conditions in which $S_i = DD_i$ ($i = 1, 2, \ldots, n$). A partial equilibrium analysis would only analyze each S_i and DD_i individually.

addition to partial equilibrium analysis and CGE, other models not considered here, such as linear programming, compliance cost analysis, input-output, and econometric input-output models, could also be used to measure costs of a proposed regulation.

4.1.4 Benefit Analysis

An economic benefit analysis aims to estimate the benefits, in monetary terms, of proposed policy and regulatory changes. Since environmental policy can lead to benefits from several natures, monetized benefits are preferred because they would provide a common *numéraire* for comparing policies from different fields. Under the RBR framework, the concept of risk is of paramount importance in the benefit analysis process for environmental policy, once benefits from these regulations are associated with mitigating environmental and human health risks.

Whereas environmental and health effects would be comprehensively assessed in a simultaneously and integrated fashion in an ideal scenario, this is seldom possible. In most cases, analysts address each effect individually, filter potential overlapping benefits and only then aggregate them in order to arrive at a consistent estimation of the total benefits of a policy. As such, EPA (2010) proposes an effect-by-effect approach, which consists in three fundamental steps. First, to identify benefit categories potentially affected by the policies under consideration. Second, to quantify significant endpoints to the possible extent by working with specialists from several fields of expertise. Third, to estimate the values of these effects using appropriate valuation methods or existing value estimates from previous studies.

The first two steps are crucial to understand how environmental BCA is connected with a RBR Policy Cycle. Instead of directly measuring benefits in economic terms, the first step in a benefit analysis is to determine the types of benefits associated with the policy option under consideration. In its guidelines, EPA secludes benefits from environmental policies in three categories, as follows:

1) Human health improvements: subdivided in mortality risk reductions and morbidity risk reductions.

2) Ecological improvements: subdivided in market products, recreation activities and aesthetics, valued ecosystem functions, and non-use values.

3) Other benefits: subdivided in aesthetic improvements and reduced materials damages.

These different categories implies that an initial understanding of the policy options of interests is crucial, as well as a research on the physical effects of the pollutant (on human health and the environmental) and the expected impact of potential changes on the emission of such substance. For that, benefit analysis depends on the existence of a multidisciplinary team composed of not only economists, but also experts in environmental science, ecology, epidemiology, among others, first to qualitatively describe the expected benefits of a policy.

The second step is to quantify the physical endpoints related to each benefit category, focusing on changes attributable to each policy option relative to the baseline. Data on extent, timing, and severity of endpoints are needed to establish changes in the risk of, for instance, incurring lung cancer, as a result of the proposed policy. In this step, economists would be on the background, working closely with ecological risk assessors in order to ensure that information provided will be useful to estimate the economic value of the effects.

At last, the final step is the economic valuation of the benefits, when the analyst attempts to monetize the likely benefits of the proposed policy options. For that, it is useful to review, briefly, the economic theory supporting benefit analysis, as well as the concept of “total economic value”.

Figure 5 graphically represents the socially optimal level of pollution and the benefits of an environmental improvement. Assuming that costs of pollution reduction and of pollution damage can be translated into monetary figures, economic theory proposes two functions, one of the marginal cost of pollution reduction (MC) and another of marginal social cost of pollution damage (MD). The interpretation of such functions is simple: the lesser the level of emission, the lesser the social cost of pollution; however, as pollution standards become more and more stringent, more resources must be displaced from productive ends to pollution control and it becomes increasingly costly to achieve new levels of discharge reductions. Thus, the intersection between MD and MC (O*) would represent an optimum level of emissions (E*). Additionally, when a new regulatory standard forces economic agents to reduce emissions from E_0 to E_1, and MD passes from A to B, the shaded

area given by the area ABE_1E_0 represents the total benefits from such regulation, representing the reduction in the marginal social cost of pollution damage (ASHFORD; CALDART, 2008; EPA, 2010a).

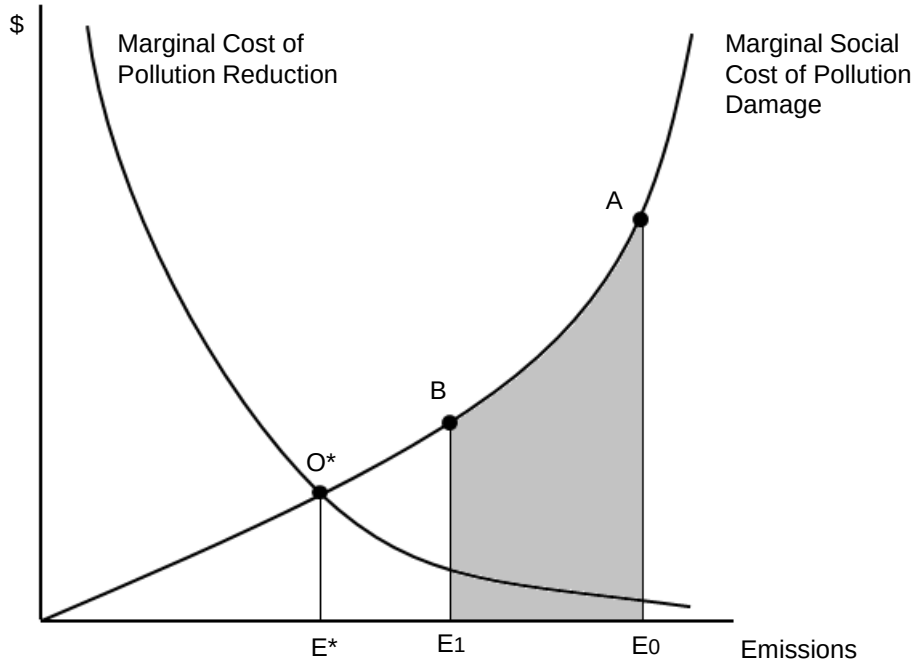

Figure 5 - Socially optimal level of pollution and benefit of an environmental improvement
Source: adapted from Ashford and Caldart (2008) and EPA (2010)

In practice, economic welfare is measured by the aggregation of individual WTP and WTA. Adopting an underlying assumption that a person could be monetarily compensated for the loss of some additional quantity of any good (or increase of some additional quantity of any "bad") by receiving a monetary compensation, the concepts of WTP and WTA are central to benefit measurement. Whereas WTP represent how much individual's would be willing to pay to maintain the new level of emissions E_1, WTA would represent how much individuals would require as compensation to go back from a stringent emission standard (E_1) to the previous level of emissions E_0. [63]

Following, the above-mentioned division between human health improvement and ecological improvements also assists in comprehending how benefit analysis is performed. Human health benefits have been a prominent topic in the risk-based regulation literature, especially regarding economic benefits of mitigating mortality

[63] While economists expect the difference between WTP and WTA to be small, practice has found substantial differences in actual values of WTP and WTA, which we will briefly discuss in section 4.3.

risks.[64] Viscusi (1992a), Viscusi, Harrington Jr. and Vernon (2005) and Sunstein (2001; 2002a; 2005) are just a sample of works who attempt at shedding light into this intricate matter. According to them, under a risk-based perspective, the economic benefits derives not from the total amount of lives saved per se, but rather from small changes in the probability of death for many individuals. With that in mind, economic benefits are how much society values (by means of aggregate individual WTP) marginal reductions in the probability of death incurred by every person subject to the risk that is being regulated.

For example, assume that for every 200.000 people that consistently inhales pollutant “X”, discharged by the automobile industry, one dies from lung cancer. This represents a probability of 0.005% of dying from lung cancer due to the inhalation of pollutant “X” (or a risk of 0.005%). Further, assume that a proposed policy aims at regulating the automobile industry in order to diminish the discharges of pollutant “X”. With the policy, less toxic substances would be discharged and, consequently, people would inhale a smaller amount of pollutant “X”. As a result, the regulation lead to a benefit of reducing the cases of lung cancer fatalities to one out of 1.000.000 (0.001%). In this scenario, the regulatory policy achieved a reduction in 0.004% on the mortality risk of lung cancer. The economic benefit would be the aggregation of how much the group of people subject to such risk would be willing to pay to have such mortality risk reduced from 0.005% to 0.001%, i.e. the sum of individual WTP of the people affected by such risk. Based on such rationale, the “Value of Statistical Life” (VSL) is a concept frequently used in economic assessment of risk mortality benefits. It extrapolates the social WTP for small risk reductions (say, 0.004%, as in the example), to 100%, thus arriving at a value which would represent how much society would be willing to pay for saving “one statistical life”. EPA usually adopts a VSL of US$ 7.9 million (EPA, 2010), meaning that for every statistical life saved by a regulation correspond to a benefit of US$ 7.9 million. [65]

As for ecological benefits, benefit assessment relates with the notion of “total economic value” (TEV). Maintaining that economic value is a function of individual preferences, TEV decomposes into “active use” and “non-use” value, the latter, further subdivided into “option” and “existence” value. Active use value derived from

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[64] The economic analysis of morbidity risks has a similar rationale relative to mortality risks, thus we will not explore them in this work.
[65] See EPA (2010b) for a summary on valuing mortality risk reductions.

the actual utilization of environmental resources. For instance, the active use of a water bay would have its use for fishing and water supply. Option value, however, exists because of uncertainty regarding the future availability of environmental assets and because individuals are risk averse. In such case, if there is uncertainty that a specific pollutant will damage the environment, the potential environmental damage is irreversible, or new information is expected to emerge about the effects of specific pollutant on the environment. As such, preserving the environment to take advantage of the new information or use the resources in the future is what creates the option value. Finally, the existence value of an environmental asset arises from the fact that people derive satisfaction from the simple knowledge that an environmental asset continues to exist (PEARCE; ATKINSON; MOURATO, 2006; ASHFORD; CALDART, 2008). Accordingly, when analyzing a proposed environmental policy, active use, option, and existence values are all measured according the concept of WTP and WTA. The sum of these values will originate the TEV that will be accounted as ecological benefit of the proposed policy.

Since the benefits of environmental policy seldom have direct relation with markets in which they are traded, economists have developed several methods to measure WTP and WTA for environmental protection and reduction in human health risks. The direct economic approaches to valuation benefits of environmental policies are classified in three major groups: revealed preference methods; stated preference methods; and benefit transfer.

“Revealed preference” methods look at “surrogate markets, that is, analyze or infer preferences for nonmarket goods as implied by past behavior in an associated market. These methods seek to quantity the market footprint of nonmarket goods (or bads) by analyzing their impacts on an actual market (ATKINSON; MOURATO, 2008). Within it, four different methods should be highlighted: averting behavior, costs of illness, travel cost model, and hedonic pricing. The first two approaches focuses on expenditure on medical services and products made in response to morbidity and other health effects of non-market impacts. On the one hand, the averting behavior method infers values from observations of individual actions to mitigate increased health risks or undesirable consequences of reductions in environmental quality conditions (EPA, 2010). On the other hand, costs of illness analysis does not focus on individual decision to incur in these expenditures, but rather analyzes the decisions made by social administrators. An

example of the last would be measuring the effects of air pollution regulations by measuring the variation on expected expenditures in medical costs incurred in treating associated health impacts, as well as a loss in wages and profits due to lower productivity (PEARCE; ATKINSON; MOURATO, 2006).

Hanley and Barbier (2009) describe the travel cost model as a measure of the benefits derived from recreational values associated with a specific site (such as a park, a natural reserve, or a lake). Specifically, the costs of assessing an environmental resource (e.g. fuel costs, opportunity time costs of travelling to a site) are used as proxies for a market that does not exist. As such, the economist analyzes the trade-offs between environmental quality and travel costs, observing whether higher environmental quality leads to a willingness to spend more resources on using environmental resources (higher travel costs). Finally, hedonic pricing may be the most flexible revealed preference method because it is not associated with a specific surrogate market. The foundations of hedonic pricing is the insight that the price of any market good is not solely a function of a sole characteristic, but rather a function of "n" different features. Thus, hedonic pricing attempts at using econometric techniques to insulate the marginal contribution of the n-th characteristic on the price of such-and-such good (GREENSTONE, 2010). [66] Specifically for environmental benefits, the house market provides a good surrogate market because environmental quality is assumed to influence the final price of the house market. As such, analysts will try to insulate the marginal contribution of, for instance, groundwater contamination within a selected area in house prices by analyzing how much these prices would drop (raise) given an increase (decrease) in the contamination levels in the selected area.

Despite the usefulness of revealed preferences methods, there are cases in which no "good" surrogate market can be found. In those cases, the stated preference method carefully constructs and use questionnaires to estimate these WTP and WTA amounts from individuals for a given environmental change. The most used method is called "contingent valuation", which directly asks people how much are they willing to pay for an improvement in environmental quality, or how much

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[66] Assuming $P(Q_1, Q_2, \ldots, Q_n)$ is the price of a market goods as a function of the quantity (Q) of "n" different characteristics. The partial derivative of P with respect to the Q of the n-th charactistic is referred to as the marginal implicit price and is used to infer the welfare effects of a marginal change in such n-th characteristic.

compensation would they require to go without such improvement (HANLEY; BARBIER, 2009). Contingent valuation's main goal is

> […] to replicate the hedonic market estimate approach used to analyze wage-risk trade-off and similar factors using survey data. […] The term contingent valuation has been used to describe such studies because they represent values that are contingent on a hypothetical existing market. (VISCUSI; HARRINGTON JR.; VERNON, 2005, p. 736)

Benefit transfer is necessary when it is unfeasible to conduct original studies for a specific environmental project or regulation. Plainly, benefit transfer refers to the use of estimated non-market values of environmental quality changes from one or more studies in the evaluation of a different policy. As Atkinson and Mourato (2008) state, there is still room for research on improving benefit transfer, but it might become largely the primary valuation method for applied policymaking, once regulatory agencies often act under staff, budget, and time constraints, limiting their ability to develop original studies for every proposed regulation.

A final qualification is need to reinforce that, although several methods for assessing economic benefits exist and are employed by economists when developing environmental BCA, it is not rare that several potential benefits are not monetized at all, being only quantified in its original unity of measurement (e.g. number of trees/species saved) or qualitatively described. Whereas these non-monetized benefits are not considered in the bottom-line final figure, EPA's guidelines state that all benefits should be listed in the final economic report, if not monetized, then quantified, and if not quantified, then qualitatively described.

4.1.5 Discounting Future Benefit and Costs

Costs and benefits of a policy frequently occur at different times. Specifically for environmental regulations, compliance costs are usually incurred in the first years of the regulatory activity, as they involve investment in new machineries or less polluting production processes, whereas environmental benefits are observed in the remote future, as the hazardous effects of climate change. The process of discounting aims at making those benefits and costs that occur in different time

periods economically comparable. Roughly, discounting is accomplished by multiplying estimated benefits and costs of a given regulation by a discount factor, which gives more weigh to those impacts accruing near the present in face of those occurring far in the future (ACKERMAN, 2008).

The rationale for discounting derives from two perceptions: resources have opportunity costs and people have a pure time preference (SUNSTEIN, 2002b). Arrow *et al.* (1996) explain that every money spent today in a public policy, say to reduce the impacts of climate change in the future, could also be spent at another policy with a different goal, say to improve education. Discounting would merely reflect such tradeoff between alternative investments, stating that if the rate of return of an investment, as controlling greenhouse gas emissions, is lower than the rate of return of an alternative project, as investing in the public educational system, future generations would be better off if more were invested in education than in environmental protection. As such, there would be a “minimum” rate of return to declare whether a specific investment, and its future benefits, are worthy the resources, given the existence of alternative projects. Regarding the second justification, discounting assumes that people are impatient, i.e. they require some compensation in order to postpone present consumption to a future period, thus preferring benefits today than tomorrow. Simply put, discounting embodies that $1 today is actually worth more than the same $1 tomorrow. As Atkinson and Mourato (2008, p. 330) state: “discounting is justified by the assumption that it is what people do, they are impatient and the fact that capital is productive (i.e., can be invested now for some future return)”.

Even though there are several methods for discounting future values of the present, the most common is the estimation of the Net Present Value (NPV).[67] Suppose a project is expected to have economic impacts during “n” periods of time. Its NPV is estimated by multiplying the benefits, B, and costs, C, in each year, t, by a time-dependent weight, the discount factor, d, and adding all of the weighted values, as show in the following equation:

[67] Other methods would be the calculus of annualized values and net future values. See EPA (2010) for a summary.

$$NPV = \sum_{t=0}^{n} d_t (B_t - C_t) \tag{1}$$

Assuming that r is the discount rate, the discounting weights for each given period t (d_t) are:

$$d_t = \frac{1}{(1+r)^t} \tag{2}$$

Just as BCA aims at enhancing social economic welfare by analyzing consumer and producer's surpluses, rather than sheer private profits, it also applies a **social discounting process**. Differently than adopting a limited perspective of private individuals or firms and their observed opportunity costs and time preferences, social discounting adopts a broad society-as-a-whole point of view. As such, while private firms might have several opportunities for achieving higher profits in the present, thus presenting a high discount rate, social discounting analyzes the intertemporal preferences of the individuals affected by a policy, i.e. how much compensation they would need to delay consumption from the present to the future (EPA, 2010).

Selecting an appropriate discount rate and using the same figure for both benefits and costs of all policy alternatives is deemed important because even small changes in its value might be sufficient for either approving or rejecting a proposed regulatory policy. This is especially important for environmental regulations whose benefits accrue only in the long run. The use of a too high discount rate can result in too little value placed on avoiding climate change and too little investment in environmental policies. As an example, by using an annual discount rate of 7%, if a project is expected to avoid damages of $ 1 billion in 50 years in the future, its present value is $33.9 million; but if we considered benefits to accrue 200 years from the present, its present value would be only $1,300 (ARROW, CLINE*, ET AL.*, 1996).

Revesz (1999) and Sunstein (2002b) elicit the two central topics which draw attention to the process of discounting when analyzing environmental (and health) regulation. The first is the existence of latent harms. When an environmental policy is expected to have human health effects, but such benefits will not accrue until the

future because the harm has a latency period. For example, a regulation will banish or reduce the emission of a certain carcinogen. However, when an individual is exposed to such substance, it faces an increased probability of deceasing in, perhaps, twenty or thirty years into the future. The second comprises harms to future generations, such as dangers resulting from climate change. Although industry discharges greenhouse gases, leading to global warming, the deleterious effects on climate and upon society might take several years, or even decades, to become salient. As such, it is not the present society who will incur in damages (and benefit from present regulations), but rather the next generations. These issues oppose intragenerational and intergenerational effects of environmental policies, leading to the adoption of different social discount rates for each case.

Several different methods for estimating the social discount rate have been proposed. Specifically for intragenerational discounting, i.e. a discount rate used for projects whose impacts are observed within a same generation, the analyst could use several frameworks. One could use the market rate of interest from long-term, risk-free assets (such as government bonds) as a *proxy* of the social discount rate. Another possibility is to adopt a social opportunity cost of capital, which accounts for the capital displacement and foregone investment resulted from meeting new government regulation. The analyst could also use a shadow price of capital approach, which adjusts costs to reflect the social costs of altered private investments while also discounting for time preferences, representing how society values consumption over time (EPA, 2010).

Regarding intergenerational discounting, a panel of specialists organized by EPA in 2012 heralded the “Ramsey formula” as providing the most useful conceptual framework (ARROW *ET AL.*, 2012). However, it must be noted that its usage for intragenerational discounting is also accepted (EPA, 2010). The basic model proposed by Ramsey (1928) state that the optimal market interest rate (r) is a function of the elasticity of marginal utility (η) times the consumption growth rate (g) plus the pure rate of time preference (ρ):

$$r = \eta g + \rho \tag{3}$$

The first term, ηg, represents the fact that as the level of consumption changes over time, the marginal utility of consumption also changes. Adopting a declining marginal utility function and assuming a growing economy, in which future generations are expected to have higher income levels, and thus higher levels of consumption, increments in future income will be valued less in future periods than they are today. The second term, ρ, is the rate of pure time preferences, which measures the rate at which individuals discount their own utility over time or the rate at which society should discount utilities over time. The rate of pure time preferences implies that present utility (welfare) itself has a greater value than utility (welfare) enjoyed in the future (EPA, 2010).

There are two primary approaches to specify the individual parameters of the Ramsey equation: the descriptive approach and prescriptive (or normative) approach. The first attempts to estimate the parameters through analysis of real-world data, arguing that economic models and analysis should be supported by actual behavior. The second adopts a less positive perspective and, instead, assume that the assigned parameters should reflect ethically correct judgments. Since the pure rate of time preferences is positive, making utility in the future count less than utility in the present, to adopt any ρ higher than zero imply disregarding the welfare of future generations. As such, the prescriptive approach (starting with Ramsey himself) assumes that the only ethically defendable parameter for the pure rate of time preference is zero (ARROW, CLINE*, ET AL.*, 1996).

The confrontation regarding descriptive and prescriptive approaches has withstood through time and it is still present in contemporary discussions regarding social discount rates. However, more questions have been presented which present new debates. One would be as adding a new (negative) parameter to the Ramsey equation representing a precautionary note regarding uncertainty about the rate of growth in consumption (ARROW *ET AL.*, 2012). Another, which has already been implemented in France and the UK (CROPPER *ET AL.*, 2014), is the adoption of declining discount rates, rather than a unique point-estimate, to account for uncertainty regarding the future discount rate itself (WEITZMAN, 1998; 2001).

Notwithstanding the debates regarding how to estimate the parameters of the Ramsey equation, which method to use, what the appropriate social discount rate is or whether to use declining discount rates, EPA's practice is relatively exempt from such issues. Under the current regulatory process, as established by EO 12886,

EPA's economic analyses are subject to OMB's review and, as such, the first must abide by whichever guidelines the latter sets. OMB's Circulars A-4 (OMB, 2003a) states that regulators should provide estimates of two scenarios, one using a 3% discount rate, reflecting the social rate of time preference, and another using a 7% discount rate, the average before-tax capital rate of return of private capital in the US, reflecting the opportunity cost of capital. Thus, environmental BCAs developed by EPA for proposed regulation should use these figures, instead of individually calculating one discount rate for every policy.

4.1.6 Additional studies and comparison of alternatives

Once costs and benefits from all policy alternatives (including the no-policy scenarios) have been properly monetized, discounted, and aggregated, the analyst is capable of ranking the alternatives. The higher the NPV, the better the alternative is, and thus the preferred it would be in comparison with all other policy options. Adopting a strict KH principle, if the proposed regulation has a net NPV higher than zero in comparison with the baseline, such regulation is warranted. In addition, among a set of several regulatory options with positive NPV, the alternative presenting the higher NPV is the preferred one.

Nonetheless, EO 12886 does not bound US regulatory agencies to a strict KH principle. As presented in section 2, EO 12886 recognizes that several impacts cannot be monetized and that not only economic efficiency, but also equity issues, which BCA disregards, matter when setting new public policies.[68] As it follows, it explicitly promoted a "soft" CBA, in which both quantitative and qualitative measures are essential to consider. Several major statutes and EOs directly require additional impact analyses addressing:

I. impact on minorities and low-income populations (EO 12898);
II. environmental health risks and safety risks on children (EO 13045);

[68] These conditions will be further explored in section 4.3.

III. substantial direct effects on the States, the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government (EO 13132);
IV. substantial effects on one or more Indian tribes (EO 13175)
V. energy supply, distribution, or use (EO 13211);
VI. impact on small entities, including small businesses, governments, and non-prof organizations (1996 Amendment of the Regulatory Flexibility Act of 1980);
VII. potential expenditure by State, local, and tribal government (The Unfunded Mandates Reform Act of 1995).

By complementing "traditional" BCA with these analyses, regulatory agencies, including EPA, attempt to assemble a comprehensive Regulatory Impact Analysis (RIA), embracing not only efficiency, but also qualitative and distributional effects. A broader RIA tries to detach itself from an exclusive KH principle associated with environmental BCA. First, Circular A-4 (OMB, 2003) requires regulatory agencies to analyze at least one alternative more stringent and one alternative less stringent than the proposed regulation. Second, if ideally all benefits and costs should be monetized, several impacts cannot be expressed in monetary terms and thus are excluded from a strict BCA analysis. To compensate this limitation, benefits that are not monetized should be, to the extent possible, presented in quantitative estimates. If quantification is not possible, they should be qualitatively described and presented in the RIA.[69] Lastly, as defended by former OIRA's Administrator, Cass Sunstein (2002a; 2013), once the process of risk analysis and management has inherent uncertainties, regulatory agencies should not base their decisions on point-estimates, but rather should perform sensitivity analysis and present potential ranges of benefits and costs.

[69] EPA's guidelines (EPA, 2010) recommends that a RIA should present four tables for comparing policy alternatives: a qualitative description of all benefits, an estimation of the expected benefits that can be quantified, a presentation of all monetized benefits, and lastly a summary of benefits and costs with both monetized, quantified, and qualitative described impacts.

4.2 ENVIRONMENTAL BCA AS AN EPISTEMIC COMMUNITY

Reviewing the foundations and guidelines of environmental BCA sheds light on the process and rationale behind adopting this economic tool within a RBR Policy Cycle. However, its importance is greater for this work's intent as it sets the stage for analyzing environmental BCA through the lens of the epistemic community framework. Since environmental BCA's goal is to "rationalize" regulatory policy and its practice demands the mastery of several underlying concepts and methods, environmental BCA is in itself a policy-relevant knowledge whose authoritative claim falls upon a group of specialists. The epistemic community framework requires exploring four central pillars connecting such specialists in a broader network: a shared normative and principled beliefs; shared causal beliefs; shared notions of validity; and a common policy enterprise (Haas, 1992). We now turn to these pillars.

Shared set of normative and principled beliefs

The practice of environmental BCA, or any BCA for that matter, as a tool for *ex ante* analysis and selection of public and regulatory policies is rooted in several normative beliefs regarding two main topics. The first addresses the manner through which government should promote welfare-improving policies and intervene in the private market. The second, and more profound, regards how does BCA incorporate the notion of "social welfare".

Section 4.1.1 argued that BCA derives from a specific view of rationality which is intrinsically attached to the neoclassical concept of "rational choice" in which any rational agent would maximize his/her welfare according to his/her hierarchy of preferences and while subject to several external constraints. When translated to policy issues, rational public choice would imply ranking every policy alternative according to its expected social results and, in a world with limited public funds, select those presenting the highest net benefits. For that, BCA becomes a tool to legitimize the selection process, filtering only those policies deemed worthy - i.e., present net benefits – for then ranking them. As such, BCA adopts an explicit

normative judgment: rational public policy is, necessarily, the result of weighing benefits and costs irrespectively of the nature of each policy. Moreover, BCA impinges upon the policymaker one specific rule for selecting each policy: the KH principle. With that in mind, a strict BCA would disregard equity issues and focus only on achieving potential Pareto improvements as the basis for policymaking. That would correspond to a value judgment that BCA's concern is only with maximizing efficiency rather than other social objectives such as justice and distributional issues. If additional studies addressing equity issues, impact on minorities or on small business, among others, are incorporated into a RIA, this is not due to BCA. These are rather complementary analyses brought into the regulatory process later for discussion along with the results of BCA.

In addition, to associate rationality with a strict neoclassical definition, deep normative value judgments permeate the concept of "welfare" *per se* as adopted by the BCA practice. BCA evolves from the utilitarian philosophy and adheres to its definition of "social welfare" as the mere aggregation of individual's welfare, measured by a common *numéraire* called "utility", whose best *proxy* would be monetary figures. In addition, BCA assumes individual sovereignty, meaning that individuals are the best judges of their own welfare, setting aside any public duty related with pursuing goals that might be interpreted as socially desirable but are not deemed meritorious on an individual level. Further and related to individual sovereignty, the main source of value and welfare are individual preferences. This implies that the lower ranked a proposed policy is within an individual's set of hierarchical preferences, the lower its value and, consequently, the welfare result of such policy for this individual. Finally, since such preferences are analyzed through market transactions and represented by monetary figures, and those that cannot be monetized are only qualitatively discussed and do not enter into the final "economic" result, BCA ignores non-economic causes of welfare.

Shared set of causal beliefs

The crucial component that differs epistemic communities from other advocacy groups is the presence of a well-established shared set of causal beliefs among its members. By using a specific chain of reasoning to elucidate complex relationships, specialists strengthen their potential influence when facing intricate matters. Parallel to the normative beliefs, several causal beliefs within BCA's practice are not exclusively linked to its application for environmental regulations, but rather derive from a much broader reasoning rooted in theoretical concepts and models of the new welfare economics. This specific school of thought attempts at presenting a consistent and cogent framework for framing aspects such as: why and when regulatory intervention is warranted, what are and how to measure economic benefits and costs, and the treatment of present *vis-à-vis* future impacts.

The first highlighted aspect is of paramount importance to support why there should be regulation and how economics analyzes benefits and costs of proposed rules: the idea that the necessity for regulatory intervention derives from the presence of market failures. As already presented, while perfectly competitive markets would lead to optimum allocation of resources, market failures create inefficiency gaps in private markets and offer opportunities for public policies to close, or at least reduce, such gaps. Although market failures do not directly affect the measurement of a proposed rule's benefits and costs, as they derive from individual preferences, they are responsible for legitimizing government intervention and OMB's Circular A-4 mandates that any RIA should clearly state which market (or institutional) failures are being addressed by the proposed regulation (OMB, 2003).

Next, if BCA assumes that welfare derives from individual preferences, which are the only source of value, while adopting utilitarianism as its philosophical foundation, such normative belief takes form into the causal understanding that market decisions are the best proxy for representing individual preferences. As such, consumer and producer's surpluses embody the basic representation of economic welfare, whilst their net variation would provide a rationale for policy decisions: if positive, a policy enhances welfare; if negative, it diminishes it. Moreover, techniques for measuring economic welfare (net benefits) rely on either analyzing existing markets (revealed preferences) or creating hypothetical markets (stated preferences)

for measuring WTP and/or WTA, which are monetary representations of individual welfare. Specifically related to environmental BCA, the main causal belief relates increased environmental quality, diminished human health risks and monetary preferences. Environmental BCA judges that both preferences for environmental and health improvements are observable through market transactions and thus can be monetized irrespectively of their intrinsic natures.

A final causal belief represents benefits and costs accruing in the present and in future as having different weighs for welfare matters. First, by assuming the existence of a pure rate of time preferences, BCA practitioners assume that people value more present welfare (or utility) in relation to future welfare, which allows one to state that BCA analyzes individuals as present-bounded. Second, by using the concept of social and private opportunity costs, BCA assumes that a “pool” of resources is intertemporally transferable among policy enterprises. As a consequence, to discount future benefits and cost reflects the opportunity cost of investing, presently, in alternative policies. A qualification is necessary due to the difference between intragenerational and intergenerational discounting. While the first adopts both reasons for discounting (pure rate of time preferences and opportunity costs), the latter adopts an “ethical” restraint and uses a null pure rate of time preference because it is not possible to measure future generations’ intertemporal preferences.

Shared notions of validity

Within a shared normative and causal framework, an epistemic community shares notions of validity, a common epistemic “language”, responsible for legitimizing the work fostered by its members. Such “language” comprises a pool of acceptable symbols, concepts and methods, which are used to present scientific (or, in our case, economic) advances for peer-approval, bolstering communication between actors within the epistemic community. Regarding environmental BCA, we observe that such pool is first comprised of concepts associated with the broader theoretical framework of new welfare economics. However, several methods and debates address issues which are idiosyncratic to the specific field of health and

environmental economics, more specifically regarding the economic analysis of environmental protection and health safety benefits.

Initially, the new welfare economics provides an initial framework by defining concepts, such as consumer and producer's surpluses, market failures, WTP, WTA, along with the underlying mathematical definitions and economics theory supporting them.[70] More importantly, the new welfare economics provides a framing system in which (environmental) regulatory policy is analyzed using quantitative methods whose foundations lie on methodological individualism (derived from the normative assumption of individual sovereignty) and on adopting utility as the common reference-point for welfare analysis. While a full RIA demands a qualitative description of all benefits and costs, environmental BCA does not consider strictly qualitative or non-monetized impacts in its final recommendation. In addition, the process of estimating costs also illustrates broader notions of validity. Analysts use partial and general equilibrium models, linear programming, input-output models, among other techniques, along with a specific cost terminology (public and private costs, explicit and implicit costs, compliance costs, etc.). These indicators belong to the toolbox of applied welfare economics and are just applied for environmental BCA.

Even though benefit analysis relies on general concepts as WTP and WTA, it represents several specific features which associate it with the specific sub-field of environmental and health economics. As it is not rare that benefits derived from environmental regulation are not readily monetized - since they do not take place in private markets - environmental BCA uses specific methods and terminologies to account for them within an economic analysis. First, the concept of VSL is of paramount importance for analyzing health benefits and, although it has roots in the notion of opportunity costs for incurring in additional small risks, its usage in environmental BCA has gained widespread attention, as previously noted. Secondly, the translation of environmental benefits to economic terms depends on the technical definitions of active use value, option value, and existence value, which are linked to non-marketed goods as environmental quality. Thirdly, for measuring the benefits incurring in non-marketed goods, environmental BCA relies on measuring cost of illness, using revealed preferences (e.g. travel cost, hedonic pricing), stated preferences (contingency valuation), or benefit transfer methods. All these features

[70] It is not our goal to review the concepts of the new welfare economics, which are present in traditional microeconomics undergraduate textbook.

provide an acceptable set of “pre-approved” tools for assessing the economic benefits of proposed environmental regulations.

Finally, discounting also presents its specific notions of validity, which are associated with the adherence to the Ramsey framework. However, an additional aspect linked to environmental regulation deserves emphasis. Regarding the discounting of intergenerational benefits, the debate between the normative view, which defends an “ethical” definition of the pure rate of time preferences, and the prescriptive view, which would base the discount rate on observed market conditions, demarks an area of unsettlement within the epistemic community. Notwithstanding such disagreement, the debate remains using a common framework and concepts associated with the new welfare economics.

Common Policy Enterprise

Finally, we intend to shed light on the common policy enterprise shared by specialists in environmental BCA, which is to foster environmental BCA as a practical, useful, and influential tool within the regulatory process. However, a more demanding task is to unveil which arguments are used to defend the environmental BCA’s application for regulatory decisions. This research has identified five main arguments which are not explicitly related with environmental BCA, but are rather applied to defend the practice of BCA for every policy decisions: i) BCA is an efficiency-enhancing mechanism; ii) BCA provides a pragmatic, transparent, and consistent framework for policymaking; iii) BCA as a politically neutral and democratic instrument; iv) BCA compensates for individual and social bounded rationality; and v) despite limitations, BCA provides valuable information for the policy makers.

The first argument defends BCA on traditional economic grounds associated with the concept of rationality already discussed in this work. Since government has limited resources and thus is not capable of enforcing every potentially desirable public policy, policy makers should seek to extract the most amounts of benefits from the same pool of resources. For that, a proper weighting of benefits and costs is crucial because it filters only regulations presenting net benefits, as well as unveils the most welfare-enhancing options. Supporting this argument is the notion that

efficient allocation of expenditures on alternative regulations would potentially maximize the net social benefits derived from public policies. Arrow *et al.* (1996) brings this argument to the case of environmental, health, and safety regulations:

> Most economists would argue that economic efficiency measures, as the difference between benefits and costs, ought to be one of the fundamental criteria for evaluating proposed environmental, health, and safety regulation. Because society has limited resources to spend on regulation, benefit-cost analysis can help illuminate trade-offs involved in making different kinds of social investments. In this regard, it seems almost irresponsible to not conduct such analysis, because they can inform decisions about how scarce resources can be put to the greatest social good (p. 221).

Economists have also fostered analyses justifying the need for incorporating BCA within the regulatory process of environmental, health, and safety regulations. Interestingly enough, it was not rare to find political actors within the US regulatory process who supports BCA practice.

Morrall III, former deputy administrator of OIRA, published a seminal article in 1986 (MORRALL III, 1986) in which he analyzed the cost-efficiency of 45 US environmental, health, and safety regulations enacted by several regulatory agencies (from 1964 to 1986), and ranked them accordingly. Using cost per live saved, and applying a discount rate of 10%, he found that while the most efficient regulation presented resulted in only US$100 per per life saved, the least efficient imposed a cost of US$72 million per live saved (1984 dollars). Regarding EPA's regulation, the best ranked was its *Tihalomethanes* regulation, which costed only US$300 dollars per live saved, whilst EPA's Land Disposal regulation imposed a cost of US$3.5 million.

On a subsequent article, Morrall III (2003) broadened its database to account for 76 regulations (1964-2003) and, using a discount rate of 7%, witnessed that the opportunity costs of statistical lives saved ranged from US$ 0.1 million to US$ 100,000 million. In addition, Hahn (2000) argued that since the cost estimations of the 10 major US federal laws addressing environmental quality (in 1997) ranged near US$ 147 billion, government should focus on getting the most benefits out of these costs.

Within the efficiency argument, we also identify the reasoning that issuing regulations without accounting for its benefits and costs could be detrimental to social welfare. Since BCA illuminates trade-offs, it would also allow an efficient allocation of

resources. The failure to do so would imply a situation in which those resources could be used for alternative regulations with greater benefits. Graham (1995), another former OIRA Administrator, studied how the failure to account for BCA when issuing environmental, health, and safety regulations can do more harm than good. Analyzing 587 US government live-saving programs, Graham found out that if the average cost per year of life saved was US$ 42,000, the range went from almost US$0 to $100 billion per life-year saved. As such, if other regulatory opportunities for saving lives at low costs, or at least lower costs than the most inefficient regulations, existed, then to keep pursuing costly regulation and leaving these more efficient opportunities unaddressed would be the same as to cause a “statistical murder”.

The second argument is a consequence of the efficiency argument. Once BCA is necessary for assuring efficiency, it would also grant a general, consistent and pragmatic rule for decision-making. Even though the ethical principles behind BCA (mainly, utilitarianism) may be questioned, once the policy maker accepts them, BCA would enable consistency based in the logic, values and assumption of the new welfare economics (FUGUITT; WILCOX, 1999). Since BCA provides a common *numéraire* for comparing every project, it also established a comprehensive hierarchy according to efficiency standards: projects leading to higher net benefits are preferred. Even though solely using efficiency as basis of comparison may be put into question, if accepted, it would render a consistent decision rule, which is especially important because hard choices are ubiquitous in policy issues (ARROW, CROPPER*, ET AL.*, 1996; HAHN; SUNSTEIN, 2005).

In an Agency report reviewing BCA’s application at EPA between 1981 and 1986 (EPA, 1987), EPA stated that BCA makes possible to compare different regulations and environmental programs across media. BCA integrates scientific and economic information into a more consistent, comprehensive framework that informs decision makers about expected outcomes of alternative regulatory proposals. Similarly, Luken (1985) also addressed how EPA applied BCA during the Reagan Administration and argued that BCA provided consistency because it introduced a new structure and terminology into regulatory analysis. He listed four ways in which he judged BCA helped EPA’s rulemaking: i) organizing scientific and economic information into a consistent framework for evaluating regulation; ii) improving the accuracy of cost estimations; iii) determining what regulatory criteria decisions

makers use; and iv) indicating, where appropriate, changes in the stringency of regulation.

Cass Sunstein, who served as OIRA Administrator between 2009 and 2012, defends that BCA is a technocratic and necessary tool. Even though BCA is based on important assumptions and involves a lot of “guesswork”, transparent and consistent regulations depends on seeking evidence-based solutions. Although flawed, current efforts to quantify regulatory impacts would be, at least, beneficial for the future and, without them, regulators would only be making a stab in the dark (SUNSTEIN, 2002c; 2005). Greenstone (2010) follows this argument and state that

> a government that fails to rely on credible cost-benefit analysis is rolling the dice with its citizen’s welfare since implementing regulation whose impacts are unknown is often equivalent to gambling with tens of billions of dollars and unknown number of human lives (p. 55).

Since BCA would be a technocratic instrument, it would provide apolitical and “neutral” decisions. This is to say that if BCA can, in fact, preclude new regulatory initiatives if they prove to be too costly, it also may foster more stringent regulations if marginal benefits are perceived as higher than marginal costs (SUNSTEIN, 2002a; c). Even further, BCA would also defend democratic principles. If without evidence-based decisions, regulatory options could be subject to interest groups’ manipulation, advancing BCA would shed light upon the reasons why policy makers make such-and-such decisions, granting public accountability and transparency. Moreover, when WTP and WTA are taken as the measures of social welfare within BCA, government uses personal choices about how to allocate limited resources, respecting individual choice rather than imposing potentially politically biased goals (Sunstein, 2005).[71]

Sunstein is also the leading sponsor of the fourth argument for applying BCA to regulatory decisions. Using insights from behavioral economics, he argues that individuals, and society as a whole, have bounded rationality and thus incur in a series of systematic cognitive mistakes, leading them to poor choices related to risk management and perception. More thoroughly, Sunstein lists, in a book entitled *Risk and Reason* (SUNSTEIN, 2002a), seven cognitive mistakes which hamper individual and social perception of risks. First, people tend to easily retrieve information regarding major accidents (such as airplane accidents or terrorist attacks), even

[71] As long as individuals are well-informed.

though their probability of occurring is low. This is also called in the literature as the availability heuristics: people tend to systematically overestimate the probability of an event if such event is easily brought to mind (TVERSKI; KAHNEMAN, 1974). As a result, individuals get exceedingly fearful of small risks, leading to overregulation, issuance of regulation with higher costs per live saved and inefficient allocation of resources. Second, “intuitive toxicology” alters people preferences regarding regulation because people tend to believe that there is only “safe” or “dangerous” levels of toxicity, rather than observing that there is a dose-response with several mid-level toxicities. Moreover, people have a “no-risk” mentality which does not account for risk trade-offs. Third, context and social relationships lead to herd behaviors. When information is easily disseminated, even if false, a social cascade occur and people’s preferences might be altered based on misleading information. Fourth, people often focus on small pieces of complex problems rather then dealing with systemic effects and trade-offs. Fifth, loss aversion makes people overweigh regulatory benefits vis-à-vis costs, leading to a “better safe than sorry” attitude. Sixth, emotions and alarmist behavior make individuals overestimate the likelihood of worst-case scenarios. Seventh, people tend to be more willing to protect a higher percentage of a pre-defined population rather than judging the desirability based on absolute numbers, especially if benefits are dispersed.

Given all these cognitive limitations, BCA would be desirable because it has the potential to elicit the “right” aspects of regulations, fostering “evidence-based” decisions rather than “perception-based” regulations. In fact, Sunstein argues that “the strongest arguments for cost-benefit analysis seem to rest not with neoclassical economics, but with common sense, informed by behavioral economics and cognitive psychology” (SUNSTEIN, 2002c, p. 25).

Finally, even though BCA faces limitations, its proponents believe that BCA may provide important information for policy makers, and thus be a valuable input for regulatory policy. Not only it may prevent agencies from adopting economically unsound regulation that would impose high costs upon society without corresponding benefits, direct costs of regulatory evaluation appear to be small, as they ranged around US$ 700,000, in 1997, according to the Congressional Budget Office (Cbo, 1997), whilst benefits could be great (HAHN; DUDLEY, 2007; HAHN; TETLOCK, 2008). Finally, although BCA would be generally beneficial, Agencies should not be bounded by a strict BCA test. In fact, its proponents defends that BCA is and should

be only one input within a much more complex regulatory process, which complements a benefit-cost test with information on equity, uncertainties, qualitative benefits, legal adherence, and political conditions (ARROW, CROPPER*, ET AL.*, 1996; SUNSTEIN, 2002C; 2013).

Once we have drawn the major characteristics of environmental BCA's epistemic community, we end this subsection by summarizing them in Chart 3.

Pillars of an epistemic community	**Characteristics of the environmental BCA epistemic community**
(1) Shared set of normative and principled Beliefs	- Neoclassical notion of rationality should guide policy actions. - Adoption of the KH principle as an indicator of a project's desirability. - Individual sovereignty and utilitarianism provide the normative-philosophical foundations for measuring welfare. - Individual preferences are the main source of value. - Non-Economic causes of welfare are ignored.
(2) Shared set of causal beliefs	- Market failures provide justification for regulatory intervention. - Individual preferences can be perceived by market decisions and represented in monetary figures. - Welfare is a function of consumer and producer's surpluses, which can be technically measured by WTP and WTA. - Benefits/Costs accruing in the future are worth less than the ones incurred in the present due to pure time preferences and opportunity costs (either social).
(3) Shared notions of validity	- Principles and standards of the new welfare economics: methodological individualism, quantitative analysis, WTP/WTA, utility, among others. - Estimating costs: partial equilibrium models; general equilibrium models; among others. - Estimating benefits: VSL; active use, option, and existence values; cost of illness, contingency valuation, travel cost, hedonic pricing, among others. - Estimating discount rates: Ramsey framework and prescriptive x normative debate.
(4) Common policy enterprise	- Fostering (environmental) BCA within the regulatory process for it promotes: i) efficiency; ii) consistency; iii) neutrality and democratic principles; iv) BCA as defense against bounded rationality; and v) BCA as an important input, despite its limitations.

Chart 3 - Characteristics of the environmental BCA epistemic community
Source: Own elaboration

4.3 ENVIRONMENTAL BCA'S MULTIDISCIPLINARY LIMITATIONS

On the one hand, the environmental BCA epistemic community has well-established pillars and is comprised of economists and law-scholars, including politically influential actors within the regulatory process, as several former OIRA's Administrators. On the other hand, the mere existence of an epistemic community built around new welfare economics and environmental BCA does not exempt such knowledge from criticism. Since the 1970s, many essays have raised multidisciplinary fragilities and disadvantages of applying environmental BCA as a practical tool. These limitations have either posed new questions to expand and develop environmental BCA's methods, or directly opposed environmental BCA *per se*, implying that it is a flawed analytical practice whose application is not socially, or environmentally, beneficial. Since the literature addressing environmental BCA's limitations is too extensive and broad, we cannot hope to review it in its entirety, and adopt the narrower objective of summarizing some of them according to whether they address the overall BCA practice or specific stages within environmental BCA (namely, cost analysis, benefit analysis, and discounting). Within these categories, we further illustrate their multidisciplinary character by classifying them according to their adherence to the following themes: economic/technical, environmental, political, and moral/ethical.

4.3.1 Limitations to Cost Analysis

At a first glance, costs imposed by government regulations are generally recognized as an accounting process, and seem to be rather easy to identify and to express in economic terms. Even when analyzing regulatory costs through concepts such as "total economic surplus" and "opportunity costs and trade-offs", cost analysis seem relatively straightforward once it uses information about actual markets and actors, as compliance costs are tangible and usually passed on to final product prices, whereas environmental benefits have to be estimated by indirect methods. However, a stream of literature has defended that estimates of costs are no more

certain or reliable than are economic estimates of environmental benefits (ASHFORD; CALDART, 2008).

When Morrall III published his 1986 paper illustrating a huge difference between the cost-effectiveness of several US live-saving regulations, he proposed that US regulatory system's inefficiency had to be tackled by a regulatory reform in which decisions should have to be based on BCA, blocking too costly regulations, assuring better allocation of resources, and avoiding "statistical murderers". If this research served as an influential argument for defending BCA, Heinzerling (1998) analyzed whether the US regulatory system was, in fact, as cost-inefficient as it was proposed. Gathering estimates published by the Agencies responsible for issuing the 45 regulation analyzed in Morrall's paper, Heinzerling found out that, when using the agency's risk estimates, the cost estimates per life saved were substantially lower than those proposed by Morrall III, being, in fact, lower than US$ 5 million on every, but 2, cases. Her argument was that cost estimates depend on assumptions made by individual analysts and as such, those cost estimates were overestimated, representing "regulatory costs of mythic proportions".

Several researches underscored that calculations of environmental policy costs were systematically overestimated and precluded new regulations. Ackerman (2006) conducted a research in which he estimated the costs of the European Union's "Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals" (the REACH Program), implemented in 2007. He stated that while the German industry federation commissioned a study, performed by a private consulting firm, showing that REACH would seriously weaken the German economy as a whole, his study estimated that registration and testing costs would amount at only €3.5 billion for the eleven-year phase-in of REACH. Moreover, if fully passed to customers, these costs would only increase the average prices of the European chemical industry in 1/16 of one percent.

Other studies have found that environmental regulation *ex ante* cost estimates are, not rarely, too high. Comparing *ex ante* estimates with *ex post* estimates of 12 US regulations controlling pollutant emissions, Hodges (1997) found that compliance costs were overestimated in 11 out of the 12 cases, including one case in which *ex ante* costs were 2,900% greater than *ex post* estimates. Harrington, Morgenstern, and Nelson (2000) found a similar pattern when they compared *ex ante* estimates of the direct costs of individual regulation to *ex post* assessments using a

pool of twenty-five environmental, health, and safety rules. The study concluded that *ex ante* cost estimates for environmental compliance were more than 25% too high in twelve cases, whereas in only three cases they were more than 25% too low.

We find in Ashford (1981), McGarity and Ruttenberg (2002), and Ashford and Caldart (2008), four main economic and technical fragilities which results in a systematic overestimation of the costs of environmental regulations. First, the policy analyst rarely have access to detailed, independent information concerning alternative industry products and processes, and resultant compliance costs. As such, regulatory agencies must rely on information provided by the regulated industry itself. However, in such a scenario of asymmetric information, industries have incentive to inflate compliance costs in order to avoid incurring in new costs, either as a result of forced emissions reductions, and consequently, lower output, or by investing resources in “less-profitable” green technologies.[72]

Second, compliance costs estimates fail to take into account the economies of scale associated with the production of compliance technology. While new environmental regulations compel incumbent industries to invest in green technologies, it may also lead to growing investment in companies specialized in green technologies. Compliance costs should account for potential scale economies for such growing amount of investment in less-pollutant means of production. Moreover, not only economies of scale might be reached over time, but also a third argument defends that traditional cost analysis fails to incorporate industry’s learning curve regarding environmental compliance: industry learns, over time, how to comply more cost-effectively (e.g. anticipating regulatory actions and preemptively investing in green processes and products).

Next, a fourth line of critics claim that while traditional cost analysis often uses present technological capabilities as a baseline, it fails to account for the crucial role that can be played by technological innovation in reducing environmental regulations’ compliance costs. Ever since the rise of 1970s environmentalism, the economic analysis of environmental regulation’s costs was based on the neoclassical assumption of fully rational firms. Since firms are taken as profit-maximizers, any new environmental regulation would dislocate productive resources to other ends, then

[72] Pelaez, Silva and Araujo (2013) present a brief and comprehensive illustration of the problem of asymmetric information regulation of pesticides.

diminishing total output and/or investment in productive technologies, hence hampering productivity economic welfare.

Early works on the 1970s and 1980s sought to incorporate technology issues within the environmental policy analysis (ASHFORD; HEATON JR.; PRIEST, 1979; ASHFORD, 1981; ASHFORD; AYERS; STONE, 1985). This subject has gained widespread attention after Michael Porter published an article called *America's Green Strategy* (Porter, 1991) and two follow-up articles co-authored with Class van der Linde (PORTER; VAN DER LINDE, 1995a; b). These articles proposed a break in the neoclassical paradigm and suggested that firms, instead of maximizing profits, actually overlook efficiency opportunities related to innovation and sustainability. Thus, government regulation could help pushing them towards higher efficiency levels and the collection of "low-hanging-fruits". By innovating, firms would be able to comply with higher environmental standards and at the same time gain competitive advantages through both the reduction of inefficiencies derived from waste production and by trading the new processes or machineries in a market for sustainable products.

This proposition was later called the "Porter Hypothesis" and has generated a strand of literature of its own over the last two decades as economists have been studied the relationship between environmental regulation, innovation, and private competitive advantages. While some studies found a negative or null statistical relationship between environmental regulation and increased private productivity/competitiveness,[73] others have found a positive relationship, supporting the Porter Hypothesis.[74] Despite such uncertainty, works have converged in two matters. The first is that positive offsets are sectoral-specific, thus cost analysis should capture the intrinsic nature of each sector. Second, instead of assuming that innovation completely offsets compliance costs, a "weak" version of the Porter Hypothesis stating that regulation-induced technologies would only diminish compliance costs seems to be gaining widespread acceptance (OECD, 2010; AMBEC *ET AL.*, 2013).

Another criticism addresses the political conditions surrounding cost analysis. Briefly, it states that regulated industries are in conditions to promote unbalanced

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[73] See Jaffe et al. (1995), Palmer, Oates and Portney (1995), and Jaffe and Palmer (1997).
[74] See Wagner (2003), Ambec and Barla (2006), Lanoie et al. (2011) and Ambec *et al.* (2013), for a comprehensive review of the empirical studies testing the Porter Hypothesis.

BCAs, which become more accurate and stringent in cost than in benefit analysis. Environmental benefits are much harder to monetize than costs, and thus would require more investment on developing new methods to incorporate these in BCA. However, since beneficiaries of environmental policy are not a well-organized and cohesive group, as environmental quality is considered a “public good”, there is no strong private individual incentive to develop new tools for measuring environmental benefits. Alternatively, industry and private interest group not only have the incentives, but also substantial resources and organization to invest in research and development of methods for cost analysis, as the more stringent are cost estimates, the harder it is for costly regulations to be issued (ASHFORD, 1981; ACKERMAN, 2006). Additionally, private industry would constantly pressure regulatory agencies with the possibility of challenging new regulation in courts, forcing greater accuracy in cost estimates (MCGARITY; RUTTENBERG, 2002).

4.3.2 Limitations to Benefit Analysis

Estimating the benefits of environmental regulations is one of the most challenging tasks within environmental BCA. As already discussed in section 4.2, in the absence of actual markets for environmental goods, analysts must recur to indirect estimation methods based on stated preferences, revealed preferences, or adapting former estimations at the task at hand (benefit transfer). Notwithstanding, it often will not be possible to quantify and monetize all of the significant economic benefits from all policy options. For instance, the lack of risk-dose response functions for a toxic substance from which to calculate marginal benefits, poor available data, and absence of methods accounting for the inherent interconnectedness of environmental benefits, are some cases that preclude economic estimation of benefits. Thus, this primary limitation requires the development of new methods for measuring and monetizing benefits, which is a demand already incorporated within environmental BCA’s literature (ARROW, CROPPER*, ET AL.*, 1996; EPA, 2010a; KRAFT, 2011).

Another fundamentally technical criticism is that while benefit estimation relies on the assumption that markets work well, in a real market, rife with

imperfections, estimates of WTP and WTA might be biased. When information is asymmetric stated preferences for environmental goods would not reflect “true” values, once individuals usually are not aware of the full environmental and health implications of, for example, maintaining higher levels of a specific toxic pollutant in the air. This is also the case for VSL estimates, which usually rely on information of the job market, measuring the risk-premium demanded for individuals for working in positions with higher levels of health/life risks. In this case, workers might not be in position to negotiate their wages, choose alternative jobs, or even be aware of less-risky positions (HEINZERLING; ACKERMAN, 2002). Moreover, income distribution also alters individual preferences and price estimates measured for environmental benefits. Since individual awareness regarding environmental quality increases with income - i.e. environmental goods are “normal” –, the richer the people, the higher their WTP for higher levels of environmental quality, and the higher the benefits of new environmental policy (VISCUSI; HARRINGTON JR.; VERNON, 2005). However, it is usually poorer people who are usually more susceptible to environmental hazards and risks, and thus the beneficiaries of environmental regulations. Hence, the more unequally distributed is a society’s income, the lower would be the benefit estimates for environmental policy (ASHFORD, 1981; SEN, 2000b). Moreover, behavioral economics has put into question the role of current conditions and framing on estimating WTP and WTA: cognitive dissonance (when people get accustomed with pollution) diminished their WTP for changing from a status quo of polluted conditions to another of enhanced environmental quality (SUNSTEIN, 2005). As such, if prices are taken alone, they are not neutral, but a biased measure of values and thus require new tools for correcting for wealth distribution.

In a broad review of environmental BCA’s limitations, Wegner and Pascual (2011) present diverse criticisms to the underlying preference structure that supports economic benefit estimates. Measuring the total economic value of environmental (or any) good depends on the presence of a set of preferences, those being exogenous, intercomparable, complete, and stable. However, these conditions are not always met, especially when addressing environmental goods. First, the perceived importance of material goods depends on prevailing social institutions and cultural norms, leading to a situation in which “an object may be assigned multiple values by the same individual depending on the institutional context within which valuation takes place” (WEGNER; PASCUAL, 2011, p. 495). In BCA, if benefits are

aggregated according to multiple rules, rather than following a single exogenously defined institutional set, then it becomes impossible to simplify BCA for a single scale of measure.

Secondly, if preferences are assumed intercomparable, benefit analysis ignores the case of “lexicographic preference”. Lexicographic preferences are preferences holding intrinsic value, making them incomparable/incommensurable with other preferences on a single scale of measurement. This is, for instance, the case when people refuse to attach monetary values to a landscape (O'NEILL; HOLLAND; LIGHT, 2008). They may emerge from alternative sources of value, which are neither use, option, nor existence value. As a result, not only such preferences cannot be aggregated in monetary terms, their mere presence precludes any trade-off comparison according to the KH principle, as scenarios within and without environmental protection become incomparable. Since preferences may be endogenous and/or lexicographic preferences, the total set of preference is not complete - i.e. it is not possible to compare the whole set of alternatives among themselves.

Finally, taking preferences as exogenous ignores how they might vary in time given changes in both individual perceptions of reality, but also on the surrounding environment itself. If benefit analysis ignores this dynamic feature, it might lead to “accurate” short term estimates, but those would lead to politically and economically unsound decisions regarding long run environmental issues, as global climate change (DOELEMAN, 1985; GOWDY, 2007)

Another set of criticism has origin in the contrast between economics and environmental science. WTP and WTA are measures of the marginal economic value that individuals attach to any good, and, within an economic paradigm, such estimates cannot be infinite as they are bounded by the level of available income (PEARCE; ATKINSON; MORATO, 2006). For that, one must assume a continuous function relating environmental quality and individual welfare (WTP/WTA). However, as Spash (2008) argues, increased pollution levels might not result in marginal impacts represented by a continuous function, but instead be discontinuous in a manner that even marginal increases in pollution might unchain an interconnected process leading to natural disasters or radical environmental hazards.

In addition, once environmental resources are limited and climate change may be irreversible, once those resources are fundamental to the satisfaction of

human needs, any further absolute losses might not be compensated by any monetary figure (WEGNER; PASCUAL, 2011). Finally, whereas environmental scientists are not capable of accurately predicting how an environment will respond to human actions due to an inherent environmental interconnectedness and complexity, to use individual's preferences for estimating benefits assumes the unrealistic assumption that a "regular" person is well-informed regarding environmental and health risks would be unrealistic. In a nutshell, economic analysis still lacks a deeper understanding of how ecosystem works (HAYS, 2000).

Environmental BCA critics have also raised moral and ethical issues regarding benefit analysis. Although this literature is extensive, few examples are Kraft (2011), Wegner and Pascual (2011), Spash (2008), Ackerman (2006; 2008), Henzerling and Ackerman (2002), Vig and Kraft (1984). Mainly, a general argument is that BCA uses a unidimensional concept of value, one resting solely in a utilitarian philosophy rather than embracing a plethora of potential sources of well-being, as expressed, for instance, by Amartya Sen's capabilities approach (SEN, 2000a). Benefit analysis would also be bounded by an exclusively anthropocentric approach, as value is attributed by how people perceive an environmental resource's worth (total economic value). However, environmental philosophy would assume that the environment has intrinsic value and should be protected irrespective of how humans value them (SPASH, 2008). Additionally, by translating environmental and health risks to monetary figures by measuring, for instance, the value of statistical life as the premium one demands for incurring in additional levels of risk and then using such values for public policies, analysts blur the line between risks, hazards, and regulatory benefits. Even though economists do not attempt to value one life, but rather the "price" of very small changes in risk, when those values become base for public policy decisions, they actually represent potential losses (HEINZERLING; ACKERMAN, 2002).

Heinzerling and Ackerman (2002) and Ackerman (2006; 2008) present political limitations associated with benefit analysis. The first is that by mandating that benefit should be monetized to the extent possible, even if those benefits that are not monetized are qualitatively described, the mere existence of a monetary figure would give more weight to the first in respective to the latter. In fact, it is not clear whether qualitative benefits would be considered at all. Sunstein (2013) states that, in his time as OIRA Administrator, whereas BCA did not impose an economic straitjacket to

regulatory initiatives, net benefits were strongly taken into consideration while qualitative considerations served as tie-breaker for cases with relatively similar monetized benefit and cost estimates. Moreover, court challenges would force regulators to be more stringent in cost estimates just as much as with benefit estimates. Since the regulated industries are more likely to challenge new regulations, regulators produce more stringent estimates, thus reducing overall monetary benefit (ACKERMAN, 2006).

4.3.3 Limitations to Discounting

The practice of discounting environmental and health benefits has raised several concerns within the realms of economics, moral and ethics, and policy making. Arrow, Cline *et al.* (1996) and *Arrow et al.* (2012) provide an overall overview of the economic discussion surrounding how to determine the most “accurate” and defensible discount rate, summarizing the debate, mentioned in section 4.2, between a normative and positivist approach to discount rate. However, other set of issues are still to be defined, as whether government should use constant or declining discount rates, this last mainly to incorporate uncertainty regarding the preferences of future generations. Additionally, EPA (2010a) finds that there is no settlement regarding whether private market interest rates could be applied as the social discount rate for public policies, or whether this last should have an estimate of its own. This debate is incorporated in OMB’s Circular A-4 (2003a), which states that agencies should conduct RIAs considering scenarios using both a 7% discount rate (private) and another rate of 3% (social). Moreover, since discounting is mainly adopted because benefits and costs accrue in the future, the definition of the accurate period to be used in any BCA also requires the analyst to establish a cut-off point based on assumptions. As benefits from environmental regulations usually accrue on the long run, properly defining a baseline implies an attempt to forecast the future and the time which economic impact estimates will no longer be “significant” or “reliable”.

Notwithstanding the economic debate, discounting has raised much criticism addressing whether it would be morally or ethically defensible to discount future impact of environmental regulations. As Revesz (1999) and EPA (EPA, 2010a)

review, while discounting intragenerational health and environmental impacts would only represent preferences of current generations who should be responsible for their own choices, maintaining the assumption of individual sovereignty to discount benefits accruing for future generations brings additional complications. As environmental benefits usually accrue in the long run while costs are borne in the present, the practice of discounting seems to overweigh regulatory costs *vis-à-vis* regulatory benefits, especially if future generations are the beneficiaries of those benefits. According to Ackerman (2008, p. 10) “the use of discounting improperly trivializes future harms and the irreversibility of some environmental problems” because discounting assumes an intertemporal trade-off between present investments vs. future ecosystem stability, environmental resources, and human health. As such, an implicit choice when discounting is between preventing harms to the current generations and preventing similar harms to future generations, with a bias to leave current problems unattended and postpone policies (and issues) to future generations. Pierrehumbert (2003) exemplifies that this moral debate regarding whether to discount benefits for future generations is important because by applying a discount rate of only 3%, saving 100 lives today is worth more than saving all lives in the planet in 650 years. As a result, benefits accrued in the far future may receive less political attention in the policymaking process (HEINZERLING; ACKERMAN, 2002).

4.3.4 General Limitations

Not only critics have addressed specific points within cost analysis, benefit analysis, and discounting, but they have also raised concerns on the application of BCA as a general decision principle. Whereas technical issues mostly present the need to amplify efforts in conducting BCAs or enhancing the quality of methods and information available to the analysts, other issues question the moral, ethical and political validity of applying BCA within (environmental) policy choice. Luken (1985) and EPA (2010a) argue that one of the most important barrier to develop proper BCAs is the absence of data regarding environmental and health risks. As such, to foster information gathering and scientific research is of paramount importance in

order to construct a comprehensive and broad database to which analysts can turn to when they need to estimate dose-response curves and quantify environmental risks.

The quality of current BCA is called into question by some works. While the section of limitations to cost analysis presented studies comparing *ex ante* and *ex post* estimates to show that *ex ante* BCA usually overestimates compliance costs, other techniques to analyze BCA's quality are also available. Adopting a different strategy, Hahn *et al.* (2000) and Hahn and Dudley (2007) used a qualitative "scorecard" method to study how well does the US government perform BCA within regulatory agencies' RIAs. The authors selected a set of *de minimis* elements, representing what they judged to be essential components of a good economic analysis, and checked whether RIAs submitted for economically significant rules presented them.[75] Mainly, both studies divided the scorecard in six categories: estimation of costs, estimations of benefits, comparison of benefits and costs, evaluation of alternatives, clarity of presentation, and consistent use of analytical assumptions. The latter study used a sample of 75 RIAs issued between the Reagan and Clinton Administrations (including in entirety the sample of the first study). As an overall result, both studies concluded that, between the Reagan and Clinton administrations, the quality of analysis is generally low, as monetization is not possible for several benefits. The RIAs did not present estimates of benefits as consistently as costs: while 100% of the RIAs monetize at least some costs, only about 50% monetized at least some benefits. Moreover, there was no trend for improvement (or worsening) over time and across administrations, but rather individual RIAs whose quality varies widely even within administrations. In fact, as shown in Hahn and Tetlock (2008) and Renda (2006), not only poor-quality RIAs are found in the US, but the EU Impact Assessments also possess similar traits.

Historically, the adoption of BCA as a public choice tool has also been involved in debates regarding efficiency and distribution. The KH principle exclusively addresses efficiency within decision-making, as policies are judged worthy when they lead to potential Pareto improvements - i.e. policies that generate net benefits, which could be potentially redistributed from net gainers to net losers in order to achieve a Pareto improvement. However, since redistribution is merely hypothetical, BCA would ignore significant equity issues, especially for judging environmental and health

[75] The scorecard method has the main disadvantage of assuming that economic estimates are accurate, as the quality of agency's numbers is not under scrutiny.

policies, whose benefits are usually directed at poorer population, while compliance costs would fall upon private industry. Challenging a strict KH principle, from the 1950s to the 1990s, works such as Little (1950), Dasgupta, Marglin and Sen (1972), Little and Mirrless (1974), Squire and van der Tak (1975; 1980) and Layard (1980) have defended that distributional weights should be incorporated in BCA. The reason was to reflect the concerns for unequal wealth distribution, not only efficiency, and thus more weight should be given to less wealthier people. If distributional weights fell in disuse after the 1990 (LITTLE; MIRRLEES, 1990), the perception that BCA was not enough for “good” policymaking fostered a “soft” BCA, which should be complemented by qualitative analysis, distributional studies, and which adopts monetized concerns as merely an input in decision making (SUNSTEIN, 2002a; 2013; TEODOROVICZ; PELAEZ, 2014).

Another debate is between BCA and the “precautionary principle”. On the one hand, BCA is embedded in a risk-based regulation, which attempts to foster “smarter regulation” and increasingly quantified and evidence-based decision parameters. On the other hand, the precautionary principle is less demanding on scientific proof and assumes that, even in the absence of conclusive scientific evidence, if human activities may lead to morally unacceptable harm that is scientific plausible but uncertain, actions shall be taken to avoid or diminish that harm. These morally unacceptable harms refer to serious, even irreversible, environmental hazards and threats to human life or health and or harms, which are also potentially inequitable to present or future generations (UNESCO, 2005). Another moral criticism is similar to those addressing benefit estimation: while BCA relies on a purely economic and anthropocentric decision principle, not only well-being is multidimensional, but nature has an intrinsic value whose protection should be a goal in itself (WEGNER; PASCUAL, 2011).

Finally, Ashford (1981), Hays (1987, 2000), Porter (1997), and Ackerman (2006, 2008 2009) raise several political issues regarding environmental BCA. First, Ashford argues that relying on BCA generates a “tyranny” of technocrats that disregard limitations in representing environmental resources and ecosystem intrinsic worth. As well, by using complex methods and generating what it seem relatively straightforward numbers and ranges, BCA hides several assumptions under a cloak of objectivity and transparency (PORTER, 1997). While assuring minimal economic impacts and efficiency is a public goal, to rely exclusively on BCA would minimize the

role of other social goals as environmental and health protection. Finally, while BCA is taken as politically neutral, Driesen (2006) found out that, at least in the US, BCA systematically reduces the stringency of environmental regulation. However, despite some efforts to analyze the impact of environmental BCA (CRANDALL, 1984; PORTNEY, 1984; HAHN; TETLOCK, 2008), the actual influence of its practice in the decision to issue new environmental standards remains inconclusive. Closing this section, chart 4 summarizes environmental BCA's main multidisciplinary limitations.

	Technical & Economic	Environmental &	Moral & Ethical	Political
General Limitations	- Incomplete datasets - Low quality of current economic analysis	-	- Efficiency x Equity - KH Principle x Precautionary Principle - Utilitarian and anthropocentric analysis x other sources of well-being - Environmental and health protection as a goal in itself	- Technocratic "tyranny" - Social x Economic policy goals - Efficiency x Equity considerations - BCA's political influence is uncertain - Biased to reduce regulatory stringency
Cost Analysis	- Systemically underestimation of costs due to: i) asymmetric information between regulatory agency and regulated parties, ii) disregard for scale economies, and iii) firms' learning curve; and iv) the Porter Hypothesis	-	-	- Private firms and interest groups have incentives to invest in new cost method and start court challenges.
Benefit Analysis	- Absence of methods and data for quantifying several benefits (e.g. absence of dose-response curve for toxic substances) - Market imperfections and behavioral conditions may bias WTP/WTA estimates - Disregard potentially endogenous, lexicographic, incomplete, and/or dynamic preferences	- Non-linear and non-continuous environmental impacts - Environmental Interconnectivity and complexity - Uncertain and irreversible impacts on environment and health conditions	- Ignores altruistic and collective preferences - Unidimensional and anthropocentric concept of value ignores intrinsic and other sources of value. - Blurs line between environmental and health hazards, risks, and benefits	- More weigh given to quantitative *vis-à-vis* qualitative benefits - Risk of court challenge incentivizes more conservative benefit estimates.
Discounting	- Social x Private discount rate - Methods for measuring the social discount rate - Normative x Positive definition of the pure rate of time preferences - Constant x Declining discount rates - Uncertainty regarding the accurate period of analysis	-	- Disregards benefits to future generations and future environmental and health impacts - Environmental benefits are assumed less important in the future than in the present.	- Disproportional analytical weighs for costs *vis-à-vis* benefits

Chart 4 – Summary of environmental BCA's multidisciplinary limitations
Source: own elaboration

5 ENVIRONMENTAL BCA, EPISTEMIC COMMUNITY AND US EPA: AN ANALYSIS OF THE NATIONAL CENTER FOR ENVIRONMENTAL ECONOMICS

The previous section presented environmental BCA's foundations, defenses and multidisciplinary limitations. We have also argued that environmental BCA is a technique whose claim belongs to a network of specialists in environmental economics, an epistemic community, connected by shared normative beliefs (utilitarianism), causal beliefs (derived from new welfare economics), notions of validity (quantitative methods, similar technical concepts and practices), and a common policy enterprise (fostering environmental CBA as tool for regulatory analysis).

Here, we go a step further and uncover the stages of the RBR Policy Cycle in which representatives of this epistemic community might exert influence or shape EPA's rulemaking. More specifically, we focus on a specific EPA department, whose members are mainly environmental economists and goals are to foster the practice of environmental economics and environmental BCA within EPA, the National Center for Environmental Economics (NCEE). This section's primary goal is to explore NCEE's primary activities and roles within EPA regulatory process and evidence how this group is embedded in a broader epistemic community.

With that goal in mind, we first present the US formal regulatory process and associate its several stages with the RBR Policy Cycle. Following, a brief description of EPA's structure and its Action Development Process (ADP) opens the "black-box" concerning the agency's procedural process for issuing environmental regulations. Finally, we present and analyze NCEE's functions and roles within EPA, explicating the stages of the RBR Policy Cycle in which this group of economists might influence policymaking; as well as uncovering how NCEE is not bounded by institutional frontiers, but rather it is connected with a broader network of environmental economists and specialists in environmental BCA.

5.1 US FORMAL REGULATORY PROCESS AND THE RBR POLICY CYCLE[76]

Although US federal regulatory agencies have a margin of discretion, they are not free from external shackles when issuing and enforcing new regulations. A first constraint is the corresponding legislative mandate to which agencies are subject to. New regulations must be consistent with the competences *de facto* attributed to each agency, or they would incur in the judicial and legitimacy risks of being overturned in courts. In addition, agencies must go through a pre-determined set of administrative proceedings for providing a certain degree of public accountability to regulatory decisions. EO 12866 sets one of these steps by bounding the approval of new "economically significant" regulations, whose expected impacts exceed US$ 100 million, to the presentation and approval of a RIA presenting both costs and benefits of the proposed regulation. Moreover, additional steps potentially preclude agencies to implement and enforce new regulations. Each stage of the current US regulatory process can be associated with one or more components of the RBR Policy Cycle.

The first stage in the development of a new regulation occurs when some agency decides to regulate a specific process or area of economic activity. Following the RBR Cycle, this stage would correspond to that of Risk Identification. Agency initiatives may arise from new scientific data, new technologies, political or social pressure, or any other reason that highlights the necessity to regulate a particular conduct. As required by EO 12866, once a topic is on the agency's agenda, it must be listed as a part of the regulatory program if regulators expect it to have a substantial cost impact. Such regulatory program must describe the most important regulation that the agency expects to issue in the upcoming fiscal year, thus embodying their core priorities.

Once a regulatory program is developed, the authority to review it falls upon OMB. At this stage, OMB analyzes and compares regulatory programs from all federal regulatory agencies with the intent to identify potential overlaps among agencies' actions or particularly controversial regulatory policies, also coordinating an interagency review process in which each agency can comment on another agency's plans. Also, OMB reviews whether specific actions within the regulatory plans

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[76] This section draws on Viscusi, Harrington Jr., and Vernon (2005) and OMB (2003b).

corresponds or surpasses agencies' attributions as determined by their legislative mandated. Finally, OMB has the authority to screen out regulation that seems undesirable or that confronts political priorities set by the executive power.

The next stage is to prepare a proposed rule along with its corresponding RIA, as determined by EO 12866.[77] The requirements for such RIA have changed over time, as presented in section 2. Currently, the RIA should first state a need for policy action comprising the problem definition and the reasons for market or institutional failure that justifies regulatory intervention (OMB, 2003a). RIA then requires agency to conduct a "soft" BCA. Preferably, benefits and costs should be represented and compared in monetary terms. If monetization is not possible for some benefits and costs, these should be quantified. Further, those that cannot be quantified should be qualitatively described. Regulatory agencies are also required to select the most desirable policy alternative, i.e. that whose net benefits are the greatest, or least negative. This step blends both Risk Assessment and Risk Management, as it implies undertaking risk studies to justify regulatory intervention, as well as defining regulatory design (market-based instruments, command-and-control rules, or other mechanisms) and the extent to which the targeted risk is going to be regulated.

After finalizing the proposed rule and RIA, the agency must send them to OMB's review. OMB's review must take place sixty days before the agency issues a Notice of Proposed Rulemaking (NPRM) in the Federal Register. There, OMB[78] conducts an extensive review of not only rule's RIA, but also of its abidance to law. Moreover, OMB contacts several White House offices and other government departments that might be interested in the proposed rule, as the National Economic Council, the Office of Science and Technology, the Department of Agriculture, Energy, and so forth (Sunstein, 2013, p. 29-33). During this 60-day period, OMB can simply approve the proposed rule, but it can also negotiate improvements and changes in the regulation or, in more extreme cases, completely reject it. At such point, the agency must choose between to withdraw or to revise it.

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[77] The RIA is mandatory for "significant rules", which according to EO 12.866 are those that: have an annual effect on the economy of $100 million or more; create a serious inconsistency or interfere with an action taken or planned by another agency; materially alter the budgetary impact of entitlements, grants, used fees, or loan programs or the right and obligations of recipients thereof; or raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in EO 12.866 (EPA, 2010a, p. 2-2).

[78] More specifically, the Office of Information and Regulatory Affairs (OIRA).

Once OMB's approval was granted, the agency can publish the NPRM in the Federal Register. This step aims to disseminate to the public the nature of the regulatory proposal and the rationale for it, as the material presented in the Federal Register typically details costs, benefits and justification for regulation. For 30 to 90 days, the regulatory proposal is open to public scrutiny and review. During such period, not only interested parties, but also overall public can review, comment, question, and propose alterations.

After receiving and processing these public comments, the regulatory agency must analyze whether it should incorporate them, or not, into regulation's final form. Besides writing the final regulation, the regulatory agency also develops a final RIA for submission to OMB's approval, in a similar process to that to which the proposed rule was submitted. After OMB has approved the final rule, the agency can publish it in the Federal Register. The Congressional Review Act of 1996 sets an additional oversight procedure before the enforcement of any new rule. The agency must submit information about the new regulation to the US Congress, which has the option to question and delay the rule's implementation. While this step is not mandatory, thus characterizing this step as a "report-and-wait process", it does insert an amount of legislative oversight over regulatory actions. If after 30 days the Congress has not signalized that it intends to review or to question the regulation, the final rule goes into effect after 30 days. After its implementation, the regulation can be further challenged in courts, therefore being subject to judicial review.

This brief explanation evidences a series of stages through which regulatory agencies must pass by when issuing new regulations. These steps are also tied to the RBR Cycle. From Risk Identification to Implementation & Enforcement, figure 6 summarizes the current structure of the rulemaking process making explicit its categorization with the main components of the RBR Cycle. While regulatory agencies hold the prominent role during Risk Identification, Assessments, Management, and Implementation & Enforcement[79], several other agents share the responsibility for Regulatory Review. However, OMB is evidently a prominent agent for Regulatory Review as its main mission is to oversee regulatory actions and to coordinate the review process.

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[79] *Ex post* "evaluation" is not present since this is the process for issuing new regulations.

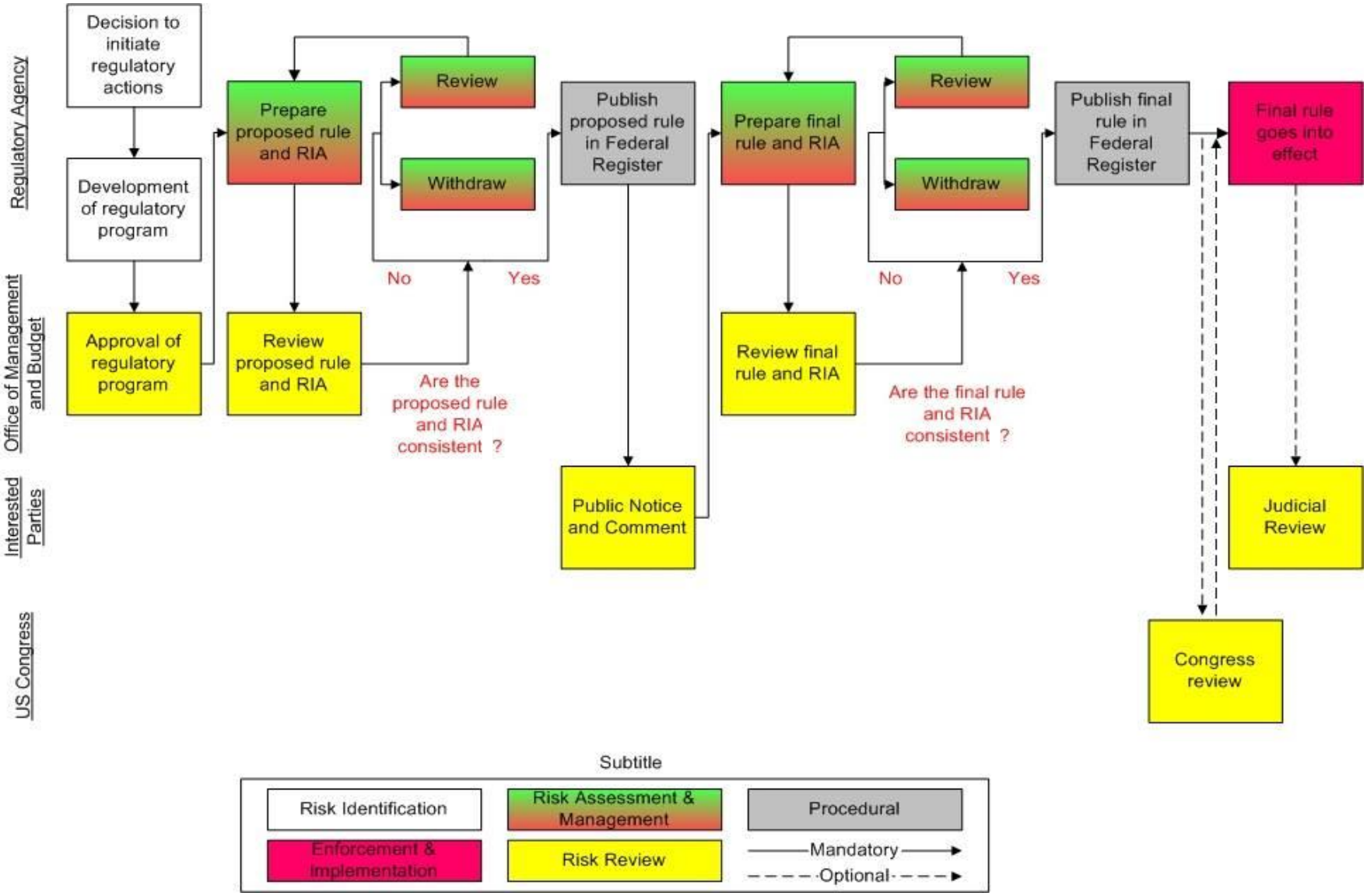

Figure 6 - US Regulatory Flow and RBR Cycle
Source: Own elaboration based on OMB (2003b).

5.2 EPA'S STRUCTURE AND ACTION DEVELOPMENT PROCESS

Explaining EPA's rulemaking process requires a first overall view of the Agency's internal organization. Appointed by the president, EPA Administrator is the head of the Agency and thus responsible for enforcing the nation's environmental status. Under the Administrator, EPA divides, roughly, in five main types of internal structures: Headquarters Offices, Regional Offices, Office of Inspector General, Labs, Research Center and Science Advisory Organizations, and the Office of the Administrator.[80]

Located in the Agency's headquarters, in Washington D.C., EPA has 11 theme-specific Headquarter Offices responsible for addressing national regulatory issues and EPA's internal matters. Four HOs are each responsible for setting federal regulations and standards regarding specific environmental fields: the Office of Air and Radiation, Office of Chemical Safety and Pollution Prevention, Office of Solid Waste and Emergency Response, and Office of Water. These four Headquarters offices are also called "Program Offices" and are of paramount importance to EPA's rulemaking since they are responsible for starting and conduction any national regulatory action within their area of expertise. The remaining seven Headquarters Offices address EPA's internal, political, or scientific matters. These are the Office of Administration and Resources Management, Office of the Chief Financial Officer, Office of Enforcement and Compliance Assurance, Office of Environmental Information, Office of General Counsel, Office of International and Tribal Affairs, and Office of Research and Development. Also located in Washington D.C., the Office of Inspector General is an independent office within EPA that is in charge of performing internal audit, evaluation and investigation of the Agency and its contractors.

In addition, ten Regional Offices across the country are responsible for the execution of EPA's national programs within their respective territories, as well as tackling state-level environmental issues. The ten regions are: Region 1 – Boston; Region 2 - New York; Region 3 – Philadelphia; Region 4 – Atlanta; Region 5 – Chicago; Region 6 – Dallas; Region 7 – Kansas City; Region 8 – Denver; Region 9 – San Francisco; and Region 10 – Seattle. Also spread across the country, Labs, Research Center

[80] Explanations regarding EPA's structure are mainly based on information gathered on EPA's website (EPA, 2015 – organizational chart).

and Science Advisory Organizations develop knowledge, assessments, and scientific tools, which form the underpinning of the vast majority of EPA's protective standards and guidance.

Finally, the Office of the Administrator is responsible for providing executive and logistical support for EPA Administrator through the work of 11 internal offices. These offices are the Office of Children's Health Protection, Office of Civil Rights, Office of Congressional and Intergovernmental Relations, Office of Executive Services, Office of the Executive Secretariat, Office of Homeland Security, Office of Policy, Office of Public Affairs, Office of Public Engagement and Environmental Education, Office of Small Business Programs, and the Science Advisory Board. The Office of Policy (OP) is of particular relevance given our goals. This office is the primary policy arm of EPA and work with other HOs and ROs to support Agency priorities and decision-making, whether by providing multi-disciplinary analytic skills and consultancy in five key areas: regulatory policy and management, strategic environmental management, sustainable communities, climate adaptation, and, this work's theme, environmental economics. Within OP, we find a special section named the National Center for Environmental Economics (NCCE) whose members are trained economists specialized in analyzing the costs, benefits, and economic impacts of environmental regulations and policies. After describing EPA's organizational structure, we now turn to explaining the process through which EPA enacts environmental regulations.

To ensure that EPA's actions are consistent across its several offices, EPA designed a comprehensive process for developing its rules, called the Action Development Process (ADP).[81] Coordinated by EPA's Office of Policy, ADP relies on cross-office, cross-media and multidisciplinary approach to incorporate several perspectives and expertise in order to assure "quality" regulation that incorporates the multidisciplinary tradeoffs inherent to policymaking.[82] With that goal in mind, EPA's ADP attempts to foster five key elements within Agency's rulemaking. First, to plan sound scientific and economic analyses to support the action, including peer

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[81] EPA has issued a document detailing the ADP, called "EPA`s Action Development Process – guidance for EPA staff on developing quality action" (EPA, 2011a). Henceforth, this section will draw on this document, unless otherwise stated.

[82] "Quality" regulation would balance several qualities when issuing new rules: to be legally defensible, timely, easy to implement and enforce, clear and concise, comprehensive, flexible, to be based on sound analyses, and to be cost-effective (EPA, 2011a).

review, when necessary. Second, to develop and select regulatory and non-regulatory options based on relevant scientific, economic, and policy analyses. Third, to incorporate early inputs from affected Headquarters and Regional managers, and ensure they stay involved until the final action is completed. Fourth, to ensure active and appropriate cross-Agency participation. Fifth, to encourage appropriate and meaningful consultation with external stakeholders.

EPA's ADP has five major stages: i) tiering the action and obtaining commencement approval; ii) developing the proposed rule or draft action; iii) requesting OMB Review (if necessary) for proposed (and final) actions; iv) requesting signature, publishing an Action in the Federal Register, and soliciting and accepting public comment; and v) developing the final action and ensuring congressional review. As expected, we observe overlapping between this structure and the overall regulatory process as enacted by EO 12866. However, instead of providing a broad framework, ADP presents how different EPA's offices and department act within every stage in order to issue new environmental rules. For that, we follow with a brief description of each one of these five stages.

The first stage of every proposed rulemaking is to tier the action and obtain commencement approval. Prior to initiating any substantive activity regarding new regulations, any Program Office who wishes to propose a new rule must prepare and submit a "tiering form" with an overall description of the action. This form supports two processes: getting commencement approval and defining the action's tier. EO 12866, as amended by EO 13422, requires the approval of the Regulatory Policy Officer (RPO) - the Assistant Administrator of the Office of Policy, which is appointed by the president – to commence any regulatory development activity. Additionally, the same tiering form submitted by the lead Program Office is used to define the actions "tier". Under the ADP, each new regulatory action is assigned a tier level corresponding to the level of complexity, required cross-Agency input, potential controversies and visibility, and need for involvement by top-level manager. The tiering process involves both the lead Program Offices, which submits the initial tiering form, as well as the Office of Policy and representatives from headquarters and regional offices, who review and provide comments and suggestions to either change the action's tier or legitimize the one initially proposed.

Tiers range from 1 to 3, with decreasing levels of complexity. Tier 3 actions are delegated to the led Program Office and need little to none cross-Agency

participation. Tier 2 actions influence cross-media and/or actions with “significant issues”, requiring deeper analysis of science, policy, economic and/or implementation issues. Tier 1 actions represents Administrator’s priority actions, which requires an extensive involvement of the Administrator’s office and cross-Agency involvement. These actions also have potential for major economic impact on other levels of government or the regulated community, since any economically significant rule (according to EO 12866, the one with expected impact higher than $100 million) should be placed under Tier 1. Usually, both Tier 1 and Tier 2 actions require the development of economic analysis for proceeding with the regulatory process. [83]

Once the action has been tiered, the lead Program or Regional Office charts a workgroup, which will be responsible for developing the action. This workgroup is responsible for providing and organizing consistent multidisciplinary analysis (risk, economic, equity, legislative, among others) in order to propose a draft of the proposed rule and its corresponding RIA. The workgroup chair is a representative of the lead Program Office. Representatives from interested Program and Regional offices who respond to a tiering request and indicate their interest in the action also join the workgroup. Particularly important is the involvement of the so-called “core offices” (Office of Policy, Office of Research and Development, Office of Enforcement and Compliance Assurance, and Office of General Counsel), which should have a representative on all Tier 1 and 2 actions, as well as representatives from Regional Offices and from State, Tribal and Local Governments. In addition, for economically significant rules, an Economics Subgroup is set.

This workgroup first issues a preliminary analytic blueprint, a document which spells out a workgroup’s plan for the data collection and analyses that will support development of a specific action, including how the information will be collected, necessity of external peer-review, and how the information will be used to craft the action within a specific budget and time frame. Next, the workgroup seeks early advice from senior managers in order to make the action’s adherence with EPA’s priorities clear, as well as indicating potential issues or point of concern. After early managerial guidance, the workgroup develops a detailed analytic blueprint identifying

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[83] Since both Tier-1 and Tier-2 actions require the development of RIAs, whereas Tier-3 actions are relatively simple, from here on this description will focus on Tier-1 and Tier-2 actions, but will not distinguish steps between them.

the key activities, consultation activities, contributors, timelines, and analysis (including risk and economic analysis). The next step involves completing data gathering, developing scientific and economic analysis, seeking advice with stakeholders and consultation offices and peer review to support and/or enhance scientific/technical work, establishing public docket to store information on the rule, and developing regulatory options. These options are presented by the lead Program Office and the workgroup to senior management (either EPA's Administrator or Deputy Administrator), who selects a few of them to be further analyzed. Finally, the workgroup drafts the proposed action and the underlying documents, such as environmental impact assessment, risk and economic assessments, and RIA, and submits them for a Final Agency Review.

After the Final Agency Review, the proposed regulation is ready to be sent to OMB, which will conduct its own and lead a cross-Agency review process. Since this topic was already presented in the previous section we will no longer focus on its details. Once the proposed regulation and RIA receive comments from OMB, the workgroup and the Office of Policy initiate a negotiation process with OMB until all necessary changes and requirements are met, for then publishing the proposed rule in the Federal Register for public comments. The Workgroup will evaluate these comments and potentially incorporate them in the final regulation, which will again go under OMB's review for then, if approved, be subject to Congressional Review.

5.3 EPA'S SPECIALISTS IN ENVIRONMENTAL ECONOMICS AND BCA: THE NATIONAL CENTER FOR ENVIRONMENTAL ECONOMICS

Though only briefly explained, EPA's ADP reveals that the Agency is not only concerned with Risk Analysis and Risk Management, but also conducts in-house Regulatory Review through processes such as subjecting tiering forms for cross-Agency review and seeking early guidance and Final Approval with senior managers. More importantly, once our interest lies on the role of an environmental BCA's epistemic community within EPA, it is worth noticing that every lead Program Office is responsible for developing their own RIAs, and consequently environmental BCAs, for proposed and final regulations. Within the Office of Policy lies NCEE, a

department majorly composed of economists specialized in environmental economics and BCA. Whilst this group would represent a potentially source of influence of the environmental BCA's epistemic community within EPA, its role is not explicitly stated in EPA's ADP. In fact, NCEE appears in the ADP only as a source for guidance on preparing economic analyses. Next, we face the challenge of filling this vacuum regarding NCEE's role within EPA's rulemaking process and the stages of the RBR Policy Cycle in which it might influence regulatory policy.

5.3.1 Method and data

This research employed a stepwise strategy to, first, identify NCEE's primary activities and to structure them according to their major intents. Secondly, to systematize and map NCEE's areas of expertise by assessing the most addressed topics regarding the RBR Policy Cycle's components and environmental BCA. Finally, to analyze "if" and "how" NCEE might be connected with a broader network of specialists, i.e. whether and how NCEE represent and internalize the views of an epistemic community of environmental BCA.

Exploratory observation and personal reports obtained during a three-week internship at NCEE and information retrieved from NCEE's website (NCEE, 2014) and reports were the main subsidy to identify NCEE's primary functions and activities. Besides attending group meetings on policy analysis, benefit and cost assessments, and appointments with other EPA program offices to observe how NCEE staff developed their economic studies, 11 semi-structured interviews were conducted to raise the following information:

i) NCEE's activities within EPA;
ii) Perception of NCEE's role within EPA's regulatory process;
iii) Factors that may foster or inhibit NCEE's activities; and

iv) NCEE's adherence to characteristics associated with an environmental BCA epistemic community. [84]

These interviews unveiled the existence of three main "pillars" which summarize NCEE activities and roles within EPA: "Consulting & Internal Review"; "Independent & Agency-Oriented Research"; and "Diffusion, Education & Outreach". These pillars further supported the study of how NCEE relates with the RBR Policy Cycle, environmental BCA, and with environmental BCA epistemic community. NCEE's activities and pillars were qualitatively systematized and categorized according to RBR Cycle's components (risk identification, risk assessment, risk management, oversight, implementation & enforcement, and evaluation), thus mapping NCEE's potential areas of influence within the regulatory process. Qualitative analysis supported our study of NCEE's "Consulting & Internal Review" pillar, which used personal statements from NCEE's and EPA's staff. Moreover, we complemented the analysis by analyzing official NCEE's reports and guidelines.

Whereas personal statements also subsidized the study of NCEE's research and diffusion roles, these were also subject to quantitative scrutiny. Regarding "Independent and Agency-oriented Research", the research outlined two indicators to identify which RBR components and research topics concentrate NCEE's efforts: grants awarded by NCEE to external projects (2002-2011) and published articles authored by NCEE staff (2000-2013).

Between 2002 and 2011, NCEE has funded 40 different external research and workshop projects, whose descriptions are available within the NCEE website, granting approximately US$ 4.2 million (adjuster for 2011 dollars) (EPA, 2014d). A qualitative inquiry of project's descriptions identified and categorized each proposal concentration around specific RBR Policy Cycle components. This first categorization allowed us to determine the quantity of grants and total amount of resources destined to each stage of the RBR Policy Cycle, indicating NCEE's concerns and focus when distributing external awards and grants.

Since 2000, NCEE staff have issued and sponsored several reports, scientific articles, book chapters, and other research reports and essays on a varied

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[84] From the 11 interviewees, 7 were NCEE staff, 3 worked on different EPA Program Offices, and 1 worked at a private think-tank, with experience on environmental economics and BCA. Five of those interviews were recorded and, in the remaining, notes were taken summarizing the responses related to NCEE's activities within EPA.

set of issues within the realm of environmental economics. On the one hand, the dispersion of NCEE's publications around specific topics offers a strong indicator of issues and subjects deemed as of minor or major relevance to this group. On the other hand, to analyze all publications ever issued by NCEE would be incredibly time and resource-consuming.[85] To cope with the great number of publications, we set several filters to delimit a manageable sample that accounted for works that had already been subject to at least some degree of peer-review and that would be relatively unbiased by momentary "hot topics". Additional conditions filtered only articles authored by current staff and published after author's affiliation to NCEE, as NCEE's website provides detailed information of only current staff's publications and 18 out of the 33 current members have joined NCEE after 2000. Finally, we set a time frame of articles published between 2000 and 2013.

After applying such filters, our initial sample had 133 articles. However, we only obtained access to 119 (89%) of them.[86] Thus, the final sample consisted of 119 articles authored by current NCEE members, published in peer-reviewed journals between 2000-2013 and after the author had already joined NCEE. Table 2 summarizes our sample.

Table 2 – Summary of sample corresponding to NCEE published articles (2000-2013)

Articles within filters	Articles within sample	NCEE current staff	NCEE current staff with published articles	Journals in which NCEE has published
133 (100%)	119 (89%)	33 (100%)	24 (73%)	56

Source: own elaboration

Through three subsequent steps, we identified the most prominent topics within NCEE independent research. First, similar to the procedure used to classify NCEE grants, we analyzed each article's abstracts and classified them according to their attachment to RBR Policy Cycle components.[87] Aiming to evaluate how prominent environmental BCA is in comparison with other topics researched by NCEE, a second step comprised of characterizing those articles pertaining to "Risk Management" according to the following secondary non-exclusive classes: "Benefit-

[85] In NCEE's website, there are more than 300 environmental economics report issued by either NCEE or NCEE-sponsored research. In addition, a quick survey evidenced over 250 publications authored by current staff (from published articles to book chapters and working papers).
[86] 14 articles were stored solely in academic databases that required paid subscriptions.
[87] Articles whose topic was not readily identified from the abstract had their introduction, conclusion, and other sections also analyzed.

Cost Analysis"[88], "Regulatory Design"[89], and "Others".[90] Following, articles addressing "Benefit-Cost Analysis" received a tertiary non-exclusive category indicating which environmental BCA's topics were addressed: i) Baseline; ii) Discounting; iii) Benefit Analysis; and iv) Cost Analysis.[91] Thus, we could quantify and analyze whether NCEE gives greater weight to specific BCA sub-fields.

The remaining pillar, "Education & Outreach" presents NCEE as an inside-agency representative of the environmental BCA epistemic community responsible for connecting EPA with a broader network of environmental economists. If the interviews revealed that some NCEEs activities intend to diffuse economic knowledge within EPA departments, it also presented activities connecting this group with an epistemic community that goes beyond the Agency's organization. Besides briefly describing NCEE's activities within the pillar of "Education & Outreach" - according to information reported during the interviews, we analyzed seminars and workshops sponsored by NCEE since 2000. These events seek to disseminate economic knowledge within EPA and to discuss "hot topics" that may influence EPAs overall economic analysis. This work collected the affiliations of all seminar and workshop's presenters to address whether NCEE concentrates its external linkages with a limited or diffuse array of institutions. Furthermore, these seminars and workshops were grouped according to its adherence to BCA-related topics, thus scrutinizing whether BCA also receives importance in NCEE's knowledge pillar.

Unfortunately, this work is subject to several limitations that should qualify its interpretations. While only articles published in peer-reviewed journals were taken into consideration, NCEE issues several technical and methodological reports that were not analyzed, hindering any absolute statement about NCEE's favored topics. Moreover, past research may not represent NCEE's concern regarding new "hot topics", which were left out of this work. Simultaneously, we focused on a limited amount of channels through which NCEE connects itself with an external network of

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[88] Articles aimed to estimate benefits and/or costs of specific regulations; improve/propose/criticize BCA-related methods (e.g. stated-preferences surveys; cost assessment); propose/re-estimate new values of reference (e.g. VSL, discount rate, social cost of carbon); discussed environmental BCA's implications, advantages, or limitations.

[89] Articles proposing or defending specific regulatory mechanisms or how to structure specific environmental policies.

[90] Articles that did not address either BCA or regulatory mechanisms but subsidized policy decisions (e.g. environmental justice, evolution of emissions of pollutants, determinants of firm's compliance and/or regulatory activity).

[91] This classification excluded the comparison of policy alternatives since it is a consequence of all previous analyses.

environmental economists, whereas a myriad of alternatives still demands further scrutiny.[92]

On a final note, if an ideal study of NCEE's role within EPA would embark its influence on EPA's final regulations, this matter was not addressed through this research. In fact, NCEE's connection with the RBR Policy Cycle was mainly descriptive, leaving open the opportunity to study its actual influence on Agency's decisions.

5.3.2 NCEE's roles and activities: RBR Policy Cycle, environmental BCA, and epistemic community

Consulting & Internal Review

The first pillar, "Consulting & Internal Review", corresponds to the most direct influence of NCEE in EPA's process of issuing new environmental regulations. Within EPA's regulatory process, the duty of issuing RIA for proposed and final rules, under the requirements of EO 12.886, falls directly upon the Program Office responsible for the corresponding regulation. However, this does not mean that they cannot resort to external contractors or even other EPA departments.[93]

In this context, NCEE joins the regulatory process as an "in-house contractor" whose work can be subdivided into four different activities: to develop guidelines, to assist the progress of economics analysis by Program Offices, to develop full-blown or partial analysis as commissioned by Program Offices, and to review RIA and economics studies to assure their soundness and consistency.

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[92] Other channels are: peer-review comments and influence on NCEE's reports, impact factor and diffusion of NCEE's published articles and reports, relative weight of a specific group of influential scholars within NCEE's work, and participation of NCEE staff on externally organized workshops, seminars, and conferences.

[93] In fact, one information retrieved from the interviews is that Program Offices, given the increasingly complexity behind economic studies, often outsource specific analyses, as industry-specific impacts or technical requirements, to private contractors, which will be later incorporated into a much broader RIA.

NCEE's most reported activity during the interviews was to issue guidelines for EPA's economic analysis.[94] The reason behind it is to establish a consistent framework to support EPA's economic studies, at the same time as they provide a roadmap for Program Offices to follow when coping with the several complexities behind economic analysis of environmental policy. Amongst the several guidelines issued by NCEE, the "Guidelines for Preparing Economic Analysis" (EPA, 2010a) must be highlighted for it directly addressed how to develop RIAs and an environmental BCA.[95] In it, not only NCEE summarizes the legislation that EPA is subject to when performing RIAs (chapter 2), but also presents and discusses major analytical methods and issues pertaining to risk management and environmental BCA key topics. Roughly, the guidelines address how to: state a need for policy action (chapter 3), select regulatory and non-regulatory approaches to pollution control (chapter 4), define baseline conditions (chapter 5), estimate (and monetize) environmental and health benefits (chapter 7), assess the likely costs (chapter 8) and a recent discussion on equity and environmental justice (chapter 10), use discount rates and compare impacts across time (chapter 6), and format and present economic analysis and results (chapter 11).

Although the "Guidelines for Preparing Economic Analysis" sets broad courses of action for economic analysis, NCEE has also used its unique position as a group specialized in environmental economists to provide guidance on intricate economic analysis with a cross-Agency usage. Subjects such as measuring VSL or impacts on children's health, which affect more than one Program Office, are topics of other several additional guidelines issued by NCEE, sometimes assisted by different EPA's Offices. Their aim is to define patterns of action and to present existing economic techniques and method regarding these specific topics within environmental and health regulation. Some of these "handbooks" are:

i) "Valuing Mortality Risk Reductions for Environmental Policy: a White Paper" (EPA, 2010b): a summary of key topics related to the valuation of mortality risks, including a description of several possible

[94] All 11 interviewees commented this activity was a primary concern to NCEE.
[95] NCEE has issued the first guidelines for economic analysis in 2002, which was later reviewed and updated in 2010. This review had left missing, however, a chapter regarding environmental justice and equity issues, later incorporated in 2014.

approaches for synthesizing empirical estimates of values for mortality risk reductions.

ii) “Handbook on Valuing Children’s Health” (EPA, 2003): a reference tool to conduct economic analysis of EPA policies when they expect to affect risks to children’s health. Developed by a joint effort of NCEE and the Office of Children’s Health Protection.

iii) “Handbook on the Benefits, Costs, and Impacts of Land Cleanup and Reuse” (EPA, 2011b): summarizes theoretical literature and make recommendations on how to assess benefits and costs of policies related to land cleanup and reuse. Developed by a joing effort of NCEE and the Center for Program Analysis within the Office of Solid Waste and Emergency Response.

iv) “America’s Children and the Environment” (EPA, 2000; 2013): two publications that compile data and quantifiable indicators to factors relevant to the environment and children’s health in the US, inform discussions about how to improve data on such aspects, and include indicators to track and evaluate efforts to minimize impact of environmental hazards on children.

If setting guidelines for EPA’s economic analyses embodies NCEE’s potential indirect influence on RIA development, the interviews indicated that, though important, this activity represents only the surface of NCEE’s real ongoing functions and ongoing actions within EPA. Even though NCEE is not a mandatory threshold through which new environmental regulations must pass by and receive approval, its members are often assigned to roles within the regulatory process as either an providing active consultancy, developing partial or full economics analysis for the RIA, or reviewing and evaluating the consistency of RIA’s economic methods.

For NCEE to assist Program Offices in developing RIAs, the interviews made clear that Program Offices actively must seek NCEE for guidance and help on economic matters. The following interview excerpts illustrate how a NCEE staff envisions the ideal relation between NCEE and Program Offices:

> Our best case is to have each of those offices do the economic analysis and […] bring us in the beginning to brainstorm, […] to get a second opinion, peer-input about what's going on, what they are planning on doing and whether it is feasible or defensible, what models they are going to use. They get a second opinion from us as colleagues. (Interviewee 1).

NCEE's role in assisting Program Offices regarding the definition of methods, variables, and an overall strategy to develop economic analysis was recurrently mentioned in interviews. Actually, one interviewee characterized NCEE as a "consulting shop" that Program Offices could resort to when developing in-house economic analysis and that NCEE would then be called to help the calculation of rules' benefits or likely impacts. However, in this role, NCEE is not limited to Risk Management stages associated with economic analysis or designing efficient regulatory mechanisms. In fact, since both benefit and cost analysis are primarily based on quantitative information that has not been monetized, NCEE also consults on the type of data that risk assessors should develop to subsidize economic analysis (such as dose-response functions for hazardous substances to both health and the environment). In addition, as a "consulting shop", NCEE can also act as an "in-house contractor" responsible for developing commissioned impact analysis. This is the case when Program Offices wishes to assess the economic impacts of a specific rule, and instead of developing themselves or outsourcing to a private contractor, they ask NCEE specialists to perform such studies.[96]

Notwithstanding, three main factors were brought up during the interviews that might limit NCEE's role as both a consulting group and a potential "in-house contractor". First, amongst EPA's Program Offices, there are some, as the Office of Air and Radiation, who already employ a relatively large group of economists among their staff. Thus, these offices would not demand NCEE's direct assistance or consulting. Secondly, even in Program Offices who are understaffed with economists, either legislative mandates or a gap in economic knowledge corresponding to the subject matter of the office might preclude more complex economic studies subsidizing new environmental regulations.[97] Finally, interviewees

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[96] To develop full environmental BCA for rules is not, however, among NCEE's primary functions. Several interviews pointed that while it is possible and NCEE sometimes is responsible for performing economic analysis to be incorporated within a RIA, this is close to an exception than to the rule.

[97] The Office of Chemical Safety and Pollution Control, for instance, enforces the Toxic Substances Control Act that grants EPA the authority to limit or ban a chemical product, but only by indicating that such chemical poses and "unreasonable risk", including an indication of net benefits of regulating. However, one interviewee stated that given the necessity of working closely with risk assessors so

stated that sometimes the Program Office calls NCEE too late in the regulatory process, when the RIA has already been developed, thus not using their expertise to initially define a sound research strategy according to mainstream economic theory.

Even constrained by these three restrictions, NCEE has a fourth activity that strongly connects this group with the regulatory process: to act as a review group for Program Offices' RIAs. A NCEE employee summarized NCEE's role as a "semi-outsider" review body:

> We [NCEE] also, in practice, serve as a second check. […] In a way, the Program Offices develop rules and then they do their economic analysis of the rule. But, they are within the same office and so, I think, a **critical role that we play is to look at that economic analysis from a "semi outsiders perspective**". **We […] pretend like we are OMB and look at what the Program Offices have done**. And, because we are a little bit further from the rule, we are not within the program, I think we have a little bit more of objectivity. Plus, we are PhD economists, so we understand most of the technical pieces, and so I think we improve the quality of economic analysis by providing this review. (Interviewee 2, emphasis added).

As such, NCEE is compelled to ask the "hard questions" to the Program Offices. During interviews, the following issues were commented as seldom analyzed by NCEE: what are the likely benefits and costs, is the economic method consistent, how real are the assumptions, are there impacts (positive or negative) that could be considered and monetized, but were not. These are the sorts of issues mentioned during the interviews[98], as illustrated in the interview excerpt below:

> The good thing about our location in Office of Policy is that we do get a final review, so before the rule goes forward, NCEE gives input on the rule. We look at how they did their benefit-cost analysis. […] NCEE, particularly on the "big rules", gets a say in "did you do this correctly?", "did you do this wrong?", and so that is one of our main functions here: to review those, to see if they did that [BCA] properly. That is where a lot of economic analysis comes in, and then we got our principles. NCEE developed their "Guidelines for Preparing Economic Analysis" so "did people follow those", and "did people follow just mainstream and environmental economics?", "did they do that properly?" (Interviewee 3).

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they provide sufficient information for economic analysis (i.e. dose-response function) its relationship with NCEE is not as strong as it could be. Another example is the Office of Air and Radiation. Since they have a larger group of economists, when compared to other Program Offices, it often does not seek NCEE consultancy. In addition, the current interpretation of the Clean Air Act states national emission standards should be based on health protection "to the extent possible", thus precluding economic analysis and considerations, limiting NCEE's influence on these matters.

[98] Not only NCEE staff, but personnel from Program Offices also lauded NCEE role as an "internal" review body.

In that same interview, NCEE's review was deemed as especially important within the regulatory process because it nudges EPA's economic analysis not only to what NCEE thinks is "good economic analysis", but also because OMB is likely to apply similar filters during their review. As such, NCEE would act as an in-house regulatory body and would simulate OMB oversight, thus mitigating issues that would preclude the approval of new environmental regulation, before such rule ever having left the agency.

Although review is central to NCEE's influence on the regulatory process, according to the interviews, its role has not been stable across time as it is influenced by political decisions and views of current EPA Administrators. If historically there were times when the Administrator has granted NCEE a "competing role" in which it could oppose Program Offices' new rules by actively issuing a "thumbs-up or thumbs-down" signal regarding RIA's economic soundness, lately NCEE's role has been less of a final approval and more of a continuum. In this continuum, NCEE and Program Offices work together to improve economic analysis and point where OMB might have issues. Two interviewees characterized this "continuum" as a much more productive, long-term, relation where both NCEE and the Program Office have a stake on RIA's outcome. In the cases that economic impacts receives attention and measuring regulatory benefits and costs become valuable input for regulatory decisions, Program Offices then find in NCEE a strong ally within the regulatory process, specifically for aligning RIA's to OMB's expectancies.

NCEE portrays an "in-house" consultancy and review group within EPA's regulatory process. As such, it potentially influences three components of the RBR Cycle. First, guiding which type of information can and cannot be monetized, NCEE partially influences Risk Assessment. In addition, Risk Management receives greater attention once NCEE provides guidelines on how to conduct and presents RIAs, assists Program Offices in selecting and structuring regulatory mechanisms and economic methods/analysis, and actively develops commissioned studies to be included in RIAs. Finally, interviews unveiled NCEE position as a "semi-outsider" review group, in which it attempts to screen out potential issues in proposed and final RIAs, thus anticipating and better preparing EPA for OMB's Regulatory Oversight.

NCEE's activities, however, go beyond assisting Program Offices directly within the regulatory process. The interviews outlined a second pillar that, while adjacent to the formal process behind new environmental regulations, has the

potential of altering how economic analysis is incorporated within EPA policymaking: the role of fostering independent and agency-oriented research.

Independent & Agency-Oriented Research

As a group of PhD economists, NCEE is not only responsible to “put theory into practice” and apply technical knowledge to support EPA rulemaking. Since its formation, NCEE has embraced far more extensive functions to “explore emerging and cross-cutting issues”, “improve EPA’s economic tools”, and “serve as a gateway for academic research” (EPA, 2014a). NCEE carries a duty to not only develop new research and studies meeting EPA’s needs, but to also nurture independent research fostering environmental economics theory and BCA methods, either developed by NCEE or external investigators. Its condition as a separate group of PhD economists without specific regulatory competence makes them accountable to address cross-program issues (such as VSL and usage of discount rates).

> NCEE has the Agency’s largest concentration of environmental economists on staff, making it uniquely qualified to conduct in-house analysis and research in support of programs or high-priority cross-program projects. NCEE also uses contracts, cooperative agreements, and grants in various ways to support program or cross-program research objectives (EPA, 2005, p. 4-3).

As an environmental economics research cohort within EPA, NCEE has two main lines of actions: external and internal. Externally, NCEE offers competitive grants for independent research projects or workshops addressing environmental economics subjects. Internally, NCEE conducts commissioned and independent studies. Even though NCEE provides in-house consulting in economic matters to EPA Program Offices and assists is specific RIAs, it must be noted that its primary purpose when conducing internal or funding extramural research is, rather than to directly assist specific rulemaking, to enhance current understanding and methods to analyze the intersection between environmental science and economics. The assumption behind this rationale is that an increased pool of knowledge will eventually allow EPA to make better and more accurate decisions. Such guidance is

particularly important for those cross-program subjects, as discounting and standards figures for VSL. While varied, these research activities are important because they may indicate which topics, within RBR and environmental BCA, are priorities for EPA and NCEE.

NCEE grants intend to promote the field of environmental economics and its sub-fields. One interviewee described NCEE grants' purpose as

> Grants are supposed to be not to help EPA make a decision, but really to help and increase the broader public's welfare and capabilities to have questions answered or improve techniques that other people can choose and use to help to inform actual EPA decision. But the work itself is not supposed to be developed, produced and then you turn it in into a chapter in an economic report for a water rule or an air rule. It is supposed to be a little removed from that purpose (Interviewee 4).

From 2002 to 2010, NCEE has awarded approximately US$ 4.3 million[99] in grants to external workshops and research projects. This amount was distributed across 41 different proposals from 30 different institutions (from universities to private think tanks), with an average funding of US$ 105,000/project and approximate range between US$ 12,500 and US$ 330,000.

Associating the subject of each proposal to a corresponding RBR Policy Cycle component revealed projects associated only with Risk Assessment, Risk Management, and Evaluation.[100] Moreover, a few projects explicitly embarked more than one RBR component, implying a non-exclusive categorization.[101] Thirteen of the 41 grants were also awarded to workshops whose description did not specify which topics within environmental economics and policy would be embarked or encompassed technical abilities useful to, but not exclusively linked with, environmental regulatory policy.[102] Thus, the projects were characterized as belonging to at least one of four non-exclusive groups: "risk assessment", "risk management", "evaluation", and "others".

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[99] All monetary figures corresponding to grants awarded by NCEE were converted to 2010 values.
[100] This concentration was expected, since "Risk Identification", "Regulatory Oversight", "Implementation & Enforcement", and "Coping" are political and/or procedural processes which are not usually subject to economic analysis.
[101] E.g. Research project "Expert elicitation of the deep uncertainty surrounding the market and non-market damages of climate change" (EPA ID: 83497701) proposed to develop and implement a survey instrument to elicit expert judgment on uncertainty regarding both non-market and market impacts of climate change policy (it relates to both Risk Assessment and Risk Management).
[102] E.g. "Micro-Econometrics Training Workshop" (EPA ID: 83414401-0)

Table 3 summarizes the information of total grants and quantity funded per RBR Policy Cycle component, exposing two interesting findings. The first is the relative concentration of grants on topics pertaining to Risk Management; 58% of all funding (close to US$ 2.5 million) addressed either regulatory mechanisms or tools and methods to study *ex ante* policy impacts. This result was already expected, once environmental economics is *per se* a subject associated with Risk Management, once it encompasses topics such as environmental BCA and studies looking for efficient regulatory instruments. However, NCEE has also expanded, although marginally, its "economic-orientation" by funding studies whose purpose was to to bridge the gap between risk assessment and economic analysis or to assess *ex post* regulatory impacts.

Table 3 – NCEE Grant's distribution around RBR Policy Cycle's components (2002 – 2010)

	Number of Grants				Funded Amount 000's of 2010 USD[1]			
	Research Project	*Workshop*	**Total Grants**	**Total Grants** (%)	*Research Project*	*Workshop*	**Total Funding**	**Total Funding** (%)
Risk Assessment	*2*	*2*	**4**	10%	*$261*	*$62*	**$323**	8%
Risk Management	*16*	*10*	**26**	63%	*$1,963*	*$513*	**$2,476**	58%
Evaluation	*6*	*1*	**7**	17%	*$232*	*$37*	**$267**	6%
Others	*0*	*13*	**13**	32%	*$0*	*$1,239*	**$1,239**	29%
Total[1]	***18***	***23***	**41**	**100%**	***$2,193***	***$1,789***	**$4,305**	**100%**

Source: own elaboration based on EPA (2014d)
[1] Adjusted to 2010 USD. Funding for proposals who embraced more than one RBR Policy Cycle component was assumed to be equally distributed among them.
[2] Total quantities do not represent the sum of its sub-components because the classification is non-exclusive

If the grants are predominantly focused on Risk Management, they have encompassed a wide range of topics within environmental economics, such as Voluntary Mechanisms,[103] Market-Based Regulatory Instruments,[104] and Benefit Analysis[105]. To study which topics comprises NCEE's major concerns, we scrutinized NCEE's internal research, which may be decomposed in four major areas: i)

[103] See the following grant: EPA ID 83497701.
[104] See the following grants: EPD ID 93456501; 83456801
[105] See the following grants EPA ID 83358801; 83359101; 82248201.

commissioned *ex ante* economic analysis, ii) commissioned *ex post* economic analysis, iii) evaluation and improvement of economic tools and regulatory mechanisms, and iv) independent research.

The first has already been presented in the previous section. Program Offices may intend to propose a new regulation but do not possess the required expertise to perform their own economic analyses. In such cases, NCEE may be "hired" as an "internal contractor" to perform specific economic analysis for either to be included in the RIA, or to provide a first rationale to define if it is worthy to continue pursuing such-and-such regulation.

In a similar pattern, EPA's Program Offices or other departments might commission e*x post* analysis for specific regulatory policies, an activity that would "complete" the RBR Policy Cycle. As observed during interviews, this activity must overcome several technical variables mainly associated with database and information. After a new regulation has passed, EPA cannot force the private sector to provide information regarding how much costs the rule actually imposed. Moreover, to gather data regarding regulatory benefits can be costly and imply major efforts to measure a rule's corresponding benefits as net welfare gains. Notwithstanding being in its beginning stages, NCEE effort to foster Regulatory Evaluation may hold the important duty to compare how EPA's *ex ante* economic analysis reflect a rule's *ex post* impacts. If major disparities are shown, this activity provides important information to improve future RIAs and EPA's rulemaking.

Furthermore, if assessing rule's impacts may expose new challenges that demand novel economic methods for developing a RIA, differences between *ex ante* and *ex post* analyses may indicate shortcomings in economic tools that have been used by EPA. As such, by incorporating Evaluation as an activity, NCEE indirectly evaluates economic methods and incentivizes studies for developing new methods for assessing environmental regulation's economic impacts. After new economic tools are developed, they are subject to peer-review, a topic that will be later addressed. While NCEE's commissioned research activities were only briefly exposed, NCEE's independent research has provided an indicator to characterize its focus within the RBR Policy Cycle and environmental BCA.

In 2005, NCEE and EPA's National Center for Environmental Research, EPA's department with the mission to support extramural research on exposure, effects, risk assessment, and risk management to support, jointly issued EPA's

"Environmental Economics Research Strategy" (EPA, 2005). Based on 75 interviews with people from 21 separate EPA offices, the report sought to establish general priority research topics, establishing five strategic objectives to be pursued: health benefits valuation, ecological benefits valuation, environmental behavior and decision-making, market mechanisms and incentives, and benefits of environmental information disclosure. These five goals illustrate once again the prominence of Risk Management within Environmental Economics, but specifically with aspects related with benefit analysis. Has NCEE exhibited this same preoccupation with Risk Management and environmental BCA within its independent research or have other topics dominated its research agenda?

Similar to the pattern identified IN their external grants, NCEE publications have encompassed three steps of the RBR Policy Cycle: risk assessment, risk management, and *ex post* evaluation. "Risk Assessment" articles worked on furthering techniques to assess risks and discuss how to incorporate "hard-sciences" within economic analysis. Articles that discussed not only how to regulate (regulatory mechanisms), but also techniques to assess, monetize, and quantify regulatory impacts, and other factors that influence analysis of "how much" regulation is warranted or how agents respond to regulation were classified as belonging to "Risk Management". Finally, "Evaluation" studies assessed *ex post* impacts of real policies at multiple levels (municipal, state, national) and in varied locations.[106, 107] These classes were also non-exclusive since few articles addressed more than one RBR component, e.g. defense/criticism of such-and-such regulatory instrument (risk management) by analyzing real policies' results (evaluation).

Figure 7 presents a Venn diagram illustrating how Risk Management has dominated NCEE publications (86% of all articles have addressed in its entirety or partially Risk Management matters, with 62% addressing solely Risk Management). It also displays important articles in the intersection between Risk Management and Risk Assessment (15%) and Evaluation (9%). Considering the RBR Policy Cycle and

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[106] A separate category for "others" was not created because, although several articles did not address specific regulations or were theoretical models, they seldom embraced aspects related to how agents might respond to regulatory policy or how they act under different constraints. These contributions were considered as relevant to the decisions of both "how to" and "how much" to regulate, thus belonging to "Risk Management".

[107] No articles embraced the following topics: the political process through which a new risk might enter the regulatory agenda (Risk Identification); mechanisms to improve or analyze current regulatory review process (Regulatory Oversight); the process of enforcing regulations (Implementation & Enforcement); or how to adapt regulations after having already being implemented (Coping).

environmental BCA, these intersections reinforce the cross-disciplinary nature behind RBR. If NCEE has worked on how to better combine and develop scientific, hard-science, information to subsidize economic analysis, by evaluating *ex post* impacts, it can improve EPA's regulatory outcomes by analyzing and comparing the efficiency, shortcomings and advantages of such-and-such regulatory mechanisms and economic tools.

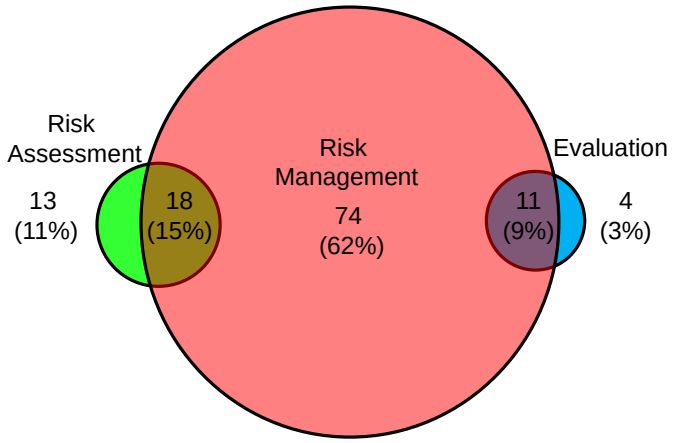

Figure 7 - Distribution of articles authored by NCEE staff and published in peer-reviewed journals (by RBR Policy Cycle's stage, 2000 – 2013)
Source: own elaboration

Table 4 – Distribution of NCEE staff and published articles (by RBR Policy Cycle, Risk Management, and BCA components, 2000 – 2013)

	NCEE staff[1]	Articles	% Total NCEE staff[1]	% Total Articles
Risk Assessment	**10**	**31**	**42%**	**26%**
Risk Management[2]	**24**	**103**	**100%**	**87%**
Regulatory Design	9	21	38%	18%
Benefit-Cost Analysis[2]	24	64	100%	54%
Baseline	3	1	13%	1%
Discounting	7	4	29%	3%
Cost Analysis	12	20	50%	17%
Benefit Analysis	22	51	92%	43%
Others	12	19	50%	16%
Evaluation	**11**	**14**	**46%**	**12%**
Total[2]	**24**	**119**	**-**	**-**

Source: own elaboration
[1] This table only considers 24 of the 33 current NCEE staff (with at least one article in the database).
[2] "Total", "Risk Management", and "Benefit-Cost Analysis" do not represent the sum of its sub-components because the classification is non-exclusive

Taking Risk Management as NCEE's research core, Table 4 summarizes our sample and presents further sub-divisions that evidence NCEE's narrower focus on a specific topic: environmental BCA. Not only 54% of all articles addressed a topic

within environmental BCA (cost analysis, benefit analysis, baseline, and discounting), but also all members within our sample have authored or co-authored at least one article addressing this topic. However, it appears that environmental BCA cannot be understood as a unique pillar within NCEE, but rather presents further subdivisions with different levels of prominence. In accordance with the research strategy established in 2005, NCEE has focused its independent research in “Benefit Analysis”, representing more than 40% of all published articles in our sample.

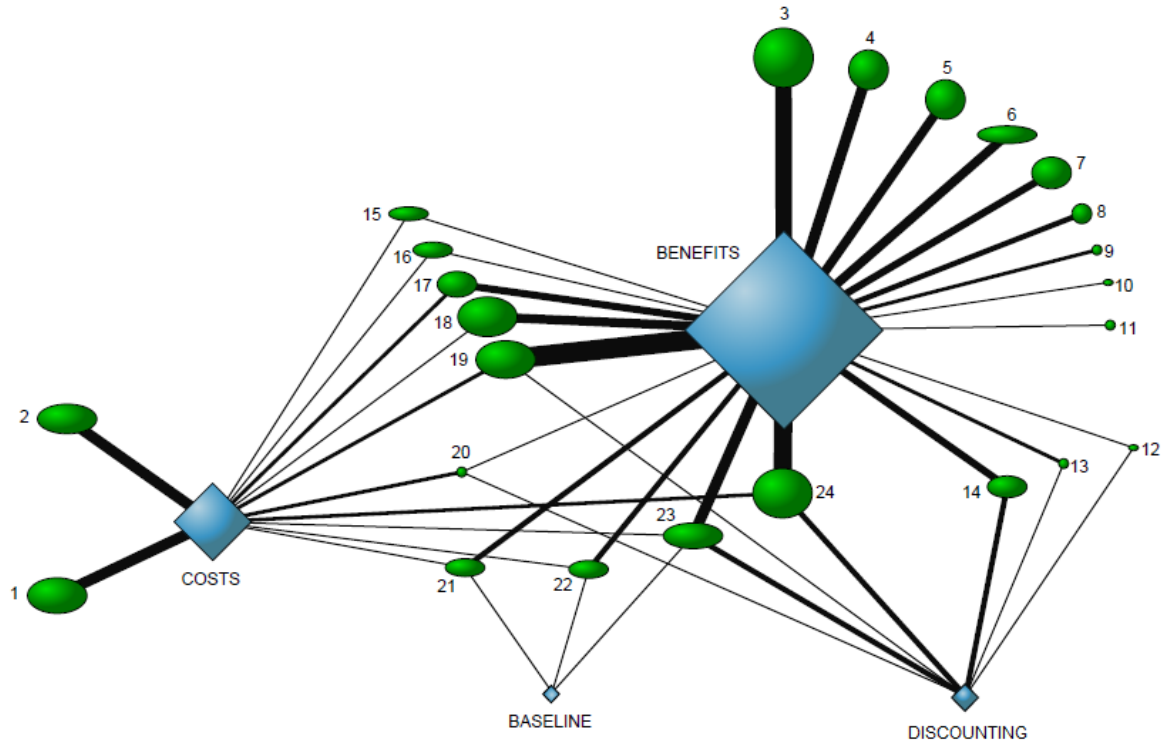

Figure 8 - Distribution of articles authored by NCEE staff and published in peer-reviewed journals (by BCA topic, 2000 – 2013)
Source: own elaboration

Figure 8 displays a network representation mapping the relative position of the 24 NCEE members who have been considered in our sample (green ovals) in relation with BCA sub-topics (blue diamonds). For the oval vertexes representing NCEE members, the horizontal length represents each person’s relative number of articles published within our sample and the vertical height represents each’s relative number of articles addressing environmental BCA (the longer the vertex, the more articles have been published; the higher the vertex, the more articles addressing environmental BCA have been published). For diamond vertexes representing BCA topics, their size is directly proportional to the total amount of articles that NCEE have published addressing that specific topic. The thickness of each line represents the

number of articles published by each author addressing the corresponding BCA sub-topic.

A first look at the network indicates that NCEE is divided in different cohorts according to their preferred research topics. Vertexes 1 and 2 are the only ones apparently specialized in cost analysis. While this is represents 17% of all articles published by NCEE, and 12 people (50%) have published articles addressing “costs”, several of them have authored only 1 article on cost analysis whereas have multiple articles on other topics, especially benefit analysis (see vertexes 17-19 and 21-24).

Benefit analysis concentrates most of NCEE publications. From the 24 members within our sample, 92% of them (22) have published at least one article addressing benefit analysis. In addition, vertexes 3 through 11 forms a clear group whose research core is Benefit Analysis, all of them have published exclusively on benefit analysis.[108] Even members 23 and 24, the most “cross-topics” and have published on, at least, three BCA sub-topics, present stronger connections with benefit analysis. As we showed in section 4, benefit analysis concentrates most of the multidisciplinary criticisms addressing environmental BCA. NCEEs focus on this aspect would be a response to the gap created by several environmental (and health) benefits which are not currently monetized within RIAs due to the lack of proper economic techniques or information. As a result, benefit analysis provides more space for further research on new methods for assessing and monetizing environmental benefits which were previously only qualitatively described on EPA’s economic analyses.

The low proportion of people and articles addressing baseline and discounting was surprising. If baseline is a preliminary condition for every environmental BCA and, thus, subject to criticism due to different possible assumptions, discounting has been one of the most discussed topics, both ethically and technically, within environmental BCA due to its effects on environmental and health long-term impacts, as those incurred by future generations. Only one article has discussed the issues regarding baseline definition, while four have addressed how to determine or which discount rate should be used. Some possible explanations

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[108] Vertex 6 deserves a note of explanation due to its below-average height to width ratio. This vertex represents a researcher whose papers mainly address Risk Assessment and how to better structure them to subsidize environmental BCA. While he has published several articles, many of them discuss only Risk Assessment and are not directly related to Risk Management or valuation of environmental resources.

for the relative inattention received to such topics are that baseline definition is extremely case-specific and based on informed assumptions and that OMB's Circular A-4 (Omb, 2003a) legally mandates that agencies should use a 3% and 7% discount rates when developing RIAs. Thus, rather than discuss methods to redefine discount rates, or even passing from constant to declining rates, NCEE focus on applied policy issues, abiding to OMB guidelines instead of questioning it.

Education and Outreach

Although environmental BCA has been present in the regulatory system since the Reagan Administration, the issuance of new environmental rules within a RBR framework is a result of a combination of the work of several specialists, each contributing within his/her own field of expertise. Economists are no exception. RIA and environmental BCA are mandatory for economically significant rules, and such efficiency requirement seems common sense for economists and environmental BCA practitioners, as NCEE. However, Program Offices employ specialists in the areas of environmental law and environmental and health sciences, responsible for proposing and drafting new rules, and conducting risk assessments, who may not understand the economic methods and rationale behind environmental BCA, as well as its underlying assumptions, advantages, and limitations. This dissonance motivates an important part of NCEE's responsibilities: to foster and disseminate environmental economics, as well as the concern with regulatory efficiency, to EPA's Program Offices.

Throughout its consulting and research pillars, NCEE educates EPA's staff in respect to how environmental economics works and how Program Offices might use it within their regulatory tasks. By issuing guidelines on how to conduct economic analysis, NCEE organizes disperse knowledge from the field of environmental economics in order to offer a simplified, and yet useful, explanation on how to organize and the steps involved in developing an environmental BCA.

Also by assisting Program Offices in developing economic analysis and reviewing RIAs for proposed regulations, NCEE assumes a teaching role, which not only standardizes EPA's economic analysis, but also provides new ideas and

explanations on how to apply economic methods and structure proper economic analysis. Even though these represent formal educational linkages between NCEE and Program Offices, interviews revealed that “brown bag lunches” are an additional and particularly informal channel of communication amongst economists and other departments within EPA. These sessions usually happen during lunch, using a normal break in the workday, are mainly informal and are used for NCEE economists to expose the potential usages and interpretations of economic analysis within the area of environmental policy.

The following interview excerpt presents the view of a NCEE economist on how the relationship between NCEE and Program Offices is not solely characterized by formal consulting and review, but also represents an educational process, as NCEE is responsible for:

> […] bringing some research ideas and kind of selling them to certain extent on the potential for some things to be done that they might not have come originally to us with. […] Trying to educate a bit because in those cases, […] many of the folks we are working with in the Programs are not PhD economics. Many are not even trained or have degrees in economics, but they have learned a little bit on the job, or […] come to learn the value, the importance, or the reliance on some economic information to help accompany all the other things they come up together for their rules. (Interviewee 4)

However, such internal educational channels are insufficient to assure the dissemination of proper economic analysis and principles within the agency. Once environmental economics is a changing field, EPA must keep to date regarding new concerns, methods, and estimations fostered by scholars working on environmental economics. It was bestowed upon NCEE the task to bridge this gap between the academic world and EPA’s rulemaking by creating channels with this network of specialists and then disseminating it within EPA.

Extending the connection between EPA and external specialists, NCEE organizes and distributes developing research papers for purposes of information and discussion through the NCEE Working Paper Series.[109] From 2001 until 2014, 102 working paper on environmental and climate change economics have been made available in NCEE’s website. Although we do not take a closer look at this specific activity, it is worth mentioning that 61 (50%) were categorized by NCEE as

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[109] See http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/workingpaperseries.html

pertaining to the following categories related with environmental BCA: i) Benefit-Cost Analysis, ii) costs of pollution, iii) discounting, iv) economic damages/benefits, v) health impacts, vi) valuation, and vii) valuation methods (EPA, 2014f).

More importantly, NCEE has sponsored several seminar series and workshops to share information about environmental economics and science, developed outside the agency, with EPA several departments. Whereas seminars usually bring one scholar (from within or outside the agency) to share his/her research and field of expertise to EPA, workshops are a forum in which several academics, EPA employees, and other federal researchers present works on a particular topic of interest. Particularly, NCEE hosts three different seminar series: “Environmental Economic Seminars”, “Climate Economics Seminars”, and “Climate Science Seminars”:

> The first series, the Environmental Economic Seminars, serves as a forum for presentations on timely topics in environmental economics. The second series, the Climate Economics Seminars, focuses on issues related to the economics of climate change. The third series, the Climate Science Seminars, […] under this series, a range of climate science issues are investigated, including forecasting challenges and impacts on ecological and human health (EPA, 2014c).

When matching such categories to its corresponding RBR Policy Cycle stages, we find that whereas the first and second mainly address Risk Management by focusing on environmental BCA, regulatory design, and economic impacts of climate change, the last relates with Risk Assessment. Since 2000, NCEE has also sponsored 18 workshops, in which NCEE gathers several specialists to discuss individual topics, which have ranged from environmental BCA, regulatory design and market-based mechanisms, environmental justice, employment effects of environmental policy, and economics of climate change. Even though environmental BCA is not the sole subject of these workshops, they all relate with the broader economic inquiry involved in conducing RIA for proposed environmental regulations.

Table 5 illustrates that, as expected, NCEE mainly sponsors events on topics covering economic aspects of environmental policy. From the 80 seminars sponsored by NCEE, 70 (88%) address environmental or climate economics. More importantly, 32 out of the 80 seminars (32%), and 9 out of the 18 workshops (50%) result that 42% of all events NCEE-sponsored events have environmental BCA as their subject, thus bridging the gap between EPA and external specialists within the

environmental BCA epistemic community. Exhibiting a similar pattern as the one observed in NCEE employees' publications, environmental and health benefit analysis are the dominant topic within NCEE-sponsored events, especially within those events addressing environmental BCA. Not only 34% of all events address benefit analysis, but 80% of all BCA-related events (33 out of 41) promote topics within the realm of environmental and/or health benefit analysis.

Table 5 – Summary of NCEE-sponsored events (2000-2014)

	Events	**BCA-related (total)**	**BCA-related (%)**	**Benefit Analysis (total)**	**Benefit Analysis (%)**
Environmental Economics Seminars	34	18	18%	15	44%
Climate Economics Seminars	36	14	14%	9	25%
Climate Science Seminars	10	0	0%	0	0%
Workshops	18	9	9%	9	50%
Total	98	41	42%	33	34%

Source: own elaboration based on EPA (2014c).

These seminars and workshops also illustrate how NCEE holds an important function of gathering a diffuse network of environmental BCA specialists, an epistemic community, in order to bridge the gap between agency and environmental economists. Over those 41 BCA-related events organized by NCEE since 2000, we find that 155 different researchers (from academia, private institutions, and governmental agencies) have presented his/her research in a NCCE-sponsored seminar or workshop, representing around 99 different institutions (including EPA NCEE).[110] Figure 9 shows how NCEE-sponsored events indicate a rather disperse environmental BCA epistemic community. Although few organizations, as NCEE itself and the private think tank "Resources for the Future" have presented 18 and 16 times in NCEE seminars and/or workshops (when those addressed environmental BCA), 68% of all presentations have been given by researchers from one out of 93 which have been represented less than 4 times.

[110] In cases where the work had more than one author, we only considered the author responsible for presenting the lecture.

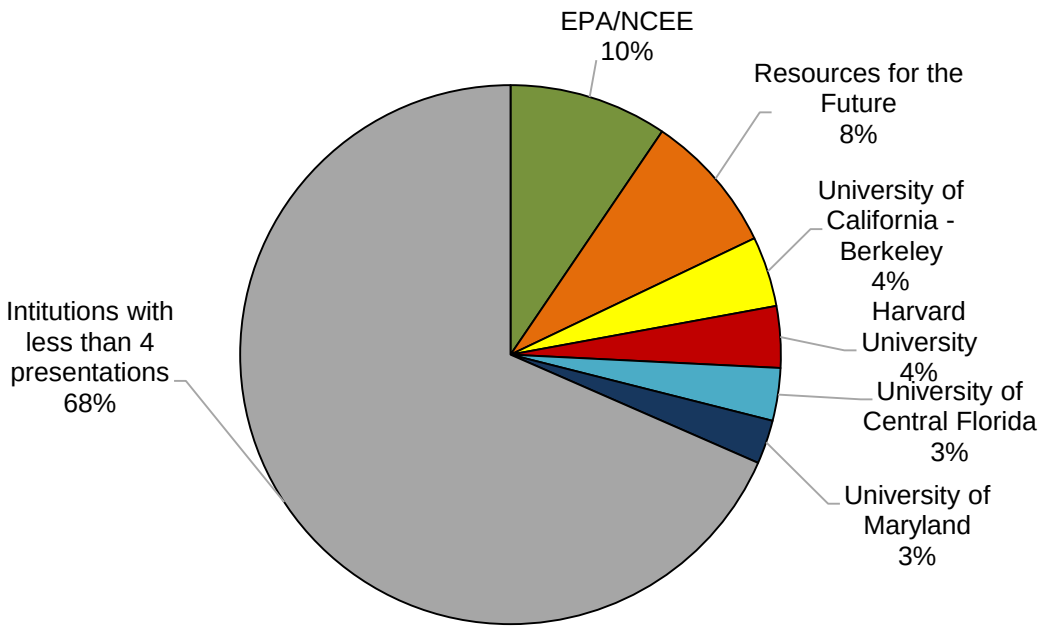

Figure 9 – Distribution of presentations in NCEE-sponsored events related with environmental BCA (by institutions, 2000-2014)
Source: own elaboration based on EPA (2014c).

NCEE has been responsible for several activities intending to not only propose new and improved economic methods for analyzing environmental issues, but also to advance the paths through which economic considerations can influence environmental policy. This section has analyzed how NCEE potentially spreads the influence of an environmental BCA epistemic community in several stages of the RBR Policy Cycle, mainly Risk Assessment, Risk Management, Regulatory Oversight, and Evaluation. Additionally, from the several stages within environmental BCA, NCEE has focused its attention on benefit analyses, as observed by published materials from this group's economists, funding for external research, and sponsored events.

Two main reasons explain why NCEE has focused its resources on benefit analysis rather than other aspects of environmental BCA. Analyzing the chart presented in section 4, which summarizes environmental BCA's multidisciplinary limitations (chart 4), we observed that benefits analysis is most criticized step. On the one hand, since assigning monetary values to non-marketed goods is not a straightforward process, economics has yet to develop methods for monetizing all benefits deriving from environmental regulations. On the other hand, regulatory costs

are naturally associated with monetary figures, and thus easier to assess – although, as we have presented, cost analysis is also heavily criticized. As a result, critics argue that environmental BCA systematically overweighs costs *vis-à-vis* benefits. As a response, NCEE would focus on developing new methods for fostering benefits assessment, thus enhancing environmental BCA's legitimacy as pragmatic and neutral.

The second reason emerged on EPA and NCEE employees' personal reports. Environmental BCA uses only monetized cost and benefit analysis to arrive at a final range of a regulation's welfare impacts. Since analysts lack methods for measuring several environmental and health benefits, which remain only qualitatively described in a RIA, BCA's conclusion disregard a set of environmental regulation's desirable impacts. If policy makers weighed evenly quantitative and qualitative benefits, this would not be an issue. However, personal reports have indicated that having an economic assessment presenting quantified, and monetized, regulatory impacts create a better argument for approving new environmental regulations than qualitative descriptions. Thus, if costs are more easily assessed and several benefits are not monetized, then environmental BCA would be biased towards cost analysis. More importantly, if those non-monetized benefits were actually embodied in the economic analysis, they could uneven the scale towards approving a new environmental standards which otherwise would be rejected. Aware of such possibility, NCEE would focus on benefit analysis because fostering new methods for assessing environmental benefits allows the Agency to consider benefits which, otherwise, would not be considered at all on environmental BCA.

Chart 5 ends this section by summarizing NCEE's activities according to their adherence to the group's pillars-of-action.

Activities \ Roles	Consulting, Internal Review & Standardization	Independent and Agency-Oriented Research	Education and Outreach
Issue guidelines for EPA's economic analysis	X		X
Assist Program Offices in developing economic analysis and regulatory design	X		X
Develop commissioned impact analyses as subsidy to RIAs	X	X	
Review RIAs and Economic Analysis	X		X
Award grants for external workshops and research projects		X	X
Develop commissioned *ex post* economic analysis		X	
Evaluate current tools, regulatory mechanisms and develop new economic methods		X	
Conduct independent research		X	X
"Brownbag" lunches			X
NCEE Working Papers Series			X
Organize and host economic workshops and seminars			X

Chart 5 - NCEE's activities and pillars
Source: own elaboration

6 CONCLUDING REMARKS

US government has embraced environmental BCA as a legitimate economic practice for *ex ante* regulatory analysis. While current practitioners argue that BCA is a mechanism to enhance regulatory policy's rationality and objectiveness, such tool's rise in the US regulatory system was actually the result of a socio-political synchronic process associated with different regulatory regimes. If economic values gained space in the political agenda after the 1929 crisis, leading to an associative regime between US government and private industrial groups in the post-war, the country witnessed a rising social demand for public action towards mitigating the environmental hazards caused by the rapid industrialization, culminating on EPA's creation in 1970.

However, the so-called societary regime was short-lived. Throughout the 1970s, as the US suffered with sluggish economic performance and macroeconomic instabilities, industries complained that environmental regulations imposed a straitjacket on private initiative and hampered the nation's economic performance. The Reagan Presidency marked the pulpit of a new efficiency regime, as Reagan made regulatory reform and deregulation one of his top priorities. Through EO 12291, Reagan brought economic values back to the center of US regulatory agenda, empowering OMB as the head of a mandatory regulatory oversight process and conditioning the approval of new "significant" regulations to the submission of a "hard BCA" proving that the rule presented net monetized benefits. Ever since, while Clinton's EO 12866 softened the strict economic requirements for issuing new rules, emphasizing the importance of qualitative impacts, BCA has been a recurrent practice in the US regulatory system, including at EPA.

Here, we focused on "environmental BCA", a particular variant of BCA applied to analyze environmental regulations' desirability and welfare impacts. A review of the literature exposed environmental BCA's idiosyncratic facets, and how they are distributed amongst BCA's stages of baseline-setting, benefit analysis, cost analysis, and discounting. More specifically, environmental BCA's practitioners rely on a set of idiosyncratic methods for assigning monetary figures to non-marketed benefits associated with environmental protection, and common concepts, as the "Value-of-Statistical-Life" and "Total Economic Value" of an environmental good.

Moreover, these experts also have shared notions of validity as the practice rests on quantitative methods and mathematical models, within the realm of new welfare and environmental economics, and on a set of normative and political assumptions derived from the utilitarian philosophy and guided by the focus on efficiency and neoclassical definition of rationality. As a result, environmental BCA's practitioners are interconnected forming an epistemic community with a common policy enterprise: to foster the application and influence of environmental BCA in the regulatory process.

If Reagan first defended BCA as a tool to reduce the "regulatory burden" upon private industry and as necessary step to reestablish US economic stability, once the economic conditions appeased, the responsibility to promote new arguments defending BCA's maintenance and usefulness in the regulatory process fell upon this epistemic community. Amid the rise of a risk-based mentality in the US regulatory system and the interpretation that public administration should rely on quantitative, evidence-based, and efficiency standards, epistemic community's members underscored that environmental BCA enhanced regulatory efficiency and consistency, promoted democratic principles, acted as a defense against society's bounded rationality, and provided a useful input in the regulatory process.

However, instead of a solid "environmental BCA" epistemic community, we exposed an "epistemic division" in which each environmental BCA's stage has particular methods, theoretical concepts and debates. Benefit analysis concentrates on issues regarding revealed or stated preference methods, or benefit transfer, to assess environmental regulation's monetized benefits. Discounting brings a profound normative discussion regarding which discount rate to use, as well as regarding how much weight to give to environmental benefits accruing on the distant future and the well-being of future generations. Cost analysis, although usually presented as relatively straightforward, analyzes compliance costs while tackling with issues such as how to account for technological innovation and asymmetric information.

Even if environmental BCA's defense rests on the idea of rationalizing the regulatory process, by relying on well-defined normative assumptions associated with utilitarian philosophy, this technique fosters a narrow, efficiency-based, view of what "rational" and "desirable" regulatory policy is. Although such limitation has already been recognized, since EPA complements a full RIA with analysis of equity issues, distributive concerns, and qualitative benefits, as well as OECD has, proposed

different methods for conducting RIAs, BCA remains heralded as a regulatory gold standard.

Furthermore, varied multidisciplinary limitations have qualified the reliance on a single comparison of monetized costs and benefits when analyzing environmental regulation. Although few economic, environmental, ethical, and political criticisms have addressed general aspects of environmental BCA, most limitations targeted aspects belonging to a particular stage within BCA, reaffirming the epistemic division. As we evidenced, benefits analysis and discounting have been the most targeted subjects, as economists artificially assign prices to non-marketed aspects of life and then incur into normative judgments regarding the welfare of future generations. Specifically on these matters, environmental BCA becomes inherently political, as normative assumptions support technical analysis, thus potentially influencing the regulatory outcome. However, this is not to say that cost analysis is strictly an accounting exercise, especially due to the opposition between proponents and critics of the Porter Hypothesis, and regulators with asymmetric information depends on regulated firms' information to calculate compliance costs.

NCEE represents a branch of the environmental BCA epistemic community located within EPA. Thus, this group is in a privileged position to influence policymaking and regulatory outcomes. Acting as an in-house consultancy and educational group, NCEE disseminates knowledge associated with environmental BCA throughout the regulatory agency, and interconnected with the broader network of specialists in environmental economics by conducting independent research, funding external research, and promoting workshops and seminars. Moreover, NCEE has concentrated its resources around one particular, yet broad, topic within environmental BCA, benefit analysis. Benefit analysis has become one of the most sensitive topics within environmental BCA and NCEE's activities reflects such situation, as the greater share of its internal and external efforts are directed at advancing techniques for benefit estimation. Such focus on benefit analysis is caused by the relatively absence of methods to monetize environmental regulation's benefits *vis-à-vis* its corresponding costs. Even though a comprehensive RIA must complement monetized calculations with qualitative description of all benefits, whilst environmental BCA continues lacking methods for monetizing several environmental and health benefits, its recommendations might promote a non-regulatory bias, as numbers may be more appealing than words for justifying new regulatory endeavors.

As such, without researching new methods for monetizing benefits, a substantial set of qualitative benefits might not be considered at all by the policymaker.

Interestingly enough, NCEE has not addressed discounting within its actions as much as the heated academic discussion on discounting environmental and health benefits would first indicate, especially those accruing upon future generations. We have attributed this to the institutions molding the US regulatory system. As OMB's Circular A-04 mandates that regulatory agencies' RIAs should have two scenarios, one considering a 3% (social) discount rate, and another considering a 7% (private) discount rate, and NCEE is majorly concerned with assisting EPA's economic analysis, this group abides by OMB's guidelines rather than questions them. However, this come at a cost, since novelties such as declining discount rates, which might have significant impact over an environmental BCA's final recommendation (and have already gained strength in Europe), are not discussed within this group. As a research group, NCEE should ideally incorporate such debates in order to propose changes in the environmental BCA's practice within the US regulatory process.

Within the RBR Policy Cycle, we found that NCEE's influence concentrates on Risk Management, as they provide consultancy for Program Offices in the process of developing RIAs for proposed regulation. In addition, NCEE also acts as an in-house oversight body, advancing OMBs economic reviews by analyzing RIAs economic soundness and proposing alternative methods for Program Offices to develop their respective environmental BCAs. Finally, NCEE is starting to conduct *ex post* evaluation of EPA's rules. This is an incipient, but crucial step to provide feedback regarding the Agency's actions and thus improving future regulations.

Notwithstanding, EPA's Action Development Process unveiled that NCEE's analysis is not a formal and mandatory threshold within EPA's regulatory process; rather, interviews conducted with EPA and NCEE employees revealed that whereas in an ideal scenario Program Offices would reach out for NCEE's assistance early in the process of developing environmental BCA and RIA for proposed regulation, this is seldom the case. Rather, NCEE usually joins the regulatory process in later stages and is less capable of assisting in the development of more solid economic analyses. Additionally, legislative mandates restrict NCEE's activities by impeding environmental BCAs usage for particular environmental regulations. Moreover, different Administrators might rely more or less on environmental BCA, thus creating

discretion around NCEE's actual influence on EPA's regulation, as its role and influence is not formal, but rather rests upon the Administrator's political and technical preferences. However, by promoting seminars and workshops, developing guidelines, and internally disseminating environmental economics and BCA, NCEE seems to articulate actions in order to increase its influence within the Agency.

Whereas this research has attempted to promote a broad overview of environmental BCA's theoretical, political, and applied characteristics, several interesting questions remain unaddressed, calling for following studies. First, although we have listed the characteristics of an environmental BCA's epistemic community, it would be fruitful to map its most influential actors and channels of communication. OMB/OIRA's influence on US regulatory decisions, which is of paramount importance to understand how BCA is embedded in the US regulatory process, also requires further studies. Moreover, as EPA is subject to several legislative mandates, and environmental regulations' characteristics vary according to the addressed topic (air, water, pesticides, waste management, and so on), it is possible that environmental BCA's impact depends on the regulated matter. To examine such hypothesis would require additional studies.

Even though we have explored NCEE several roles and mapped in which stages of the RBR Policy Cycle it might exert some influence, we have not addressed its relative position within environmental BCA epistemic community. Analyzing whether NCEEs contributions are marginal or influential within the development of environmental BCA would represent another research possibility.

We underscore the importance of future studies addressing environmental BCA's capacity to swerve or influence regulatory decisions. As the practice of RIA has spread throughout the world, BCA might follow its steps as the preferred method for applying it. For the sake of transparency, the policy-maker must comprehend whether such tool actually influences decision-making or whether it is a mere formality to legitimize vested political interests. In fact, as scholars have reached controversial conclusions regarding environmental BCAs influence, a hypothesis is that its first application derived from a political bargain, in which Reagan would trade the enforcement of industrialist's claim for political support, but without the intention of actually pursuing its enforcement over regulatory decisions. Such hypothesis would justify why (environmental) BCA's political influence is still uncertain, and propose that, just as NCEE tries to introduce itself in EPA's regulatory process, such

epistemic community is still struggling to consolidate its legitimacy as an advisor in regulatory decisions.

Finally, as the claim for evidence-based and rational regulations has risen since the 1990s, BCA gained strength in the developed countries. However, we have shown that an opposing group has exposed several multidisciplinary limitations to such practice, especially when applied to environmental, health, and safety regulations. The most profound criticism argues that (environmental) BCA rests on normative foundations, which may not represent a plethora of aspects concerning social welfare, such as intrinsic value, equity, morality. Moreover, several technical issues have also showed how environmental BCA may produce unreliable numbers, especially when addressing technological innovation and non-marketed goods. Policy-makers must be aware of such limitations before deciding to implement BCA as the preferred methods for developing RIAs, otherwise they will abide by several assumptions regarding the State's regulatory role without questioning whether they correspond to society's best interest.

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