IMPROVING THE THEORY AND PRACTICE OF
BENEFIT-COST ANALYSIS

Society for Benefit-Cost Analysis
9TH ANNUAL CONFERENCE AND MEETING
MARCH 15-17, 2017
WASHINGTON, DC

Presentation Abstracts
2017 Annual Conference and Meeting

March 15-17, 2017
The George Washington University
Washington, D.C.

Contents

Session 1: Thursday, March 16, 2017, 9:00 – 10:30am

➢ A-1: Valuing Mortality Risk Reductions in Low- and Middle-Income Countries: Addressing Data Gaps and Inconsistencies (Roundtable)

Chair: Lisa A. Robinson, Harvard University

In benefit-cost analysis, reductions in mortality risks are typically valued using estimates of the value per statistical life (VSL). These estimates are derived from studies of individuals' willingness to pay for small changes in their own mortality risks. However, few such studies address low- and middle-income countries, raising issues related to how to best estimate VSL in these contexts. While some issues are positive and could be resolved through more primary research, others are normative and require applying value judgments. This panel brings together several researchers who have developed approaches for estimating VSL in these countries. Each will first discuss the approach they recommend and the rationale for the approach, including how they have adjusted for factors such as income and age or life expectancy as well as how they have addressed concerns related to estimating social rather than individual values. We will then discuss options for harmonizing these approaches as well as priorities for future research.

Panelists:

Nils Axel Braathen, OECD

Maureen Cropper, University of Maryland

James K. Hammitt, Harvard University

Alan Krupnick, Resources for the Future

Urvashi Narain, World Bank

W. Kip Viscusi, Vanderbilt University

➢ B-1: Estimating Economic Values: Methods and Applications

Chair: Frits Bos, CPB Netherlands Bureau for Economic Policy Analysis

Presentations:

Sensitivity to Scope in Contingent Valuation and Discrete Choice Experiments: Results Based on Valuing Health Risk Reductions; *Henrik Andersson*, Toulouse School of Economics*

There is a large stated preference literature estimating willingness to pay (WTP) for health risk reductions using the contingent valuation (CVM) approach, and more recently often based on

the discrete choice experiment (DCE) approach. Irrespective of method, these studies often fail to show adequate sensitivity to scope, i.e. WTP does not increase as the quantity of the good or the number of goods increases. In this paper we compare the sensitivity to scope with the CVM and DCE approach based on respondents' WTP for mortality and morbidity risk reductions. We analyze scope sensitivity using between-subject tests, which is a novelty in the DCE setting. The results show that we can reject adequate sensitivity to scope in both the CVM and DCE design, and the degrees of bias and welfare estimates are very similar in the two approaches. Thus, using a more stringent scope sensitivity test than the standard approach in the DCE literature indicates that sensitivity to scope is an equal pressing issue in DCE as well as in CVM studies.

Hedonic Vices: Fixing Inferences about Willingness-to-Pay in Recent House-Value Studies; *John Yinger*, Syracuse University*

A key tool for studying the demand for neighborhood amenities and estimating the benefits from amenity improvements is a regression of house value on amenity levels, controlling for housing characteristics. Several scholars have developed methods to address the methodological challenges, such as endogeneity, faced by these "hedonic" regressions. Unfortunately, however, some recent studies neglect basic principles of hedonic estimation in Rosen (1974). After providing conceptual background, this article explains these hedonic "vices" and how to avoid them. We focus on inappropriate functional forms, inappropriate control variables, and misinterpretation of hedonic regression results. Our analysis is supported using data from the Cleveland area in 2000 and a simulation model.

Including the Perspective of the Incarcerated Person in Jail CBAs; *Chris Mai*, Vera Institute of Justice*

Most cost-benefit analyses of incarceration focus on crime victims and taxpayers, ignoring the perspective of incarcerated people. Yet jail incarceration clearly causes harm, and an analysis that ignores this perspective does not capture the full cost of incarceration. This session will introduce an original framework to calculate the human cost of jail or prison incarceration which can be used in benefit-cost analyses of jail and prison policy. Using the extant cost of crime literature and economic data, this analysis models the costs of jail incarceration to the incarcerated individual. These costs include lost liberty, lost wage earnings, fees paid during incarceration, the cost of substitute child care, and the harm–translated into financial cost–of the additional risk of sexual and physical assault and suicide while incarcerated. The session will discuss a methodology to average the cost of harm over a diverse population. It will also investigate several additional harms of incarceration that do not yet have reliable shadow prices.

This research is based on a Vera Institute of Justice project to analyze the true cost of criminal justice fines and fees and financial bail practices in New Orleans. Combined with the taxpayer costs to run the jail, the human harm of jail incarceration far exceeds the revenue collected from fines and fees. While the estimates from this project are specific to New Orleans, this session will provide a framework for calculating the harm of jail that can be applied to any jurisdiction.

➢ C-1: Non-Market Valuation of Environmental Goods Using Revealed and Stated Preference Methods

Chair: Steve Newbold, U.S. Environmental Protection Agency

This panel of presentations focuses on non-market valuation of environmental goods using either revealed or stated preference methods. Topics include: water quality, offshore wind projects, environmental quality of lakes and bird biodiversity. The first paper focuses on using stated preference data to look at a general approach to examine sensitivity to scope and test the adding-up condition using choice-experiment stated preference data. The second paper measures the effect of the presence offshore wind projects on beach goers on the east coast of the United States using a travel cost model combining stated and revealed preference data from an internet-based survey of residents from 20 east-coast states. The third paper studies the theoretical and empirical foundations for the use of social media data (FLICKR) as a novel means to measure the welfare effects of changes in environmental quality of lakes to whether the non-random generation of these data rules out their meaningful use for welfare estimation. The last paper analyzes the preferences of bird watchers who are involved in the citizen science project called eBird, run by the Cornell Ornithology lab. The trip data for each member is combined with an external survey to analyze how the characteristics of the birder affect their preferences for site attributes.

Presentations:

External Scope and Adding-Up Tests for Stated Preference Choice-Experiment Surveys; Chris Moore*, U.S. Environmental Protection Agency

We propose a flexible approach to test the adding-up condition using choice experiment stated preference data. The approach involves estimating a model that is sufficiently general that it would comply with the adding-up condition only if certain parameter restrictions are not rejected. If the parameter restrictions are rejected, then a willingness-to-pay function that does not comply with the adding-up condition would provide a better explanation of the survey responses than one that does. We illustrate the approach using a series of numerical experiments and sensitivity tests using simulated data. We also show how to examine the quantitative deviation from the adding-condition when the test of statistical significance is failed. We discuss some features of choice experiment survey design that influence the power of the proposed test, and make suggestions for the design of future surveys to allow stronger validity tests to be performed. In particular, this strategy is facilitated by a survey design that varies the baseline levels of environmental quality across two or more versions of the survey instrument.

Measuring the Effects of Offshore Wind Projects on Beach Use and Tourism on the East Coast of the United States; *George Parsons*, University of Delaware*

We measure the effect of the presence offshore wind projects on beach goers on the east coast of the United States using a travel cost model combining stated and revealed preference data from an internet-based survey of residents from 20 east-coast states. The data were gathered by GfK (formerly Knowledge Networks) using their probabilistic-based, pre-screened KnowledgePanel. Respondents (n=2051) were shown photo simulations of hypothetical wind projects at distances ranging from 2.5 to 20 miles offshore and were asked if the projects would

have affected their beach experience and/or caused them to change in their trips plans. In the context of a random utility model we predict changes in trip patterns and measure welfare effects. The east coast, in our case, includes beaches from states as far north as Massachusetts and as far south as South Carolina. We have 275 beaches in our model. In addition, we consider a number of auxiliary models to predict (i) effect of wind projects on enjoyment, (ii) likelihood of cancelling a trip, and (iii) likelihood of making a special trip to see a new wind project. The results of the models are used to simulate impacts on selected beaches in each state on the east coast.

The Use of Social Media Data for Nonmarket Valuation; *Yongjie Ji*, Iowa State University*

This paper studies the theoretical and empirical foundations for the use of social media data as a novel means to measure the welfare effects of changes in environmental quality. A key question for non-market valuation is whether the non-random generation of these data rules out their meaningful use for welfare estimation. Several outcomes are possible. First, it may be that analysts will be satisfied that the preferences of some subgroups of the population can be adequately represented through the use of a social media generated sample, but that it will not be possible to make inferences about the values of all households in the general population. The sub population for which inference is possible may be quite limited. Alternatively, with additional structural assumptions and/or comparisons to external data sources, it may be possible to conclude that preferences of a broader set of users can reasonably be captured. In this paper, we address these questions in the context of recreation demand modeling for the specific case of FLICKR data associated with 135 major lakes in Iowa. We focus on this set of FLICKR data because we have an independently collected random household sample to these same lakes, providing a unique opportunity for comparison between a social media data set subject to numerous selection problems and a sample that is relatively free from such concerns. In addition to standard visitation and socioeconomic data, information on whether the household used FLICKR or other social media was also elicited from the random household survey. This information provides another unique comparator on which to assess the representativeness of the FLICKR sample.

The Value of Bird Biodiversity to eBirders: Exploring Citizen Science Data using a Recreational Site Choice Model; *Sonja Kolstoe*, Salisbury University*

Environmental citizen science projects provide the researcher with access to unique data that would not otherwise exist. These projects engage people to report their natural-resource-related activities in real time, for example, their bird watching trips. In this study, we analyze the preferences of bird watchers who are involved in the citizen science project called eBird, run by the Cornell Ornithology lab. We know the member's home address and their birding destination alternatives. This allows us to set up a random utility model (RUM) of site choice based on site attributes which can be used to generate willingness to pay (WTP) estimates. We explore both fixed and random parameter specifications with these unbalanced panel data on recreational choices. We build on an existing analytical framework we developed in earlier papers using a smaller data set. We now have a much larger and different sample of eBird members and their birding trips than used for these prior studies. We combine these trips with information learned from a separate survey distributed to eBird members in Oregon and Washington, to collect more variables that allow us to address questions our earlier work did not, including the frequency

with which eBirders report their trips to eBird. Armed with this additional information, we unpack the preference of eBirders, to include understanding the preferences of those who travel and those who do not. Additional questions we address include: 1) what is the appropriate site-choice consideration set; 2) how does a birder's perceived ability level affect their preferences for site attributes; 3) how does being a competitive birder (also known as a "lister"), versus a casual birder, affect their preferences for site attributes, etc.

➢ **D-1: Strengthening Benefit-Cost Analysis of Early Childhood Interventions Through High-Quality, High-Utility Cost Analysis**

Chair: Jonathan Belford, Child Trends

Discussant: Phaedra Corso, University of Georgia

Benefit-cost analyses (BCA) documenting the investments needed to implement effective social programs and the returns that can be anticipated are increasingly sought to inform the allocation of scarce public and private resources. Yet a 2016 consensus study, Advancing the Power of Economic Information to Inform Investments in Children Youth, and Families, by the National Academies of Science, Engineering, and Medicine concluded that the utility of BCA and economic evaluation more broadly is hindered when analyses do not follow best practices or adequately consider the context in which findings will be used. In support of high-quality, high-utility economic evaluation, this panel will present cost analyses of three early childhood interventions targeting families and children at increased risk for behavioral health problems: (a) REDI, an enhanced version of Head Start designed to increase school readiness by developing social-emotional and emergent literacy skills, (b) the Family Check-Up, a family-oriented intervention that addresses child and adolescent adjustment problems, and (c) Promoting First Relationships, a brief home-visiting intervention for strengthening parent-child relationships and reducing child welfare system involvement. The papers illustrate how attention to quality methods and stakeholder context strengthens social program cost estimates, the foundation for subsequent benefit-cost analyses, and the utility of standalone cost information. They also show how decisions made in the research design, data collection, analysis, and reporting phases have implications for the utility of cost analysis findings. Together the three papers help provide a roadmap for increasing the impact of cost and benefit-cost analyses of social programs. After the three presentations, the discussant will comment on the papers from the perspective of best-practices and relevance to a broad set of stakeholders.

Presentations:

Issues in Estimating Costs of Early Childhood Interventions: An Example from the REDI Intervention; *Damon Jones*, Pennsylvania State University*

Cost analyses of early childhood educational interventions can provide important information for improving efficiency of program delivery as well as setting the stage for considering the potential for return on investment. However, the nature of such efforts varies widely, given those leading the cost analyses in this field may be less familiar or experienced with best practices. Such

differences limit the ability to make comparisons across different programs in order to inform policy. This research reviews the key issues in cost analysis approaches for interventions directed toward young children in preschool settings. We discuss how efforts to increase consistency, transparency, communication, and standards can help the field better leverage cost analysis findings going forward. We also identify a set of key elements that are especially salient for assessment of resources with these types of programs. To illustrate how attention to these elements increases both quality and value, we present a cost analysis of the REDI project—an enhanced version of Head Start designed to increase school readiness through broader development of social-emotional and emergent literacy skills. We examine per-family costs for children receiving a classroom only program versus children additionally receiving home-visiting services. Results indicate a per-child cost of $183 to deliver one year of the program in pre-school. Additional costs to implement the home visiting component were estimated as $2,823 per family for the same time frame. We present a range of costs based on a sensitivity analysis, and include a focus on areas expected to drive variation in total and per-family costs in different settings and timeframes (e.g., training costs, home visiting travel cost, coaching needs). Finally, we discuss implications from our cost estimates for the REDI program in general as well as plans for assessing REDI's cost-effectiveness based on past indication of program effectiveness.

Dynamic Cost Analysis of Evidence-Based Family Services in a Randomized Controlled Trial; *D. Max Crowley*, Pennsylvania State University*

The rise of tailored interventions in a number of policy and practice environments requires thoughtful and detailed cost analyses that model the dynamics of resource flow across time at the individual level. The Family Check-up (FCU) is a family-oriented intervention that promotes family management, strengthens relationships between parents and children, and addresses child and adolescent adjustment problems in a manner that is brief, timely, and adapted to the specific needs of each child and family. The FCU has demonstrated significant reductions in substance abuse, delinquent behavior and developmental psychopathology across multiple randomized trials offered to indicated populations in diverse service settings (e.g., WIC families, schools, homes). In a comprehensive cost analysis of the FCU as implemented in the Early Steps trial involving 731 WIC-eligible families with children between the ages of 2 and 5 at three geographically distinct sites, we explore the resources needed to invest in this effective family-centered intervention. Our analysis benefits from individual-level time tracking of intervention resources deployed to each family, which clinicians maintained throughout the intervention. In addition to estimating the total ($621,045 in constant 2015 dollars for 4 years of intervention with 367 families randomly assigned to receive the FCU, SD across sites = $40,168), average ($1,692 per family for 4 years, SD = $64), and marginal ($759 per family for 4 years, SD = $85) costs of the FCU intervention, we describe time spent and associated costs of key intervention components (e.g., training, contact with families, ongoing support and technical assistance, time spent driving to family homes). This uniquely detailed dataset allows us to explore the variation in family resource needs and related costs across time and across different intervention sites. Key cost drivers will be identified. Implications for the development of an optimized FCU model will be discussed.

Efficient and Effective Early Childhood Home Visiting Programs for High Risk Families: A Cost Analysis of Promoting First Relationships; *Margaret Kuklinski*, University of Washington*

High-quality cost analyses provide a crucial foundation for return on investment analyses of social programs targeting children and families, yet they also can guide the development of more efficient, effective interventions. Home visiting programs for parents of young children at elevated risk for behavioral health problems provide a case in point. Though they can be cost-effective, they also are quite costly per family to the public and private funders of these services, which may limit their reach. Alternative approaches that improve outcomes at reduced cost could increase overall public health impact. In this paper, we present a cost analysis of Promoting First Relationships (PFR), a 10-week, manualized home visiting program for families with children ages 0 to 3 at increased risk of child welfare system (CWS) involvement and removal from the home. In contrast to more resource intensive approaches, PFR assumes that brief attachment-based intervention at a time of heightened family need can have an enduring positive impact on the emotional bond between parents and children, children's developmental outcomes, and system impacts including CWS involvement. Findings from a randomized controlled trial involving a high-risk sample of 247 parents and their 10-24 month old children randomly assigned to PFR or an alternative resource and referral condition showed significant improvements in social-emotional outcomes and out-of-home placements in PFR compared to control families. Effects were sustained for 18-months post-intervention, the latest funded follow-up. This presentation highlights the total and per family average (preliminary point estimates: $190,539 total, $1,537 per family), marginal, and incremental costs of delivering PFR. It also shows how the utility of cost analyses is enhanced when costs are disaggregated by key intervention components, resource use, unit price, and cost information are delineated separately, possible sources of efficiency gains are identified, and findings are communicated in a transparent but credible manner.

➢ E-1: Estimating Benefits and Costs of Risk Interventions in Face of Uncertainty

Chair: Elisabeth Gilmore, Clark University

Discussant: Laura Stanley, U.S. Environmental Protection Agency

Presentations:

Uncertainty Evaluation in DOT and EPA RIAs of Lifesaving Regulations; *David Good* and Kerry Krutilla, Indiana University*

Benefits and costs are naturally subject to several uncertainties. On the theoretical level, these can be incorporated into benefit cost analysis using a variety of mechanisms, e.g., Monte Carlo analyses, bounding analysis, etc. In our paper we compare the treatment of uncertainty in the regulatory impact analyses (RIAs) for two Federal agencies: the US Department of Transportation and the US Environmental Protection Agency. Our attention focuses on one of the most contentious areas in the impact analysis, the lifesaving potential of these regulations.

With the central value of VSL approaching 10 million per life, the value of lives saved tend to overwhelm other benefits. Together, these two agencies comprise the majority of Federal lifesaving regulations over the four year period of our study from 2011 through 2014, a total of 18 regulations. We eliminate from our analysis studies whose primary purpose is other than saving lives such as Corporate Average Fuel Efficiency standards.

Unfortunately, often uncertainty analysis focuses on the aspects of the problem where it can be most easily applied, rather than the aspects of the problem that would be most illuminated by its use. For example, we recognize the importance of uncertainty in VSL, but note that it affects all regulations equally. Instead, we diagnose several sources of uncertainty for each of the regulations in the study, sometimes using one regulation as a better practice than others. Often the primary source of uncertainty is with the input-output process (i.e., translating actions into lives saved). For each of our regulations, we develop a mechanism for qualitative, and in cases quantitative, assessment of how much the performed uncertainty analysis in the RIA has captured, and how much it has missed.

Risks and Benefits of Reducing Ozone Exposure after Re-Evaluating Most Recent Chamber Study Data; *R. Jeffrey Lewis*, ExxonMobil Biomedical Sciences, Inc.; and Richard Belzer, Regulatory Checkbook*

Our previous work has shown that conventional spirometric methods understate maximum forced expiratory volume in 1 second (FEV1) by about 7% (interquartile range: -7.9% to -6.4%). This measurement error or bias exceeds the consensus threshold for within-day differences generally considered biologically or clinically significant (>5%). Thus, some reported FEV1 differences are interpreted as significant but actually are test protocol artifacts.

Conventional methods also fail to account for within-person inter- and intra-test variability. That is, they treat each test values as a fixed result instead of as a realization of random variable with known (or estimable) properties. Differences in FEV1 across tests are thus incorrectly assumed to be real when they may in fact be statistically indistinguishable.

The National Ambient Air Quality Standard (NAAQS) for ozone is based in part on chamber studies in which volunteers are exposed under varying conditions. These studies follow the conventional spirometric protocol. Reported comparisons across exposure conditions do not account for inter- or intra-test variability and thus are statistically unreliable.

This presentation adds to this body of knowledge by disclosing alternative estimates derived from the most recent chamber study modified by us to incorporate inter- and intra-test variability. Results are especially sensitive to within-person intra-test variability. It is shown that under robust conditions differences reported as statistically significant are actually well within the range of test variability. Reported statistical inferences concerning small differences in ozone exposure are thus unreliable. This has implications for published estimates of the health benefits likely to result from reducing the ozone NAAQS. Developing statistically valid inferences requires first obtaining reliable and objective estimates of the intra-test coefficient of variation for the population and for numerous subpopulations of interest.

Adaptive Benefit-Cost Analysis for Changing a Few of Many Causes; *Tony Cox*, Cox Associates*

Identifying which action or policy from a small set of alternatives creates the greatest net social benefit is a key task for benefit-cost analysis (BCA), but this criterion must be refined when benefits and costs are so uncertain, e.g., due to the effects of uncontrolled factors, at the time a choice must be made (i.e., ex ante) that future information is likely to change the comparison of the alternatives (ex interim or ex post). Under these conditions, different stake-holders with access to different information may also disagree in their assessments of the probability distributions for costs and benefits, and hence disagree about the best alternative to embark on even if they have the same preferences for outcomes. Although stochastic dynamic programming can in principle solve such dynamic decision problems under uncertainty for a single decision-maker, no analogously complete and conceptually satisfactory framework exists for multiple stakeholders with divergent preferences for the initial choices to be taken. To overcome this challenge, we propose to apply techniques developed in machine-learning and artificial intelligence to help cooperating agents learn to improve their collective performance over time in an uncertain, changing environment. We synthesize key ideas including actor-critic algorithms for multiagent reinforcement learning, cooperative planning architectures and algorithms, and methods for adaptively estimating net benefits for different actions and policies while hedging against the possibility that initial estimates could be mistaken and misleading. We illustrate the practical value of these techniques for adaptive BCA and decision-making under substantial uncertainty with tow practical applications: adaptive regulation of air pollution when the public health effects of alternative regulations are uncertain, and deciding whether to ban animal antibiotics when the effects of a ban on human health and on the evolution of multi-resistant "superbugs" are initially highly uncertain.

Session 2: Thursday, March 16, 2017, 10:45 – 12:15pm

➤ A-2: Assessing Approaches to Updating the Social Cost of Carbon (Roundtable)

Chair: Casey Wichman and Richard Newell, Resources for the Future

The social cost of carbon dioxide (SC-CO2)—the present discounted value of the net damages caused by a 1-metric ton increase in carbon dioxide (CO2) emissions in a given year—has been estimated and used by the federal government in several dozen regulatory impact analyses since 2008. Estimating the SC-CO2 involves four steps: (1) projecting a future path of GDP, population and global greenhouse emissions; (2) translating this emissions path along with an alternative that adds 1 ton of CO2 into temperature, sea level rise and other climate variables; (3) estimating physical impacts of these climate variables on humans and ecosystems and monetizing these impacts; and (4) discounting future monetized damages back to the present. The SCC is the difference in damage valuations with and without the additional ton of CO2.

A recent NAS report evaluates approaches to updating the SC-CO2. The report recommends that the SC-CO2 be computed using an integrated, modular framework. The committee provides criteria for conducting each of the four steps of the analysis and suggests approaches

that could be used in constructing each module in the near term. The report also makes suggestions for improvements in the longer term and associated research recommendations. This panel brings together several of the members of the NAS committee, who will discuss the main results of the report and provide an opportunity for broader discussion of future estimation of the SC-CO2.

Panelists:

Max Auffhammer, University of California, Berkeley

Maureen Cropper, University of Maryland

Richard Newell, Resources for the Future

William Pizer, Duke University

Richard Schmalensee, Massachusetts Institute of Technology

➢ B-2: Evidence-based Policy (Roundtable)

Chair: Craig Thornton, Mathematica Policy Research

On March 30, President Obama signed the Evidence-Based Policymaking Commission Act of 2016, a bill law creating the bipartisan Commission on Evidence-Based Policymaking. The 15-member Commission is charged with examining all aspects of how to increase the availability and use of government data to build evidence and inform program design, while protecting privacy and confidentiality of those data. Panelists, who include experts on the Commission, from academia, non-profit organizations, and charitable foundations focused on evidence-based policy will discuss the work of the Commission and key concepts involved in "evidence-based policy."

Panelists:

Tony Cox, Cox Associates

Sandy Davis, Bipartisan Policy Center

Nicholas Hart, Commission on Evidence-Based Policymaking

Sofie Miller, The George Washington University

Kathy Stack, Laura and John Arnold Foundation

> C-2: Issues in BCA Applications in Energy and the Environment

Chair: Timothy Brennan, Resources for the Future

Discussant: Charles Griffiths, U.S. Environmental Protection Agency

Presentations:

Climate Change Adaptation: Benefit-Cost Analysis of Coastal Flooding Hazard Mitigation; *Federico Garcia* and David Ryder*, ICF International*

The damages caused by hurricanes are a reminder of the sheer power of nature. In the aftermath of these storms, crippled infrastructure hampers restoration. Airports are a critical link in the supply chain for relief supplies and regional commerce, and are a priority for repair after storms. Some airports, however, suffer severe flooding and operations are severely limited for months. Given the critical nature of airports for relief efforts and economic activity, adaptation strategies are fundamental to maintaining airport operations following a hurricane.

In this study, we develop an economic model to assess the costs and benefits of protecting an airport with a flood mitigation system that includes a series of flood walls and pumps to mitigate the effect of coastal flooding caused by a hurricane. Where possible, we use the Federal Emergency Management Agency Benefit-Cost Analysis toolkit to develop estimates of avoided damages and loss of function based on flood depth. We account for the lifecycle costs of the project, including costs for upfront construction of the flood mitigation system, ongoing maintenance, administration, and contingency costs. Benefits of the project include avoided damages to the terminal building, hangars, and aircraft; avoided fuel spills; and avoided loss of function of the airport and the fire station. To account for the effects of climate change, and to verify that the project effectiveness over the long term, we factor in the effects of sea level rise and account for higher flood depths over the 50-year useful life of the project.

According to our findings, present value benefits of the project exceed present value costs, suggesting that the project would be cost-beneficial. We found that conservative estimates valued the net benefits of the project between $3 and $190 million, depending on discounting and benefits included, with benefit-cost ratios ranging from 1.05 to 8.01.

Triple-Bottom-Line Benefits for Urban Resiliency Projects; *James Cottone* and Aaron Henderson, Arcadis*

Our presentation will provide an overview of traditional hazard mitigation BCA, and describe the new approaches using a triple bottom line approach that have been successful, including case study projects.

The framework for federal assistance following natural disasters was laid out by the Robert T. Stafford Act in 1974 and its amendment in 1988. A key concept of the Stafford Act is the idea that recovery from disasters is an opportunity to mitigate against natural hazards in the future. The Act stipulates that such mitigation projects must be cost effective. Over decades, this requirement has led to the creation of software and accepted methods by FEMA to be used for

hazard mitigation benefit-cost analysis, or BCA. In the fields of emergency management and mitigation, benefits have traditionally been based solely on the reduction of loss of life, property damage, and loss of critical public services.

Since Hurricane Sandy in 2012, mitigation against coastal storms and the long-term effects of climate change have become areas of significant federal interest. The Rebuild-By Design competition, and subsequently the National Disaster-Resiliency Competition, sponsored by HUD, required design proposals to include BCA in their proposals. This has catalyzed a sea-change in hazard mitigation BCA, bringing in a new emphasis on what we might call triple-bottom-line analysis. With renewed interest in the social and environmental effects of large scale mitigation projects, the BCA is slowly transforming from a strict focus on the reduction of loss into one that integrates a number of different benefits focusing on environmental and social sustainability.

Thinking outside of the old box and evaluating a project across multiple levels can not only lend itself to projects that resolve a number of different issues but can provide a project that communities can get excited about.

Benefits and Costs of Authorizing the Use of Substances of Very High Concern under REACH; *Matti Vainio*, European Chemicals Agency*

In June 2017, the European Union's REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) regulation will have been in force for ten years. One unique feature of REACH is that it allows firms to continue the use of substances of very high concern (SVHC), if they can demonstrate that no suitable alternative exists and the benefits of continued use outweigh the associated risks to human health and the environment. To be authorized firms have to submit an application to the European Chemicals Agency (ECHA), whose scientific committees will examine the application documents and forward a corresponding opinion to the European Commission, which will then, together with EU Member States, decide whether to grant the authorization of a particular use. Shifting the burden of proof to industry is a novel feature in chemicals regulation, making the REACH authorization process a 'living lab' of applied benefit-cost analysis. Since August 2013, ECHA has processed 112 applications for authorization and as of October 2016 its scientific committees have provided opinions on 84 different SVHC uses. In this study, we analyze what the impacts of authorization have been so far and provide a nuanced picture of the benefits and costs (in terms of health and environmental impacts) that applicants have associated with their continued use of SVHC. Evidently, information asymmetry pertains—as applicants seek to continue the use of SVHC, they have a clear incentive to overstate the benefits of doing so and to downplay risks to human health and the environment. We therefore also assess to what extent ECHA's scientific committees have concurred with the applicants' analysis of the welfare impacts of their authorization. Our results suggest that, overall, authorization of SVHC results in benefits that are substantially greater than the monetized risks.

➢ D-2: Role of CBA in Decision Making in OECD Countries

Chair: Fran Sussman, Independent Consultant

Discussant: Chris Dockins, U.S. Environmental Protection Agency, and Emile Quinet, Ecole des Ponts-ParisTech

Presentations:

A General Survey of CBA in Decision Making in OECD Countries; *Nils Axel Braathen*, OECD*

This presentation will show results of a recent OECD survey of practices in the use of CBA in relation to public investments in the transport and energy sectors, as well as in relation to ex ante and ex post assessments of public policies or programs. The presentation will focus in particular on how environmental impacts, such as changes in CO_2 emissions and emissions of local air pollutants, are being addressed in these CBAs. The presentation will also highlight administrative aspects of the CBAs, for example whether or not they are made publicly available, whether the public is invited to make comments on them and on their impacts on final decisions.

Looking Back at Social Discount Rates: The Influence of Papers, Presentations, Political Preconditions and Personalities on Policy; *Ben Groom*, London School of Economics*

In the past 20 years, discounting policy has evolved alongside the theoretical and empirical contributions of academics to this topic. But how influential were the academic advances in changing discounting policy? Did academics drive the process along, or were there political preconditions in policy that pushed the academic endeavor? This paper couches the process of policy evolution in terms of a policy demand side and an academic supply side. We highlight the importance in this process of policy brokers who bring these two sides together, and of personalities who influence change when institutional procedures fail to keep policy up to date with the academic frontier. The examples of discounting policy changes in the UK, US, Netherlands and Norway are discussed using qualitative evidence from interviews with key individuals in government, academia and consultancy. This evidence is coupled with our own experiences of having informed discounting policy in each case.

➢ E-2: Applications of Benefit-Cost Analysis in Developing Countries

Chair: Michael Toman, World Bank

Discussant: Elisabeth Gilmore, Clark University

Presentations:

Economic Consequences of an Infectious Disease Event for a Small, Island Economy; *Jamison Pike*, U.S. Centers for Disease Control and Prevention*

The Federated States of Micronesia (FSM) experienced a measles outbreak from February–August 2014. A total of 393 cases were detected in three of four states. During any infectious disease outbreak, the resources needed to respond to the outbreak can strain local public health resources. In the case of FSM, this strain was exacerbated by the unique logistic, economic, and geographic challenges in responding to the outbreak. Further, because FSM is a narrowly-based economy with large distances to major markets, an outbreak can result in economic volatility. FSM is linked to the United States through a Compact of Free Association and receives immunization funding and technical support from the United States. The compact allows residents of FSM to travel freely between FSM and the United States. Fifty-nine measles cases were imported into the United States as a consequence of the 2014 outbreak. The response, containment, and local direct medical costs of the outbreak (not including medical costs incurred in the United States) are estimated to have totaled over $3 million. FSM's share of the costs ($848,000) was equivalent to 0.23% of their gross national income while the US costs were 0.00001% ($2,637,000) of their gross national income. These estimates do not include the costs incurred to the United States from imported cases. Further research will be presented on simulated interventions that could have prevented and controlled the outbreak to assess costs and benefits. We pose the questions, (1) what were the specific consequences of this adverse health event for a small, island economy? and (2) what consequences could have been avoided through different degrees of intervention and at what cost? Utilizing a dynamic transmission model, we evaluate the cost-effectiveness and cost-benefit of preventing versus controlling such an event, including the rippling effects of an infectious disease outbreak on economic activity.

Performance Based Financing and Improving Girls' Education: Lessons Learned in Zimbabwe; *Jordan Nanowski*, Limestone Analytics; and Bahman Kashi, Queen's University*

This study explores the theoretical and practical aspects of evaluating an education intervention in which funding is tied to a measure of impact. A number of challenges are identified and discussed, including the usage of alternative measures of impact for contractual purposes, dealing with perverse incentives, and managing the ability to control for external events that can affect the outcome. Furthermore, challenges and opportunities in disaggregation of impact by gender and attribution of impact when faced with multi-component programs are discussed. The results of an empirical analysis of an ongoing education intervention in rural Zimbabwe are then presented. Findings highlight the role of impact investing in promoting the use of rigorous benefit-cost analysis in decision making, the importance of aligning a project's objectives with the measures of results reflected in financing contracts, and the potential for adverse results if incentives aren't properly aligned.

On-Grid Solar PV versus Diesel Electricity Generation in Sub-Saharan Africa: Economics and GHG Emissions; *Glenn Jenkins*, Queen's University and Eastern Mediterranean University and Saule Baurzhan, Eastern Mediterranean University*

Many power utilities in sub-Saharan Africa (SSA) have inadequate generation capacity, unreliable services and high costs. They also face capital constraints that restrict them from making necessary investments needed for capacity expansion. Capacity shortages have compelled power utilities to use leased emergency power generating units, mainly oil-fired diesel generators, as a short-term solution. An economic analysis is carried that compares the economic net present value (ENPV) of fuel savings as well as greenhouse gas (GHG) savings,

from investing capital in solar PV power generation plants as compared to investing the same amount of funds into diesel power plants. The results show that economic net present value is negative for solar PV plant, whereas it is a large positive value for the diesel plant. In addition, the diesel plant would be almost three times as effective in reducing GHG as the same value of investment in solar PV plant. Even with solar investment costs falling, it will take 12 to 24 years of continuous decline before solar PV will become cost-effective for SSA. The capital cost of solar PV would need to drop to US$ 1058.4 per KW to yield the same level of ENPV as the diesel plant.

➢ F-2: Risk, Competition, and Procurement Design

Chair: Aylin Sertkaya, Eastern Research Group, Inc.

CBA focuses on selecting those investments that would improve social welfare most. Having a view what the benefits and cost of particular project will be, though, does not guarantee that the Value for Money will be maximized or even attained. Sub-optimal procurement design can substantially undermine the net welfare we can expect from the "best" projects, selected through diligent CBA. Theoretically, different options available for particular projects could potentially affect the conclusions of the CBA. An established and robust process comparable to the CBA, which would systematically inform procurement design based on theoretical and empirical findings is to date not available. In this context there is a limited understanding of how a key element in procurement design – risk, its allocation, the extent of transfer, and the availability of information about risk -- affect the cost and the benefits of project delivery. Little is also understood about how other choices, such as the size of the project, the "freedom" of the contractor to inform/change design, and decision to bundle project phases, affect competition, and through that the outcomes of project delivery. This session will showcase three presentations demonstrating how important procurement design choices are and how far we have gotten in the process towards a robust system for procurement design to complement the efforts of CBA.

Presentations:

The Inefficiency of Risk Pricing in PPPs; *Dejan Makovsek*, International Transport Forum; Marian Moszoro, George Mason University*

The transfer of risk to a contractor is an essential component for providing efficiency incentives in procurement. How risk transfer affects project outcomes and informs procurement design, however is surprisingly under investigated area, especially in terms of empirical evidence. Despite this there is a drive around the World towards delivering and operating public infrastructure through public-private partnership (PPP) rather than traditional public procurement, where a PPP is in essence a high-powered contractual scheme with very strong incentives but also high cost. The assessment of the value for money achieved by the two alternative approaches rests in the cost of financing and their efficiency in delivery and operation. If capital markets were efficient and complete, the cost of public (government) and private financing should be the same, with the relative delivery and operational efficiency remaining as the primary determinant of value for money. Evidence suggests, however, that the

risk transfer to a public-private partnership entails an inefficient risk pricing premium. We argue that a high price for public-private partnerships results from large risk transfers, risk treatment within the private sector, and uncertainty around the past and future performance of PPP consortia. Hence, risk transfer not only increases the incentives for efficiency but also has an offsetting effect on the competition. More importantly, if information about risk is insufficient, high-powered contracts may increase contingencies well beyond what the effective risk exposure might require. On PPPs specifically, the corollary is that the efficiency gains from a PPP must be much higher than commonly expected to deliver a greater value for the money than under a traditional approach. In a larger context, this contribution unwinds some of the complexities of risk transfer and its impact on procurement outcomes in high powered contracts in general not only PPPs and can be used to inform procurement design. Lastly, the work represents an input to the Working Group on Private Investment at the OECD/ITF, which seeks how to address the issue of lack of information about risk in long-term contracts in the context of infrastructure investment.

A Decision-Making Model for Procurement Design; *Adrian Bridge*, Queensland University of Technology*

Evidence is presented of the short-term nature of procurement decision-making associated with current procurement theory and practice, which lacks rigor and transparency. Developed as part of an Australian Research Council grant a new procurement decision-making model is presented (that is cited/endorsed by Australia's Productivity Commission and in CIB TG72's PPP research road map, and published at the International Journal of Project Management). The new model comprises a series of analytical procedures that begin by breaking-down the project into production activities (design, construction, operations and maintenance). These activities are then assessed in terms of the make-or-buy procedure (using an integration of a range of theories from the New Institutional Economics and the capabilities perspective). Externalized activities (that represent the part of the project to be procured by government) are subject to filtering procedures in which activities likely to lead to market failure (either ex ante market failure associated with thin markets or ex post market failure related to the appropriation of quasi-rent, or hold-up) are excluded from the subsequent bundling procedure (in which the potential for net gains arising from positive externalities are assessed). As such, the model unlocks the full potential of bundling (e.g. Oliver Hart) to speak to individual projects, instead of– hitherto–mere sectors. In doing so, the model delivers a comprehensive procurement strategy for the entire project including identifying whether the project–either whole or part/s–is a suitable Public-Private Partnership or if another form of procurement is more suitable. A successful empirical test of the model is also presented (using case study and survey data of major road and health projects) including developing competition (i.e. expressions of interest) as a proxy of both ex ante and ex post market failure, and thus Value-for-Money. Finally, we provide an update and next steps for the new model including its upcoming live trial and transition to reforming procurement public policy.

How does PPP Contract Design Respond to Introduction of Uncertainty; *Philippe Gagnepain*, on behalf of David Martimort, Paris School of Economics*

For several decades, economists have shed light on how the optimal design of concession contracts and organizational forms in a principal–agent context allows a public authority to provide the contracted firm with perfect incentives to reduce infrastructure and operating costs.

As real world regulatory relationships are ongoing processes in changing environments, parties lay down arrangements for trading goods and services covering several periods. Thus, economic theory has also devoted considerable attention to understanding dynamic contractual relationships and especially how contracts are renegotiated over time. It claims in particular that renegotiation prevents attainment of the efficient solution that could be obtained under full commitment. More recently, researchers have also shown a growing interest in the impact of uncertainty in the design of concession contracts. In a context of dynamic moral hazard, the possibility of future and uncertain productivity shocks on the returns on the firm's effort may create an option value of delaying efforts, which leads to an increase of operating costs. This presentation aims at proposing an overview of the tools proposed by contract theory to control this cost of delegated flexibility. In particular, it will be reminded that the possibility to unbundle different stages of the construction project through short-term contracts becomes particularly appealing in this context.

Session 3: Thursday, March 16, 2017, 2:00pm - 3:30pm

➢ A-3: International Approaches to Analyzing Benefits and Costs of Chemical Risk Policies (Roundtable)

Chair: Susan Dudley, The George Washington University

Governments around the world rely on benefit-cost analysis in one form or other to develop and evaluate policies aimed at reducing their citizens' exposure to chemical risks. This roundtable panel of experts will share practices and experiences associated with analyzing benefits and costs of chemical risk policies in Europe and North America.

Panelists:

Nils-Axel Braathen, OECD

Jessica Coria, University of Gothenburg

Joe Devlin, Environment & Climate Change Canada

Matti Vainio, European Chemicals Agency

➢ B-3: Value of a Statistical Life: Recent Advances

Chair: Thomas Kniesner, Claremont Graduate University

Discussant: Al McGartland, U.S. Environmental Protection Agency

Presentations:

Is Survival a Luxury Good? Income Elasticity and the Value per Statistical Life; *James K. Hammitt*, Harvard University*

The value of changes in mortality risk is conventionally estimated by the marginal rate of substitution between income and mortality risk—the value per statistical life (VSL). The income elasticity of VSL is important for estimating how the value of mortality risk varies with time (for evaluating programs with long-lived effects) and across populations with different income levels (for evaluating programs with international consequences). Previous estimates of income elasticity based on meta-analysis of wage-differential studies and cross-sectional comparisons in stated-preference studies suggest values of approximately 0.5 while international comparisons and extrapolation from estimates of the coefficient of relative risk aversion imply values between 0.5 and 2 or more. We present new estimates based on a 16 year series of wage-differential estimates in Taiwan. Between 1982 and 1997, estimated VSL increased eight-fold while per capita GNP increased two and half times and the occupational fatality rate in manufacturing and service industries decreased by half. Comparison of VSL with GNP per capita implies the income elasticity is between 2 and 3, but controlling for changes in endogenous job risk and worker characteristics yields estimates between 0.6 and 0.9.

Best Estimate Selection Bias of Estimates of the Value of a Statistical Life; *W. Kip Viscusi*, Vanderbilt University*

Assessments of key economic parameters frequently rely on the best estimate or a meta-analysis of the "best-set" of estimates of the parameter from the literature. Government agencies' choices of the VSL for policy evaluations typically rely on the "best-set" estimates of the VSL. But the selection of the best estimates by either the article authors or policymakers may involve judgments of what magnitudes of VSL estimates that are viewed as being reasonable, thus inducing selection biases. This paper's meta-regression analysis considers over 1,000 VSL estimates from 68 studies. The all-set sample consists of all reported estimates of the value of a statistical life (VSL), while the best-set sample consists of the best estimates from these studies. This article finds statistically significant selection biases in each case, but much greater biases for the best-set sample. "Best estimate selection bias" exacerbates the problems associated with existing publication selection biases. Estimates based on the Census of Fatal Occupational Injuries (CFOI) are considerably greater than for other studies even after correcting for publication selection effects. The bias-corrected estimates of VSL for the all-set USA sample is $9.6 million. Rather than focusing on a best-set sample, policymakers can avoid the selection biases by choosing the VSL based using the estimates from their preferred specification from an all-set analysis.

Estimating the Value of a Statistical Life in (the Likely Many) Cases of Reference Dependence; *Jack Knetsch*, Simon Fraser University*

Estimates of the value of statistical lives (VSL) are based on the values that people place on a small change in the probability of death. Particularly when these assessments are based on surveys, the assessments are commonly people's willingness to pay for a decrease in the risk of death (the WTP measure). The resulting VSL estimates are, in practice, assumed to be equally applicable for all changes in the risks of death -- ones that impose losses or reductions of losses, as well as ones that provide gains.

However, changes resulting in losses and reductions of losses are more accurately assessed with the WTA measure of the minimum amounts people would require to accept an increase, or to forego a reduction, in the risk of death. To the extent that assessments that use the WTP measure differ from those that are based on the WTA measure, the inappropriate choice of measure will impose a potentially important bias to the results of the analysis and the guidance which is provided.

The present study was conducted to provide more direct tests of possible disparities between people's valuations of small positive and negative changes in the probability of death. Further, the study examined the possible extent to which positive changes of a reduction in the risks of death were regarded by people as being a gain, and therefore best assessed with the WTP measure, or a reduction of a loss and more appropriately assessed with the WTA measure.

The findings strongly suggest large disparities between gain and loss measures. They also indicate that many positive changes are regarded as reductions of losses rather than gains, which the WTP measures would likely understate. Together, these findings have likely implications for estimates derived from wage-risk observations as well as those elicited from contingent valuation surveys.

➢ C-3: Issues in BCA of Energy and the Environment

Chair: Ann Wolverton, U.S. Environmental Protection Agency

Discussant: Fran Sussman, Independent Consultant

Presentations:

Consumer Willingness to Pay for Vehicle Attributes: What Do We Know?; *Gloria Helfand*, U.S. Environmental Protection Agency*

A full benefit-cost analysis seeks to take into account impacts on consumer welfare as well as financial benefits and costs. Tighter standards for vehicle greenhouse gas emissions and fuel economy have raised questions about possible effects on other vehicle attributes, such as noise, safety, comfort, or performance. Assessing the effects of these impacts on consumer welfare requires estimates of consumer willingness to pay (WTP) for the foregone benefits. This paper evaluates WTP estimates for a range of vehicle characteristics from academic literature. We use 52 U.S.-focused papers since 1995 with sufficient data to calculate WTP values for various vehicle attributes. We identify over 150 individual characteristics included in these papers, which we consolidate into 15 general categories: comfort, fuel availability, fuel costs, fuel type, incentives, model availability, non-fuel operating costs, performance, pollution, prestige, range, reliability, safety, size, and vehicle type. We then calculate, for each observation, WTP values and their ranges for those characteristics, based on the coefficients and data reported in the papers. In addition to mean WTP estimates, we present uncertainty estimates around each WTP value, based either on standard errors of the estimated coefficients

or the standard deviations in random coefficient models. We also examine the implications of heterogeneous consumer characteristics (e.g., different levels of income, household size, and other factors). Findings suggest large variation in estimates of WTP values, both within and across studies. This variation may result in part because of methodological difficulties in estimating how attributes affect consumer vehicle choices, such as omitted variables, collinearity, and the use of proxies. We discuss the implications of this variation in WTP estimates for estimating impacts on consumer welfare due to changes in fuel efficiency technology.

Re-Searching for Hidden Costs: Producer Heterogeneity and Adoption of Fuel-Saving Vehicle Technologies; *Hsing-Hsiang Huang*, Oak Ridge Institute for Science and Education*

Hidden costs – undesirable aspects of the new technologies – have been suggested as reasons for the "energy paradox": markets are slow to take advantage of cost-effective opportunities for energy efficiency in the light-duty vehicles market. Though quantitative evidence about the existence of hidden costs is limited, a recent study by Helfand et al. (2016) did not find systematic evidence of hidden costs associated with the use of fuel-saving technologies. We extend Helfand et al. (2016)'s study by exploiting a pooled dataset of professional auto reviews for consumers for model-year 2014 and 2015 vehicles. The preliminary results show that, for the technologies examined, reviews with positive evaluations significantly outnumber those with negative evaluations. The conclusion of Helfand et al. (2016) holds after we control for potential confounders, such as year, year-by-reviewer, and year-by-automaker fixed effects. Overall, the use of fuel-saving technologies does not increase the probability of getting a negative evaluation of operational characteristics. In addition, there is heterogeneity across automakers in the relationships between some technologies and operational characteristics. For instance, for the start-stop technology in the pooled data, 50 percent and 36 percent of the evaluations are negative for Subaru and BMW, respectively, while Chevrolet, Ford, Honda, and Toyota have zero negative evaluations. The heterogeneity may be due to quality of implementation of the technology across automakers. The heterogeneity is much smaller for some technologies, such as full electric and mass reduction, which have 0 to 17 percent and 0 to 8 percent of negative evaluations for all the automakers reviewed, respectively. It implies automakers have been and might be able to implement fuel-saving technologies without imposing hidden costs. Consistent with the findings of Helfand et al. (2016), the results do not provide evidence for hidden costs as the explanation of the energy paradox.

Benefit-Cost Analysis: Problems with Product Failures; *Arthur Fraas*, Resources for the Future; and Sofie Miller*, The George Washington University*

Federal regulation in the energy, environmental and product safety area often require the adoption of new technologies. However, the incorporation of a new technology in products does not necessarily go smoothly as evidenced by several examples of notable product failures (e.g., Whirlpool clothes washers, Subaru engines). In such cases, the costs and benefits to consumers may vary significantly from initial agency estimates. This presentation would consider several case studies. These case studies would review regulatory agency treatment of the potential for product failures, outline the nature of the product failure, and discuss the effectiveness of market and legal institutional responses to product failures. Ex post responses include manufacturer warranties, market information channels like Consumer Reports, and legal

remedies like class action lawsuits. Finally, we would consider the extent to which product failures deserve further consideration in the rulemaking process and in both prospective and retrospective benefit-cost analyses.

➢ D-3: Regulatory Review and Benefit-Cost Analysis in the States (Roundtable)

Chair: Stuart Shapiro, Rutgers University

Much of the debate on the role of benefit-cost analysis in policy-making has centered on the regulatory process at the federal level. This debate has gone on for 36 years and shows little signs of abating. Meanwhile, many of the fifty states have begun to take steps to incorporate economic analysis into their regulatory decisions. As is often the case at the state level, the process for developing regulations takes many different forms and the use of benefit-cost analysis and its level of incorporation into the regulatory process varies across states.

This panel will consider the basis and implementation of requirements for various forms of analysis at the state level. It is made up of four practitioners from states which have implemented regulatory review and cost-benefit analysis. The states have taken different approaches to their implementations and are in different stages of implementation.

Each panelist will provide an overview of the role of analysis in their state. We will also explore the challenges associated with analysis and regulatory review at the state level, and lessons which may be useful to other states, and BCA practitioners across many levels of government. Each panelist will speak for 15 minutes and there will be a half hour for questions and discussion.

Panelists:

Larry Getzler, Virginia Department of Planning and Budget

Anca Grozav, North Carolina Office of State Budget and Management

David Sumner, Pennsylvania Independent Regulatory Review Commission

Ben Witherell, New Jersey Department of Environmental Protection

➢ E-3: BCA Applications in Transportation and Infrastructure

Chair: Deborah Aiken, U.S. Department of Transportation

Discussant: David Luskin, U.S. Department of Transportation

Presentations:

Information Saves Lives: An Impact Evaluation of Automobile Crash Tests; *Damien Sheehan-Connor*, Wesleyan University*

Imperfect information about product quality can lead to market failure, creating the potential that a policy of information provision can improve welfare. Consumers are unlikely to be able to accurately assess motor vehicle safety with the consequence that automakers in a competitive market will produce vehicles of sub-optimal safety. Third-party information providers, whether private or public, may ameliorate this sort of problem. In an effort to do this, the Insurance Institute for Highway Safety (IIHS) began performing frontal offset crash tests in 1995 and side impact crash tests in 2003 on many vehicles sold in the United States. This paper finds strong evidence that manufacturers responded to the tests by producing safer vehicles and that consumers respond by increasing purchases of those vehicles rated as safest. An impact analysis is performed to quantify the safety benefits attributable to this shift toward safer vehicles. Significant changes in the ability of a vehicle model to withstand a crash are most easily made when that model undergoes a substantial redesign, which typically occurs every five to eight years. This paper includes vehicle redesign year in a richly controlled model of impacts on driver fatality and compares outcomes in vehicles redesigned just before versus just after implementation of the IIHS crash testing programs. The key findings are that the frontal crash test program was associated with a reduction in fatality risk for drivers involved in severe frontal, but not side, collisions whereas the side crash test program was associated with a reduction in driver fatality risk in side, but not frontal, collisions. A lower bound estimate of the health benefits attributable to the programs is a reduction of 1,800 fatalities in 2013 while the overall economic benefits are estimated at a minimum of $2,400 per vehicle.

Estimation of Logistics Cost Savings for a Multi-Jurisdictional Freight Rail Project using a BCA Framework; *Saravanya Sankarakumaraswamy*, University of Washington*

This work applied a novel approach to logistics cost estimation for multijurisdictional freight rail projects based on a case study conducted as part of research sponsored by National Cooperative Freight Research Program Project. This discusses the application of the methodology to the Heartland Corridor. The approach adopted relies on publicly available open data sources to support Benefit-Cost Analysis (BCA) in order to address problems associated with the availability of input data and a more representative measure of logistics cost. These data sources include Freight Analysis Framework freight movements' data between states, the Surface Transportation Board's Uniform Railroad Costing System (URCS) data and R-1 reports for Norfolk Southern, and data on Class 1 rail track miles operated from American Association of Railroad. These sources are combined to provide commodity and rail specific logistics costs comprising of transport, inventory, loading and unloading costs and damage costs. As such this allows a better comprehensive breakdown of the cost of shipping between origin-destination pairs, than the conventional approach of focusing only on inventory costs. The Heartland Corridor project's intermodal terminals and line-haul improvements are expected to produce diversion from trucks to rail apart from capacity enhancement through double stacked trains. Hence we have discussed the modal diversion from trucks to rail and estimated the amount of potential diversion and the associated savings in logistics cost. The diversion benefits were accounted by estimating the cost savings for new users apart from the benefits accounted for existing users. The main contributions of this work can be listed as the following: (1) demonstrate the use of open source and publicly available data in BCA (2) demonstrate the

choice of appropriate data sources among the different options (3) estimate logistics cost savings by accounting for modal diversion from freight investments and (4) demonstrate the cost savings estimation for multi-jurisdictional freight rail projects.

Addressing Uncertainty in the Estimation of the Benefits and Costs of Complex Transportation Infrastructure Projects; *Kenneth Kuhn*, RAND Corporation*

This research describes and applies a methodology for addressing uncertainty inherent in the estimation of benefits and costs of transportation infrastructure projects. The methodology involves transparency, the identification of sources of uncertainty, sensitivity testing including purposely pessimistic scenarios, Monte Carlo simulation, and Robust Decision Making. Time and resources will be limited in practice, but it is important for practitioners to understand the strengths of the weaknesses of each of the mentioned techniques. The methodology describes how to categorize sources of uncertainty. For example, a parameter may be a source of epistemic uncertainty, aleatory uncertainty, and/or deep uncertainty. If uncertainty could be eliminated or reduced by collecting additional data, then the parameter creates epistemic uncertainty. Freight and passenger values of time are sources of epistemic uncertainty in transportation. Classification of sources of uncertainty helps analysts devise mitigation strategies. For instance, sensitivity testing and Robust Decision Making are established ways for dealing with sources of deep uncertainty. This presentation includes sample results from the application of the techniques to a case study based on the Heartland Corridor project. The Heartland Corridor is a multimodal, multijurisdictional freight transportation infrastructure project, a particularly challenging type of project to evaluate. The project reduced the distance and time required for freight movement in the Mid-Atlantic and Midwest regions. The project benefited new users of facilities that were improved or constructed. A model of diversion was required to estimate associated benefits. States benefited from reduced tractor-trailer traffic on roads in the region and, thus, reduced required pavement maintenance. The public at large also benefited from reduced tractor-trailer traffic, through reduced safety and environmental externality costs. These and other benefits and costs were evaluated. The complete results highlight the presence of substantial uncertainty and risk of wrongheaded analysis and/or recommendation.

➢ F-3: Issues in BCA of Research, Development, and Innovation

Chair: R. Jeffrey Lewis*, ExxonMobil Biomedical Sciences, Inc.

Discussant: Kathleen Miller, U.S. Food and Drug Administration

Presentations:

Human Capital Benefits of Big Science: Evidence from Early Career Researchers at CERN; *Massimo Florio*, University of Milan*

Is there a social benefit of Big Science arising from increasing human capital? High-energy physics laboratories at forefront of science are breeding ground of ideas and skills. More than 36,000 students and post-docs will be involved in research until 2025 at the Large Hadron Collider (LHC) at CERN mainly through international collaborations, which include also non-

member states as the US and other countries. To what extent do these early career researchers value in money terms the skills they have acquired? Do they expect that their learning experience will have an impact on their professional future? By drawing from earlier literature on experiential learning and salary expectations, we have designed an in-depth survey involving two samples, one of current and the other one of former students at LHC, the latter now employed in various jobs, including industry and finance. We want, particularly, to compare the expectations of current students with the assessment of those who have completed their PhD. Results from ordered logistic regression models suggest that the experiential learning at LHC positively correlates with both current and former students' salary expectations. Those already employed clearly confirm the expectations of current students. The results are driven by the self-assessment of the skills acquired. Respondents put a price tag on their experience at LHC, a 'salary premium' ranging from 5% to 12% compared with what they would have expected for their career without such an experience at CERN. The expected perceived cumulative human capital social benefit from training at the LHC is expected to be around 6 billion Euro over the period 1993-2025.

Benefit Cost Analysis of Research, Development and Innovation (RDI) Infrastructures-Strategy for Europe 2020; *Kristina Gogic*, Office of the Croatian Ombudsman*

The research, development and innovation (RDI) infrastructure is the generic name for investment projects that are designed and operated according to very different specifications, in some cases their features are unique and cannot be analyzed with the same degree of standardization of methods as, for example, in railways or in water, for which there are several decades of evaluation experience and a large library of appraisal documents. Benefit Cost Analysis of RDI infrastructures is a new field and the project proposer should be aware that, at the same time, it requires a solid understanding of the principles of BCA, professional experience in project evaluation in different areas and a very flexible practical approach tailored to the specific project under appraisal. While the target groups of other infrastructures are relatively well identified, e.g. passengers for high-speed rail or residents in an urban area for solid waste management, the multifaceted nature of RDI is such that many types of direct and indirect target groups are involved, from business to the general public. Each of them has standing in the BCA and this makes the evaluation of infrastructures a particularly complex task. It is expected that over the planning period (2014.-2020.) a portfolio of BCA of RDI infrastructures will be gradually built within the Member States, following the high priority given to research and innovation for the European Union growth strategy. Many research and innovation projects face difficulties in securing finance, despite being fundamentally good projects.

The Inclusion of Economic Variables in Case Studies of Biomedical Research Impact; *Sue Hamann*, National Institutes of Health*

Science evaluators are increasingly asked to include economic variables and econometric analyses in their evaluation of the outcomes and impacts of federally funded research. Cost studies, particularly cost benefit analysis and cost utility analysis, are frequently used to assess the costs and economic outcomes of medical prevention and treatment interventions; however, taking a step backward and linking federally funded biomedical research to an implemented specific health intervention and outcome is not yet, and may never be, standard. Interest in

quantifying the impact of federally funded research on markets and industries is also growing. Much administrative data on federal research expenditures, research topics, and published research findings is available, but linking such data to discoveries and downstream interventions is challenging. Case studies, including those with economic analyses, are being explored as one method of tracing federally funded biomedical research from basic science to public health improvement and other societal benefits.

At the 2016 SBCA Annual Conference, we presented the results of evaluability assessments to determine readiness to conduct economic analysis for several oral health research programs. We also presented a preliminary framework of information types and sources that would be necessary and sufficient for economic analysis, as well as one method for determining the quality of economic analysis. We received valuable feedback at the conference, which has been included in our continued design of the framework. In parallel, policy analysts at the National Institutes of Health (NIH) have articulated a case study method for producing and analyzing evidence of the impact of selected federal research programs (e.g., molecular medicine, vaccines, neuro-stimulation technologies, and longitudinal cardiovascular disease study). For the 2017 SBCA Annual Conference, we propose to assess these case studies against our framework and the quality indicators. This work is an important step in the development of the Science of Science Policy.

Session 4: Thursday, March 16, 2017, 3:45pm - 5:15pm

➢ A-4: Advice to Policymakers for Interpreting BCA (Roundtable)

Chair: Kerry Krutilla, Indiana University

While numerous technical guidelines exist to aid those responsible for developing benefit-cost analyses (e.g., OMB, 2003; OECD, 2008), none is geared toward the policymakers who are responsible for interpreting those analyses and forming policy decisions. This panel of current and former analysts and policy officials will discuss relevant technical, policy, legal and institutional issues and offer advice to policymakers on what to look for when reviewing a benefit-cost analysis and what questions to ask.

Panelists:

Susan Dudley, The George Washington University

Heidi King

Randall Lutter, University of Virginia / Resources for the Future

Brian Mannix, The George Washington University

Al McGartland, U.S. Environmental Protection Agency

➢ B-4: Methodological Issues in the Application of BCA

Chair: Lynn Karoly, RAND Corporation

Discussant: Joseph Cordes, The George Washington University

Presentations:

Distributionally Weighted Cost-Benefit-Analysis: A Three-Step Method, Merits and Limitations; *Thomas van der Pol*, CPB Netherlands Bureau for Economic Policy Analysis*

In cost-benefit analysis (CBA) practices all over the world, benefits and costs are aggregated irrespective of who benefits or loses. This is commonly known as the Kaldor-Hicks compensation principle. Actual compensation, however, may be infeasible, costly or absent in practice. This paper investigates how CBA would look like when inequality aversion and decreasing marginal utility of consumption or income are taken into account. To this end, a three-step method is developed to perform a distributionally weighted CBA. In the first step, weighting schemes are identified. For this purpose, a selection of Social Marginal Welfare Weights (SMWWs) is proposed, including smoothened SMWWs from the inverse of an optimal taxation model. In a second step, income and weighting distributions are discretized. This, amongst others, has an impact on the weights applied to low income households. In a final step, the weighting schemes are to be rescaled or normalized, for which different alternatives exist. These choices are illustrated with a Dutch case study on child care benefits. The paper concludes that guidelines are needed for this type of CBA to consistently aggregate the effects of an investment project, social reform or tax policy on disposable income. The usefulness and limitations of the results of SMWW applications are discussed, as well as less ambitious ways to show distributive effects in CBAs. These include stakeholder analysis and a report of unweighted net benefits for different income groups.

Hurdle Rates, Declining Discount Rates, and Uncertain Opportunity Cost; *Daniel Wilmoth*, U.S. Small Business Administration*

The appropriate discount rate for policy analysis is uncertain. Some economists have argued that the uncertainty implies that impacts should be discounted using declining discount rates, and declining discount rates have been adopted in some countries. The appropriate discount rate for evaluating private projects is also uncertain, and a discounting method that can be used to address uncertainty has been adopted by some firms. However, those firms use hurdle rates rather than declining discount rates. For a given sequence of costs and benefits, uncertainty about the appropriate discount rate creates uncertainty about net benefits after discounting. This presentation compares hurdle rates and declining discount rates as methods for characterizing a probability distribution of net benefits after discounting. Declining discount rates correspond to the expected value. However, positive net benefits under a declining discount rate can be consistent with a very small probability that the realized value will be positive. Hurdle rates correspond to the probability that the realized value will be positive. However, negative net benefits under a hurdle rate can be consistent with an arbitrarily large expected value. Hurdle rates and declining discount rates each capture a different aspect of the probability distribution of net benefits after discounting.

Macroeconomic Effects of Sterilized Intervention; *Yuxuan Huang*, The George Washington University*

Accumulation of foreign reserves enables a country to maintain a stable exchange rate and to meet its foreign debt obligations. However, an increase in foreign exchange increases the reserve money (money base) and thus causes monetary expansion and which brings inflationary pressures to the economy. To offset the expansionary effect of the increasing foreign reserves, the central bank can sterilize the foreign assets by taking intervention using both non-market and market-based tools. In this paper, I construct a DSGE model with working capital constraint for an open economy to study the macroeconomic effects of sterilized foreign exchange intervention under reserve accumulation scenario. The model explicitly includes the central bank and financial intermediary to capture the crowding out effect of the sterilized intervention on private sectors that has been documented in the empirical literature. It also allows the comparison between different sterilization tools and incorporates economic differences between advanced and developing countries. The main aim of this research is to study and compare the different cost and benefit of sterilized intervention policy and find out the optimal policy for conducting sterilized intervention under different economic conditions. The preliminary result suggests capital control can reduce the crowding out effect on investment, countries with higher economic growth are encouraged to conduct a higher degree of sterilization.

➢ C-4: Economic Valuation for Environment and Natural Resource Policy

Chair: Robin Jenkins, U.S. Environmental Protection Agency

Presentations:

Practice What You Preach: The Effectiveness of Recreational Use Value Estimates in Policy Analysis; *Martha Rogers* and Mark Berkman, The Brattle Group*

Contingent valuation methods are often viewed as the "Cadillac" of natural resource damage assessments in part because they are able to capture the "passive use" value of natural resources. Although there are some strong critiques of this method, a major impediment to its widespread use appears to be the extremely high implementation costs. As a result of these impediments, benefit transfer methods remain the most frequently used valuation method. A substantial academic literature has developed on the most appropriate methods of implementing benefit transfer analyses but little of these findings have transferred over to policy work.

We review 57 of the most recent oil spills involving the National Oceanic and Atmospheric Administration and show that benefit transfer is used as the primary lost recreation valuation method in nearly 75 percent of all spills with a specified valuation method. Despite the academic literature's focus on the implementation of function transfer estimates these policy applications tend to use a more straightforward average-value transfer approach. In this paper, we provide a method for empirically testing the validity of average-value transfers. We apply a "jackknife-in-jackknife" approach to a 2011 database compiled by Rosenberger (see http://recvaluation.forestry.oregonstate.edu/) that contains 2,703 recreational values drawn from

352 studies to show that a study's estimated recreational value falls in the 95 percent confidence interval of the average-value transfer from the remaining studies less than 30 percent of the time, well below the 95 percent threshold one would expect. We then expand on these results using a larger benefit transfer database, the Environmental Valuation Reference Inventory, which contains information on over 4,000 valuation studies. These results suggest that additional research needs to be done on the implementation and use of benefit transfer methods in policy analysis, particularly as they relate to average-value transfers.

Value of Reusing Remediated Land as Greenspace: A Benefit Transfer Application to EPA's Superfund Sites; *Karen Sullivan, Achyut Kafle* and Jacqueline Waite, U.S. Environmental Protection Agency*

United States Environmental Protection Agency (US EPA) and its state and territorial partners have developed a variety of land cleanup programs to assess and, where necessary, clean up contaminated land sites such as Superfund and Brownfields sites across the country. After cleanup many previously contaminated land sites are reused as greenspace for local communities to use as parks, playgrounds, trails, community gardens, natural habitats, and other recreational open spaces. Greenspace provides a multitude of benefits—opportunities for recreational uses or amenity values for local communities, may provide habitats for native plants and wildlife, may sequester carbon to contribute to efforts to address climate change, etc. Benefits of converting such sites to greenspace after cleanup have only been captured qualitatively by the US EPA, for example, in success stories or case studies. This study estimates the value of reusing remediated Superfund and Brownfields sites as greenspace. To do this, a meta-dataset of empirical hedonic studies that evaluate the impact of greenspace on nearby residential property values is compiled and a benefit transfer function is developed using a meta-regression model. Hedonic property value models have long been used to estimate willingness to pay (WTP) for marginal changes in greenspace in a revealed preference framework. This study uses WTP estimates from empirical hedonic studies that value greenspace conducted in the late 1990s or later in the United States. The meta-analysis is in progress. Results will identify the value of greenspace reuse on remediated Superfund and Brownfield sites across the nation. This will increase our understanding of the benefits accruing to local communities as a result of the US EPA's cleanup programs. Results may also be of interest to stakeholders engaged in the redevelopment of remediated Superfund and Brownfield sites when considering different reuse options.

Bad Air Days: On the Valuation of Air Quality Using Different Measures of Subjective Wellbeing; *Kate Laffan* and Paul Dolan, London School of Economics*

A new approach to benefit cost analysis has emerged from the growing field of subjective wellbeing (SWB) economics. This approach – commonly referred to as wellbeing valuation-- involves using the variations in SWB reports associated with both income and the non-market good of interest, to calculate the income- EQ trade-off when maintains the same level of SWB. The appeal of this approach is that it avoids some of the key limitations than more traditional approaches to non-market good valuation; it does not rely on market assumptions and it is unaffected by biases such as those arising from strategic responses or the framing of the questions. As a result, this method of benefit costs analysis is gaining traction in policy circles; for example the UK's Green book, which contains guidance on how to appraise and evaluate

policies, was amended in 2011 to incorporate the wellbeing valuation approach. To date work in this area has mostly focused on valuing elements of environmental quality, such as pollution and the effects of drought, using reports of life satisfaction as the measure of SWB. There is a growing consensus in the literature, however, that wellbeing is a multidimensional construct and that beyond life satisfaction, both affective measures which capture positive and negative experiential wellbeing, and eudemonic measures which can relate to purpose and meaningfulness of an activity or life overall, provide additional insights into how an individual's life is going. This paper explores whether the measure matters in the wellbeing valuation of local air pollution and finds that the monetary valuations vary greatly across different measures of SWB, begging the question which SWB measure is fit for purpose in the context of the valuation of non-market goods relating to the environment?

➢ D-4: Application of BCA in Europe: Experiences, Challenges, and the Future

Chair: Daniel Perez, The George Washington University

Discussant: Bahman Kashi, Queen's University

Presentations:

Trends in Non-Market Valuation in the UK*; Ben Groom*, London School of Economics*

The future has become more important, according to the recent guidelines on Cost Benefit Analysis and the social discount rate, with the advent of declining discount rates (DDRs). The changes on government policy followed from numerous academic advances in the theory and empirics of DDRs. But how pivotal were academic contributions to the evolution of government policies and guidelines? How pivotal are they in general? Clearly, academics are on the supply side of the policy making process, providing important inputs, which can be viewed as technological innovations. But what of the demand side, and the way in which policies are adopted to address political and other practical needs within government? Then, between the demand and the supply side, how important are the policy brokers who bridge and coordinate between willing "buyers" and willing "sellers" of ideas. In this paper we use the recent rolling-out of new discounting guidance within countries, and its diffusion across countries, to study these questions and determine the roles of papers, presentations, political preconditions and personalities on policy. We study the UK, US, Norway, France and the Netherlands and present evidence from semi-structured interviews with key officials in their governments and key academics. For sure, academics have an important role to play in policy, we argue, but the success of this role is conditioned on many demand side factors, the way in which ideas are brokered, and sometimes just good fortune.

Evolution of BCA-based Decisionmaking – the Example of the Swedish Transport Sector; *Gunnar Lindberg*, Norwegian Institute of Transport Economics*

BCA has a long tradition in planning of national transportation infrastructure in Sweden. Beginning as a planning tool within the national road administration in the 1960's, BCA became a pillar stone of national transport policy as a result of strategic choices made by the national parliament in the late 70s and 80s.The 1979 decision adopted marginal cost, instead of average

cost, as the overarching principle for pricing of transport, which implied that investment decisions could not be based on business-case considerations. The separation of rail infrastructure from the business management of the train-service providers in 1988 is another case. Therefore, a foregone conclusion in both cases were that efficient investment priorities should be made based on societal BCA. No one asked whether the political decision makers, or the BCA models, were apt to that task. In this paper, we review the current state of BCA for transport in Sweden. Especially we focus on a number of design issues which have been very much debated over the years, and to some extent still are.

BCA on Health Risks in France; *Henrik Andersson*, Toulouse School of Economics, on behalf of Luc Baumstark, University of Lyon*

> ➢ E-4: Issues in the Use of Economic Evaluation in Public Sector Decision-making

Chair: Margaret Kuklinski, University of Washington

Discussant: Gary VanLandingham, Florida State University

Presentations:

Can Analysis Facilitate Public Participation; *Stuart Shapiro*, Rutgers University*

Many forms of policy analysis, including benefit-cost analysis, tout the virtues of analysis as a tool to improve the transparency of government decisions. But these discussion often have a "if you analyze it, they will participate' quality about them. Rarely is the success of analysis in stimulating participation evaluated and rarely are the factors that determine whether analysis stimulates participation analyzed.

This paper hopes to fill this gap. I conducted interviews with 48 high level analysts (including economists, risk assessors, and environmental impact assessors) and a case study of a panel under the Small Business Regulatory Enforcement Fairness Act (SBREFA). The interviews showed examples of analysis facilitating participation and analysis deterring participation.

Analysis can make government decisions more transparent or more opaque. Placing analysis early in the decision-making process makes it more likely that it will be helpful to outside parties hoping to weigh in on policy decisions. Making the analysis simpler and clearer also enhances transparency and in doing so facilitates public participation.

Many of these qualities are present in the SBREFA panel process. The case study of an OSHA regulation subject to the SBREFA panel requirement revealed that the analysis was clear even for lay people and allowed them to weigh in meaningfully on the regulation in question. However SBREFA is geared to a particular constituency so its generalizability is in question. In any case the principles of early analysis, simplicity, and focused participation are important for the ability of any kind of analysis to help secure public input on government decisions.

Implementing Results First: Adventures in Capacity-building to Produce Benefit-Cost Analysis for Policymaking; *Steven Lize*, The Pew Charitable Trusts*

The Pew-MacArthur Results First Initiative (Results First) provides intensive technical assistance to states and counties to develop their capacity to produce benefit-cost analyses (BCAs) of evidence-based programs and policies. Using an econometric model created by the Washington State Institute for Public Policy applied in a cloud-based software application, the Results First technical assistance team trains partners to use the model and customize it to reflect local criminal justice, juvenile justice, education, and public health systems. Key components of technical assistance include instruction in BCA concepts, cost analysis methods, analyzing administrative data to produce outcome trends, and communicating findings.
This presentation will highlight lessons learned about preferred methods, typical challenges, and common solutions for supporting BCA in state and local policymaking. Marginal cost estimates are preferred to represent the values of unit changes through government systems. Yet, government analysts have limited backgrounds and training in economic methods, requiring an iterative process to whittle down average costs with "top-down" and "bottom-up" methods. Furthermore, many jurisdictions do not have rich, high-quality administrative data for estimating unit quantities, requiring adjustments to model assumptions or exclusions that limit the perspectives for monetary impacts. The approach trades methodological rigor for face validity whereby stakeholders accept estimates as agreeable from their practical perspective. Communicating findings requires balancing brevity and relevance with maintaining detail and clarity in documenting methods and assumptions.

Results: First partner jurisdictions have included, to various degrees, BCAs in policymaking. Noteworthy examples include Illinois, Iowa, Mississippi, Massachusetts, New York, Rhode Island, and Vermont, which have used findings from BCAs to make budget and programmatic decisions across a range of social policy areas.

Unbundling Political and Economic Rationality: A Non-Parametric Approach Tested on Spain; *Salvador Bertoméu-Sánchez*, ECARES - Université Libre de Bruxelles*

Approaches such as cost-benefit analysis are commonly used to analyze the strengths and weaknesses of different policy alternatives. We propose a simple method to complement such analyses in ex-post evaluations to rank the various objectives that often underpin investment and policy decisions. We illustrate the method in the Spanish transport sector context and use it to assess the extent to which political concerns dominated economic concerns or vice versa over time. The true motivation can be revealed by modeling each policy goal as the focus of the optimization anchoring a data envelopment analysis of the efficiency of the observed implementation. The method clearly shows that investments have generally been more consistent with a political objective (the centralization of economic power) than with an economic objective (maximizing mobility).

➢ F-4: Considerations in Developing High-Quality BCA Estimates

Chair: Judy Temple, University of Minnesota

Discussant: Lindsay Abate, U.S. Small Business Administration

Presentations:

Understanding and Avoiding Pitfalls of Benefit/Cost Analysis; *Ernest Forman*, The George Washington University*

Mathematically meaningful and accurate, proportionate, measurement of both tangible and intangible benefits is fundamental to any benefit cost analysis. Approaches such as converting intangible benefits to dollars with multiple regression analysis do not work well. However, measurement methods based on pairwise comparisons, as practiced in the Analytic Hierarchy process, have been successfully used for decision making and resource allocation for more than 30 years and are becoming widely available in commercial software tools. This paper will describe the underlying theory behind deriving accurate ratio scale measures of both tangible and intangible benefits. Ratio scale measures are required in benefit cost analysis in order for benefit cost ratios to be mathematically meaningful. We will discuss benefit cost considerations in choice decisions as well as in portfolio decisions. We will examine why, in choice decisions, selecting by benefit/cost ratio may be shortsighted, and why in portfolio decisions, optimization of benefits subject to cost and other constraints is superior to deciding based on benefit cost ratios. We will also discuss approaches to deriving benefit measures for alternatives that differ by several orders of magnitude in cost -- such that low cost alternatives do not dominate a portfolio.

Forecasting Affected Populations for Benefit-Cost Analyses; *Douglas Scheffler*, U.S. Coast Guard*

Many cost-benefit analysis studies involve forecasting of affected populations, which becomes a key input into the costs and benefits analyses. A regulatory analysis under Executive Order 12866, "Regulatory Planning and Review." typically covers 10 years after the rule comes into effect. A simple approach with regard to the affected populations is to assume that the population is steady throughout the analysis period. However, that can overlook important trends in areas such as demographics, economics, and developments in the industry under study. This leads to an inaccurate forecast of affected populations and consequently errors in the estimates of costs and benefits.

This proposed presentation has two parts. The first will present examples from recent Coast Guard projects on examples of forecasting affected populations. These examples will discuss why a "steady state" model was inappropriate, the methodologies developed for forecasting the populations, and the data used to make the forecasts.

The second part will discuss general problems with forecasting demographic and economic data, such as population shifts and business cycles. This part also will provide sources for demographic and economic data such as the U.S. Census Bureau, the Department of Energy's Energy Information Administration, and the National Bureau of Economic Research.

Should CBAs Include a Correction for the Marginal Excess Burden?; *Frits Bos*, CPB Netherlands Bureau for Economic Policy Analysis*

In some countries, like the USA and Norway, a cost correction factor of 20-30% is applied in CBAs for the marginal excess burden (MEB) of taxation. This is also in line with the recommendations by some CBA textbooks. However, in most countries no such corrections are made. In the Netherlands, this issue was subject to intense debate in a national economic journal and remained unresolved. The recently revised Dutch CBA guidelines only state that the issue still has to be clarified. Therefore, the Dutch government has asked a special CBA-Working group to advice on this issue. In line with the Working group's report, this paper investigates the theoretical, empirical and practical arguments in favor or against a MEB correction. It argues that the distortions by taxation are often the consequence of the wish to reduce income inequality. Including a correction for the costs of taxation while ignoring offsetting benefits from income redistribution would therefore be misleading. Moreover, estimates of their relative sizes are uncertain. A simple and pragmatic solution is to assume that the MEB is broadly counterbalanced by the benefits of redistribution of these taxes. This is consistent with the preferences for equality in a country's current tax system. As a consequence, the marginal cost of public funds is equal to one and no correction is needed in CBAs for the MEB. This is also consistent with CBA practice based on the Hicks-Kaldor criterion provided that the policy measure's distributional effects are also taken serious, i.e. net benefits are shown for different income groups whenever substantial and relevant.

A Benefit-Cost Analysis of the Multiplier Effect; *Erik Rose*, Oregon State University*

The ability of currency to circulate within an economic network is analogous to the circulation of blood through a body. Currency that escapes the network, like blood through a cut, ceases to perform work within the system, reducing growth. The average US resident spends 65 cents of each dollar they earn locally, and the recipient spends 65% of that until a total of $1.84 in re-spending takes place annually.

What happens if people are able to spend a higher percentage of each dollar locally? At 80%, a 15 cent increase, total re-spending doubles in size, growing to $3.95. At 86%, re-spending would grow by another two dollars to $6.07. As the re-spending percentage increases, growth increases at an exponential rate. The current research of Erik Rose as a PhD student at Oregon State University studies the ability of tight circulation patterns to capture currency within economic networks, achieving higher local re-spending rates.

This presentation concerns the analysis of financial instruments that invest in re-spending growth. Discuss methods to compare the return on investment in 're-spending instruments' at various re-spending rates to the returns of traditional loans at various rates and terms. Using the hypothetical example of disaster relief funding, compare the benefits of traditional relief funding to the benefits of re-spending instruments under a range of performance scenarios.

Session 5: Friday, March 17, 2017, 9:00am - 10:30am

➢ A-5: Benefit-Cost Analyses and Food Safety Regulations on Meat, Poultry and Egg Products (Roundtable)

Chair: Flora Tsui, U.S. Department of Agriculture

Discussant: Sandra Hoffmann, U.S. Department of Agriculture

A roundtable discussion highlighting how USDA/FSIS conducts benefit cost analyses for food safety regulations on products under jurisdiction. The content would include a brief overview of the methodology and data most frequently used, and three most recent BCAs as case studies.

Presentations:

1. Overview of Food Safety Regulations; *Richa Ajmera*, U.S. Department of Agriculture*

2. Benefit Cost Analysis for the New Performance Standards for Pathogen Reduction in Certain Poultry Products; *Angelica Marrero*, U.S. Department of Agriculture*

3. Benefit Cost Analysis on Control of Listeria Monocytogenes in Ready-to-Eat Meat and Poultry Products; *Flora Tsui*, U.S. Department of Agriculture*

➢ B-5: BCA in Political Decision-making

Chair: Joe Devlin, Environment & Climate Change Canada

Discussant: Ronald Bird, U.S. Chamber of Commerce

Presentations:

Michigan v. EPA and the Inescapable Normative Nature of the Concept of Cost; *Daniele Bertolini*, Ryerson University*

In this paper, we examine the decision of the US Supreme Court ("USSC") in Michigan v. EPA (2015) in the context of the rapidly evolving jurisprudential framework concerning the relationship between judicial review and cost-benefit analysis. This Article is divided in three parts. In the first Part, we examine the decision from a legal positive perspective. First, we scrutinize parties' opposing line of arguments. Second, we identify weaknesses and limitations of the USSC's line of reasoning, and emphasize the extent to which the decision has departed from consolidated case law.

In the second Part, we provide a normative conceptual analysis of cost in the context of regulatory action. Drawing on institutional economics literature, we examine the logical features of the concept of cost and the difficulties associated with the use of the term 'cost' in legal economic analysis. More specifically, we identify cost as a partial function of both the

institutional structure and legal framework. On this view, the identification of a relevant set of costs hinges on the prior definition of the normatively relevant set of interests. That is, to operationalize the concept of cost one must rely on a well-defined normative framework that specifies in advance 'whose interests are made a cost to whom.'

In the third Part, we apply the proposed normative framework to the central issue in Michigan v. EPA–i.e., whether it is reasonable for the agency to not consider the costs of regulation at the listing phase. We contend that this legal issue depends on defining the set of interests that is relevant at the listing phase. The discussion of this point provides useful generalizable insights on the role of costs in the contest of regulatory action. The ultimate analytical goal is to provide a conceptual framework that enhances transparency and consistency of legal-economic reasoning in the context of regulatory action.

Cost-Benefit Analysis, Policy Impacts, and Congressional Hearings; *Joseph Ripberger* and Deven Carlson*, University of Oklahoma*

In 1981, President Reagan signed Executive Order 12291, which required agencies to conduct a cost-benefit analysis of every major proposed regulation. Although the details of this order have changed from administration to administration, cost-benefit analysis remains a crucial component of the federal policymaking process today. In order to be maximize informational value, a cost-benefit analysis must contain a comprehensive accounting of each and every impact—both positive and negative—of the policy under consideration. Existing work, however, provides relatively little guidance on the optimal approach to systematically identifying all valued impacts of the policy being evaluated. Consequently, this process is often driven by ad hoc theorizing, path-dependent reviews of previous work on the topic, or dialogue with stakeholders invested in a given policy alternative. Occasionally, the process also includes public comments that are collected from comment periods or focus groups. Though useful, these practices are not always systematic and can result in omission of significant policy impacts, thus limiting the value of the cost-benefit analysis from a policymaker's perspective.

In this paper, we develop a systematic approach to identifying relevant policy impacts for valuation in a cost-benefit analysis. Specifically, this approach involves systematic analysis of every statement from each witnesses across the universe of Congressional hearings on the topic. By using Congressional hearings as the basis for our approach, we are identifying potential policy impacts from information provided during the very process the cost-benefit analysis is intended to inform. In doing so, this approach is designed to ensure that all impacts valued by policymakers and relevant stakeholders are accounted for in the cost-benefit analysis. We demonstrate the utility of our approach by using it to identify potential impacts from proposals to alter operations of the Glen Canyon Dam.

Analyzing the Effects of the Tarmac Delay Rule: Data and Methodological Challenges; *Deborah Aiken*, U.S. Department of Transportation; Ali Gungor, U.S. Coast Guard; and Rayik Samara, George Mason University*

In 2010, the U.S. Department of Transportation issued the tarmac delay rule (TDR). The Department adopted the rule partly in response to instances where passengers were held on aircraft during lengthy delays on the airport tarmac. The TDR requires airlines to give

passengers on domestic flights an opportunity to deplane no more than three hours after the cabin door has closed at the gate if aircraft liftoff has not occurred, or no more than three hours after touchdown at the arrival airport. Airlines that violate the TDR may be subject to financial penalties.

Several studies have evaluated the effects of the TDR. Overall, studies agree that the rule has significantly reduced the frequency of lengthy tarmac delays. However, some studies suggest that the reductions in tarmac delays may come at the expense of unintended consequences that potentially leave airline passengers worse off. For example, one concern is that the reductions in delays reflect an increased tendency of airlines to cancel flights rather than risk penalties associated with violating the TDR. Increased cancellations may reduce passenger welfare due to the need to rebook flights, and the resulting delays in reaching final destinations.

Previous studies typically use the Airline Service Quality Performance (ASQP) database collected by the Bureau of Transportation Statistics. Because the number of daily flights is in the thousands, researchers have employed various methods to reduce the data to a more manageable size. The methods include: reducing the size by random sampling of the daily flight data, aggregating to monthly cancellation rates, and limiting the analysis to certain months of the year. In this study, we review these data reduction approaches and systematically evaluate whether they lead to loss of critical information, which may mask important effects and cause misleading interpretations of the impacts of the TDR on passenger welfare.

➢ C-5: Applications of BCA in Energy and the Environment

Chair and Discussant: Ann Ferris, U.S. Environmental Protection Agency

Presentations:

National Security Benefits within the Renewable Fuel Standard; *Daniel Perez*, The George Washington University*

I'm proposing to assess the assumptions concerning the national security benefits estimated within EPA's RIA of its Renewable Fuel Standard. These benefits are listed broadly under the term "energy security." EPA estimates a $2.6 billion annual benefit in its 2010 Regulatory Impact Assessment of the RFS2 Program. This is estimated to the potential benefit to the U.S. economy in the form of reduced macroeconomic/disruption costs (in the event of a shock to oil markets). My presentation would focus on EPA's claim that there is little to no correlation between the price of crude and the price of renewable fuel feedstocks - it is possible that the potential benefits to the U.S. economy would be limited by a substitution effect during a global oil shortage.

The (r)Evolution of Non-Energy Benefits in Energy Efficiency; *Christopher Chan*, Eversource Energy; Greg Clendenning, NMR Group, Inc; Bruce Tonn, Three3, Inc; and Beth Hawkins, Three3, Inc.*

Eversource, New England's largest energy delivery company, is one of eight "Program Administrators" (PAs) responsible for planning and administering Massachusetts' energy efficiency programs. Many states, including Massachusetts, require that these ratepayer-funded programs be screened for cost-effectiveness through application of a "Total Resource Cost" (TRC) test. The TRC test, in concept, weighs the program costs for administration and implementation and the program benefits, which include energy, secondary fuel, and other resource savings, as well as "non-energy benefits" (NEBs).

However, NEBs – such as improved comfort, health, and worker productivity – are rarely incorporated in the TRC test because they can be difficult to quantify or viewed as an "externality" outside the usual realm of utility regulation. As a result, regulatory decisions can be biased against cost-effective efficiency investments. Fortunately, Massachusetts regulators encourage the PAs to conduct studies of NEBs and include their values in the TRC test.

Massachusetts is widely recognized as a NEB leader, as exemplified by its groundbreaking research covering many NEB categories and market sectors. As their programs mature and more energy efficient standards or practices are adopted, the PAs continually assess and deploy novel, robust methods for quantifying NEBs to bolster the cost-effectiveness and continued promotion and expansion of program offerings. As an example, the PAs recently completed a comprehensive, integrative study that reexamined and assessed the NEBs of their low-income weatherization program, which include the avoided medical costs and deaths from reduced asthma, thermal stress, fire, and carbon monoxide poisoning; reduced losses in work income; reduced use of short-term predatory loans; and increased home productivity. This research was based on occupant pre- and post-weatherization survey responses coupled with medical incidence and cost and wage data, and a value per statistical life. The PAs are considering using the study results to support a program for replacing heating systems in low-income housing.

Welfare Impact of Electricity Subsidy Reforms: A Micro Model Study; *Syed Adnan Khalid*, National University of Sciences & Technology*

Manned space flight has been risky to the persons involved. The U.S. space program has had to cope with one ground fire killing three astronauts, (Apollo 1) and two shuttle explosions (the Challenger launch in 1986 and the Columbia reentry in 2003, each killing a crew of 7). The events with fatalities each led to significant delays in the space program. As NASA increases its use of commercial enterprises to support manned missions, with transport or even missions themselves contracted out and private businesses undertaking their own space endeavors (tourism, mining), understanding how to think about these risks will continue to be important, particularly regarding risks to life. The "value of statistical life" (VSL) is the standard tool to assess whether the benefit of actions to reduce the probability of mortality exceed the cost of those actions. While useful in assessing some aspects of space risk and liability awards, its use may be qualified first by whether those taking the risk signed on to the prospect, astronauts being the leading example. Another qualification is the extent to which the public at large bears the cost of this risk by being averse to witnessing losses of those exploring space. We assess the relevance of VSL in settings where participants choose to take on the risk and where the policy question involves willingness to pay to reduce risks to others rather than reducing risks to oneself. A relevant question to consider is whether the public's aversion to mortality should be

the standard for determining whether expansion of space activity is worth the risks borne by participants in the commercial space sector. (This work was funded by a grant from NASA to Resources for the Future; Molly Macauley, Principle Investigator.)

> D-5: Applications of BCA to Jobs and Transfer Programs

Chair: Weston Merrick, Minnesota Management and Budget

Presentations:

Imagining a Tax System with Universal Basic Income; *Kyle Rozema*, Northwestern University*

Proposals for a universal basic income (UBI), in which each citizen receives an unconditional cash payment from the government on a monthly or annual basis, date at least as far back as the late eighteenth century but have been increasing in recent years. The movement for a UBI in the US appears to be coalescing around a plan to replace some or all existing anti-poverty programs with a payment of approximately $12,000 to each adult each year. Despite widespread discussion of these proposals among academics and activists, no one has yet produced a rigorous estimate of the budgetary or distributional effects of a UBI along the lines proposed. This article aims to fill that gap. Using microdata drawn from US tax returns, we seek to answer two questions: (1) What changes to the tax system would be necessary to finance a UBI of the size suggested?; and (2) What would be the distributional consequences of repealing existing anti-poverty programs and replacing them with an annual $12,000 UBI (with or without additional adjustments to the tax code)?

We first estimate that the net cost of one of the main UBI proposals, $2.3 trillion, could be raised if each marginal rate in the federal individual income tax schedule were increased by 31 percentage points. The assumption that a UBI would be funded by uniform increases across the rate schedule is, to be sure, just one possible way that Congress might choose to pay for such a program—and perhaps not the most politically feasible option. We therefore evaluate other possibilities for financing a UBI, and we provide estimates of the distributional effects of these options. We also consider the revenue and distributional effects of expanding the UBI to include children.

A Benefit-Cost Analysis of a Workforce Development Program for Disconnected Youth; *Mithuna Srinivasan* and Sonam Gupta, Impaq International*

Given the pressing issue of high rates of unemployment among young adults and disconnection from the educational system and labor market, the U.S. Department of Labor in July 2012 awarded a grant to the Riverside County Economic Development Agency (EDA) to implement the Linking Innovation, Knowledge, and Employment (@LIKE) program. This program provided services to disconnected young adults (ages 18-24) to address skill gaps and enable them to meet their educational and labor market goals. The @LIKE program operated in Riverside, San Bernardino, and Imperial counties in Southern California until October 2016. In 2012, the

Riverside EDA engaged IMPAQ International as a third party independent evaluator to evaluate the grant initiative. IMPAQ was responsible for all components of the evaluation including a quasi-experimental design to determine the overall impact of the @LIKE program.

IMPAQ also performed a benefit-cost analysis (BCA) to determine whether, in addition to being effective in improving outcomes, the program resulted in positive net benefits. Two categories of benefits were considered: (1) direct benefits accruing to program participants because of attained outcomes; and (2) indirect benefits accruing to non-program entities. As a measure of cost, we computed the incremental per capita cost of the @LIKE program compared to "business as usual." Under the assumption of a one-year time horizon and a social discount rate of 3 percent, the BCA revealed that the program's per capita net benefits amount to $1,449. Overall, our findings support continuing investments in programs similar to @LIKE. More generally, the @LIKE context provides an example of how BCA can serve as a tool in the promotion of evidence-based decision-making for public policy concerning young adult training programs. This is essential to ensuring that the government is making the best use of taxpayers' funds and deriving the maximum benefits for society.

Evaluating the Iowa's High Quality Jobs Program; *Zhong Jin*, Iowa Department of Revenue*

Iowa state governments awarded an average of $50 million a year on a High Quality Jobs program (HQJ) that intends to induce business investment and encourage job creation in Iowa through the use of subsidies and tax incentives. In this paper we use an estimation approach that is valid under relatively weak assumptions to measure the impact of HQJ projects on business investment decisions and local labor markets. The study also examines the fiscal impact of the HQJ program on Iowa's budgets. The study finds indirect evidences that the tax incentives help local jurisdictions to induce business investments to local there. The study also finds that the HQJ program have positive, statistically significant, impacts on local labor markets in terms of the employment growth rate and the wage growth rate. The fiscal impact of the program is found to usually spread out a period over ten years.

My results are noteworthy for several reasons. First, most previous studies are either focus on the economic impacts of place-based economic development programs, or aimed to estimate the responses of businesses toward such programs. This study is one of the few to measure both the incentive effect and the welfare effect of a state placed-based economic development tax credit program. Second, this study is also one the first to analyze how fiscal impacts of the tax credit program spread out over a long period to influence the government budgets. While state governments increasingly face situations of very tight budgets, the findings add to our understanding of the efficacy and the cost of these business development tax expenditures.

Examining the Costs and Benefits of Family Rewards 2.0; A Conditional Cash Transfer Program in Two American Cities; *Timothy Rudd*, MDRC*

Family Rewards was an innovative approach to poverty reduction in the United States that was modelled on the conditional cash transfer (CCT) programs common in lower- and middle-income countries. The program offered cash assistance to poor families to reduce immediate hardship, provided they met certain criteria related to family health care, children's education, and parents' work, in the hope of reducing poverty over the long term. The first version of Family

Rewards was evaluated in New York City in 2007. The lessons learned from that evaluation led to the next iteration of the model ("Family Rewards 2.0").

MDRC evaluated Family Rewards 2.0 through a randomized controlled trial involving about 1,200 families in each city, half of whom could receive the cash rewards and half of whom could not. This report presents the program's costs and the economic value of the estimated effects over four years.

This benefit-cost analysis attempts to answer the following questions: How much did it cost to operate Family Rewards 2.0? Which components of the program were most and least expensive? What is the economic value of impacts on primary outcomes? Does the program produce a positive net present value? What is the benefit-cost ratio for the program? How do various types of uncertainty affect the benefit-cost conclusions?

The findings show that the level of effort required to support participants and process rewards, as well as the value of potential impacts on targeted outcomes, are primary drivers of success for CCT programs. Conditional cash payments are more likely to produce benefits in excess of program costs for taxpayers and society when the level of effort required to administer reward payments is low and the potential value of impacts on targeted outcomes is high.

> E-5: Economic Evaluation Applications in Health Care and Public Health

Chair: Jamison Pike, U.S. Centers for Disease Control and Prevention

Presentations: Estimating the Monetary Benefits of Medicare Eligibility for Reducing the Symptoms of Dementia; *Robert Brent*, Fordham University*

Dementia is a term used to describe various symptoms of cognitive decline, involving memory, language and thinking that are severe enough to affect daily activities. In 2015, worldwide, there were 897 million people aged 60 and over and 5.2% of these had dementia. Global costs of dementia were US$ 818 billion in 2015.

Given the prevalence and costs of this disease, it is important that interventions for dementia be identified and evaluated using cost-benefit analysis (CBA) to assess whether they are socially worthwhile. The challenge is to identify and quantify the benefits of interventions that can be shown to have a causal impact on dementia.

We adopt a three-component method, based on the idea of cost-saving, for estimating the monetary benefits of Medicare eligibility for reducing dementia. The method involves Medicare eligibility lowering dementia, which reduces the need for dependent living, which in turn lowers caregiving costs. We use a varying slopes Regression Discontinuity approach first utilized by Card et al. (2008, 2009) that shows how dementia is affected by age before and after the 65 years cutoff for Medicare eligibility. The downward difference (discontinuity) between the before and after age slopes at the cutoff records any causal shift that Medicare eligibility has on dementia. Our data is based on a nationally representative sample of 12,239 participants with

normal cognition, mild cognitive impairment and dementia at 32 Alzheimer's Disease Centers. We use the Clinical Dementia Rating (CDR) Scale to measure dementia severity.

The novel aspect of the study comes from using a quality of life proxy measure for the utility function to derive the marginal rate of substitution between dementia reduction and dependent living arrangements. The main findings are that Medicare eligibility does causally reduce dementia and that this reduction can be valued at around $5,029 per person.

Economic Losses Associated with Oral Problems in the United States - Using the National Health Interview Survey, 2008; *Uma Kelekar*, Marymount University; and Shillpa Navaal, Virginia Commonwealth University*

Poor oral health not only costs resources to treat associated diseases, but may also affect an individual's earning potential. Due to oral health problems, apart from pain and discomfort, an individual may have additional financial or academic losses associated due to time lost from work or school. This study proposes to quantify the economic losses associated with oral health problems among families and children in the United States using the most recent Oral Health Supplement of the National Health Interview Survey (NHIS) data available for year 2008. More specifically, the study will aim to first estimate the total number of work and school hours missed by employed individuals and school-going children aged 5-17 years due to dental visits. The hours lost in seeking planned or routine care along with unplanned/emergency care will be separately estimated. Furthermore, the missed hours will be reported across gender, age, race, education level, family income, and occupation. Using the wage or compensation data, the study will attempt to assess the economic losses associated with these missed hours for the working adult population. The findings of this study will be of particular interest to several audiences including individuals, businesses, schools, and the government.

Estimating Economic Value of Illnesses Impacted by Environmental Hazards; *Ying Zhou*, U.S. Centers for Disease Control and Prevention*

In benefit cost analysis of public health programs, health outcomes need to be assigned monetary values to make them comparable and to determine if the improvement in health can offset the cost of the program. There are two major approaches for estimating economic value of illnesses: Willingness-to-pay (WTP) and Cost of Illness (COI). WTP represents true cost of the illness compared to COI. However, WTP is more difficult to estimate and is currently available for a limited number of illnesses. In this study, we compared estimates in the literature using these two approaches. First, we compared results of WTP and COI estimates reported in the peer-reviewed literature when these two methods were applied to the same study participants. Second, we reviewed the availability and summarized valuations using these two approaches for three health endpoints impacted by environmental hazards: asthma, carbon monoxide (CO) poisoning, and lead poisoning. First, for the same study participants, studies reported WTP that were significantly higher than COI for minor and moderate cases. For more severe cases, where costs paid by insurance were substantial, COI could exceed WTP. Second, using COI approach, annual medical cost of asthma ranged from $800 to $3,300 and indirect costs ranged from $85 to $1,700. As a comparison, WTP to eliminate asthma symptoms ranged from $580 to $4,200 annually, though these estimates were for different study participants. We found no studies estimating WTP to avoid lead or CO poisoning. For lead poisoning, most studies focused on lead exposure and cognitive ability, and its impact on lifetime earnings. Cost of a CO poisoning hospitalization ranged from $10,000 to $17,000. For

patients who sustained long-term cognitive sequela, lifetime earnings and quality of life losses can significantly exceed hospitalization costs.

Conclusion: For asthma, more WTP studies are needed, particularly studies designed for conditions that involve third party payers. For CO poisoning and lead poisoning, WTP studies need to be conducted, so that more comprehensive and accurate economic valuation estimates can be provided.

Estimated Savings to Medicaid Obtained by Substituting Electronic for Tobacco-Based Cigarettes*; Richard Belzer*, Regulatory Checkbook*

Health insurers cover most medical care costs, including those resulting from smoking. Coverage is limited to current year events, however, so private insurers have weak incentives to reward individuals for behavior that reduces future outlays. Government insurers such as Medicaid have different incentives. Financial exposure is long-lived even if participation is subject to considerable churn. "Vaping" administers similar doses of nicotine but offers substantial reductions in respiratory and cardiovascular risks. Thus, encouraging the substitution of vaping for smoking is expected to result in substantial long-term savings in the cost of providing medical care for Medicaid beneficiaries who smoke.

Under the Affordable Care Act, private insurers are permitted to impose substantial surcharges on smokers who choose to reveal themselves. (Outed smokers can avoid the surcharge by enrolling in a tobacco cessation program even if they are not serious about quitting.) Government insurers generally cannot charge smokers higher premiums or otherwise leverage their price responsiveness.

Federal and State tax policies actively leverage consumers' price responsiveness to reduce tobacco consumption. Regulations restricting access to tobacco, or the venues in which it may be consumed, have implicit price effects. At the same time, governments have become reliant on revenues from tobacco taxes. Large revenue losses would result if domestic tobacco sales sharply declined.

Estimates will be provided of the net benefits to individuals and savings to the Medicaid program of switching from smoking to vaping and choosing to vape instead of smoke. State-level results will be presented to the extent feasible given data quality considerations. Sensitivity analyses will be performed where reliable literature is lacking, or uncertainty and variability inhibit precise estimation.

➢ F-5: Evaluation and Ex-Post Impact Assessment in the EU – Methodology and Practice

Chair: Joseph Cordes, The George Washington University

Discussant: Reeve Bull, Administrative Conference of the United States

The chair will introduce the panelists and the discussant and provide some background for the discussions. The panel will feature three presentations from one representative of the European Commission and two representatives of the European Parliament, respectively. The first presentation will provide a succinct introduction into the way the EU Commission carries out its ex-post evaluations, the guidelines it uses and the main improvements of the 2015 Better Regulation Package, followed by a practical example of how the European Commission carries out retrospective evaluations. The second presentation will offer an overview of how the European Parliament exercises its oversight function as to how EU policies are implemented. The third presentation will outline Parliament's setup and position, its legislative cycle and the methodology and practice of implementation reports and its research services in the area of ex-post impact assessment. Following the presentations, the discussant will provide a short wrap up, ask questions to each panelist and open up the discussion thereafter to the audience.

Presentations:

Retrospective Evaluation as a Key Component of the EU's Better Regulation Agenda and Recent Practical Examples; *Geraldine Emberger*, European Commission*

The first part of the presentation provides an overview of the instrumentarium the European Commission uses including ex post evaluations, fitness checks and the Regulatory Fitness and Performance Programme (REFIT) to assess how a specific intervention has performed and decide whether and how it should be adjusted to improve its effectiveness, relevance and coherence or to eliminate excessive burdens. The second part of the presentation will serve to illustrate how ex post evaluation works in practice, showcasing a real-life example to which the guidelines have been/are being applied, including forward planning, choice of a relevant regulatory act/several relevant acts for review, evaluation, consultations carried out, role of the Regulatory Scrutiny Board, etc.

The EU Commission's Better Regulation Guidelines provide guidance to services ("Directorate Generals") when developing regulations and legislative proposals. They cover the whole policy cycle – policy design and preparation, adoption; implementation (transposition, complementary non-regulatory actions), application (including enforcement), evaluation and revision. Two and a half years into its mandate, the Juncker Commission is on track to deliver on its ambitious better regulation agenda. A major reform of the Guidelines was carried out in 2015 and the 2016 Inter-institutional Agreement on Better Law-making reached by the European Parliament, the Council and the European Commission marks a significant step forward in the culture of better regulation.

The European Parliament's Scrutiny Toolbox for Transposition and Implementation;
Irmgard Anglmayer*, European Parliament

Scrutiny and oversight is an important function of parliaments. This is also true for the European Parliament, whose scrutiny powers are set out in the EU Treaties. One of the key areas where Parliament exercises an oversight function over the executive is the follow-up of how EU policies are implemented of EU policies as enshrined in the Treaty of the Functioning of the EU, programs and legislation. To this aim, the European Parliament has established a number of scrutiny tools to assist its committees in their scrutiny work. In particular, some of these tools have been developed by the EP Research Services, like initial appraisals of the state of

implementation of all legislative acts the European Commission has put forward for revision, or rolling check-lists on transposition deadlines and review/reporting clauses in EU legislation, including international agreements. This presentation provides an overview of the European Parliament's 'scrutiny toolbox', explaining their rationale and practical application. Implementation reports, as outlined in the next presentation, are just one of them, albeit the most important.

Ex-Post Impact Assessment at the European Parliament; *Sten Ramstedt*, European Parliament*

As part of its general oversight function over the European Commission, the European Parliament began to develop a capacity for ex-post impact assessment/evaluation in 2013. This move was prompted by a parliamentary report adopted in 2011, which invited Parliament to set-up its own integrated impact assessment capacity 'throughout the whole policy cycle, from design to implementation, enforcement, evaluation and to the revision of legislation'. In particular, the European Parliament makes use of its own ex-post evaluation tool, the so-called 'implementation reports'. These own-initiative reports, drawn up by parliamentary committees, seek to establish how a piece of EU legislation, designed in theory, performs in practice and why that is so. Once voted in Plenary, they form Parliament's position on the performance of that particular piece of legislation. If Parliament finds that an act requires revision, the adopted resolution contains a call upon the European Commission to act. The latter is bound to inform Parliament of its follow-up, or to justify any non-action. In this respect, and in the context of the Commission's quasi-monopoly to initiate legislation, Parliament's implementation reports are at the same time a scrutiny and an agenda-setting tool. To ensure implementation reports are evidence-based and accurate, committees are entitled to analytical support provided by the European Parliamentary Research Service (EPRS) in form of 'European Implementation Assessments'. These strictly non-partisan background studies help members to take informed decisions. This paper outlines the practice and methodology of Parliament's research services in the area of ex-post impact assessment.

Session 6: Friday, March 17, 2017, 10:45 – 12:15pm

➤ A-6: Developing a Reference Case for BCA in Low- and Middle-Income Countries (Roundtable/"Listening Session")

Chair: James K. Hammitt, Harvard University

In 2014, the International Decision Support Initiative (iDSI) completed work on a reference case for the conduct of economic evaluation of investments in health in low- and middle-income settings, funded by the Gates Foundation (http://www.idsihealth.org/knowledge_base/the-reference-case-for-economic-evaluation/). That reference case focused on cost effectiveness analysis; the Foundation is now funding a project to expand it to address benefit-cost analysis of investments in global health and development (https://sites.sph.harvard.edu/bcaguidelines/). The reference case provides guidance on best practices, including principles, methodological specifications, and reporting standards. This session will begin with a summary of the cost-effectiveness analysis reference case by a member of the iDSI project team. A second

presentation will summarize the results of the scoping phase of the project to extend the reference case to address benefit-cost analysis. This scoping includes identifying existing guidance and current practices, barriers to the conduct of benefit-cost analysis, and key challenges to be addressed. We will then ask the audience to provide feedback on the results of the scoping phase and suggestions for future work.

Panelists:

Lisa A. Robinson, Harvard University

Thomas Wilkinson, iDSI

David Wilson, Bill & Melinda Gates Foundation

➢ B-6: Issues in Risk, Uncertainty, and Information

Chair: Glenn Blomquist, University of Kentucky

Discussant: Randall Lutter, University of Virginia / Resources for the Future

Presentations:

Applying VSL When Persons Choose Risk or Care about Risks to Others: The Case of Commercial Space Exploration; *Timothy Brennan*, Resources for the Future*

Manned space flight has been risky to the persons involved. The U.S. space program has had to cope with one ground fire killing three astronauts, (Apollo 1) and two shuttle explosions (the Challenger launch in 1986 and the Columbia reentry in 2003, each killing a crew of 7). The events with fatalities each led to significant delays in the space program. As NASA increases its use of commercial enterprises to support manned missions, with transport or even missions themselves contracted out and private businesses undertaking their own space endeavors (tourism, mining), understanding how to think about these risks will continue to be important, particularly regarding risks to life. The "value of statistical life" (VSL) is the standard tool to assess whether the benefit of actions to reduce the probability of mortality exceed the cost of those actions. While useful in assessing some aspects of space risk and liability awards, its use may be qualified first by whether those taking the risk signed on to the prospect, astronauts being the leading example. Another qualification is the extent to which the public at large bears the cost of this risk by being averse to witnessing losses of those exploring space. We assess the relevance of VSL in settings where participants choose to take on the risk and where the policy question involves willingness to pay to reduce risks to others rather than reducing risks to oneself. A relevant question to consider is whether the public's aversion to mortality should be the standard for determining whether expansion of space activity is worth the risks borne by participants in the commercial space sector. (This work was funded by a grant from NASA to Resources for the Future; Molly Macauley, Principle Investigator.)

Behavioral Responses to Health Information and Warnings; *Rosemarie Lavaty* and Carolyn Wolff*, U.S. Food and Drug Administration*

One of the most common risk-reduction strategies used by the Food and Drug Administration (FDA) to achieve its public health mission is to ensure that relevant health information and warnings about FDA-regulated products be disclosed to consumers and healthcare providers. Informational approaches, such as warning labels and nutrition labeling, are often used as a more flexible regulatory alternative to "command-and-control" approaches for addressing risks. From a social welfare perspective, informational strategies may be more efficient than "command-and-control" approaches in reducing risk because they reduce information asymmetry and allow individuals to decide for themselves how to best proceed. While informational approaches have the potential to be effective in promoting public health goals, compared with bans and other more restrictive types of regulatory approaches, their effects on actual behavior and consumption decisions are inherently more difficult to predict and to quantify ex-ante. We develop and apply a theoretical model of consumer response to predict the behavioral change brought about by health information and warnings. In this model, we first estimate the effect of new health information about a product on consumers' willingness to pay for that product. We then estimate the change in the equilibrium price and quantity demanded for the product. The model takes into account consumers' absorption of new risk information, the change in perceived health cost or benefit of consuming a product, and spillovers to consumers who are not the target of the health information treatment.

The Value of a Statistical Life: Economics and Politics; *Ryan Bosworth*, Utah State University*

The value of a statistical life (VSL) is the marginal rate of substitution between income (or wealth) and mortality risk. The VSL indicates how much individuals are willing to pay (WTP) to reduce the risk of death. There is a growing consensus in the academic literature that the population average VSL is in the range of $4 to $10 million (U.S. dollars). This consensus reflects stated VSL estimates used by various government agencies. Ideally, an estimate of how much individuals are willing to pay for safety improvements would enable governments to efficiently allocate resources to safety improvements in a wide variety of areas: road safety, environmental pollution regulations, food safety regulations, etc. However, achieving this ideal may be problematic. In this paper we identify and discuss some problems associated with government policy regarding risks to life and health. In particular, we discuss methodological problems associated with estimating the VSL, cognitive biases that may distort risk perceptions, the possibility of publication bias, and the political economy of the VSL in practice. Public choice theory indicates that agencies have the incentive to maximize budgets by inflating or misapplying estimates of risk and WTP for risk reductions to increase benefits estimates and improve the likelihood that proposed policy programs are adopted. Academic researchers and publishers may also face incentives that lead to publication bias in this area. We investigate whether there are reasons to suspect that the VSL may be overestimated in the academic literature and or inflated due to political considerations in government policy.

> C-6: Consequences of Environmental Policies for Employment and Education

Chair: George Parsons, University of Delaware

Presentations:

Employment and Pollution Abatement: A Nonparametric Cost Function Analysis; *Carl Pasurka*, U.S. Environmental Protection Agency*

Morgenstern et al. (2002) investigated the employment effects of environmental regulations using a cost function that relied on survey data of the cost of inputs assigned to pollution abatement. In contrast, Färe et al. (2013 and 2016) investigated the link between pollution abatement and employment by specifying regulated and unregulated production technologies that model the joint production of good and bad outputs, where the regulated technology exhibits weak output disposability and null-jointness while the unregulated technology exhibits outputs that are strongly disposable. Färe et al. (2016) specified input distance functions to model the regulated and unregulated production technologies and decompose changes in employment, while our decomposition employs a nonparametric cost function (Ball et al 2005) that models the joint production of good and bad outputs.

Like Färe et al. (2016) we measure the relative importance of factors associated with changes in employment without pollution abatement cost data. Here, we will decompose changes in employment into the following components: (1) the cost effect - reflecting employment changes associated with differences in the regulated and unregulated isoquants, (2) the scale (output) effect – reflecting employment changes associated with changes in output levels due to a change in factor prices, (3) the substitution effect – reflecting employment changes associated with changes in factor prices holding output constant, (4) changes in overall (technical and allocative) efficiency – reflecting employment changes associated with increases or decreases in efficiency, and (5) technical change – reflecting employment changes associated with shifts in the regulated isoquant.

We operationalize our model using panel dataset of coal-fired electric power plants with net electricity generation as the good output, SO2 emissions as the bad output, and five inputs - capital stock (a quasi-fixed factor), employment, and fuel consumption (coal, oil, and natural gas).

Air Quality and College Attendance; *John Voorheis*, U.S. Census Bureau*

A growing body of literature suggests that pollution exposure early in life can have substantial long term effects on an individual's economic well-being as an adult. I contribute to this literature by linking responses to the American Community Survey to SSA administrative data on place and exact date of birth, allowing me to examine how exposure to ground level ozone, in utero and during the first year of life, affects college attendance among 18-24 year olds. Additionally, I link these individuals to the universe of IRS tax returns to obtain location and family resources during secondary school (at ages 14-17), allowing me to control for exposure later in a child's life. In both OLS and IV specifications, I find that ozone exposure early in life has a large, economically significant effect on college attendance. Using conventional estimates of the

college wage premium, these effects imply that the air quality improvements due to the Clean Air Act Amendments of 1990 are associated with an $877 increase in annual wages, highlighting the importance of human capital accumulation in explaining the long term economic effects of pollution exposure.

Compensating Workers Who Lose Jobs Due to Carbon Taxes: Lessons from the Trade Adjustment Act; *Craig Thornton*, Mathematica Policy Research*

While the overall climate benefits of reducing carbon consumption seem likely to outweigh the total costs, those benefits and costs are distributed unevenly. In particular, workers currently engaged in sectors that produce a lot of carbon (for example, coal mining) are likely to face substantial losses and can therefore be expected to oppose carbon pricing policies that do not address their losses. To deal with this issue, it has been proposed that revenue from new carbon taxes be used to assist affected workers. Assistance could include job training, career assistance, and other community supports as well as direct income support. However, the 40 years of experience the United States has had with a similar program under the Trade Adjustment Act suggests that delivering effective assistance can be very difficult. In fact, results from a recent evaluation find that participation in TAA, as the program operated under the 2002 amendments, had a negative effect on total income during the four-years following their entry into the assistance program. The factors that led to that outcome provide some guidance to designing new programs that would target workers affected by carbon taxes.

➢ D-6: Applications of BCA in International Trade and Economic Development

Chair: Glenn Jenkins, Queen's University and Eastern Mediterranean University

Presentations:

Towards Meta Benefit-Cost Analysis: The Case of Brexit; *Aurelien Portuese*, Leicester De Montfort University / King's College London*

The referendum on the European Union (EU) which took place in June 2016 ended up in one of the most important decision of the recent history of the UK: to exit the EU - or "Brexit".

This decision will have major impacts on the economy of the United Kingdom and of the European Union. The debate preceding the referendum has been over political gains or losses of leaving the EU, not necessarily on the weighing out of the benefits and costs of such prospect of leaving the EU.

The kernel of the argument of this article is the following one: the Brexit is a fantastic opportunity to carry out a benefit-cost analysis of not only one policy but of an entire country's historical choice. Therefore, not so much is Brexit a phenomenon which has to be scrutinized in a benefit-cost analysis, but the Brexit has a lot to offer as an opportunity to enrich benefit-cost analysis with a meta and on-going case study.

Therefore, this Article shall discuss the fundamental elements of a Brexit's benefit-cost analysis (II) after having demonstrated the reasons why Brexit constitutes a chance for benefit-cost analysis to engage in more meta-analyses (I). We shall conclude by sketching out a framework for further refined benefit-costs analysis on Brexit and on meta-tools (III).

Fukushima: U.S. Response and the Short-Term Impact on U.S.-Japan Trade in Seafood;
Aliya Sassi*, U.S. Food and Drug Administration

The U.S. response to the import of potentially contaminated food from Japan following the Fukushima Daiichi Nuclear Power Facility meltdown has not been closely examined in the economic literature. The incident caused global concern about the safety of foods imported from Japan. Several of Japan's major trading partners introduced bans on imported foods. The U.S., which monitored information and data from foreign governments and international organizations, adopted an import alert and conducted extensive monitoring. The U.S. did not detect radionuclides and did not advise consumers to alter their consumption of foods from Japan. Using a modified Global Simulation Model (GSIM) of trade impacts, this paper assesses the impact of U.S. actions on U.S.-Japan trade in seafood commodities. We estimate that U.S. policy preserved approximately $150 million in annual consumer surplus from the continued import of Japanese seafood (at a cost of less than a million dollars for seafood import sampling), while finding no additional exposure to harmful radionuclides.

A Portfolio-Wide Assessment of MCC's Economic Rates of Return; *Marissa Block* and Sandra Ospina, Millennium Challenge Corporation*

The main purpose of this report is to concisely document facts on ERRs that have been updated upon compact closeouts as of end-2015. The report's first three sections describe coverage, characteristics of all closeout ERRs and characteristics of closeout ERRs that fall below MCC's ten percent threshold. Section IV presents original ERRs for open compacts using data available as of end-2015.The data used to estimate these closeout ERRs reflects final cost data as available at closeout. As the benefits stream for most projects may only start after compact closeout, these closeout ERRs remain an ex-ante estimate of economic return.

Institutional Capacity on Health Regulation, Key for Development and Global Trade;
Carlos Santos-Burgoa*, The George Washington University

Evidence on health risks management is translated in a limited manner into enforced regulations in many developing countries involved in trade agreements. We will present a framework for analysis of the impact of the level of institutional development to integrate, adapt, and establish health risks protection standards and regulations in developing nations that enter into trade agreements. Based on that, we will present an initial modeling of selected countries on the impact on the effective reduction of health impacts adjusting for level of country development, as a consequence of institutional development. We will address the risks in the health regulatory space such as the control of tobacco, alcohol, food, chemicals, or medical products. The expanded use of institutional economics and public health will then be considered for the future advancements in this area, key not only for sustainable development, but also for the increased commercial partnership between countries.

> ➤ E-6: Issues in Valuing Costs and Benefits in Health Policy

Chair: Donald Kenkel, Cornell University

Presentations:

The PROMIS-Preference (PROPr) Score: A New Health Utility Measure; *Barry Dewitt*, Carnegie Mellon University*

Health utility measures place individuals' health states on a common scale, allowing researchers and policy makers to aggregate individuals to summarize the effects of clinical trials and the results of population health studies. These measures attach values (i.e., utilities) to states of health. These values can be used to create outcomes, such as quality-adjusted life years (QALYs), that provide the estimates needed for regulatory analyses, such as cost-effectiveness analyses. The Patient-Reported Outcomes Measurement Information System (PROMIS) is an NIH-funded, open-source tool that provides unprecedented granularity for describing health (www.nihpromis.org). We have developed a utility function for PROMIS, the PROMIS Preference (PROPr) score, based on multi-attribute utility theory and using data from a nationally representative US sample. By building on PROMIS, the PROPr score solves many of the problems of previous health utility measures: it has no ceiling or floor effects; it can be adapted to individual tracking and decision-making; it is grounded in psychometric item response testing theory; and it is free to use.

Economic Rents and Cost-Benefit Analysis - Issues and Application to Health and Energy Policy; *Ken Acks*, Cost-Benefit Group, LLC and Environmental Valuation & Cost-Benefit News*

Liberals and conservatives agree that the use of government power by special interests often produces suboptimal outcomes, market distortions, unfairness and inequality. Much of the influence results in the generation of economic rents. Economic rent is any payment to a factor of production in excess of the cost needed to bring that factor into production. In classical economics, economic rent is any payment made or benefit received for non-produced inputs such as location (land) and for assets formed by creating official privilege over natural opportunities (e.g., patents). In neoclassical economics rent also includes income gained by beneficiaries of other contrived exclusivity, such as corruption. Liberals often attribute rents to natural market dynamics whereas conservatives point to government policies.

Rents have been of interest to economists from Adam Smith, who noted that "People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices." Anne Kruger coined the term in 1974. Mancur Olsen (in The Logic of Collective Action, Gordon Tullock and others revived and modernized the discussion. Nobel Prize winner Joseph Stiglitz recently emphasized the importance of rents. In "A Firm-Level Perspective on the Role of Rents in the Rise in Inequality" (2015) Jason Furman Chair of the CEA and Peter Orzag use firm-level data to argue

that there has been a trend of increased dispersion of returns to capital across firms, with an increasingly large fraction of firms getting returns over 10-30% annually.

This paper will discuss how the generation of rents can affect Cost-Benefit Analysis in general and with respect to the energy, health care and finance industries. The Theory of the Second Best will also be applied and discussed.

Eliciting Individual Preferences for End-of-Life Treatments; *Susan Chilton*, Newcastle University*

In the UK, the National Institute for Health and Care Excellence (NICE) provides guidance to improve health and social care. In January 2009, they indicated that it may be appropriate to recommend treatments for terminal illness even if the costs of saving a quality-adjusted life-year exceed the range normally considered acceptable. There is, however, a very limited evidence base addressing whether prioritizing end-of-life treatments relative to other life-extending interventions accords with preferences of members of the general public.

The aim of this study is to elicit how, all other things equal, individuals make trade- offs between extensions to their life expectancy in normal health versus improvements in their health state if they were to become terminally ill. Our ex ante approach mimics the conditions under which NICE (or indeed international regulatory bodies) make decisions, rather than an ex post scenario in which respondents value extensions to life, given that they (or others) are terminally ill. Using risk-risk trade-offs, our approach elicits individual-based relative preferences over different interventions, contrasting with previous endeavors which have primarily focused on distributional concerns and/or whether groups of people with a terminal illness should be prioritized. Quantification is necessary for any national authorities using a benefit-cost approach to healthcare provision, as well as indicating whether NICE advice broadly reflects UK public opinion per se.

98 members of the public participated in the survey. The survey comprised of an incentivized, economic experiment, followed by risk-risk questions. Despite the relatively small sample size, clear results are found. Individuals do prefer end-of-life treatments. However, this comes with a caveat: the strength of these preferences vary with the quality of health at the end of life. Results suggest that more research would be useful to better deal with the quantity-quality trade-off in any regulatory decisions pertaining to end-of life interventions.

Advanced Data Integration for Epidemiologic Modeling in Benefit-Cost Analysis: A Case for Complex Behavioral Disorders; *Xindi Hu*, Harvard University*

Research on the economic impact of preventive interventions can support effective health policy and reduce disease burdens, yet economic studies applied to complex behavioral disorders such as substance use disorders and eating disorders have been scant. Evaluating policies supporting public health prevention requires accurate and up-to-date epidemiologic modeling of the complex disease course, which currently does not exist. We address these two challenges by developing and calibrating a decision analytic microsimulation model to conduct economic evaluations of disease prevention strategies. The method is presented using an illustrative example of a primary care based eating disorders screening program. We follow a virtual

population of people under the intervention (i.e., screening) and control (i.e., no screening) scenarios. Each individual in the model is followed over a 25-year period as they transition among several health states annually: eating disorder-free, anorexia nervosa, bulimia nervosa, binge eating disorder, other specified feeding or eating disorder, and dead. Data on diagnoses, outpatient, and inpatient charges were obtained from 10,782 patients and 67,119 patient visits provided by six U.S. pediatric hospitals in the PEDSnet research collaborative, one of the largest in the nation. We model duration and expense of outpatient treatment, risk for hospitalization by treatment and patient characteristics, and transition between eating disorder types. We calibrate the model to gold-standard data such as the Global Burden of Disease 2015, the National Comorbidity Study-Adolescent Supplement and the Healthcare Cost and Utilization Project Nationwide Inpatient Sample. After calibration, cumulative 25-year incidence and prevalence projections were similar between the microsimulation model and the most recent epidemiologic evidence. The calibrated model is then applied to assess the cost-effectiveness of a screening program where primary care provider screens adolescents for eating disorders. This presentation has broad applicability to the development of epidemiologic models to evaluate the cost-effectiveness of prevention strategies for complex behavioral disorders.

➢ F-6: Issues and Applications in Benefit-Cost Analysis of Transportation Projects

Chair: Douglas Scheffler, U.S. Coast Guard

Discussant: Jack Wells, U.S. Department of Transportation (former)

Presentations:

The Criterion for Evaluating Transportation Projects: Social Welfare Analysis; *Omid M. Rouhani*, McGill University*

Public authorities often evaluate transportation projects using benefit/cost analysis or Value for Money (VfM) analysis. However, such analysis generally provides little information about the detailed impacts of a project. A more comprehensive evaluation criterion should determine the impact on overall social welfare. Apart from several theoretical studies, a detailed methodology to determine social welfare change of transportation projects has not been developed in detail. In this paper, we offer a social welfare framework that estimates the benefits and costs of using alternative projects/scenarios on major stakeholders of the process. Using these alternatives, we provide an empirical study detailing major components required for the analysis. From a social welfare perspective, we should search for a Pareto-improvement where all stakeholders are better off (possibly using a redistribution policy), a win-win situation. Our estimates indicate that a mixed profit making and congestion management scheme can offer such a solution.

Ex-Post Studies of Transport Investments in France; *Emile Quinet*, Ecole des Ponts-ParisTech, on behalf of David Meunier, MINES ParisTech*

Ex-post studies of investment projects are usually considered as being of major interest. Nevertheless, not many countries have formal obligations requiring the realisation of such studies.

In France, the « LOTI » law adopted in 1982 made compulsory ex-post analyses of very big transport infrastructure projects. These analyses are to be made 5 to 10 years after the infrastructure came into operation.

The paper will present the main results from these ex-post studies made on French transport infrastructures and discuss the roles that could be given to such studies. A qualitative analysis of some mechanisms which led to important differences between ex-ante estimates and ex-post observations will be performed, together with quantitative international comparisons and estimates of the order of magnitude of the consequences on aggregate assessment indicators. The distinction between optimism biases and technical biases is discussed, using the information available on ex-ante assumptions and delays. A special focus will be given to the question of risks and uncertainties associated with the project's ex-ante assessment, which is usually performed for a central scenario, sometimes with sensitivity analyses testing several scenarios or using simple methods, and more rarely with more sophisticated methods incorporating risk issues.

The paper will give practical advice on risk analysis and its technical representations in CBA, examining the possibilities for further use of ex-post analyses in the treatment of risks and uncertainties at the stage of ex-ante assessment.

A Tale of Two Cities and Five Benefit-Cost Analyses: Australia's Inland Rail between Melbourne and Brisbane; *David Luskin*, U.S. Department of Transportation*

The proposed inland rail link would run for 1,072 miles between Melbourne and Brisbane, Australia's second and third largest cities. For freight services between these cities, the distance would be much shorter than on the existing costal route that runs through Sydney. The inland link would also avoid the coastal route's drawbacks of track congestion in Sydney and of alignments that prevent double-stacked operations. Transit times would be significantly reduced and reliability significantly improved. Intercity track in Australia is largely government owned, and proposals for the inland railway have included calls for large contributions from the federal government. The initial BCA of the inland rail project was led by the SBCA conference presenter, David Luskin, and developed a simple revealed preference approach to ameliorate severe limitations of the available data. The presentation will compare methodology and findings between this 1996 analysis and three benefit-cost analyses of the same project conducted between 2000 and 2010.

Session 7: Friday, March 17, 2017, 2:00 – 3:30pm

➢ A-7: Developing Guidance or Best Practices for Regulatory Impact Analysis (Roundtable)

Chair: Lisa A. Robinson, Harvard University

Circular A-4 provides the Office of Management and Budget's guidance to Federal agencies on the development of regulatory analysis as required under Executive Order 12866. Although useful, many Federal agencies find developing additional guidance and best practices specific to the needs of their agencies useful. This roundtable features economists from different agencies discussing current efforts to develop guidance and best practices to improve the quality, consistency, and policy-relevance of regulatory impact analysis at their agencies.

Panelists:

Deborah Aiken, U.S. Department of Transportation

Elizabeth Ashley, U.S. Office of Management and Budget

Amber Jessup, U.S. Department of Health & Human Services

Al McGartland, U.S. Environmental Protection Agency

Clark Nardinelli, U.S. Food and Drug Administration

➢ B-7: Ex Ante and Ex Post Applications of BCA

Chair: Richard Bruns, U.S. Food and Drug Administration

Discussant: Brian Mannix, The George Washington University

Presentations:

Retrospective Benefit-Cost Analysis of Federally-Funded Buyback Programs for Southeast Alaska Salmon Purse Seine Permits; *Keith Criddle*, University of Alaska Fairbanks*

In 1975, the Alaska Commercial Fisheries Entry Commission (CFEC) issued 419 perpetual transferable limited entry permits (LEPs) that entitle participation in the Southeast Alaska salmon purse seine fishery. Beginning in the 1990s, ever increasing global supplies of farmed salmon precipitated a collapse in ex-vessel prices for wild salmon and concomitant declines in ex-vessel revenues and permit values such that by the early 2000s, ex-vessel prices and the value of LEPs hovered at around 20% of their peak values. In response, fishermen lobbied for and secured a buyback program to permanently retire of some permits. The first phase of the buyback program was financed under a federal grant and led to the retirement, in 2008, of 35 permit. The second phase was financed under a federally-backed fishery reduction loan that led, in 2012, to the retirement of 65 additional permits. It was anticipated that these reductions in the supply of LEPs would bolster average revenues for remaining vessels and increase the market value of remaining permits. The goal of this analysis is to determine whether the increased value to remaining permittees offsets the cost to taxpayers of financing the buyback. Conducting that cost-benefit assessment necessitates disentangling concomitant but unrelated changes in ex-vessel prices and catch volumes. Multivariate statistical analysis indicates that

the buybacks were in increased the asset value of permits and forestalled the reentry of latent fishing capacity. However, because the buybacks do not alter the fundamental conditions that predispose the dissipation of rents, relief accorded by the buyback is likely to be ephemeral.

Combining Ex Post and Ex Ante Analyses to Assess the Performance of a Historical Biocontrol Program for Diffuse Knapweed; *Duncan Knowler*, Simon Fraser University*

According to a recent study, 25 % of Canada's endangered species are at risk because of alien species. While significant work has been done on valuing the potential benefits from control of invasive plants in the US, little has been done in Canada. Diffuse knapweed is a rangeland weed introduced to North America from the Mediterranean region and western Asia. Both managed rangelands and disturbed sites are susceptible to invasion. We use a modified BCA framework to assess the economic merits of an historical biocontrol program for diffuse knapweed in British Columbia (BC), Canada. Because our analysis takes an ex post perspective, it differs from many ex ante analyses that instead forecast hypothetical benefits and costs using the best information available (e.g. government records, published papers). However, we also simulate an alternative or counterfactual scenario assuming chemical treatment was used instead of the actual biocontrol program, but since no such program existed we used data from local spraying programs to generate the necessary information. This counterfactual allowed us to consider whether the historical biocontrol program was actually the preferred control program for diffuse knapweed and not just whether it met a strict BCA test on its own. This approach mimics the common formulation of many ex ante benefit-cost studies that compare several project alternatives. For the all-inclusive analysis of the diffuse knapweed biocontrol program, we estimated an NPV of $16.0 million (all prices 2006) with baseline assumptions and a 4 percent discount rate. In contrast, our simulated economic analysis of the baseline scenario for the chemical treatment of knapweed indicated a negative NPV. Based on our comparison of the two programs, it seems clear that the biocontrol program was a success and the preferred control method. We conclude the paper with a discussion of our results, including several caveats, and recommendations for evaluating future control programs.

Benefit-Cost Analysis in Educational Regulatory Actions; *Viviana Rodriguez-Andrade*, CBCSE - Columbia University*

Under Executive Order 12866, all significant regulatory actions in federal education policy should provide estimates of their anticipated costs and benefits. Yet, the application of Benefit-Cost Analysis to education policy is far from straightforward. In this paper we critically evaluate prior education BCAs with respect to methods, findings, and conclusions. We base our evaluation on extensive documentation from OIRA reports on over 30 education BCAs from 2005-2015. Our initial evidence indicates that these BCAs generally apply consistent costing methods but rarely estimate benefits precisely; and very few report BC ratios or Net Present Values. We highlight several areas where BCA practice might be enhanced.

➢ C-7: Distributional Issues: Applications in Energy and the Environment

Chair: Kelly Maguire, U.S. Environmental Protection Agency

Presentations:

Preferences for Equality in Environmental Outcomes; *William Raich*, Industrial Economics, Inc.*

Benefit-cost analyses of health regulations traditionally evaluate their economic efficiency—ignoring equity. To help address the importance of equity, we develop a survey to elicit respondents' preferences towards equality in health risks stemming from environmental causes. Survey responses are used to parameterize an Atkinson index over environmental health risks. We compare these results to similar questions in the income context and find that respondents are significantly more averse to inequality in health risks than in income. The mean respondent is willing to accept a 22% increase in average health risk if risks are equally distributed in the population, but willing to accept a decrease of only 5% in average income if incomes are equally distributed in the population. We find that 30% of respondents answer health risk questions lexicographically—always preferring an equal distribution of risks to an unequal distribution, even if the latter makes everyone better off.

Differential and Distributional Effects of Energy Efficiency Surveys: Evidence from Electricity Consumption; *Thomas Kniesner*, Claremont Graduate University*

Our research investigates the magnitude of the effect of residential energy efficiency audit programs on subsequent household electricity consumption. There is only a one-time interaction between households, which participate voluntarily, and the surveyors. Our research objective is to determine whether and to what extent such surveys lead to behavioral changes. We argue that the perceived complexity of the surveys' personalized feedback will determine whether the subsequent behavior is sustainable. We then examine how persistent the intervention is over time and whether the effects decay or intensify. The main evaluation problem, however, involving the surveys is participants' self-selection. To address this econometrically, we propose two non-parametric estimators involving kernel-based propensity score matching. In the first method we use "difference-in-differences" (DID) estimation. The second estimator is quantile DID, which produces estimates on distributions. Importantly, the comparison group consists of households who were not yet participating in the survey but participated later. Our evidence suggests that the customers who participated in the survey, which cost about $12 to administer, reduced their electricity consumption by about 7%, compared to customers who had not yet participated in the survey. In addition, as the quantiles of the outcome distribution increase, the effect of the program decreases. Considering the total number of high usage households participated to the survey in 2009, electricity consumption reduced by an aggregate 1.8 million kWh per year, an amount approximately equal to consumption of 3,200 average households in California in a month or an estimated 1,258 metric tons less of carbon dioxide emissions.

Are There Distributional Impacts from the National Flood Insurance Program?; *Okmyung Bin*, East Carolina University*

This study examines possible redistributional effects of the National Flood Insurance Program, using a nationwide database of flood insurance policies and claims from the Federal Emergency Management Agency. Exploiting the tax and transfer progressivity literature we use the departure from per capita income proportionality at the zip code level as our measure of progressivity. Our findings indicate that premiums as a percentage of coverage purchased are mildly regressive: premium shares are larger than income shares for lower-income zip codes.

Payouts, however, also as a percentage of coverage purchased, are progressive, meaning lower-income zip codes receive a larger portion of claims paid. Overall net premiums (premiums – payouts) divided by coverage are also regressive, with an income elasticity close to zero, indicating flood insurance behaves like a lump sum tax. We offer several policy proposals to ameliorate regressivity in the NFIP.

Distributional Weights in Environmental Valuation and Cost-Benefit Analysis; *Vaino Nurmi*, Finnish Meteorological Institute*

The economic valuation of public goods, including environmental ones, and the methods applied in BCA are built on the Kaldor-Hicks efficiency criterion. To determine Kaldor-Hicks efficiency we need to measure whether winners have gained more than the losers have lost. Usually this is done by measuring the benefits and costs in money, making income the numeraire. Without adjusting or "weighting" the monetary welfare changes by differences in the social marginal utility of money, BCA is systematically favorable to those who value money the least relative to alternative numeraires. Consequently BCA is not symmetric between agents' preferences.

Distributional weights were for a long time a standard in public and welfare economics to compensate for the differences in the individuals' monetized values, but have been largely neglected in both practice and theory in the past few decades. An exception is climate change economics, in which the climate change impacts of poor countries received more weight relative to the effects on rich countries. In climate change studies, it has been shown that the addition of weights can change the results by two orders of magnitude. Our hypothesis is that similar kinds of results could be shown in environmental BCA at other than global scales.

Whether or not the neglect of distributional weights is a problem depends on the use of taxes and the form of individuals' utility functions. We go through the theoretical arguments in favor of and against weighting, and present the options to design such weights, including the theory behind the designs.

Aside from the theoretical issues, it is also important to test how the weights affect the results of BCA. We use pre-collected data of individuals' WTP/WTA for emission mitigation paired with income, to test the effects of the weights on the BCA. We show that different weighting schemes (or their absence) can result in very different policy recommendations.

➢ D-7: BCA in Economic Development

Chair: Julian Cristia, Inter-American Development Bank

Presentations:

Educational Gender Discrimination and its Economic Developmental Impact; *Fatima Ali**

The countries of Asia are at different levels of economic development. In educational development too they are not uniform. Historical Legacies and other factors have impacted on the modernization course that each country embarked upon. These countries can benefit and are benefiting by doing studies that compare their experience in development with that of the more advanced nations of the west. However, there is much that they can learn by studying about each other inside Asia; likewise, they have much to offer to the outside world.

In what follows we look at the attempts of some of the Asian countries to eliminate gender discrimination in education and how these impacted on their course of modernization. We would also look at the impact of education on the female labor force participation. Finally, we attempt an interregional comparison and the main focus will be on East Asia the best performing region and South Asia the worst performing region. As the countries of Asia stands at different levels of development this exercise is similar to the one that compares a developing countries experience with that of a developed countries historical experience, further countries at nearly the same level of economic development too have much to learn from each other as the educational development and the degree to which the elimination of gender discrimination in education has proceeded aren't the same.

The benefits that a country gains by eliminating gender discrimination in education are enormous as we will try to document. Likewise, the losses a country undergoes by neglecting to educate girls and women are substantial.

Access and Quality in Higher Education Project (Paces) - Higher Education Student Loans in Colombia; *Felipe Lozano-Rojas*, Indiana University and World Bank*

The article developed will present the results of a benefit-cost analysis addressing the goals and challenges faced by the Colombian government, student loan agency, ICETEX, using input data from tertiary education information systems which allow to forecast the average differences in relevant outcome variables for students with and without student loans, outcomes such as dropout, dropout, and employment rates, across education levels. We try to address the question of how to provide the best assessment possible given the restrictions on data availability.

To promote quality and foster its role in access to tertiary education in Colombia, ICETEX, the main student loan agency of the country is studying the possibility of reforming their current student loan program. On the other hand, to promote quality ICETEX introduced a handful of reforms, which have limited the reach of their resources. For instance the agency started providing 100% student tuition funding, strengthened high quality accreditation requirements which are more expensive, and it is developing a new program to foster productive research in the Colombian academia. The project affects ICETEX supply of student loans, differentiating in interest rates charged to students as well as in the share of payments made during the studying period, from 0% of capital up to 100%.

Additional to this policy, ICETEX is also adapting to an environment in which interest rates subsidies are capped to address the fiscal pressure that these subsidies were exerting over the Colombian Ministry of Education finances. In context, ICETEX, moved from providing student

aid for 20,000 students per year in 2003 to more than 65,000 in 2014. The analyzed project will level the number of students per year at 64,000 mainly among the most vulnerable students.

Gender Impacts in Benefit-Cost Analysis; *Bahman Kashi*, Queen's University; Jennifer Watt and Kamin Peyrow, Queen's University; Stephanie Schmidt, International Development Group*

Most major organizations have policies in place to address gender gaps in developing countries and increase their understanding of gender impacts in project design, monitoring, and evaluation. However, the incorporation of gender considerations in the practice of cost-benefit analysis is still far from ideal. There is still no or very limited quantitative analysis done on direct investments that target gender gaps as their main objective.

This study seeks to identify theoretical and practical ways of integrating gender impacts into benefit-cost analysis of international development projects. Cultural norms and gender gaps create constraints and opportunities that can affect the outcome of international development projects. An overview of such experiences is provided here in health and agriculture sectors, and alternative metrics and measures used to report and estimate impact by gender are compared. Furthermore, policies and practices of major international development institutions including policies that affect the project identification and design process, as well as those used during monitoring and evaluation are reviewed.

The results highlight the significant gaps concerning quantitative evidence that support gender-related assumptions in benefit-cost models. The study then recommends ways to coordinate efforts and funding to cover this information gap, learning from the way in which the integration of environmental impacts has progressed over the past 20 years.

This material is based upon work supported by the United States Agency for International Development under the Learning, Evaluation and Analysis Project-II (LEAP-II) award number AID-OAA-I-12-00042/AID-OAA-TO-14-00046.

Estimating Mortality and Economic Costs of Particulate Air Pollution in Developing Countries: The Case of Nigeria; *Natina Yaduma*, American University of Nigeria*

The value of statistical life is an essential parameter used in ascribing monetary values to the mortality costs of air pollution in health risk analyses. However, this willingness to pay estimate is virtually non-existent for most developing countries. In the absence of local estimates, two major benefit transfer approaches lend themselves to the estimation of the value of statistical life: the value transfer method and the meta-regression analysis. Using Nigeria as a sample country, we find that the latter method is better tailored than the former for incorporating many characteristics that vary between study sites and policy sites into its benefit transfer application. It is therefore likely to provide more accurate value of statistical life predictions for very low-income countries. Employing the meta-regression method, we find Nigeria's value of statistical life estimate to be $489,000. Combining this estimate with dose response functions from the epidemiological literature, it follows that if Nigeria had mitigated its 2006 particulate air pollution to the World Health Organisation standards, it could have avoided at least 58,000 premature deaths and recorded an avoided mortality related welfare loss of about $28 billion or 19 % of the

nation's GDP for that year.

Chair: Heidi King

Presentations:

Benefits and Costs of Bank Regulatory Capital Standards; *James R. Barth, Auburn University; and Stephen Miller*, Mercatus Center at George Mason University*

Banking legislation in the U.S. has historically been driven more by the politics of banking than sound economic analyses. Following the most recent and severe banking crisis since the Great Depression, legislation has been enacted that instructs the banking authorities to impose stricter and higher capital requirements on banks, among other more stringent restrictions. Our focus is on estimating the marginal benefits and costs of increasing the leverage ratio from 4 percent to 15 percent. We draw from Miles, et al.'s (Economic Journal (2013)) approach to comparing the benefits and costs of higher regulatory capital requirements. To estimate benefits, we multiply the loss per crisis, calculated as in Miles, et al. (2013), by the marginal effects at representative values from profit regressions applied to annual data from 1892-2014 that measure the relationship between changes in the leverage ratio and changes in the probability of a banking crisis; we find similar results using logit and complementary log-log regressions.

We weigh these benefits against the costs in terms of reduced lending, arising from banks passing off the higher equity costs resulting from a higher leverage ratio onto borrowers. To measure the costs, we use data for all bank holding companies with at least $1 billion in total assets between Q1 1996 and Q4 2014. We find that the marginal benefits cover marginal costs in more than 95 percent of the 256 cases we consider. Fails arise when we assume low benefits and high costs. Higher taxes, an increased market risk premium, a greater fraction of corporate funding coming from bank loans or a lower cost of a crisis tend to lower the net marginal benefit, while assuming banking crises generate permanent shocks or increasing the discount rate tends to increase the net marginal benefit.

The Systemic Risk Paradox: Costly Regulations and Consolidation in Heterogeneous Financial Markets with Uncertainty; *Sharon Brown-Hruska* and Trevor Wagener, NERA Economic Consulting*

Following the enactment of the Dodd-Frank Act in 2010, regulation of financial markets in the United States has become both qualitatively more cumbersome and quantitatively more costly for market participants. Much of the new regulation has been justified by concerns about systemic risk in financial markets. However, many of the new regulations impose both fixed and variable costs for market participants, and may create barriers to entry through one-time compliance startup costs in those markets. If there are fixed compliance costs and initial compliance startup costs, such regulations may drive consolidation through economies of scale

in compliance, and may prevent market entry during boom periods through barriers to entry. Such consolidation may actually increase the systemic risk in that market, which has the potential to reverse all of the expected benefits of such regulations.

We present a multi-period partial equilibrium model of an OTC derivatives market with uncertainty about future market conditions and heterogeneous market participants, divided into an end-user category and a dealer category. We model the implications of new regulations imposing startup, fixed, and variable costs on market participants, and consider the relevance of ex ante barriers to entry in assessing new regulatory barriers to entry. We also examine the implications within the model of including a requirement for central clearing, either universally or for those participants who have crossed an exposure threshold. We conclude that under plausible assumptions about market participant heterogeneity, counterparty credit exposures, and economies of scale, markets with costly regulatory regimes may increase in systemic risk over time.

Improvements in SEC Economic Analysis since Business Roundtable: A Structured Assessment; *Jerry Ellig*, Mercatus Center at George Mason University*

Several D.C. Circuit decisions that remanded regulations to the Securities and Exchange Commission (SEC) provide a natural experiment that permits researchers to identify the correlation between judicial review and the quality of regulatory agencies' economic analysis and its use in decisions. Subsequent to these decisions, the SEC staff in 2012 issued new guidance for economic analysis. This paper offers a structured assessment of the economic analysis accompanying a sample of post-2012 SEC regulations, utilizing the evaluation method developed for the Mercatus Center at George Mason University's Regulatory Report Card. SEC economic analysis improved substantially following issuance of the 2012 guidance.

Improvement occurred on all major elements the SEC staff identified as important in its guidance: explanation of the justification for the regulation, clear definition of the baseline against which to measure the rule's economic impacts, identification and discussion of reasonable alternatives, and analysis of the benefits and costs of the proposed rule and the principal alternatives. The improvement occurred both on criteria that address "conceptual" economic analysis and on criteria that require quantification of benefits or costs to receive full credit. Although there is still substantial room for improvement, the court decisions appear to have motivated the SEC, in just a few years, to close the gap between the quality of its economic analysis and the average quality of economic analysis produced by executive branch agencies.

International Trade and the Willingness to Pay by SMEs for Online Banking Services; *Glenn Jenkins*, Queen's University and Eastern Mediterranean University and Parvaneh Shahnoori, Eastern Mediterranean University*

The objective of this study is to determine the important attributes of online banking services for small and medium-sized enterprises (SMEs). Of particular interest are the attributes relevant to SMEs engaged in international trade. A choice experiment (CE) method is used to value the attributes of online banking services, namely travel time saved, waiting time saved, unlimited 24/7 accessibility, and a high level of security. The data were collected through face-to-face interviews with 400 SME financial managers/owners from the Free Trade Zones of the United Arab Emirates

(UAE). Using mixed logit estimation models, the results of this research show that 24/7 accessibility to banking services and a high level of security are highly valued by these enterprises. If these attributes are absent, over 93% of the value of the service to the SME owners is lost. The willingness to pay (WTP) for a high-quality service is very substantial, rising from $163.31 per month for those firms not involved in international trade to $736.26 per month for those SMEs who export in excess of 25% of what they produce. At the same time, supplying such banking services provides banks with an opportunity to enjoy an overall reduction in their operating costs. Governments should provide a regulatory environment for their financial sector that will facilitate the provision of such high-quality banking services to their SME sector.

Session 8: Friday, March 17, 2017, 3:45 – 5:15pm

➢ A-8: Measuring the Effectiveness of Regulations

Chair: Sofie Miller, The George Washington University

Presentations:

Retrospective Evaluation of Chemical Regulations; *Susan Dudley*, The George Washington University*

OECD countries rely on regulatory tools to manage potential risks from exposure to targeted chemicals. While it is standard practice to analyze and estimate how proposed regulations might affect regulated entities, consumers, citizens, etc., *before* they are issued, regulators have devoted much less analysis to evaluating the impacts of their regulations once they are in effect. This background paper for the OECD Workshop on Socioeconomic Impact Assessment of Chemicals Management draws on experience in OECD countries, primarily the United States, to examine the practices used to understand the likely impacts of regulations aimed at reducing chemical risks both before and after they are issued.

Improving Retrospective Review; *Reeve Bull*, Administrative Conference of the United States*

This presentation will offer a brief history of retrospective review efforts in the United States, identify some of the limitations of past regulatory lookback initiatives, and explore potential reforms designed to produce a more robust, enduring system of retrospective review. It will begin with a quick analysis of past regulatory lookback efforts, which date to the Carter Administration. It will explain how each of these programs relied on agencies' self-review of regulations, which caused such efforts to falter.

The presentation will then explore potential improvements. Reform proposals tend fall into two categories: (1) an independent body overseeing retrospective reviews and (2) enhanced stakeholder participation. There have been several permutations of reforms involving expanded independent oversight, including expanding OIRA's role in retrospective review, creating a new entity housed in either the executive or legislative branch, and periodically convening a "regulatory improvement commission." A number of possible reforms involving enhanced stakeholder participation have also been put forward. These range from implementing an improved process for soliciting public comments to allowing groups of stakeholders to propose

alternative regulatory regimes. The presenter recently published an article in the *Administrative Law Review* exploring the latter proposal, and the talk will examine how this might work in practice.

Finally, the presentation will offer a comparative perspective, examining recent retrospective review initiatives in the European Union and various British Commonwealth nations. It will explore the REFIT and evaluation initiatives in the EU, which seek to design new regulations to facilitate subsequent retrospective review. It will also explore various regulatory budgeting proposals that have emerged in the UK, Canada, and Australia, all of which aim to provide strong incentives for retrospective review by placing a ceiling on overall regulatory costs.

Building Retrospective Evaluation Capacity to Enhance EPA's Prospective Analyses; *Nicholas Hart*, The George Washington University*

Since the inception of the USEPA, considerable emphasis has been placed on the use of policy analysis tools that aim to prospectively inform environmental policy decisions, including cost-benefit analysis and risk assessment used for regulatory actions. However, compared to the amount of such *ex ante* analysis conducted at the USEPA before a decision is reached, relatively little evaluation of these same environmental policies is produced after implementation to inform future policy development or to modify existing policies. This research discusses EPA's history producing retrospective program evaluation, including retrospective regulatory reviews. The presentation will outline key factors affecting EPA's ability to expand production of program evaluation and highlight the potential benefits of more widespread applications.

Improving the Elicitation of Professional Judgements for Use in Regulatory Benefits Analysis; *Jennifer Baxter*, Margaret Black, and Henry Roman (Industrial Economics, Inc.); Arturo Rios (U.S. Coast Guard)*

In order to estimate the benefits of federal regulations, analysts require quantitative estimates of the effectiveness of regulatory requirements. Developing or obtaining such estimates is often the most difficult component of benefit-cost analyses, as certain key parameters needed to estimate effectiveness may be uncertain. One option for filling data gaps, addressing inconsistencies in the literature, or adjusting estimates derived from one context (e.g., a training program focused on motor vehicle safety) for use in another context (e.g., a training program focused on maritime safety) is the use of formal, structured expert elicitation. However, this tool is resource intensive, and such elicitations often require a year or more to complete. For regulations that are unlikely to result in large costs or benefits or raise major concerns about equity, a substantial investment of time and resources in formal, structured expert elicitation may not be appropriate. To address this issue, U.S. Coast Guard explored options for developing a streamlined approach for obtaining professional judgements that draws on the best practices of formal, structured elicitation. Its goal is to enhance the quality, reproducibility, and transparency of the process and its results, while accounting for time and resource constraints. In this presentation, we describe a pilot study implementing this streamlined approach, and discuss the results, lessons learned, and suggestions for improvements.

➢ B-8: Defining the Boundaries for Benefit-Cost Analysis

Chair: John Mendeloff, University of Pittsburgh

Presentations:

'Three Basic Postulates' Revisited: A Sufficient Statistics Approach to BCA; *Don Kenkel*, Cornell University*

In his seminal paper, Harberger (1971) advocates a framework for applied welfare economics that uses the demand price and supply price as measures of benefits and costs. The framework is now conventional and guides the current practice of BCA, for example in regulatory impact analyses of federal regulations. However, the current practice of an important line of empirical economics research no longer focuses on estimating the demand curves and supply curves that underlie the calculation of consumer and producer surplus. Instead, a typical study estimates a reduced-form equation that shows the impact of a policy variable on some socially desirable outcome such as better health or more schooling. Reduced-form research emphasizes clean identification of the causal treatment effect of the policy. Reduced-form research is often less informative about whether the policy improves the allocation of resources, i.e. whether the social benefits from more of the desirable outcome are worth the social opportunity costs. Reduced-form studies do not necessarily discuss the market or individual optimizing failures that mean the pre-policy equilibrium is inefficient. Also, BCA is often not conducted or left for back-of-the-envelope calculations. In this paper, I discuss the link between reduced-form econometric research, the sufficient statistic approach to welfare economics, and BCA. Chetty (2009) derives formulas that show the social benefits of policies in terms of high-level elasticities that can be estimated through reduced-form empirics. The sufficient statistics/ reduced-form approach also captures the social opportunity costs of policies. I discuss other links between the sufficient statistics approach and the current practice of BCA, for example the parallels between the multipliers in Chetty's approach and the shadow prices commonly used in BCAs. In the final sections I discuss the advantages of more structural econometric estimation to extrapolate policy effects and conduct ex ante BCA of new policies.

Bridging the Partial and General Equilibrium Divide; *Scott Farrow*, University of Maryland Baltimore County*

Advances in theoretical and computable general equilibrium modeling brought their conceptual foundations in line with standard microeconomic constructs. This reduced the theoretical and empirical gap between welfare measurements using a partial or a general equilibrium approach. However, the separation of the partial and general equilibrium literatures lingers in many applications which this manuscript seeks to bridge. The now shared conceptual foundations, the importance of functional specification, the role of common price movements, and closure rules are discussed. The continuing US Government exclusion of secondary effects from welfare measures in some applications is questioned.

Wellville or Funville: You Got a Problem?; *Clark Nardinelli*, U.S. Food and Drug Administration*

The economic analysis of a public policy should start with the identification of the market, government, or behavioral failure that caused the problem, thereby making the policy potentially effective and welfare-enhancing. In the market failure part of a benefit-cost analysis, we identify what is broken; without a failure of some kind, nothing is broken that a policy intervention can

fix. One curious feature of many benefit-cost analyses, however, is that the market, government, or behavioral failure causing a problem is given short shrift in the benefit-cost analysis. Many analyses simply identify a failure in broad terms and move quickly on to the problem the policy will solve. This reluctance to fully define and explain what is broken arises not because market or other failures are difficult to find; rather, it arises because failures are too easy to find. The economist seeking justifications for policy effectiveness has an almost limitless catalogue of failures to choose from. The cornucopia of failures available to the analyst has the perverse effect of truncating the identification and analysis of the failure. In this paper, I illustrate the ease of finding failures with a social puzzle, the different behaviors of people in two small towns, Wellville and Funville. I will identify an apparent problem arising from the observed difference and describe the wide array of market, government, and behavioral failures available to explain what we observe.

Distinction between Benefit-Cost Analysis and Cost-Benefit Analysis in Law and Economics; *Scott Farrow*, University of Maryland Baltimore County on behalf of Richard Zerbe, University of Washington*

The tension between deontological and economic thinking is old and pervasive. This tension lessens when the sphere of economics is more carefully delineated. This article aims to distinguish between cost benefit analysis (CBA) and benefit-cost analysis, (BCA). BCA recognizes rights and moral sentiments as values insofar as they are reflected in the willingness to pay to obtain them and the willingness to accept payment in return for giving them up. CBA is often limited to analyzing only the monetary, fair market value of property. BCA provides a more accurate measure of well-being, drops the CBA grounding in the PCT, and reflects moral sentiments in valuation.

➢ C-8: Applications in Energy and the Environment

Chair: Martha Rogers, Brattle Group

Presentations:

Cost Efficiency of Payment Systems for Forest Carbon Sequestration Incorporating Spatial and Temporal Heterogeneities; *Seong-Hoon Cho*, University of Tennessee*

Concern is growing about climate change and its threats to human health, the environment, and ecosystems. Establishing new or expanding forest areas through afforestation, reforestation, and mitigation of deforestation by providing incentives to landowners can be an effective policy tool for offsetting greenhouse gases. Many studies have focused on the efficiency of different incentive payment approaches intended to account for the spatial variations in the benefits of forest-based ecosystem services and opportunity costs of forestland. Although spatial heterogeneity has received much attention, few, if any, studies have explicitly focused on the potential for payment programs for ecosystem services that account for both spatial and temporal heterogeneity to improve cost efficiency. The objective of this research is to assess the spatial and temporal heterogeneities in the costs of supplying forest-based carbon storage to

help identifying spatial targeting of incentive payments under different time periods. We developed a case study that aimed to achieve the objective based on one of 179 Bureau of Economic Areas, which consists of 17 Tennessee counties and 1 Kentucky county over three time periods (i.e., 1992-2001, 2001-2006, and 2006-2011). Our empirical results show that there are spatial and temporal heterogeneities in the cost efficiency of carbon storage. Our findings are triggered by the difference in dynamics of the response of forestland changes to the change in net return of forest land that is reflected in the difference in the transition probabilities of forestland from sustaining forests and afforestation of non-forested lands by space and time. The cost-efficiency maps for each of the three periods can be used as a reference for spatial targeting of incentive payments under different periods. For example, policymakers can anticipate regional budget allocation based on the cost-efficiency maps to predict variations of impact areas under a hypothetical budget scenario under different periods.

Ambiguity Aversion and the Expected Cost of Rare Energy Disasters: An Application to Nuclear Power Accidents; *Romain Bizet* and François Lévêque, MINES ParisTech*

Assessing the risks of rare disasters due to the production of energy is paramount when making energy policy decisions. Yet, the costs associated with these risks are most often not calculable due to the high uncertainties that characterize their potential consequences. In this paper, we propose a non-Bayesian method for the calculation of the expected cost of rare energy disasters that accounts for the ambiguity that characterizes their probabilities of occurrence. Ambiguity is defined here as the existence of multiple and conflicting sources of information regarding the probabilities associated with these events. In other words, this method generalizes cost-benefit analysis to situations of uncertainty characterized by ambiguous probability distributions: it provides a rational way of taking into account the existence of multiple probability distributions (such as public beliefs or probabilistic risk assessments) that are often associated with rare energy disasters.

We then apply this method to the particular case of nuclear accidents in new builds. Our results suggest that the upper-bound of the expected cost of such accidents is 1.7€/MWh, which is consistent with most of the recent estimates. This expected cost may rise to 7€/MWh when the macroeconomic shock caused by a nuclear accident is taken into account. Our numerical results suggest that, even under maximum pessimism, the expected costs of nuclear accidents remain small when compared to the total LCOE of nuclear new builds. Another policy implication of this paper is that public perceptions as well as technical expertise ought to be taken into account by policy-makers in cost-benefit analysis when it looking at particular risks such as nuclear accidents. The method we propose allows to combine these two sources of information, and could also be used to assess other catastrophic risks, such as oil spills or dam failures.

The Effect of Water Quality Characterization on Recreation Demand Model Results; *William Wheeler*, U.S. Environmental Protection Agency*

The three main characterizations of water quality seen in the economic literature are direct measures of water quality, water quality indexes (WQIs) which condense multiple water quality measures into a single number, and designated uses intended to signal whether or not a water body is achieving quality levels necessary for different uses. A tension in the literature is that

stated preference studies of water quality benefits seem to rely more frequently on indices or designated uses to characterize water quality while revealed preference analyses tend to use direct measurements of water quality. We are not aware of any work that systematically investigates how the use of these different water quality metrics affects estimated willingness-to-pay (WTP).

This paper attempts to determine which water quality metrics best explains behavior, using lake water quality and recreator behavior data from the Iowa Lakes Study. This study matched detailed water quality data for 21 parameters for 129 Iowa Lakes with a survey data (of 3,859 households) on use of these lakes. Direct water quality measurements, water quality index values calculated from those measurements, and the achievement of designated uses are included in separate repeated choice mixed logit travel cost recreation demand models. Preliminary results indicate that the use of the direct measures of water quality and using the water quality index imply similar WTP for water quality improvements. For example, the per-trip value of one unit changes in Total Nitrogen (TN) and Total Phosphorus are valued at between $0.01 and $0.06 using direct parameters and WQI. We also find that survey respondents prefer lakes with better designated uses, especially those lakes that are described as high quality. But respondents do not appear to value achievement of the water quality criteria necessary to achieve those uses. The results are somewhat puzzling and deserve further research.

➢ D-8: Issues in Valuing Outcomes in BCAs of Social Programs

Chair: Anne Gordon, Mathematica Policy Research

Presentations:

Reducing the Double Counting of Benefits: A Bayesian Approach to Model Multiple Outcomes in Education Evaluations; *Yilin Pan*, Columbia University; and Wenjie Joanna Zhang, The George Washington University*

Education interventions usually involve multiple goals and objectives. For example, a reading program is aimed at not only increasing students' knowledge and skills in reading, but also fostering students' non-cognitive skills and promoting common values of the society. The multiplicity of objectives leads to the complication of aggregating multiple outcomes in cost-benefit analysis. A solid cost-benefit analysis should rest on a good estimation of the impact of each outcome conditional on other outcomes in the model. However, in evaluation studies (including experimental and quasi-experimental designs, either parametric or non-parametric), the effectiveness of an intervention on different outcomes is usually estimated separately. The outcomes of interest, as dependent variables, are plugged into the estimation model one at a time. Therefore the reported impact on each outcome is marginal effectiveness, rather than conditional effectiveness. When marginal effectiveness is used for cost-benefit analysis, the total benefit could be overestimated due to the double counting of the joint benefits induced by the correlation of multiple outcomes. To address this issue, this paper proposes a Bayesian approach that models the multiple outcomes of an intervention as a multivariate normal joint distribution defined by a mean vector and a variance-covariance matrix. The dependency of

these outcomes is accounted for in the correlation matrix, and each element of the mean vector is modeled as a regression. Using the data of the Head Start Impact Study, this paper also demonstrates the application, estimation and interpretation of the Bayesian model.

Private Investments in Public Preschools: The Use of CBA in Determining the Feasibility of Pay-for-Success Contracts; *Judy Temple*, University of Minnesota*

In the last five years, private investors in the U.S. have contributed well over $100 million to expand state and local provision of promising cost-effective, preventive interventions. Through the use of social impact financing combined with Pay-for-Success contracts, investors agree to finance social program expansion with the understanding that states, cities or counties will pay them back in later years. These payments to the investors are made possible when cost-effective preventive interventions generate future government cost savings. In the fall of 2016, the U.S Department of Education sponsored a grants competition to help support feasibility studies of Pay for Success contracting for preschool programs. The funded applications will be made publicly available in late 2016. This paper investigates the use of benefit-cost analysis in promoting this type of private investment in public services and provides some assessment and guidance on how economic evaluation is and can be used to identify the taxpayer benefits arising from expansion in preschool programming. The use of benefit-cost analysis to promote early childhood investments has been discussed in detail in Temple and Reynolds' 2015 paper in the Journal of Benefit-Cost Analysis. The proposed presentation extends this discussion to new developments across the U.S. since that paper was published.

The Impact of Job Satisfaction on Subjective Well-Being; *Tapas Ray*, U.S. Centers for Disease Control and Prevention*

Objective: The benefits of being employed and at the same time satisfied with job is estimated in terms of workers' subjective (evaluative and hedonic) well-being. While earned income is considered a determinant of well-being and the impact of work environment on job satisfaction is established, the potential effect of job satisfaction of income earners on their well-being has not been recognized. To address this gap, we examined the association between job satisfaction and well-being. We also find out the income equivalent of the benefit of job satisfaction.

Methodology: We analyzed responses from 1, 77,701 US respondents to the 2013 Gallup-Healthways Well-Being survey. This survey is part of Gallup's Daily Tracking Survey of 1000 U.S. adults, ages 18 and over, and features questions on various political, economic, health, and well-being topics (Gallup Daily Methodology, 2013). Following Kahneman and Deaton (2010) and Deaton and Stone (2013), we measured subjective well-being in terms of current and future life evaluation (evaluative well-being); daily positive emotional experiences (hedonic experiences) in terms of feelings of happiness, smiles, and enjoyment; and, daily negative experiences in terms of sadness, anger, worry, and stress. We used job satisfaction as a binary explanatory variable. After controlling for demographic characteristics, and health and socioeconomic factors, we estimated the marginal effect of job satisfaction on workers' subjective well-being. Following Fuziwara et.al. (2011, 2014), we also measure the benefit of job satisfaction in terms of (EV) income.

Results: We found a significant and positive relationship between job satisfaction and subjective well-being both in terms of higher life evaluation scores and higher odds of positive hedonic experiences. After controlling for covariates, compared with unsatisfied workers, satisfied workers had higher current (13%) and future (7%) life evaluation scores, and were twice as likely to experience positive emotional feelings of happiness and enjoyment and lower levels of sadness. Income equivalency of job satisfaction is high.

Project Finance through Impact Investment in the Social Sector; *Jay Mackinnon* and Bahman Kashi, Limestone Analytics*

In this paper, we discuss some of the questions that emerge from the study of impact investment in the social sector, particularly in the form of impact bonds.

We will begin with a discussion of where impact bonds exist in the spectrum of performance based contracts, and what features differentiate traditional grants, outcomes based aid, results based finance, impact bonds and conditional cash transfer. We will then move to a discussion of how the two major varieties of impact bonds, SIBs (social impact bonds) and DIBs (development impact bonds), are differentiated. We will discuss why, in theory and in practice, SIBs are relatively easy to assess under a cost-benefit analysis frameworks, while DIBs have specific challenges inherent in their structure that make cost-effectiveness analysis a more suitable tool for their evaluation.

Our third section will focus on a discussion of the challenges inherent in selecting metrics for performance-based contracts in the social sector. We define characteristics of contracts that change for better or worse as one moves from output focused metrics to impact focused metrics. We conclude with a broad summary of some of the other areas of study for those interested in the role of impact investment as a project financing mechanism in the social sector. These include the renewed focus that impact investment entails for quantitative rigor in the social sector, the danger of perverse incentives in contracting, the challenges involved in pricing impacts and the potential transaction costs and verification costs that might make impact bonds infeasible. These issues will be discussed, among others, in a forthcoming technical report on impact investing in the social sector.

> ➢ E-8: Issues in Costs and Benefits in Agriculture Policy

Chair: Elisabeth Newcomb, U.S. Food and Drug Administration

Discussant: Sandra Hoffmann, U.S. Department of Agriculture

Presentations:

Corn or Cattle? Comparison of Ecosystem Services under Different Land Uses; *Haochi Zheng* and Stefano Potter*, University of North Dakota*

Tallgrass prairies are one of the most productive ecosystems in North America, but 99% of the original extent has been converted, primarily to agriculture. This conversion comes at the expense of the societal value derived from the ecosystem services they provide. The Sheyenne

National Grassland of southeastern North Dakota is managed by the USDA Forest Service and represents the largest publicly owned tract of tallgrass prairie remaining in the United States. In this paper, we use various geospatial tools combined with benefit transfer method to quantify the economic value of ecosystem services including agricultural production, water regulation, soil erosion, soil organic carbon and biodiversity on the Sheyenne grassland and surrounding private agricultural land. Under the benefit cost analytical framework, we evaluate the trade-offs of ecosystem service values and commodity values in either cropping or cattle ranching to gain insights on the economic efficiency of different land uses. Our results show that, except for the economic value of crop production, all other ecosystem service values on the Sheyenne National Grassland are much higher than on the surrounding private land. Overall, when considering both ecosystem service values and commodity values, the grassland is more economically valuable than cropped private land which indicates that land use policy should consider ecosystem service values in addition to commodity values when making sustainable land use decisions.

The Impact of Groundwater Depletion on Farm Exit Rates in the High Plains; *Bern Dealy*, U.S. Food and Drug Administration*

The High Plains Aquifer underlies 175,000 square miles of land in the US and spans eight states. Farming on the High Plains contributes significantly to production in the agriculture industry and thus the US food supply. Much of the farming on the High Plains relies on the aquifer for irrigation. Water pumped from the aquifer represents over one fourth of all water used in US agriculture production (Houston et al., 2013). Heavy pumping and low recharge have depleted the aquifer considerably over the last 60 years. In the long-run, as the aquifer continues to deplete, farming in the region is expected to change considerably. Specifically, farms will have to adopt new technologies and farming practices or switch to less water-intensive crops in order to continue operations after irrigation is no longer viable. However, adaptation is costly. In the short-term, existing farm establishments may not be able to successfully pivot their operations and choose instead to exit. Historically, farm exits are linked closely to the life cycle of farmers and are offset by a similar number of farm entries (Hoppe and Kolb, 2006). However, evolving resource constraints have the potential to disrupt historical farm transition patterns, generating numerous policy implications at the federal and local level. This study uses longitudinal data constructed from the USDA Census of Agriculture joined with ground water and climate data to investigate the impact of groundwater depletion on farm exit rates in the High Plains region of the US. Preliminary results suggest that even when accounting for heterogeneity between farm operations and their operators, groundwater depletion has a significant impact on the likelihood of farm exit.

**The views expressed in this article are those of the authors and are not intended to represent the opinions of the Food and Drug Administration.

Reliable Reduction in Agricultural Runoff under Environmental Uncertainty; *Zhiyu Wang*, University of Minnesota*

Agricultural runoff is a major source of nonpoint water pollution. Because of environmental variability, a target for water pollution reductions cannot be met with certainty. Most studies use an average target for water pollution reductions over time. However, they sidestep a thorough

consideration of stochastic water pollution. In this paper, I derive a probabilistic target for water pollution reductions. This target looks at the reliability of a reduction, where reliability means achieving a given target with a level of probability regardless of environmental changes. I further derive a robust solution that protects against the worst case of all possible probability distributions of water pollution, and apply it to the Wolf Creek watershed in Iowa. The results demonstrate a positive relationship between abatement costs and reliability levels. Compared with an average reduction over time, achieving a 41% reduction in total nitrogen (TN) with a 70% reliability level will increase the abatement cost by $44.9 million. I also examine the Margin of Safety (MOS) in Total Maximum Daily Load (TMDL) requirements. In order to reliably reduce pollution, the current values of the MOS should change with changes in reduction targets.