

THINKING ABOUT THE WIDTH AND BREADTH OF BENEFIT-COST ANALYSIS

Society for Benefit-Cost Analysis
11th Annual Conference & Meeting
March 13-15, 2019
Washington, DC

**Presentation Abstracts 2019 Annual Conference and
Meeting**

The Marvin Center at The George Washington University

Session 1: Thursday, March 14, 2019, 9:00 – 10:30am

➤ **1A: Innovations, Precaution, and Benefit-Cost Analysis**

Chair: Tim Brennan, University of Maryland – Baltimore County

Additional Presenters:

Julian Morris, International Center for Law and Economics

Brian Mannix, The George Washington University Regulatory Studies Center

Neil Chilson, Charles Koch Foundation

Val Giddings, Information Technology and Innovation Foundation

➤ **1C: Perspectives on Social Discount Rate**

Chair: Joseph Cordes, The George Washington University

Two dominant approaches to estimating a social discount rate exist for benefit-cost analysis. They are known as the social rate of time preference (STP) method and the social opportunity cost of capital (SOC) method. This panel discussion will include presentations in support of each approach, as well as discussion about potential shortcomings of each method. The purpose of the panel is to help to clarify where there is agreement, and disagreement, among the competing views in this area, so as to chart a path forward for future research.

Presentations:

The Social Time Preference Approach to Discounting; *Maureen Cropper, University of Maryland*

The Social Opportunity Cost of Capital Approach to Discounting; *Arnold Harberger, UCLA Benefit-Cost*

Analysis with a Zero Social Discount Rate; *James Broughel, Mercatus Center at George Mason University*

➤ **1D Agricultural Trade and Policy**

Chair: Kelly Maguire, United States Department of Agriculture

Discussant: Aliya Sassi, United States Food and Drug Administration

Presentation:

Predicting Potential Impacts of China's Retaliatory Tariff on U.S. Farm Sector; *Dallas Wood, RTI International*

Trade tensions have been escalating between the United States and China in recent months. In early April 2018, China proposed to increase import tariffs by as much as 25 percentage points on hundreds of U.S. products. These tariffs were imposed as a response to the announcement that the United States proposed to impose tariffs on a number of Chinese imports including steel and aluminum. In this article, we predict the potential impacts of China's retaliatory tariff on four of the most important commodities effected by China's retaliatory tariffs: (1) pork, (2) soybeans, (3) cotton, and (4) sorghum. Our results provide timely and useful information to U.S. policy makers, producers, and other agricultural stakeholders as to the breadth of impact of the retaliatory tariffs.

Using BCA to Make the World Better: Conversation on the Copenhagen Consensus; *Brad Wong, Copenhagen Consensus Center*

➤ **1E Alternative Approaches to Regulation**

Chair: Amber Jessup, United States Department of Health and Human Services

Discussant: Richard Belzer, Regulatory Checkbook

Presentations:

Emerging Technologies Will Reduce WTP for Population Risks; *Richard Williams, Writer*

Two Far-Reaching Changes to How we Quantify and Balance Risks and Regulatory Costs; *Adam M Finkel, University of Michigan School of Public Health*

When the current period of disdain for risk-reducing regulation ends, the first question facing a new Executive Branch and Congress will be whether to restore 'the old days' of evidence-based regulation, or to consider new ideas for identifying and implementing actions whose health/safety/environmental benefits dwarf their costs. I start from the premise that the 1970-2016 period was not in fact a golden age for cost-benefit-based regulation-risks were often underestimated, costs generally grossly overstated, non-carcinogen health effects were not assessed in units of risk, aspirational goals were set and not tracked or achieved, risk-risk tradeoffs were largely ignored, and distributional inequities were unexamined. Therefore, I offer two changes to cost-benefit balancing that might swing the pendulum beyond "neutral" and towards maximally welfare-increasing policies.

First, I suggest we look at several of the ideas being implemented or regarded as "serious" by the Trump Administration, and examine how radical or how reasonable each would be if simply recast as its own opposite. For example, a 'regulatory budget' (a per-agency amount of regulatory costs that can't be exceeded, regardless of greater benefits) is a 'serious' idea, despite the illogic of a system designed to produce regulations whose benefits exceed their costs and yet (now) determined not to produce "too many" of these welfare-increasing policies. The exact obverse idea would be an annual 'benefits budget' (a per-agency minimum amount of

regulatory benefits that must be met, so long as costs are smaller). Similarly, economists always define 'cost-effective' regulatory policies as ones that achieve a given level of benefit at the least cost, rather than the obverse (policies that achieve the maximal amount of benefit for a given cost). The former policy defines "the least buck for the bang," even though it is always incorrectly touted as "the most bang for the buck."

Secondly, our method for monetizing risks and comparing them to costs tacitly biases policy towards harms (either environmental/health harms or monetary ones) that affect large populations in very diffuse ways, and away from economic or non-economic suffering that affects small populations intolerably. We could instead construe net benefit not as total population benefit minus total cost, but as the amount of human suffering a regulation would avert net of the economic suffering it imposes—shining a light on intolerable individual risks and on unemployment or bankruptcies.

A Coasean Approach to Cost-Benefit Analysis; *D. Bruce Johnsen, Antonin Scalia Law School
George Mason University*

Many federal regulators are required to perform cost-benefit analysis of rules proposed to correct the failure of private markets to efficiently allocate society's resources owing to so-called 'externalities.' Yet, as Ronald Coase showed decades ago, social inefficiencies cannot persist if the 'costs of market transactions' are zero, putting the entire notion of market failure on shaky ground. What kind of failure is it when the parties affected by an apparent externality could resolve the inefficiency but in practice decline to do so because the costs of transacting outweigh the net benefits? Transaction costs are real social costs and should be factored in to the regulator's cost-benefit calculus. This essay proposes a relatively simple Coasean approach to cost-benefit analysis. Where the parties deal directly or through competitive markets, a rule is justified only if the regulator can show it is likely to reduce the relevant transaction costs. If so, the parties can be relied on to adjust their private arrangements to reduce any inefficiencies out of self-interest. There is no need for the regulator to quantify costs and benefits. This is information the parties—the men and women 'on the spot'—are best able to identify on their own.

➤ **1.F: Environmental Policy: Up in the Air and Back Down to Earth**

Chair: Chris Dockins, Environmental Protection Agency

Discussant: Charles Griffiths, Environmental Protection Agency

Presentations:

Maximizing the Potential Benefits of Air Quality Warnings; *Lisa A. Robinson, Harvard University*

Although the U.S. has made significant progress in reducing air pollutant emissions, air quality (AQ) levels continue at times to exceed the levels deemed protective under the National Ambient Air Quality Standards (NAAQS). When such exceedances are forecast, regional and local AQ authorities issue advisories warning individuals (especially those who are particularly vulnerable) to limit their exposures by decreasing the time spent outdoors and taking other actions. Warning systems have the advantage of allowing each individual to judge whether the health benefits of taking action to reduce his or her exposure exceed the costs associated with foregoing his or her preferred activities. However, the benefits of these warnings also depend on other factors, such as the accuracy of the air quality forecasts, the effectiveness of the resulting communications, the relationship between the associated reduction in exposure and health effect incidence, and the monetary value of these changes. Our work includes two components. First, we estimate the potential health benefits of warnings based on assumptions regarding infiltration rates, behavioral responses, and other factors. We focus on exposures to fine particles and ozone in three urban areas (Denver, Los Angeles, and Pittsburgh) with differing air pollution sources, climates, and populations. Second, we identify policy options that could aid in achieving these benefits, by improving both individual responses to warnings and the options available for protection from exposure. We find that actions to decrease infiltration rates as well as minimize exposure to indoor sources may be necessary.

Achieving Air Pollution Reduction Goals of Planning: Pathway and Costs of Main Industries in China; *Beibei Liu, Nanjing University*

Quantitating the cost of air pollution emission reduction and understanding the pathway are critical for implementation of environmental regulations. However, there is limited literature on the measures' abatement cost associated with regional difference, which is an important, affecting factors of abatement pathway and cost. In this paper, we are trying to answer the following questions, (1)What is the optimal pathway and cost of main industries to achieve the air pollution reduction goals of 13th FYP under the implementation of 'near zero'? (2) How much loss will the dominant allocation method in China, i.e., the top-down allocation under different provinces, entail? Using the Chinese Environmental Statistics Database (ESD) and desulfurization and denitration Inventory of the Ministry of Environmental Protection (MEP), we constructed the marginal abatement cost (MAC) curves for desulfurization of thermal power industry (S-P), desulfurization of iron and steel industry (S-IS), denitration of thermal power industry (N-P) and denitration of cement industry (N-C). Based on the MAC curves, we calculated the optimal abatement cost for achieving the air pollution reduction goals and analyzed the abatement route including the choice of technologies and allocation of goals among 31 provinces. Finally, we assessed the efficiency loss range under different allocation scenarios by policies simulation analysis. The Results show that the optimal costs for fulfilling the reduction target of S-P, S-IS, N-P and N-C amount to 87.41 Billion Yuan (12.45 Billion Dollar), 29.66 Billion Yuan (4.43 Billion Dollar), 76.61 Billion Yuan (11.43 Billion Dollar) and 6.34 Billion Yuan (0.95 Billion Dollar) in 2020, respectively. The costs account 2.34%, 0.69%, 2.05% and 1.44% for their respective output value of 2020. The Chinese typical 'top-down' allocation approach of emission reduction target would cause the loss of efficiency but not serious. The cost gap for S-P, S-IS, N-P and N-C reach at least 290 Million Yuan (12.55 Billion Dollar) , 503

Million Yuan (75.07 Billion Dollar), 103 Million Yuan (15.37 Billion Dollar) and 230 Million Yuan (34.33 Billion Dollar) respectively and they account for 0.33%, 13.94%, 1.29%, 7.56% optimal cost. To achieve the optimal and lowest cost, for S-P and S-IS, emissions reduction ratio of western provinces should be higher than other regions. On the contrary, for S-IS and N-C, emissions reduction mission should be prioritized to the central provinces and northern provinces. For S-P, N-P and N-C, conventional EOP technologies should combine the technological remodeling (such as improving the abatement rate) and introducing advanced technologies to control the air pollutants emission.

Considering Benefits of Landscape Conservation in Benefit-Cost Analysis; *Michael Getzner, Vienna University of Technology*

The aim of benefit-cost analysis to fully account for all real (technological) effects of a public project or policy is highly challenged when the valuation of changes of biodiversity including scenic beauty and landscapes is concerned. For instance, large infrastructure projects such as high-voltage power lines, railroads, and tourism infrastructure may induce correspondingly large changes of the landscape. Environmental economics certainly provides a range of valuation methods to deal with such changes (e.g. contingent valuation, choice experiments, travel cost and contingent behavior).

However, the choice of the appropriate baseline to value changes of the landscape, the perception of citizens with regard to the landscape, and the selection of the concrete valuation method are questions that cannot be answered in a standardized way. Guidelines and recommendations might provide a general framework for valuation, but the contexts of each valuation exercise and the concrete regions of study are always different from each other in terms of the regional economy and ecology, the appearance of the landscape, socioeconomics of users and citizens, and the public debate.

In many regions, the scenic beauty of landscapes, and a high degree of biodiversity are paramount for tourism. The empirical estimates of the benefits that landscape and nature conservation programs in two regions in the Austrian Alps are likely to bring, provide a case-study for the discussion of the above-mentioned issues. In an on-site survey, most of the tourists whom we questioned in the two regions accepted the stricter nature conservation policies even though there would then be restrictions of access to certain ecologically sensitive areas. Similar changes of the landscape were presented to the respondents both verbally and visually. The respondents were willing to pay at least EUR 1.50 per person and night in addition to the existing tourism levies for the implementation of additional nature conservation programs. The results suggest that these tourists are not only aware of the need for certain policies to conserve and to improve biodiversity, they actually expect these. The preferences of these tourists were not the same on account of the difference between regional contexts, as well as socio-economic attributes, such as income, age, and perception of the degree of naturalness of the surrounding landscape.

The results of the case-study are used to show how values elicited by such surveys may be used for benefit-cost analysis, how they might differ from representative household surveys

(including choice experiments), and what the main advantages and disadvantages from such approach as used in the case-study may be.

Keywords: Scenic beauty, landscapes, the visualization of changes in biodiversity, the degree of naturalness, contingent valuation, use of values in benefit-cost analysis.

➤ **1.G: Transportation Policy: BCA Asks, “Is it Worth the Trip?”**

Chair: Deborah Aiken, Department of Transportation

Presentations:

Meta-Analysis of the Value of a Statistical Life in Road Safety; *Henrik Andersson, Toulouse School of Economics*

In this paper we conduct a meta-analysis on the value of a statistical life (VSL) in road safety. We use VSL estimates from 64 studies consisting of 401 estimates. The full data set is labelled 'All-Set', but we also consider a sub-sample 'Best-Set' (111 observations), consisting of the best or the two bests estimates of each study. These estimates are the ones recommended by the author(s) of each study, and two best estimates are provided when the good/policy varies. For instance, one estimate may reflect VSL for a public safety measure whereas a second one for a private safety measure. We further run a third analysis on a 'Trimmed-Set' (105 observations) in which the data set has been trimmed at the 95 percentiles, resulting in the exclusion of a few outliers. A funnel plot for the All-Set reveals that the estimates include negative values of VSL. As expected, these negative values disappear in the Best-Set since there is reluctance to report theoretically improbable negative estimates. In addition, there is a clustering of the small positive values combined with an upper right tail of the distribution that extends farther than does the left tail. This overall distribution is consistent with the presence of publication selection bias reported in the literature. To clarify, one might expect two opposite effects through the 'Best Estimate Selection Bias'. The first effect is supposed to be positive since no negative values are reported anymore. The second effect is assumed to be negative since the most extreme positive values are deleted, reducing the range of the statistical series. From the regression analysis we retrieve some common results from the literature; the VSL is directly impacted by the value assessment approach (revealed vs. stated preferences), by the elicitation format (willingness-to-pay vs. willingness-to-accept) and by the dimension of the safety policy (public vs. private). However, we also find strong effects from publication outlet, i.e. which peer-reviewed journal in which the article has been published in. That is, the results suggest, controlling for large group of explanatory variables, that estimates are significantly different if published in specific journals. This could be interpreted as a second definition of publication bias.

Causal Inference for Ex-Post Evaluation of Transport Interventions; *Daniel Graham, Imperial College London*

This paper reviews methods that seek to draw causal inference from non-experimental data and shows how they can be applied to undertake ex-post evaluation of transport interventions. In particular, the paper discusses the underlying principles of techniques for treatment effect estimation with non-randomly assigned treatments. The aim of these techniques is to quantify changes that have occurred due to explicit intervention (or 'treatment'). The paper argues that transport interventions are typically characterized by non-random assignment and that the key issues for successful ex-post evaluation involves identifying and adjusting for confounding factors. In contrast to conventional approaches for ex-ante appraisal, a key advantage of the statistical causal methods is that they can be applied without making strong a-priori theoretical assumptions. The paper provides empirical examples of the use of causal techniques to evaluate road network capacity expansions in US cities, High Speed Rail investments in Spain and airport capacity expansions in China.

Cost Benefit Analysis and Transport Policy Decisions: Why Such a Gap? *Emile Quinet, Paris School of Economics; Alain Quinet, SNCF Réseau*

Policy decisions are rarely in line with the recommendations of economists. As authors of several reports on the socio-economic and environmental incidence of transports, the authors experienced the difficulty to transform policy recommendations based on academic work and statistical evidence into tax, regulation and investments decisions. This situation is well-known when we compare economics with for instance engineering or medicine. However, the gap is especially important in the case of transport. The aim of this paper is to cast light on the causes of this situation and to present a few proposals to reduce the gap. It builds only partly on the corpus of references and studies which is not that numerous, and also on the experiences of the authors as deciders and economists. The main illustrations and examples will come from, but not only, transportation which is the main field of professional experience of both authors and will refer to France, while similar situations arise in Europe.

A first part will list the reasons which make this gap paradoxical. A second part will analyze the causes of this situation. Some of them are not specific to transportation; In the case of transportation, other characteristics add to the previous ones. Transport and transport policy have impacts on various fields such as environment, redistribution, social, strategy, geography, with a strong pure policy dimension. On top of these characteristics of the transport sector, two major changes occur in the past two decades:

First of all the decision making has dramatically changed with the growing importance of local authorities. This fragmented landscape has disturbed the relations between academics and policy-makers more focused on business performance, competition and financial models than on socio-economic approaches.

So the two worlds of economic analysis and decision making are progressively diverging. In the case of transportation, the history of successive steps in economic knowledge shows it clearly: from the foundation of economic calculus in the 19th and the beginning of the 20th century, to

the surge of traffic modelling in the mid of 20th century, then impact of industrial economics and finally the consideration of economic geography.

Now we are entering a new era, where transportation, like many other sectors, is becoming a fast changing technology industry, with upcoming of big data, the technological changes coming from communication technology, new organization services of sharing, and the challenges to regulate an innovation which will come from the private sector but cannot avoid public intervention.

How economists should cope with this situation? Apart from the solution adopted in social sciences (do not recommend, just describe and explain), a first avenue would be to enhance the status of economic expertise (regulation of access to the activity, ...), and a second one would be to make more links between research and the world of decision-making, with some kind of downstream command of research. A last one would be pedagogic, in order that the recommendations of economists are better understood and more widely diffused.

Estimating User Benefits of a New Transportation Option with the Logsum Method; *Lucile Kellis, Steer Group*

Our presentation demonstrates the application of the logsum method in conducting societal benefit-cost analysis (BCA) of a hypothetical new transportation mode. Traditional BCA techniques fall short in estimating benefits of new transportation alternatives that will only be used by a fraction of travelers on a particular route. Using the example of a hypothesized ferry service in New York City, the presentation demonstrates the inadequacy of the traditional travel time savings calculation. It then shows how a discrete choice model can be used not only to forecast ridership for this service, but also to obtain the overall user benefits, or consumer surplus, from the transportation system. In this case, the consumer surplus is equivalent to the 'logsum' of the discrete choice model. The consumer surplus is then incorporated into a benefit-cost analysis, accounting for fare payments such that fares paid by consumers are treated as a transfer instead of as a net loss or gain to society. External impacts from the new service and non-user benefits and costs need to be added to the consumer surplus user benefit calculation to complete the BCA.

Session 2: Thursday, March 14, 2019, 10:45 – 12:15pm

➤ **2.A: Economic Evidence Informing Government: Policy Implications of BCA**

Chair: Steven Lize, The Pew Charitable Trusts

Presentations:

Efficiency Criteria for Nudges and Norms; *W. Kip Viscusi, Vanderbilt University*

This article develops benefit-cost tests for nudges and behavioral norms for a wide range of policy situations. The principal benefits from well-designed policies usually derive from promoting efficient behaviors, but there also may be counterpart costs in terms of undermining efficient behaviors. The distinguishing economic characteristic of nudge policies is not that they are less intrusive interventions that nudge behavior rather than mandate behavior but that they exploit additional dimensions of policy design other than financial incentives. Policies utilizing financial incentives have a cost advantage over nudge policies to the extent that they involve financial transfers, which are not net social costs. Failure to understand this cost distinction has led to overestimation of the cost effectiveness of nudges compared to financial incentives in the four principal areas for which comparative cost-effectiveness evidence is available: retirement savings, college enrollment, energy conservation, and flu shots. Financial incentives can be varied continuously, whereas nudge policies usually involve indivisible components and consequently may be less flexible. Nevertheless, nudges may be a desirable addition to the policy toolkit because they expand the dimensions of available policies.

WTA vs. WTP Choices and Valuations vs. Remedial Guides: The Illustrative Example of the Loss from the BP Gulf Oil Spill; *Jack Knetsch, Simon Fraser University School of Resource & Environmental Management*

The choice of the appropriate measure to assess the monetary value of environmental, and many other, losses and reductions of losses, appears to be more controversial because of the often different uses of the results. The choice, for example, to set priorities and design deterrence structures, is commonly dependent on valuations based on the reference people use in valuing particular changes -- and is often the WTA measure. The choice to justify mitigation actions is more dependent on extant assignment of entitlements and policies -- and likely more often call for WTP measures.

The potential confounds stemming from combining these different purposes, and resulting biases, seems well illustrated by the report of the assessment of losses due to the BP oil spill (Bishop, et al., *Science*, 2017). In spite of the near universal agreement that the WTA measure will yield the more accurate estimates of such losses (e.g., Arrow, et al., *Fed. Regist.*, 1993), the distinguished group of 20 authors of the report, carried out "under the guidance of" U.S. NOAA, used the WTP measure -- by eliciting how much people would pay for "a proposed program for preventing a similar accident in the future".

To the extent that people regard the reference state of the Gulf of Mexico environment as being one without a major oil spill and the occurrence of such an event as a negative disruption, the attempt to justify the use of the WTP measure by manipulating the evaluation exercise away from viewing the BP spill as a loss to a gain of protection for a future spill, is seriously undermined. Further, even if the seemingly positive change of avoiding a future loss could be imposed as representative of the change at issue, the most accurate measure of its value is not people's willingness to pay for it, but rather the minimum sum they would require to forego it (e.g., Knetsch, et al., *JBCA*, 2012).

The widespread practice of using the WTP measure for losses in nearly all benefit-cost and other such analyses is one of long standing -- and, curiously, rarely challenged. The justification for this near indifference has largely been an appeal to standard economics that prescribes their near equivalence. However, hundreds of widely reported tests have provided overwhelming empirical evidence of wide disparities between the measures for changes such as that of the BP spill (e.g., Tuncell and Hammitt, *J. Environ. Econ. Manage.*, 2014). The prominence of the BP spill evaluation report somewhat unfortunately also provides a further signal that disregarding such evidence is fully acceptable.

While the WTP measure is unlikely to yield a valid assessment of value such assessments can be useful in dealing with mitigation efforts when beneficiaries of such actions are required to bear their costs. To the extent that entitlements and policies reflect considerations in addition to values -- such as temporal orderings -- WTP assessments can be useful in justifying mitigation actions.

GAO's Assessment Methodology for Economic Analysis; *Oliver Richard, U.S. Government Accountability Office*

In its engagements, the U.S. Government Accountability Office (GAO), the legislative branch 'congressional watchdog' agency, may review economic analyses that are intended to inform decision-makers and stakeholders about the economic effects of a public action. The economic analyses that GAO reviews, such as benefit-cost and cost-effectiveness analyses, may have been performed to meet requirements described in Executive Order or related statutes, to propose or support an action, or to examine an action that has already been taken. In 2018, GAO published a report that informs the public about the methodology that GAO may use to assess these economic analyses (<https://www.gao.gov/products/GAO-18-151SP>). GAO identifies five key methodological elements to the baseline structure of an economic analysis: Objective and scope, Methodology, Analysis of effects, Transparency and Documentation. GAO's assessment methodology evaluates each key element and provides an overall assessment based on the assessment of the individual key elements. This presentation by GAO's Chief Economist will describe GAO's assessment methodology and its application in a recent GAO report to an agency's benefit-cost analysis.

Policy Formulation in Brazil: New Policy Evaluation Guidelines, and their Comparison to Best Practices in the U.S.; *Kerry Krutilla, Indiana University – Bloomington; Kelvia Albuquerque, Office of Chief of Staff, Presidency, Republic of Brazil; Martin de Almeida Fortis, Ministry of Planning, Republic of Brazil*

Under a framework for enhancing public governance, Brazil is developing a new policy evaluation system to better demonstrate to citizens the impacts and benefits of policymaking, to increase efficiency in the allocation of public funds, to improve service delivery, and to reduce the costs of regulations. In 2018 the government published four best-practice guidance documents to promote these objectives: 'The Evaluation of Public Policies: Practical Guide for Ex Ante Analysis (Volume 1)', 'Guidelines and Guidebook for Regulatory Impact Analysis – RIA',

'Guidelines for Public Governance Policy' and 'Guidelines for Policy ex post evaluation'. The distribution of these guidelines to governmental departments and agencies as well as the training of public servants, is seen as a first step in the institutionalization of a new policy evaluation regime.

This presentation will review the best practice ex ante guidelines newly developed in Brazil, and compare them to the recommendations specified in Circular A-4, EO12866, and EO13563 for regulatory evaluation in the United States. There are similarities in the guidance provided in both countries, but the emphasis differs, reflecting institutional difference. Benefit cost analysis is well established in the United States for regulatory evaluation, and guidance documents, in particular Circular A-4, make specific recommendations regarding procedures, e.g., the use of standard willingness to pay (WTP) and willingness to accept (WTA) measures including the value of statistical life (VSL), and the use of real discount rates of 3% and 7%. In contrast, BCA is not well-institutionalized in Brazil and procedures for its conduct are not specified in detail in best-practice documents. However, the importance of framing the policy decision, the definition of policy objectives, and the specification and evaluation of alternatives are emphasized in more detail than in U.S. guidelines. A policy evaluation reporting format is also specified. And implementation strategy, ways of building public confidence and support of policy initiatives, and strategy for monitoring, evaluation, and control are also emphasized in the Brazilian guidelines.

Circular A-4 suggests that benefit categories that cannot be monetized should be listed and discussed qualitatively, and similarly for distributional effects. The Brazilian guidelines are open to the possibility of using Multi-Criteria Analysis to handle this kind of situation.

Overall, the contrast between the two sets of guidelines provides an interesting comparative study of the way institutional differences influence policy evaluation, and also offers insights that could prove useful to both countries in future iterations of their guidance documents.

➤ **2.B: Economic Assessments of Specific Health Interventions**

Chair: Craig Thornton, Mathematica Policy Research

Discussant: Gabriel Movsesyan, U.S. Food & Drug Administration

Presentations:

Benefit Analysis of Reducing Opioid Prescription Rates; *James Oehmke, Professor Emeritus, Michigan State University*

The opioid crisis is exacting a terrible toll in the United States: overdoses claimed almost 50,000 lives in 2017. Prescription opioids are important to pain management, but can cause addiction after just a few doses with 25% of patients receiving long-term opioid therapy reporting problems with addiction. Overdoses are often associated with over-prescription and diversion

of prescription opioids to non-prescription users. Starting about 2012 state-level prescription drug monitoring programs (PMDP) and other policies were implemented to restrict over-prescription and diversion. The opioid prescription rate (number of prescriptions per 100 persons) increased from 72.4 in 2006 to 81.3 in 2012 before declining to 58.7 in 2017 (CDC). However, this decline induced greater use of 'street' opioids including fentanyl, a synthetic opioid 100 times stronger than morphine and relatively easy to produce illegally. Almost 30,000 or about 60% of opioid overdose deaths in 2017 were from synthetic opiates including fentanyl, a tenfold increase from 2010. Government has taken additional steps to control the opioid epidemic, including a recent announcement by the White House of \$6 billion in funding.

This paper quantifies the benefits from reduced opioid prescription rates. We focus on benefits associated with preventing opioid deaths, as previous studies have shown that the costs associated with opioid deaths are much higher than the costs associated with non-lethal overdoses. The benefits are calculated to be the age-adjusted economic value of the life lost plus the pecuniary costs associated with the death itself; psycho-social costs for family members etc. are excluded. These costs figures are taken from existing literature. Data are taken from a variety of sources, including the Centers for Disease Control (CDC) WONDER data on age-adjusted opioid death rates by county. The CDC suppresses data from counties with less than ten deaths for confidentiality reasons and reports data as 'unreliable' for counties with less than 20 deaths. The remaining sample size was 1,248.

The innovation is a multivariate regression analysis of the relationship between opioid prescription and death rates using county-level data. Although prior works have established a relationship between prescription and death rates, ours is the first analysis to estimate this relationship at a level as granular as the county level. We control for endogeneity of prescription rates through a first-stage instrumental variables estimation. We then control for censored death rate data through a probit binary selection model of whether or not the country reports a death rate; this probit model includes the estimated prescription rate from the first stage to remove endogeneity. The inverse Mills ratio from the probit regression is then included in the final regression of the opioid death rate to eliminate selection bias.

The final results confirm a large and statistically significant effect of prescription rates on opioid death rates (2.984, $P < .001$). From this effect we estimate the number of opioid deaths avoided due to the reduction in prescription rates between 2012 and 2017. Finally, we estimate the economic benefit of avoided deaths.

The Heterogenous Responses to and Social Welfare Effects of Smoking Bans in Bars and Restaurants; *Anne Burton, Cornell University*

Since 1990, 35 states and hundreds of municipalities have implemented bans on smoking in bars and restaurants. In this paper, I conduct a theoretical and empirical investigation into the effects of smoking bans on the amount and location of alcohol consumption and alcohol-related externalities such as drunk driving, domestic violence, and bar fights. The theoretical analysis examines the implications for social welfare and cost-benefit analysis. The empirical

analysis allows for the bans to have heterogeneous effects on the cigarette and alcohol consumption of different smoking and drinking 'types'. Smoking bans can be expected to make bars and restaurants more attractive to nonsmokers and less attractive to smokers. The effects of a smoking ban on an individual's total alcohol consumption depends on whether drinking at a bar and drinking at home are complements (through habit formation or addiction) or substitutes.

In the first part of the paper, I estimate reduced-form difference-in-differences models to determine how these smoking bans affect the amount and location of alcohol consumption for different 'types'. I use the Behavioral Risk Factor Surveillance System to measure alcohol consumption by smoking type. I use the Nielsen Consumer Panel data to measure alcohol purchases for home consumption by smoking type. I combine these two datasets to back out the effect of smoking bans on alcohol consumption at a bar.

In the second part of the paper, I estimate the effects of these bans on alcohol-related externalities, such as drunk driving, domestic violence, and bar fights. I use data from the Fatality Analysis Reporting System and the Uniform Crime Reports for these outcomes.

In the third part of the paper, I construct a theoretical model of different 'types' of smokers and drinkers and 'competing' externalities (from smoking and drinking) to analyze the social welfare effects of these bans. What are the relative weights that a social planner would need to assign to the different 'types' for this policy to be neutral from a social welfare perspective? Given certain relative weights, what are the effects on social welfare? What does a cost-benefit analysis tell us about the effectiveness of this policy?

This paper contributes to the health economics literature on smoking and drinking policies and their effects on smoking and drinking and related externalities; to the economics of crime literature on causes of crime; and to the public economics literature on the optimal regulation of externalities. Prior research has studied the effects of smoking bans on measures of alcohol consumption, but to my knowledge, I am the first to incorporate county-level smoking bans to fully explore the heterogeneity in possible outcomes by smoking type. In addition, this paper is the first to study the effects of these smoking bans using the BRFSS and the Nielsen Consumer Panel data, both of which have more observations and may be more representative of the population than datasets used in prior work.

A CBA of Corrective Lenses for Reducing the Symptoms of Dementia; *Robert Brent, Fordham University*

Research Question:

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. One of the most important symptoms of late-life dementia, especially those with Alzheimer's disease, is the person's lack of orientation. As poor vision can lead to disorientation, the loss of vision can be a primary contributor to dementia. Anything that can improve vision, such as corrective lenses,

would therefore be one way of preventing the development of dementia. However, for any dementia intervention to be socially worthwhile, it is not sufficient that the intervention reduce the symptoms of dementia. It is also necessary that the benefits of the reduced symptoms be greater than the costs.

The Analysis:

In this study, we carry out a CBA of corrective lenses as a method for reducing the symptoms of dementia. The benefits of corrective lenses are obtained by estimating the direct and indirect effects (working through dementia symptoms reductions) of corrective lenses by reducing the probability of dying. The two mortality effects are converted to monetary benefits by using the value of a statistical life (VSL) obtained from the literature.

There are two estimation equations: one for estimating the effect of corrective lenses on dementia symptoms, and a second one for estimating the effects of corrective lenses and dementia symptoms on the probability of dying. We use the Clinical Dementia Rating (CDR) Scale to measure dementia severity and the probability of dying is derived from our data set supplied by the National Alzheimer's Coordinating Center (NACC).

The Data and Estimation:

The NACC data set consists of a panel of 118,00 patient visits, made up of an average of 3.2 visits over 13 years for over 30,000 participants at 32 US Alzheimer's Disease Centers over the period September 2005 and May 2017. We use a fixed effects model for estimating the impact of corrective lens on dementia symptoms, which controls for time invariant individual variables. We use a random effects Logit model for estimating the effects of corrective lenses and dementia symptoms on the probability of dying, which has to be exogenous.

Main Findings and Conclusion:

Corrective lenses reduce the symptoms of dementia by about 0.19 of a point (on a scale of 1 to 18). A one-point reduction in dementia decreases the probability of dying by 0.003. With a VSL of around \$5 million (in 2000 prices), this makes the indirect benefits of vision correction \$2,850. Since vision correction reduces the probability of dying by 0.004, and with the VSL again equal to \$5 million, the direct benefits amount to \$20,000. With the cost of vision correction found to be \$226.48 (80% of this total being the cost of eyeglasses), the indirect benefits on their own cover the costs. Including the direct benefits, the benefit-cost ratio of vision correction is over 100 and therefore very socially worthwhile. Traditional Medicare and not just Medicare Advantage should cover vision correction.

➤ 2.C: Digital Rights, Data Protection, and Data Privacy

As more and more items of personal information become potentially available to internet providers, the government, and employers, a lively debate has emerged about the role of public policy in ensuring a proper balance between the various parties who may benefit from greater access to information, and the protection of individual rights to privacy in addition to the appropriate role of government in setting standards for data protection. As various scholars have noted, it is desirable that this debate be informed by a formal benefit-cost analysis based

on empirical measures of benefits and costs. Our panel proposes to contribute to this development in several ways. Given that the EU moved forward with its solution - GDPR - it is imperative that policymakers in the U.S. be informed by scholarship that takes into account the effects of varying data privacy and data protection frameworks. Our panel begins by discussing the GDPR with a presentation on what discrete benefits and costs accompany the overarching EU regulation. Additional presenters compare the benefits and costs of various proposals including: the current proposal by California, the existing privacy regime under the FTC and the FCC regime proposed under the Obama administration.

Chair: Joseph Cordes, George Washington University

Presentations:

Data Protection under the EU's GDPR; *Roslyn Layton, American Enterprise Institute*

Many American policymakers have wisely recognized that the GDPR is not appropriate for the U.S. However, they are seeking to review and update existing information privacy laws to ensure consistency and effectiveness while avoiding fragmentation with state level rules. The scientific research on data protection and privacy suggests that consumer education and privacy enhancing technologies are essential to creating trust online, but these inputs are ignored in both the GDPR and the California Consumer Privacy Act. This presentation reviews perspectives on the GDPR, misconceptions about the policy, legal risks, and the GDPR's unintended consequences. The purpose of the GDPR is not to protect privacy, but rather to regulate data processing. In the past decade, the increasing data protection rules have not resulted in improved trust or increased cross-border commerce in the EU. The GDPR's unintended consequences include violations of the freedom of speech, closures of startups, blocked foreign news outlets, the disruption of online ad markets, the compromising of the WHOIS database, and the hampering of innovation. These are important realities which U.S. policymakers should consider as they evaluate whether and how to regulate online data in the U.S. In addition to the aforementioned, issues relevant for practitioners of benefit-cost analysis covered by the presentation include the policy's effects on: innovation, security, compliance costs for businesses, and outstanding privacy concerns.

The Other Side: What's the Cost of Data Protection; *Aryamala Prasad, George Washington University*

The demand for online data protection is increasing across the world. In 2018, the European Union implemented the General Data Protection Regulation. The state of California enacted Consumer Privacy Act of 2018 to give people right over their personal data. More recently, the Senate Committee on Commerce, Science, & Transportation reviewed current privacy safeguards in top technology companies. Data protection regulations have the obvious benefit of reducing risk to individuals - it gives them the right to control information stored and processed by companies. However, ensuring information privacy means businesses have to comply with new requirements such as new methods of data processing, time-bound breach

notification, and impact assessments. How do these provisions affect tech industry that has thrived on the utility of individual data? Is there a tradeoff between privacy and innovation? Does it stifle competition? Using a cost-benefit framework, this paper examines the effect of data protection regulations on businesses. The relevant costs are associated with the anonymization of data, adoption of new business practices, and fines for potential privacy breaches. The costs are then analyzed in the broad context of the technology industry to assess the influence of data protection regulations on market competition.

Benefits and Costs of Privacy under Different Regimes; *Daniel Perez, George Washington University*

Regulation of privacy involves weighing the future benefits of increased consumer privacy protections against the existing benefits enjoyed by consumers in exchange for collection and use of their personal information (PI). In 2015, the Federal Communications Commission (FCC), under the Obama administration, issued its Open Internet Order reclassifying broadband internet service providers (BIAS) as common carriers. Along with being subject to common carrier regulation by the FCC under Title II of the Communications Act of 1934, this effectively ended the Federal Trade Commission's (FTC) role as the regulator of data privacy for BIAS. The FCC published a rule at the end of the Obama administration to regulating data privacy for BIAS. Although the 115th Congress vacated this regulation using the Congressional Review Act (CRA), this proposed rule provided an outline for how FCC intended to regulate data privacy. This article compares the alternative regulatory regimes data privacy regulation of BIAS under the FTC vs. the proposed FCC regime in order to analyze the policy alternatives using a formal benefit-cost analysis based on empirical measures of benefits and costs. It is worth noting that there are various theoretical arguments to be made in defense of one regime over the other, but most of these arguments including the FCC's proposed rule are not informed by empirical estimates of the consumer privacy valuations.

Ex Ante vs. Ex Post Enforcement of Privacy and Data Security; *Neil Chilson, Charles Koch Foundation*

➤ **2.D: Emerging Developments in Food Policy Regulatory Analysis & Research: Experiences Across Countries**

Across multiple countries we are seeing a push for regulatory reform. Often the focus is on reducing the impact of government programs on business. In other cases, it is focused on streamlining regulatory process. In this session we will hear from senior economists and regulatory officials in food policy about how these efforts are affecting the way they conduct regulatory impact analysis and other economic analysis of their regulatory systems.

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

Additional Presenters:

Jason March, Food Standards Australia New Zealand;
Vanna Aldin, UK Food Standards Agency; Angela Lasher, U.S. Food and Drug Administration;
Linda Abbott, U.S. Department of Agriculture Office of Risk Analysis and Cost Benefit Analysis;
Lin Ai, Canadian Food Inspection Agency;
Wonyong Kim, South Korean Food Authority;
Joseph Dunne, The German Marshall Fund of the U.S.

➤ **2.E: Advances in Methodology**

Chair: Aaron Kearsley, U.S. Food and Drug Administration

Discussant: Elizabeth Quin, U.S. Food and Drug Administration

Presentations:

Discounting for Public Cost-Benefit Analysis; *Qingran Li, Duke University*

The choice of discount rates has a significant impact on the evaluation of public policy questions where costs today have benefits over long time horizons. Standard practice in the U.S. is to use two alternative discount rates for public cost-benefit analysis, 7 and 3 percent, as bounding cases. These two rates are meant to represent the rate of return paid by capital investment and the return received by consumers. These bounding cases arise when benefits accrue directly to consumers in either a two-period model or when future benefits are a perpetuity. In this paper, we show how to bound the discount rate for other patterns of benefits. We find that the appropriate discount rate for benefits increasingly far into the future converges to the consumption rate. Using the specific pattern of climate mitigation benefits from a recent National Academies of Sciences report, we estimate the discount rate to be bounded by a narrow range (+/- 0.5 percent) around the consumption rate.

Premature Deaths and Statistical Lives: Toward Clearer Quantification and Valuation of Environmental Mortality Risks; *James Hammitt, Harvard University*

The mortality effects of exposure to air pollution and other environmental hazards is often described by the estimated number of 'premature' or 'attributable' deaths, and the economic value of a reduction in exposure is quantified using an estimate of 'statistical lives saved'. These terms can be misleading, because the number of deaths advanced by air pollution or by other environmental exposures cannot be determined from epidemiological information alone. The fraction of deaths 'attributed' to environmental exposure is conventionally derived as the hazard fraction $(R - 1) / R$, where R is the relative risk of mortality between specified high and low exposure levels. The fraction of deaths advanced by exposure (the 'etiologic' fraction) can be substantially larger or smaller than the hazard fraction: it can be as large as one (when all deaths occur earlier because of exposure) and as small as $1/e$ (≈ 0.37) times the hazard fraction. Economic valuation of a change in population mortality hazard (due to a change in exposure) is based on the change in mortality risk within a specified period and is not dependent on

knowing the fraction of deaths that are advanced by the exposure. When individuals facing larger or smaller changes in mortality risk cannot be identified, the mean change in population hazard is sufficient; otherwise, the population value of a change in exposure can depend on the distribution of risk reductions in the population.

Examining the Expert Performance Through the Random Expert Hypothesis; *Deniz Marti, George Washington University*

Cooke's Classical Model suggests aggregating experts' elicitations based on a performance-based weighting mechanism. Specifically, the model posits that experts' elicitations should be weighted by how calibrated and informative the experts are. While this approach has been widely used in many expert elicitation practices over the past decades, some critics suggest using an equal weight approach (EW) to combine expert opinions. Underlying EW is the assumption that one expert is as good as another and that observed differences between experts' performance are caused by random fluctuations and not by persistent differences in expert ability. This 'random expert hypothesis' is tested on data from the TU Delft expert database and rejected at the 0.001 significance level. We emphasize that expert performance here concerns only statistical accuracy and not informativeness. We assess the significance of these findings for expert combination in relation to previous cross-validation studies.

➤ **2.F: Some Unsettled Questions in Environmental Benefits and Costs**

Chair: Richard O. Zerbe, University of Washington

Discussant: Eliane Catilina, Environmental Protection Agency

Presentations:

Co-Benefits; *Timothy Brennan, University of Maryland – Baltimore County*

Co-benefits, also called ancillary benefits, refer to the idea that regulation to alleviate one market failure might mitigate other market failures. Regulating emissions of A may also reduce emissions of B and their cost of abatement. An EPA rule to control mercury emissions passed a benefit-cost test only because of co-benefits, and recent efforts to repeal it rely on arguments that co-benefits should not count.

Krupnick, Burtraw and Markandya (KBM) (2000) and Lutter and Shogren (2002) provided analytical frameworks, particularly to illustrate the importance of whether the co-benefit is already regulated, and if so, how, e.g., through marketable permits or taxes. First is to expand upon KBM's graphical presentation to illustrate the prominence of reduced cost, whether through abatement or reduced output of pollution-intensive goods, relative to increased benefits of reduced emissions. Attention to costs in co-benefits leads to recognizing shared fixed costs as well as reduced marginal abatement cost.

An argument against co-benefits is that they risk double counting benefits from reduced emissions of B directly in regulating B and indirectly through regulating A. If most of the co-benefits involve reduced cost, there is a risk of overregulation due to double counting cost savings or under-regulation if shared costs are attributed to both A and B. I also address counting co-benefits even if the regulator intends to regulate B efficiently, as regulating A can lead to a different regulatory target as well as reduce B's abatement cost. We end with a brief discussion of 'division of regulatory labor,' discussing why an environmental regulator should incorporate co-benefits while, say, an antitrust agency should not base enforcement choices on whether monopoly pricing, by reducing output of a pollution-intensive good, mitigates environmental harms.

Electric Vehicles in China: Implications of Variability in Costs, Health, and Climate Benefits;

Yana Jin, College of William & Mary

The market of pure electric vehicles (EV) grows unprecedentedly in world major economies. Governments encourage this development by subsidizing EV purchase and scheduling bans for the sale and usage of gasoline vehicles (GV). China, the country with the second largest vehicle fleet and will be the first by 2020, faces the challenge that so far there is no agreement on whether in a ten-year term the substitution of GV by EV can lead to any reduction in greenhouse gas emissions (GHG). We argue that this debate needs inputs from a more complete welfare analysis with not only GHG impacts but also quantitative assessments of health benefits, and costs. In this paper we combine Monte Carlo simulation based probabilistic benefit cost analysis with an air pollution dispersion model to evaluate the geospatial-population distribution of the health, climate and net social benefits (loses) of substituting GV by EV in hundreds of cities across China. We found that various local factors lead to divergent welfare outcomes, from cities with high net benefits towards those with significant net losses. We further quantified and ranked the impacts from key factors on the level and distributions of net benefits. Key factors are projections of relative fuel price, projections of battery costs, energy mix of power grids, location of power plants, climate zones, population density, background pollution, form of pollution concentration response function, income level, willingness to pay for health risk reductions and discount rates. Our results provide inputs for context specific, differentiated interventions on EV development not only in China but also many other countries.

Environmental Benefits of Federal Conservation Efforts: Lesson from Agricultural Program

Analyses; *LeRoy Hansen, U.S. Department of Agriculture/Economic Research Service*

In an effort to advance the science in valuing the benefits of Federal programs' impacts on ecosystem services (ESs), USDA is hosting a workshop that invites innovative economic and econometric methods, advances in theory, efficiencies in data collection, and access/use of existing data that Federal program and policy impacts to ESs (<https://www.fs.fed.us/esv2019>). Unique to Federal programs' impacts is the need to measure where, throughout the country, ESs have changed, the affected population, and the value they place on ES changes. For example, a change in waterfowl habitat can affect ecosystem services locally and throughout all

migratory flyways. By advancing the science and through additional research, the long-run objective of this effort is to produce a comprehensive set of spatially-explicit ecosystem service values (ESVs) that can be applied in policy and program benefit-cost analyses. Fourteen agricultural-related ESVs are posted on the USDA Economic Research Service (ERS) web site (<https://www.ers.usda.gov/publications/pub-details/?pubid=47550>). This set is far from comprehensive and, given that most are more than a decade old, can be improved.

The objective of this paper is to summarize the analyses, data used, and the ESVs that have been used to value USDA program/practices, focusing on unique features of the analyses and their implications for future research. Research is very limited. One example of a find is: by comparing the 14 ESVs discussed above, one discovers the need to consider more than the water-based recreation; these are about 1/3 of the total benefit measured. Another example, some analyses are (in effect) an effective means of applying benefits transfer; the analyses transferred regional and national benefit estimates to sub-regional estimates, hence theoretically justifiable. Such analyses could be made much more precise given the spatial data and models that are now available.

➤ **2.G: Transportation: BCA Asks, “Is it Road-Worthy?”**

Chair: Timothy Skeel, Seattle Department of Transportation

Presentations:

Making the Case for Transportation Investment with BCA; *Patrick Miller, Steer Group*
Problem Statement

Metrolinx is an agency of the Government of Ontario, established with the purpose of creating an integrated transportation system that would support a higher quality of life, a more prosperous economy and a healthier environment. One of the key issues at Metrolinx was to inform decision making process that is able to comprehensively assess and monitor a transit investment, so as to meet the multi-faceted goal of delivering 'an integrated transportation system that would support a higher quality of life, a more prosperous economy and a healthier environment'.

To manage this complexity, Metrolinx developed a set of comprehensive Business Case Guidance documents to help evaluate projects. Each business case compiles evidence on benefits, costs, risks, and overall impacts to communicate if there is a case to advance a potential transport project or investment. Benefit Cost Analysis for transit investment can be a complex process involving a range of issues, stakeholders, and decision makers. As a result, project appraisal for major transit investment may often vary between projects – making it challenging to compare projects in a like for like manner.

Method

Metrolinx launched its draft Business Case Guidance in 2018, and it is now the most comprehensive guidance in Canada. The guidance was developed to inform investment decisions and policies valued over \$50 million in the Greater Toronto and Hamilton Area. The guidance aims to provide a robust, standard approach for assessing the benefits, costs, and impacts of a range of potential transportation investments and policies. The Business Case informs decision making at several stages during the transit investment's lifecycle. This guidance equips analysts, managers, and project sponsors with a robust approach to conducting benefit cost analysis, including:

- (1) Demonstrating the wide ranging benefits of transit to different audiences – (example: increased ridership, faster travel) along with wider strategic and economic benefits - such as improved health and well-being or augmented economic prosperity.
- (2) Ensuring all projects are analyzed using a consistent approach – this allows an apples to apples comparison of projects on the same terms using the same metrics and indicators .
- (3) Combining multiple dimensions for a holistic evaluation of projects – each business case outlines the rationale for pursuing a project (including how the project furthers regional planning and the monetized economic benefits and costs of the project) as well as the financial and delivery requirements to implement the project.
- (4) Supporting improved planning and design by focusing on benefits – planning and design processes can be embedded in business case development with a focus on optimizing projects to realize higher performance against clearly defined benefits.

Estimating Social Discount Rate for the Long-Term Transport Investment Projects in Russia;
Maria Sheluntcova, National Research University Higher School of Economics

Due to its huge area, Russia has always experienced difficulties in ensuring the economic coherence of different regions. Special attention is paid to the development of rail transport since it has high carrying capacity and traffic safety. At present, the most ambitious project is the construction of a high-speed Moscow-Kazan railway as the part of a railway from Europe to Western China. To finance transport projects, the Russian government are going to use not only budget funds, but also attract private investments in the form of a public-private partnership or concession. The expected costs are unprecedented, thus careful benefit – cost analysis is required.

In our research, we estimate the social discount rate for investments in transport infrastructure. In Russia, there is no official guidelines with the determined value of the social discount rate as in the US or European Union. Research papers give values of 3,2% for the social rate of time preference (Kossova & Sheluntcova, 2014) and 4% for the social opportunity cost of capital (Kossova & Sheluntcova, 2016) for any short-term and medium-term investment projects in Russia. To estimate the social discount rate for long-term transport projects, we consider the social opportunity cost of capital regarding the risk of investing in the transport infrastructure. In Russia, the forecast of the social discount rate for the long term is hampered by the lack of statistical data for a long retrospective period. Furthermore, the country experiences transition to a market economy and has disproportions in economic development of various economic sectors. It should be taken into account during the benefit-cost analysis of

public investments. We base our research on the concept of time-declining social discount rate of Weitzman (1998) and consider the recent papers of Freeman and Groom (2016) on the long-term social discount rate and Goldmann (2017) on estimating social discount rates for transport infrastructure planning in Germany. Our paper presents new data on the Russian transport investments and suggest methodology of estimating social discount rate that is useful for the decision-makers in Russia and other Post-Soviet countries.

Evaluating Future Highway Access via Risk-Cost-Benefit Analysis with Data Uncertainties;
Marwan Alsultan, University of Virginia

Acknowledgment:

This effort was supported by the Virginia Department of Transportation, National Science Foundation, and Commonwealth Center for Advanced Logistics Systems.

Abstract:

Access management is used by transportation agencies to balance the mobility of roadways with the ability of road users to access adjacent properties. The literature describes how access management programs can help in saving billions of dollars by reducing the number of crashes and improving travel time for road users. However, it is common for transportation agencies to have limited resources, including budgets, equipment, time, human resources, and others, and thus they need a framework to prioritize their access management needs among hundreds of thousands of access points. This presentation introduces a risk-cost-benefit analysis framework to prioritize access management projects that focus on safety and travel time improvements as follows. First, the safety and travel time benefits and costs of these projects are quantified and a benefit-to-cost ratio (BCR) is developed using parameters from the literature, such as crash rate, traffic volume, access point density, crash reduction factor, delay index, value of time, and others. The uncertainty associated with some of these parameters is described by an interval analysis. Next, a key innovation of this research combines risk analysis and cost-benefit analysis with data uncertainties. This is accomplished by introducing three key risk components-hazard intensity, exposure, and vulnerability-which can be used to evaluate roadway performance and to monetize the potential benefits and costs of access management projects. These components are then presented in a three-dimensional risk communication diagram. In this diagram, the bounds of the exogenous parameters are used to generate two curved surfaces (lower and upper) that divide the diagram into three zones of priorities: low, moderate, and high. The low priority zone is below the lower curved surface, where the BCR does not exceed one for any possible value of the uncertain parameters; the moderate priority zone is between the lower and upper curved surfaces, where the BCR exceeds one for some possible values of the uncertain parameters; and the high priority zone is above the upper curved surface, where the BCR exceeds one for all possible values of the exogenous parameters. A main goal of this diagram is to facilitate decision-making processes and to allow for risk-cost-benefit analysis with data uncertainties and tradeoff analysis to complement one another. The developed framework is demonstrated by applying it to thousands of access points located on four major U.S. highways. The results of this demonstration should assist decision makers to prioritize these access points based on safety improvement and travel time savings perspectives. This

framework ought to be of wide interest to planners, stakeholders, analysts, and policymakers with limited resources and heterogeneous and sparse data, and it is transferable to multi-scale systems in various fields. Thus, the approach should influence the use of cost-benefit evaluation, including models and data, in enterprise management of transportation and a variety of other infrastructure systems.

Joint CBA of Maintenance and Investment: The Role of Quality of Service; *Marc Gaudry, University of Montreal*

CBA widely covers investments and regulation, but rarely addresses issues of maintenance, though these types of operations are increasingly important for the management of infrastructure networks. The aim of this communication is to contribute to filling this gap, using the case of transportation infrastructure.

Transportation infrastructure maintenance, notably for roads and railways, is a longstanding research concern. Most work belongs to the operations research literature where the types and sequencing of maintenance operations, aiming at technical maintenance staff to guide operational decisions, generally focus on costs and pay little attention to the economic consequences in terms of benefits. Other work, more concerned with pricing, focuses on the econometrics of current maintenance expenditures but takes little account of interactions among types of maintenance, notably between current maintenance and regeneration (or renewal); those types of studies mainly arise from the need to design infrastructure charges, especially in Europe where a lot of work has been done in this field under the auspices of the European Commission.

At the juncture of these two research directions, we propose a model embodying some core knowledge of degradation mechanisms but simultaneously linking policies on current and regenerative maintenance categories to their service quality impacts. We put the emphasis on quality of service, which is one of the main outputs of maintenance. Its inclusion in maintenance modelling is both a necessity and a source of difficulties as it is difficult both to measure and to monetize. In this vein, we consider several quality of service indices and discuss their relevance and implementation, as well as their translation into monetary values.

We use these indices to build a model which, involving both current maintenance and renewal, achieves a joint optimisation of OPEX (current maintenance) and CAPEX (periodic regeneration). This intertemporal optimization model is structured by an objective function balancing continuous maintenance expenditures and discretely timed renewal expenditures against service quality benefits for users. The objective function in question can be interpreted either as the owner's profit or as a collective surplus, depending on how service quality is valued. The model is solved by Pontryagin's method, making the optimal solutions analytically tractable. We also explore the case where the effects of maintenance on track quality are treated as random: this requires the use of numerical simulation methods. Lessons from the reasonable results so obtained are drawn, and we deduce pricing implications that significantly differ from usual marginal cost pricing rules.

In our model calibrations, equations are tested on national French rail track segment databases using Box-Cox transformations and results are consistent with prevailing rail regeneration and maintenance practices.

In conclusion, we consider how to embed quality of service in maintenance optimisation and discuss the meaning of quality of service in terms of user's willingness to pay, of collective surplus and as an appraisal of disruption risk.

Session 3 – Thursday, March 14, 2019, 2:00 – 3:30pm

➤ 3.A: Benefit-Cost Analysis of Tax Regulations

Internal Revenue Service (IRS) regulations have long been exempt from requirements for Office of Information and Regulatory Affairs (OIRA) oversight and regulatory impact analysis, but a memorandum of agreement between OIRA and Treasury signed in March 2018 lifted that exemption. As a result, tax regulations are now subject to the analytical and review requirements of Executive Order 12866 and its successors. This has caused consternation in the tax community about what such oversight will mean and how benefit-cost analysis should be applied to understand the social impacts of tax rules. While much of the impact of taxes are transfer payments, they may also have real resource allocation impacts that better analysis could elucidate, potentially leading to better tax policies. This panel brings together experts with experience in both tax practices and regulatory BCA to 1) examine how well the economic analyses the IRS has developed for regulations issued in the first year under the MOA comport with BCA principles, and 2) explore what tools and data could further government understanding of the social benefits and costs associated with tax regulations.

Chair: Bridget Dooling, The George Washington University Regulatory Studies Center

Additional Presenters:

Joseph Cordes, George Washington University;
Susan Dudley, The George Washington University Regulatory Studies Center;
Jerry Ellig, George Washington University;
Mark Mazur, Urban Institute

➤ 3.B: Economic Methods for Assessing Health Policies and Regulations

Chair: Anne Burton, Cornell University

Discussant: Elizabeth Ashley, OIRA

Presentations:

Sensitivity and Uncertainty Analysis of Particulate Matter and Ozone Health Impacts Using Alternative Inputs in BenMAP; *R. Jeffrey Lewis, ExxonMobil Biomedical Sciences, Inc.*

Introduction/Problem Statement:

The US Environmental Protection Agency (EPA) Environmental Benefits Mapping and Analysis Program (BenMAP) is commonly used to estimate the health and economic impacts of air pollution regulations in the US. More recently it has been used to estimate the impacts of air pollution globally as part of the Global Burden of Disease Study. BenMAP estimates county-level, state-level, or national-level changes in adverse health effects (for example, average number of premature deaths avoided) associated with a change in a pollutant concentration, for example, assuming a reduction in the concentration of particulate matter (PM), using health impact functions or concentration-response functions (CRFs). The CRFs are derived typically from relative risks reported in epidemiological studies that estimate associations between ambient air pollution and adverse health effects. Although BenMAP users may understand that health impacts (such as premature deaths) calculated from preloaded inputs (i.e., CRFs derived from measures of association in epidemiological studies of different populations, geographic locations, and study periods) will output different results, they may not fully understand that applying these CRFs to produce county- and state-level estimates will produce estimates that may not be valid and may not represent a measurable change in health associated with a measurable change in the pollutant concentration.

Method:

Whether the CRFs from the underlying epidemiology study results are generalizable to different time-intervals, population age-distributions, and geographies is one source of uncertainty that generally requires expert evaluation. We conducted a sensitivity analysis to assess how the BenMAP-estimated health impacts differed depending upon the selection of the CRF. For example, state level estimates of premature mortality associated with particulate matter exposures can differ by more than 50% depending on the pre-loaded CRF selected by the user. In addition, we explore the uncertainty associated with BenMAP inputs that include changes in pollutant concentration, baseline health incidence, and the exposed population.

Conclusions:

Currently, BenMAP accounts for the statistical uncertainty in the CRF. Our analysis also considered additional uncertainty in the CRF, such as in the shape of the CRF, which is incompletely assessed in BenMAP analyses. We recommend that BenMAP users carefully consider the impact of the selection of a CRF on the BenMAP modeling results, including all potential sources of uncertainty.

Challenges for Rulemaking and Insurance Guidelines from Conventional Definitions of Tobacco and Nicotine Products; *Gabriel Movsesyan, U.S. Food and Drug Administration*

The growth of e-cigarettes (or electronic nicotine delivery systems) and related smoking or vapor devices has created a distinction between tobacco products and nicotine products that

challenges conventional definitions and categories in regulation, public policy, and insurance. Traditional characterizations of smoking are no longer sufficient for tobacco control and related rulemaking by federal and state agencies. As regulatory policies gradually advance to cover the full spectrum of nicotine-containing products, there are potential hazards for consumers, insurers, and regulators who will rely on proper classification and understanding of these products. I conduct several case studies where insurers and regulatory bodies encounter such issues when creating regulations or guidelines. I review existing Federal Register rules and the definitions used by various state and local agencies and examine the effects of when these nicotine products are treated in the same way or not. For instance, ACA marketplace health plans do not provide guidelines about whether e-cigarette use qualifies as tobacco use, yet enrollees may be subject to significantly larger premiums if they are tobacco users. On the other end of the range of categorization is the FDA, which is establishing a regulatory framework that encompasses all nicotine and tobacco products subject to FDA regulation.

To the extent public policies, regulations, and insurance standards treat these products in an equivalent manner, other actors (consumers, insurers, and regulators) may respond to this equivalence in both intended and unintended ways. If some of these products are determined to be effective at tobacco harm reduction, then their potential benefits may not be captured by those most likely to realize them. And if indeed their negative health effects outweigh any positive ones, then these definitions should be better aligned. Poor understanding of these products, confusion about their health consequences, and inaccurate beliefs about their substitutability pose significant problems for the public and policy-makers.

A Comparison of Delay Discounting by e-Cigarette and Cigarette Users: Implications for U.S. Food and Drug Administration's Regulatory Impact Analysis; *Ce Shang, University of Oklahoma Health Sciences Center*

Background:

Existing literature shows that delay discounting is associated with cigarette smoking. However, very limited evidence exists on the magnitude of delay discounting among exclusive e-cigarette users and among dual users of cigarettes and e-cigarettes. The association between delay discounting and choices of different tobacco products (i.e. e-cigarettes vs. cigarettes) is also unknown. Using the 2016 Georgia State University Tobacco Products and Risk Perceptions Survey of U.S. adults, this study compared the magnitude of delay discounting by tobacco use status, which are defined as nonuse, exclusive cigarette smoking, exclusive e-cigarette use, and dual use of cigarettes and e-cigarettes. The association between delay discounting and tobacco use outcome was also assessed.

Methods:

Delay discounting was assessed using multiple price lists (MPL) with hypothetical monetary tradeoff payment between a smaller reward awarded today and a larger reward in the future (e.g. \$19 today vs. \$20 awarded 5 weeks from today). Wald test was used to compare the magnitude of delay discounting by tobacco use status and multinomial regressions were used to assess how delay discounting was associated with tobacco use status.

Results: 28% of nonusers, 29% of exclusive e-cigarette users, 31% exclusive cigarette smokers, and 34% dual users were hyperbolic discounters that have present biases. The prevalence of hyperbolic discounting did not differ by tobacco use status among the adult population. However, among younger adults aged 18-34, hyperbolic discounting is significantly higher among exclusive smokers than among nonusers and exclusive e-cigarette users. ($p < 0.05$). Multinomial regression results further show that being a hyperbolic discounter is significantly associated with higher likelihood of being a smoker among young adults aged 18-34.

Conclusions:

Hyperbolic discounting was significantly higher among young adult smokers aged 18-34. Being a hyperbolic discounter also was associated with cigarette smoking among young adults, suggesting that present bias may contribute to the decision to smoke cigarettes, but not to use e-cigarettes. Therefore, regulatory impact analysis should account for differences in lost consumer surplus by tobacco products .

➤ **3E: Regulatory Reform Under EO 13771: The First 2 Years**

In January 2017, President Trump issued Executive Order 13771 directing agencies to offset the costs of new regulations by modifying or eliminating existing ones. This incremental regulatory budget overlays, rather than replaces, previous orders (e.g., President Clinton's 12866 and President Obama's 13563) calling for regulatory decisions to be based on an analysis of benefits and costs. In this roundtable, agency experts responsible for implementing these orders will share their experiences.

Chair: Matt Wiener, Administrative Conference of the U.S.

Additional Presenters:

Linda Abbott, U.S. Department of Agriculture;
Deborah Aiken, Department of Transportation;
Jeffrey Horn, U.S. Coast Guard;
Daniel Lawver, U.S. Health and Human Services;
Nellie Lew, U.S. Food and Drug Administration;
Nan Shellabarger, Federal Aviation Administration

➤ **3.F: Some Unsettled Questions in Environmental Policy**

Chair: John Whitehead, Appalachian State

Presentations:

Do the Costs of The U.S. Withdrawal from the Paris Agreement on Climate Change Outweigh the Benefits of Its Membership? *Carolina Arlota, University of Oklahoma College of Law*

In June 2017, President Trump announced that the United States would withdraw from the Paris Agreement on Climate Change. The U.S., which ranks first as the biggest polluter of dioxide carbon in history, has been actively involved in the negotiation and approval of the Agreement. The withdrawal, which will only be effective in 2020, is a contentious topic even within members of the current administration. The Agreement has been considered an overall success, as the U.S. nationally determined contribution (NDCs), i.e., the voluntarily established target only required, in practice, the country to continue the current rate at which its carbon emissions were already decreasing. CEOs of major U.S. companies and members of both political parties have criticized the withdrawal. European leaders strongly condemned President Trump's decision. In this context, this article argues that the withdrawal from the Paris Agreement is not justified based on three different accounts of a cost-benefit analysis. First, it evaluates the manner in which this decision was reached focusing on its procedural terms. Second, it assesses the costs and benefits of the policy decision itself, addressing the substantive effects of the withdrawal. Third, it examines the withdrawal using the normative approach of CBA based on moral considerations.

The goal of this article is not to discuss the existence of the Paris Agreement itself or whether the U.S. should have become a member. By focusing on whether the costs of the withdrawal are outweighed by its benefits, this article assesses if the current administration has made a reasoned decision regarding the U.S. withdrawal. It also illustrates how the withdrawal departed from reasoned decision making and how it is unlikely to produce winners in the medium and long runs.

The contributions of this article are unique because it provides novel arguments against the U.S. withdrawal from the Paris Agreement. The principles of administrative law as applied to the requirement of reasoned decisions, for instance, may be informative of future presidential actions on climate change. Similarly, the framework of this research may provide additional arguments based on its findings. From a theoretical perspective, this article fills a void in the literature, because studies on the CBA of the withdrawal have not been published. In addition, the framework chosen contributes to the literature as it addresses a contemporary example of a public policy that was enacted disregarding CBA as a methodological tool for maximizing overall well-being. This article also advances a trending topic on the literature, namely, that CBA should not be blind-folded to moral considerations.

This article is organized as follows. Part II presents a CBA of the decision focusing on its procedural account, i.e., the hurried manner in which such withdrawal was decided, without scientific advising. Part III assesses the substantive terms of the withdrawal, including its potential quantitative and qualitative effects. In Part IV, the results of CBA reveal how moral dimensions were disregarded. Part V concludes that the U.S. withdrawal is not justified according to accurate CBA.

Federal Common Law Suits as a Remedy for Greenhouse Gas Emissions: An Efficiency Analysis of the American Electric Power Company Case; *Richard Zerbe, University of Washington;*
Howard McCurdy, American University

The toughest emissions reductions being proposed, even by the most committed nations, will, probably not be able to achieve any given global temperature stabilization target. By increasing the amount of climate change gasses in the atmosphere, we are passing on a huge remediation burden to future generations that may have no solution. The argument here is first that there are significant efficiency advantages to damages granted under strict liability in the form of creating incentives for innovation and the search for alternative technologies. As the court in *Spur Industries* crafted a novel remedy, so too could the Supreme Court in Federal common law global warming cases. Second, the argument is that courts can contribute to a reduction of the huge damages from climate change, as well as reduce the potential for catastrophic risks, by creating a cause of action based on public common law, rooted on strict liability, combined with a damage remedy adopting a simple calculation based on current knowledge. The damage calculation could reasonably be based on the level of U. S. avoidable damages, and defendants contribution to global greenhouse emissions. The damages should be a yearly assessment in order to produce a proper incentive for emission reduction and, most importantly, related technological change.

Segregated Welfare Losses from Cognitive, Informational and Politico-Economic Distortions-with Applications; *Kenneth Acks, The Cost-Benefit Group*

Many rules, policies and procedures supported by widely accepted cost-benefit analyses and the majority of citizens have not been implemented or face elimination. Unpopular tax, health care, immigration, criminal justice and other policies have been pursued despite little correlation with optimal results.

Three reasons for the divergence of actual and optimal or popular policies are 1) cognitive flaws, 2) false and incomplete information accepted by large segments of the population and 3) distortions fostered by the political system

Relevant cognitive flaws analyzed by behavior economists include the Anchoring Effect, availability heuristic, bandwagon effect, clustering illusion, gamblers fallacy, hyperbolic discounting, illusion of validity, ostrich illusion, reactive devaluation, risk compensation and status quo bias.

Evidence of false and incomplete information is in Vosoughi, Roy and Aral (2018) which used a data set of rumor cascades on Twitter from 2006 to 2017. About 126,000 rumors were spread by 3 million people. False news reached more people than the truth; the top 1% of false news cascades diffused to between 1000 and 100,000 people, whereas the truth rarely diffused to more than 1,000 people. Falsehood also diffused faster than the truth. In addition, according to the WaPo President Trump made more than 5,000 false and misleading statements in office as of 9/13/18. Dale tallied 3,086 by 10/24. The frequency increased over time. Despite this 35% to 45% approves of his performance.

Serious divergence of policies from optimal choices as reflected in BCAs and public desires has resulted from: the role of money in politics, over-representation of small states via the Senate and Electoral College, voter suppression and gerrymandering.

Studies have found companies can get as much as a 22,000 percent return on lobbying dollars, a 2014 poll from Global Strategy Group found over 90% want to reduce role of money in politics. A Civis Analytics study found that Wisconsin's strict voter ID law suppressed 200,000 votes. There is only 1 polling place for 27,000 people in Dodge City, KS, which is 60% Hispanic, & it's being moved outside of town, 1 mile from nearest bus stop. Serious voter suppression has occurred in Georgia and Texas. Gerrymander has skewed results in Michigan, Wisconsin, Pennsylvania, Texas and elsewhere.

In addition, most recent polls show strong support of efforts to combat climate change yet these efforts have generally been doomed politically and several other popular policies are similarly doomed. Huge tax cuts for the wealthy were passed partially because of the power of small states and gerrymandering.

In a 7/18 RFF Paper "Emission, Mortality, and Coal-Mine Employment Effects of a Two-Year Delay in Coal and Nuclear Power Plant Retirements" Shawhan and Picciano employ a detailed electric sector simulation model to estimate effects of a proposed policy that prevents retirement of coal and nuclear generators in the US projecting delaying retirements would cause 353-815 additional premature deaths in U.S and welfare losses between \$4,000,000,000-\$9,000,000.

The paper will utilize this model and others to estimate welfare losses from cognitive, informational politico-economic distortions upon coal policy.

➤ **3.G: Transportation on Waterways: Keeping Afloat Using BCA**

Chair: Henrik Andersson, Toulouse School of Economics

Discussant: Joe Devlin, Environment and Climate Change Canada

Presentations:

Evaluating Forecast Risk in Maritime Related Infrastructure Projects; *Bruce Lambert, Mentis*

In a world of increased connectedness, the developing or sustaining of transportation corridors has become a focus area to strengthen economic and cultural ties. The sizes of these corridors and their related projects range from the multinational to the local. For example, there are several groups working on pan-Asian corridors, which would require a significant political will to streamline economic integration, improve security while lower costs and improved services to Asian firms. While inland /domestic markets are changing, the maritime sector is experiencing its own challenges. Larger vessels and the specialization of maritime shipping has

led to increasing concentration in vessel operations, especially concerning the ability of ports to handle changing vessel traffic. There are also concerns that the multinational firms, while not rejecting their vested, long-distance supply chains, are also incorporating nested regional structures to satisfy emerging needs. While every investment in a 'primarily freight-related project' could be viewed as necessary, the assumption is that those investments will generate increased traffic through a port. Ports represent expensive, specialized public sector investments. There are many areas where port investments can be invalidated by the action of a particular firm or a changing market condition. Oftentimes, the potential construction costs are considered, but such techniques are not developed to examine benefits, which may lead to the potential result of misaligning project approval and stranded assets/obligational funding. The problem statement is how to account for the potential for forecast traffic activity to change due to various market factors. The literature review indicates that while guidance on transportation investment in facility planning should include some measure of sensitivity analysis, most do not necessarily develop a potential range for the forecasts of project cargos or traffic, mostly relying upon a single point forecast. When these forecasts are evaluated against the observed values, there is a rate of adoption that occurs, but there are also some ports where the anticipated benefits did not occur due to external market events. The use of developing some potential range to account for these differences could have potentially addressed differences from the anticipated and the observed.

Benefit-Cost Analysis of Restricting On-demand Draw Bridge Openings; *Timothy Skeel, Seattle Department of Transportation*

The Seattle Department of Transportation (SDOT) operates three draw bridges spanning the Lake Washington ship canal. More than 30 million motor vehicles cross the three draw bridges annually. Federal law gives marine vessels the right-of-way over vehicular traffic and the bridges must be opened on demand (with some exceptions) to allow passage of any vessel requesting it. The combination of high traffic flows and frequent bridge openings causes vehicle delays that generate significant financial, social and environmental costs. Annually, more than 2 million vehicles are delayed about three minutes each by on-demand draw bridge openings for about 8,000 vessels – consisting mostly of recreational sailboats. This analysis estimates the net economic benefits of reducing the number of vehicles delayed by restricting on-demand bridge openings. The net benefits of two different approaches to limiting bridge openings are compared. The first proposed approach is to limit bridge openings to only two scheduled times per hour. Bridge operators believe that unscheduled, multiple openings in a single hour (e.g., the bridge is opened for 5 minutes at 10:10, and again at 10:25, 10:35 and 10:50, as boats arrive) cause significant additional avoidable traffic delays. The second proposed approach is to eliminate openings during weekday rush-hour traffic. Bridge openings during rush hour delay the greatest number of vehicles per opening. SDOT Traffic Studies provide every 15-minute interval traffic volumes over the bridges. This analysis uses the most recent traffic data to calculate average vehicle/minute flows for each bridge over the day. SDOT bridge operators record each individual opening time, duration, and type of vessel crossing. That data, together with traffic flow data, provide a means to estimate the duration and number of vehicles delayed, as well as the number and type of vessels passing, for all

openings over the period covered by the data. Estimated delay costs include travel-delay time cost calculated as 80% of median hourly income times average vehicle occupancy times the average delay time per vehicle times number of vehicles delayed. Other vehicle costs include average fuel and emissions cost (carbon dioxide, hydrocarbons and nitrous oxide gas) produced by delayed idling vehicles. The net benefits of eliminating bridge openings for one hour during the morning and evening weekday commute times are estimated to be over \$1 million per year. In contrast, restricting bridge openings to two scheduled openings per hour results in estimated net benefits at just over \$100 thousand per year. This was surprising to bridge operators who intuitively believed, prior to the study, that the benefits of the two approaches would be similar. Careful benefit/cost analysis helped to decide which approach to recommend and pursue with regulatory authorities. A further implication of the study is that assignment of superior rights of some groups over others may unintentionally lead to inefficient economic outcomes. Benefit/cost analysis has a place in determining when and how to change regulations and laws to improve economic outcomes, especially when inferior outcomes from those.

Estimating the Value of NOAA's Physical Oceanic Real Time System; Douglas Scheffler, U.S. Coast Guard

This presentation will report on two studies conducted by the National Oceanic and Atmospheric Administration (NOAA) to estimate the value of its Physical Oceanic Real Time System (PORTSÂ®). PORTSÂ® is a system of sensors that transmits environmental conditions such as temperature, wind speed, and current. The goals of the system are to enhance safety and improve the economic efficiency of operations. The first study cross sectional study was conducted by NOAA in 2012 and expanded on the findings from four earlier analyses. It examined the use of PORTSÂ® systems operating in 58 ports and estimated the present value of expanding the system to the top 175 ports in the U.S. The benefits analysis was based on a combination of anecdotal evidence and a 'de minimis' imputation methodology. The study estimated that benefits of the then current 58 PORTSÂ® installation is \$217 million per year and the expansion of the system would increase that to \$300 million per year. NOAA currently is conducting an update of the valuation estimate. This estimate includes PORTSÂ® systems installed since the original study and uses three different methodologies for estimation of benefits. This study replaced the original de minimis approach with an analysis of maritime accident data from 2008-2016, supplied by the U.S. Coast Guard. A statistical analysis identified trends in fatalities, injuries, property damages, and pollution. The fatalities and injuries data were monetized using the Department of Transportation's value of statistical life. Pollution was monetized using the Coast Guard's estimate of the cost of response to oil spilled and property damages are reported in dollar values. NOAA will summarize the results into an estimate of the present value of the benefits, which will be included in the presentation.

Session 4 – Thursday March 14, 2019, 3:45 – 5:15pm

➤ **4.A: Analysis for Uncertain Futures**

Among the most contentious and complex policy issues confronting decision-makers and academics today are those poorly suited to traditional risk analysis, such as: climate change; threat of nuclear war or wide-spread natural disasters; cyber-attacks and other technological threats; global pandemics; and systemic financial crises. Benefit-cost analysis, as traditionally applied, is sometimes ill-equipped when dealing with large irreversible changes, with policies that only make sense on a global scale, in situations involving networked effects, or when confronting long time horizons. Further, the likelihood of these risks occurring is often unknown or even unknowable; we are calling them 'uncertain futures' in this proposal. Considering these complex risks calls for a framework that incorporates uncertainties and tradeoffs across policy decisions. More flexible and dynamic decision-analysis approaches that anticipate the need to learn from experience (and that encourage learning) are essential. Policy analysis of these uncertain futures would benefit from cross-fertilization of ideas and interdisciplinary analytical tools. To this end, we propose to present four papers on the topic of uncertain futures from experts in different disciplines. The goal of these papers is to draw on different perspectives to frame the issues and serve as a catalyst for how to improve the state of the science.

Chair: Daniel Perez, George Washington Regulatory Studies Center

Presentations:

Planning for Everything (Besides Death & Taxes); *Susan Dudley, The George Washington University Regulatory Studies Center*

Policymakers face demands to act today to protect against a wide range of future risks without impeding economic growth. Yet traditional policy decision-making tools may sometimes be inadequate to frame the relevant uncertainties and tradeoffs. Although some risks can be estimated using actuarial methods, others have unknown probabilities and potentially severe and widespread consequences. For example, benefit-cost analysis (BCA) has enjoyed both academic and bipartisan support as a valuable approach for examining different policy options and informing policy choices. Since at least the 1970s, it has been the preferred instrument for comparing incremental (marginal) alternatives and addressing discrete policy questions in isolation. As traditionally applied, however, BCA may be ill-equipped to cope with some challenges now facing policy makers, such as climate change, nuclear war, electromagnetic pulse (EMP) or cyber-attacks against critical infrastructure, widespread natural disasters, global pandemics, and systemic financial crises. Traditional methods of analysis that focus on marginal changes can break down when dealing with large irreversible changes, with policies that only make sense on a global scale, in situations involving networked effects, or when confronting long time horizons. Furthermore, how likely it is that the particular problem may occur can be unknown or even unknowable. For this reason, we refer to these issues as uncertain futures. This presentation first identifies the characteristics of, and offers several illustrations for, what we label uncertain futures. It then lays out the challenges for anticipating these futures and developing effective policies to address them. Next it discusses the advantages of policy approaches that learn from different disciplines and experimentation. It concludes with a brief set of recommendations for next steps.

Responsible Precautions for Uncertain Environmental Risks; *W. Kip Viscusi, Vanderbilt University*

Uncertain future risks pose cognitive and analytical challenges. Low probability events coupled with potentially severe outcomes pose well-known problems for decision making and are also prone to public overreactions. Imprecision in risk estimates generates behavioral biases such as ambiguity aversion. Policy prescriptions to adopt conservative values and to undertake “no regrets” policies sacrifice potential gains that can be reaped by exploiting risk ambiguity and opportunities for learning about uncertain risks. Simple guidelines such as recommendations for less ambitious investments in the presence of irreversible effects may have restricted applicability. Standard discounting procedures without any adjustment for temporally remote effects can properly weight future benefits and costs. Distant risks often pose considerable cognitive and practical challenges, three of which will be the focus of this presentation. First, many potentially severe risk outcomes may involve small probabilities. Making sensible decisions when dealing with very small risks is especially difficult and may create inordinate pressures for regulatory intervention. Second, because of the future nature of the risk, the informational basis for forming precise risk assessments may be very limited. As a result, there is often tremendous ambiguity regarding the risk and its consequences. This ambiguity, in turn, has led to seemingly sensible prescriptions such as it is better to be safe than sorry, to be conservative when dealing with risks of harmful events, and to pursue policies for which we will have no regrets. In each instance, these prescriptions are the opposite of what policymakers should seek to achieve. Third, the future aspect of the risk makes the discounting of these remote effects of substantial consequence and an integral part of any responsible assessment of benefits and costs.

Analytical Challenges Surrounding Analyses of Nuclear War; *James Scouras, Johns Hopkins University Applied Physics Laboratory*

This presentation would assess the potential contributions and limitations of diverse qualitative and quantitative analytic disciplines in assessing the risk of nuclear war and discuss the challenges of evaluating policy options in the face of profound uncertainties.

From Football to Oil Rigs: Risk Assessment for Combined Cyber and Physical Attacks; *Fred Roberts, Rutgers University*

While cyber security has become widely recognized as a serious threat to our modern world, there are sectors of that world that are lagging behind others in response to cyber threats and there are new threats to our security that combine cyber with other modes of attack. A case in point is the maritime transportation system (MTS), which still accounts for a vast percentage of commerce in the world, and where cyber security initiatives have lagged behind. For years, there has been discussion about physical security in the MTS. That discussion has led to standards, regulations, etc. An increasingly important theme in homeland and national security is that future attacks (e.g., on the MTS) will be multi-modal. In particular, these could include

both a cyber and a physical component. As a simple example, hacking into security cameras at a port increases vulnerability to a physical intrusion. Thus, a cyber attack could be a precursor to a physical attack, and in fact the opposite could also be the case. This talk presents an analysis of why cyber security in the MTS has lagged behind, presents scenarios of combined cyber and physical attacks on the MTS, and describes ways to understand their likelihood based on ease of attack and seriousness of potential consequences.

➤ **4.B: International Issues in Health Economics**

Chair: Ce Shang, University of Oklahoma Health Sciences Center

Discussant: James Oehmke, U.S. Agency for International Development

Presentations:

Altruism and Efficient Allocations in Three-Generation Families (in Poland); *Susan Chilton, Newcastle University*

Understanding inter-generational transfers within the family is key to the design of effective policies in health and social care. Research into resource allocation in a two-generation household, i.e. one consisting of parents and children, is well established. However, perhaps surprisingly, little is known about three-generation households, regarding the motivations, preferences and/or behaviors of the 'middle' generation towards the older generation i.e. grandparents. In this paper, we focus on the familial situation in which the grandparent lives with the family and, as such, is assumed to be a household member. Theoretically, this allows us to extend the current two-generation 'parental altruism' model of family resource distribution to three-generations. This underpins the empirical investigation, which is to establish whether the middle generation has altruistic preferences with respect to their own parents as well as their child and, if so, whether the degree of altruism varies across the different generations. The answer to this question has profound implications with respect of the degree to which the so-called 'squeezed middle' can substitute for the government in the area of health and social care for the elderly, in particular if life expectancy continues to increase.

We report the results of a stated preference study carried out in Poland. The current structure of Polish households provides a unique opportunity to explore this issue, as the share of three-generation households in Poland is relatively large (10%) in comparison with other European countries. We use a split-sample Choice Experiment (CE) to estimate the 'middle' generation's WTP for reducing their child's (youngest generation) risk of getting heart disease and their WTP to reduce the same risk for their parent (oldest generation). We also examine the impact of the 'middle' generation's perceptions of their own, their child's and their parents' risk of heart disease. The risk reducing initiatives are described as voluntary vaccination programs. The CE comprises two attributes; the lifetime risk reduction and a price attribute. Each respondent was randomised into one of two sub-samples. Both sub-samples contain a block of choice sets

,concerning a reduction in her/his own risk of the illness. Further, one sub-sample, contains a block of choice sets relating to her/his child's and the other sub-sample contains a block of choice sets concerning his/her parent's risk reduction. Based on respondents' choices, we elicit the middle generation's marginal WTP to reduce these risks for the other two generations. Data analyses has not yet commenced but will be carried out before the SBCA conference. In addition to estimating relative degrees of inter-generational altruism, we will also establish whether these allocative decisions are efficient at the margin.

To the best of our knowledge, our study is the first to investigate how including a third generation alters household decision making over resources using non-market valuation methods. The results of our study may provide guidance for policy makers to design policies to improve the situation of the elderly in particular in the context of health care.

Retrospective and Prospective Benefit-Cost Analyses of Anti-Smoking Policies in China; *Feng Liu, Shanghai University of Finance and Economics*

The Chinese government has the potential to 'nudge' smoking behaviors of the largest smoking population (350 million), who consume the most cigarettes (2.3 trillion in 2009) in the world. As a significant commitment to tobacco control the Chinese government ratified the WHO Framework Convention on Tobacco Control (an international treaty intended to reduce tobacco-related disease and death) in 2005 and in the following years started to implement stronger tobacco control policies such as banning smoking in all healthcare system. The effects of the anti-smoking policies have started to emerge, for example, the Chinese males' smoking prevalence declined from 55.2% in 2000 to 51.6% in 2011.

In this study we estimate the consumer benefits and costs of the recent China anti-smoking policies following the method implemented by Jin et al. ('Retrospective and Prospective Benefit-Cost Analyses of U.S. Anti-Smoking Policies. *Journal of Benefit-Cost Analysis*', (6)154-186, 2015). They adopt the market-based behavioral benefit-cost analysis approach and allow individuals' choice errors in lifetime utility maximization (due to imperfect information, bounded self-control, etc.) and the influence of individuals' addictive stock on their current rational choices.

We use dynamic population models to simulate smoking prevalence and cigarette consumption retrospectively for 2000-2015 and prospectively for 2015-2030. In the retrospective analysis we estimate a counterfactual demand curve in absence of the recent anti-smoking policies (smoking behaviors remain at the 2000 level throughout) and another counterfactual demand curve assuming individuals do not make any lifetime utility maximization errors in smoking choices. The monetary value of consumer utility gains (or losses) from the anti-smoking policies is the compensating values, which can be measured as the consumer surplus under the demand curves. In the prospective analysis we assume a counterfactual with more anti-smoking policies in effect including comprehensive public place smoking bans, complete advertisement bans for smoking, and moderate cigarette tax increases.

We use micro data from the China Health and Nutrition Surveys and China Health and Retirement Longitudinal Survey to estimate annual smoking initiation and cessation rates and cigarettes smoked per day. We use fertility and mortality rates from the China Health Statistical Yearbooks. These data are fed into the dynamic population models.

Our findings will shed light on the consumer benefits and costs of tobacco control policies in developing countries, which are likely to be encouraging for governments' commitment to continuing anti-smoking interventions.

➤ **4.C: Breaking Good or Breaking Bad? Using Break-even Analysis in BCA**

Breakeven analysis is sometimes used in regulatory benefit-cost analysis when important categories of costs or benefits are difficult to quantify, and its use may be increasing in some regulatory agencies. While there are many textbooks and other sources of guidance on benefit-cost analysis, there is comparatively less information on the specific application of breakeven analysis in this context. This session will talk about the strengths and limitations of break-even analysis, how it can best be applied, and other tools (e.g., expert elicitation) that can enhance the use of break-even analysis. It should be of interest to practitioners who want to know how and when to use breakeven analysis, and to policymakers who may be interested in how to interpret the results of a breakeven analysis. An open forum for discussion will be encouraged.

Chair: Joe Devlin, Environment and Climate Change Canada

Panel:

Jennifer Baxter, Industrial Economics;

Joseph Cordes, George Washington University;

Charles Griffiths, Environmental Protection Agency

➤ **4.D: Food Safety Regulatory Analysis in a Global Setting (1)**

There is growing interest in food safety in low and middle income countries and in building capacity to manage foodborne illness in low and middle income countries. Recent WHO global burden of foodborne disease estimate show that the burden of foodborne disease is borne disproportionately by low income countries. With expanding trade in food, there is also interest in better understanding and managing the food safety impacts of food trade in high income countries. This session is focused on research needed to build better manage food safety in a global setting.

Chair: Flora Tsui, U.S. Department of Agriculture Food Safety and Inspection Service

Discussant: Stephanie Desparo, U.S. Department of Agriculture

Presentations:

Food Safety and International Development: Health, Nutrition and Economic Impacts; *Ahmed Kablan, U.S. Agency for International Development, Bureau for Food Security, Agriculture Research and Policy Office Ingrid Weiss, U.S. Agency for International Development*

Food safety is an important public health concern globally and particularly in developing countries where food standards, principally within local/informal market systems, are more lax, resources are fewer, potential contaminants are abundant and human and financial capital ability are less. Food is a significant pathogen transmitter, particularly in foods such as meat, milk, fish, eggs and fresh fruits and vegetables. In developing countries these foods are primarily produced by smallholder farmers and sold in local, informal wet markets. These foods, which have the potential to provide significant nutrition and health benefits, can also be the most dangerous in terms of foodborne disease (FBD) potential. In 2015 the World Health Organization (WHO) released the first significant assessment of the world's global health burden from 31 hazards of foodborne diseases, highlighting their devastating health burden, similar to malaria, HIV/AIDS and tuberculosis. The report highlighted that the most vulnerable (98%) were within developing countries and that children under the age of five accounted for 40 percent of those who suffer from foodborne diseases and one-third of foodborne disease deaths. It further underlined that of the 1.5 billion cases of diarrhea worldwide, close to 70 percent were due to biologically contaminated food and that mycotoxins and foodborne parasites were more prevalent in developing countries than in developed ones. The fragmented structure of the food sector in developing countries compounds food safety risks. The majority of the actors in these food systems are small-scale actors who produce, process, sell and operate informally, which is challenging to monitor. FBDs also play a role beyond health and affect entire economies and societies, including food exports, tourism, livelihoods and overall economic potential.

Modeling the Influence of Income Growth on Global Patterns of Foodborne Disease; *Sandra Hoffmann, U.S. Department of Agriculture; Andrew Muhammad, University of Tennessee Institute of Agriculture; Birgit Meade, U.S. Department of Agriculture*

In 2016, the WHO released the world's first estimates of the global incidence and burden of foodborne diseases. In low- and middle-income countries, these regionally specific estimates provide a foundation for analysis that can help target efforts to reduce foodborne illness. This project integrates the authors estimates attributing regional foodborne illnesses to specific food exposures and estimates of the influence of income and price trends on national food consumption patterns around the world to show how simulation modeling can be used to help forecast how national food disease and burden patterns might change over time. The modeling uses prior research and sensitivity analysis to explore how food safety performance might change with income and price trends.

Food Safety in Africa: Past Endeavors and Future Directions; *Lystra Antoine, World Bank*

- **4.E: Retrospective Review of the Bureau of Consumer Financial Protection: Three Case Studies**

Section 1022(d) of the Dodd-Frank Act requires the Bureau of Consumer Financial Protection to conduct an assessment of each significant rule or order adopted by the Bureau under Federal consumer financial law and to publish a report of the assessment within five years of the effective date. The Bureau determined that three of the rules that the Bureau issued in its early years-on remittance transfers, mortgage loan servicing, and ability-to-repay requirements on mortgage loan originations-were significant rules. Reports of the assessments were due in late October 2018 (for the remittance rule) and early January 2019 (for the mortgage rules). Under the statute, the assessment must address, among other relevant factors, the rule's effectiveness in meeting the purposes and objectives of title X of the Dodd-Frank Act and the specific goals stated by the Bureau for the rule. The assessment must reflect available evidence and any data that the Bureau reasonably may collect. Before publishing a report of its assessment, the Bureau must invite public comment on recommendations for modifying, expanding, or eliminating the significant rule or order. Led by the Office of Research, the Bureau developed plans for assessments in 2015 and began formal work on all three assessments in 2016. In this roundtable, the lead for the assessment program and the team leads for each of the three assessments will discuss the planning, execution and findings of each of the three assessments. All of these rules were mandated at least in part by the Dodd-Frank Act, imposed significant new requirements on business practices; and in the case of mortgage loan origination and servicing, were an outgrowth of the financial crisis. Topics that may be discussed include: defining a "significant rule," "available evidence" and data that the Bureau "reasonably may collect"; resources and staffing requirements; engagement with internal and external stakeholders; and for each of the assessment reports, the questions addressed, the baselines we were able to define, the measures of effectiveness in meeting Bureau goals, the data collected and selected findings.

Chair: Paul Rothstein, Consumer Financial Protection Bureau

Panel:

Eric Durbin, Consumer Financial Protection Bureau;
Sergei Kulaev, Consumer Financial Protection Bureau;
Scott Fulford, Consumer Financial Protection Bureau

➤ **4.F: Environmental Protection Agency's Detailed Analytic Blueprint: Model Plan for Agency Completion of Quality Benefit Cost**

Chair: Kevin Bromberg, US Small Business Administration Office of Advocacy

EPA's Detailed Analytic Blueprint: Model Plan for Agency Completion of Quality Benefit Cost Analyses for Rulemakings For at least two decades, scholars have criticized the quality of benefit-cost analyses at Federal executive agencies. Despite the plethora of handbooks and guidances, including OMB Bulletin A-4, EO 12866, the EPA Guidelines for Preparing Economic Analyses, agencies have fallen short, in large part, in developing quality benefit cost analyses.

These analyses often lack transparency, miss important details, omit significant regulatory alternatives, and suffer from various other methodological flaws. Scholars have suggested various methods to improve implementation, including requiring executive summaries, or checklists. At the 2015 SBCA Conference, Professors Carrigan and Shapiro suggested reliance on back-of-the-envelope calculations to improve BCA quality at low cost. Shapiro has further suggested that collaboration with the affected entities in a 'analytic deliberative' manner would contribute to higher quality work, borrowing from the 1996 work by the National Research Council, *Understanding Risk: Informing Decisions in a Democratic Society*. This panel discussion will focus on the little known 'analytic blueprint' procedure developed at EPA in the early 2000s, as part of the 'Action Development Process' for 'Developing Quality Actions'. We assert that adherence to a set of implementation procedures, in combination with the executive determination to adhere to such procedures, in parallel with a planned deliberative iterative process, is a critical element to the development of a quality BCA. These procedures, last amended in 2011, requires EPA to create a very specific 'blueprint' for the development of all key issues, including consideration of significant regulatory alternatives, including small business alternatives, with an implementation timeline. In 2004, EPA Administrator Steve Johnson determined that no Final Agency Review process would be scheduled unless all aspects of the required economic analyses had been completed. In this manner, the Administrator would enforce the requirements of the 'Detailed Analytic Blueprint'. Panel members will discuss experience with implementation of the blueprint procedures and requirements at EPA, or comment on the utility of those procedures from their own research.

Panel:

Kevin Bromberg, US Small Business Administration Office of Advocacy;
Stuart Shapiro, Rutgers School of Planning and Public Policy;
Allen Basala, Former Economics Analyst, Environmental Protection Agency

➤ **4.G: Safety, Security, and Crime: Making Us Safer with Benefit-Cost Analysis**

Chair: Tony Cheesebrough, U.S. Department of Homeland Security

Presentations:

The Public Health Risks Addressed by the Import Alert Program; *Andrew Estrin, U.S. Food and Drug Administration*

Food and Drug Administration (FDA) may detain food offered for import without physically examining it when it is subject to an Import Alert. Firms generally submit to FDA the results of analytical tests for consecutive shipments to demonstrate that their food is contaminant-free and can be removed from the Import Alert. There are 17,000 to 19,000 negative findings and 330 to 740 positive findings annually from tests of food subject to Import Alerts. We estimate the risk from shipments of food subject to Import Alerts by considering both positive and false negative test findings. We use published findings of test performance to obtain an estimate of

the rate of false negatives. We use 2016 OASIS data for 26 food categories to estimate the number of kg in a line, convert to servings using information from the Serving Size Final Rule and obtain a mean number of servings per line of 579,662. We use @RISK to model the probability that a serving in a line is contaminated given a representative sample tests positive and estimate between 53 thousand to 440 million contaminated servings are rejected annually when only positive test results are considered. When we include lines represented by false negatives we estimate between 240 thousand and 1.9 billion contaminated servings addressed by Import Alerts. We use FDA's Food Handling Practices Model to convert contaminated servings to numbers of illnesses and apply the QALD loss per case of foodborne illness reported in Minor, et al. We estimate the QALD loss avoided from rejected lines of food of between \$5 million and \$32 million when only lines represented by positive test findings are considered. When we also consider lines represented by false negatives, the potential risk addressed by the Import Alerts program is between \$14 million and \$135 million annually.

Alternatives to Break-even Analysis in Safety and Security Regulations; *Ali Gungor, U.S. Coast Guard*

Estimating the benefits of safety and security regulations are difficult for many agency economists and analysts. Agencies must frequently estimate the consequences of highly unlikely or low-probability, high-impact events, such as catastrophic safety incidents or terrorist attacks in the process of developing safety and security rules. Such events are rare, and historical data either is rare or doesn't exist.

Agencies continue to design their regulations and policies that account for the potential risks of these unique and infrequent safety and security events, and do their best to first do a comprehensive risk analysis to be able to establish and quantify baseline consequences and avoidable costs in order to ultimately monetize their benefits of their regulations. However, agency economists typically end up using the break-even analysis when risk reduction from those baselines, future probabilities of such events cannot be directly or easily calculated or estimated.

This presentation will provide an overview of latest safety and security regulations across agencies to help illustrate the challenges agencies face in treating the benefits of safety and security rules. In particular, it critically evaluates the status-quo practice of break-even analyses and consider using alternative methods in both risk and benefit analyses in future regulatory analyses.

Homeland Security and Emergency Management Grant Allocation; *Barry Ezell, Old Dominion University*

The Federal Emergency Management Agency provides grants to select areas to fund disaster and non-disaster all-hazards projects. For the Commonwealth of Virginia, these grants are administered by the Virginia Department of Emergency Management. Each year, under the leadership of the governor's office, VDEM allocates millions of dollars to enhance homeland

security and emergency management across the Commonwealth. It is the goal of the governor's office to promote transparency and public safety stakeholder involvement in the decision-making process for the allocation of these critical grant funds. A continuous challenge for administrators has been ensuring that investments are consistent with federal, state, and local priorities while balancing the differences in stakeholder discipline, risk profile, resources, experience, and access to information. To achieve an objective and transparent decision rationale and to give decision makers confidence that public funds are being well spent; VDEM uses a portfolio decision analysis methodology for grant allocation. The approach supports continuous enhancements and improvements to the grant process from initial kick-off to final funding decision, using a multi-objective decision analysis framework for benefit-cost analysis. This methodology has enabled decision makers to make objective, transparent, and traceable decisions consistent with the priorities of the emergency management community.

Estimating Crime Costs in the States: Lessons Learned from Applied BCA; Steven Lize, *The Pew Charitable Trusts*

Over the past decade crime rates have tended to decline coinciding with shrinking prison populations. Policymakers have made changes to criminal laws and sentencing guideline which have influenced these trends. At the same time, state and local governments engaged in evidence-based policymaking to direct criminal justice funds towards rehabilitation programs that have been shown by rigorous evaluations to be effective and reducing recidivism. The use of benefit-cost analysis has played a key role in implementing evidence-based policymaking. Several states and counties have used the Results First benefit-cost tool to project the economic value of evidence-based programs for offenders. In this presentation, the authors look at approaches to valuing criminal justice system resources to compare estimates and methods by states and counties that have used the Results First benefit-cost tool.

The Pew-MacArthur Results First Initiative (Results First) provides technical assistance to states and counties to conduct benefit-cost analyses (BCA) using an econometric model originally created by the Washington State Institute for Public Policy, adapted by Results First into a cloud-based application. To date, Results First has partnered with more than 25 states and counties to assess policy and budget proposals for evidence-based programs intended to prevent criminal recidivism. The authors compare published estimates and methodological summaries from these states and counties, along with the authors' notes from technical assistance sessions.

The authors highlight the similarities and differences in state-specific crime estimates derived from unit-cost analyses used in each state's Results First BCA model. Cost estimates involved negotiating choices of scale in policy change that could substantially change marginal cost values and subsequent impact estimates. For example, nearly every jurisdiction (state or county) considered marginal costs relative to step-fixed thresholds where the variable costs increase after a certain number of average daily population changes. By contrast, few jurisdictions applied regression analysis of time series data to estimate marginal costs. Despite

similarities in methodologies, states and counties produced noteworthy differences in marginal costs.

The authors discuss the implications for government planning taken from the experience of estimating criminal justice resource costs. The authors will highlight gaps in training and resource needs for regional governments to apply benefit-cost analysis routinely. The authors will also note lessons learned about preferred cost analysis methods, specific challenges, and creative solutions. Some discussion will be given to trade-offs learned from using 'top-down' and 'bottom-up' methods employed in state and county analyses.

Session 5: Friday, March 15, 2019, 9:00 - 10:30am

➤ **5.A: Benefit-Cost Analysis in Low-and Middle-Income Countries: Illustrative Case Studies and Future Research Needs (1)**

Over the past two years, SBCA members have been extensively involved in an effort to develop reference case guidelines for the conduct of benefit-cost analysis in low- and middle-income countries, funded by the Bill and Melinda Gates Foundation. This involvement included contributing methods papers and case studies, discussing related issues at SBCA conference sessions and project workshops, and submitting substantial written comments. A subset of the resulting papers are being published in a special open access issue of the Journal of Benefit-Cost Analysis. In this session, we will celebrate completion of this project by illustrating the results through a series of case studies and discussing future research needs. We will begin with an introduction from Damian Walker, Deputy Director of Data and Analytics in the Global Development Division at the Bill and Melinda Gates Foundation, who initiated and shepherded this effort. The authors of six case studies (listed below) will then present their findings. Lisa A. Robinson, James K. Hammitt, and Dean Jamison will comment on the results and their implications for future work. Ms. Robinson will then moderate the discussion with the audience. More information on the project is available here: <https://sites.sph.harvard.edu/bcaguidelines/>.

Chair and Discussant: Lisa A. Robinson, Harvard University

Presentations:

Reference Case Guidance Purpose and Goals; *Damian Walker, Bill and Melinda Gates Foundation*

Applying Benefit-Cost Analysis to Air Pollution Control in the Indian Power Sector; *Maureen Cropper, University of Maryland and Resources for the Future; Sarath Guttikunda, UrbanEmissions.Info; Puja Jawahar, UrbanEmissions.Info; Zachary Lazri, University of Maryland; Kabir Malik, World Bank; Xiao-Peng Song, University of Maryland; Xinlu Yao, University of Maryland*

Air pollution is a persistent and well-established public health problem in India: emissions from coal-fired power plants have been associated with over 80,000 premature deaths in 2015. Premature deaths could rise by four to five times this number by 2050 without additional pollution controls. We site a model 500MW coal-fired electricity generating unit at 8 locations and examine the benefits and costs of retrofitting the plant with a flue-gas desulfurization unit (scrubber) to reduce sulfur dioxide (SO₂) emissions. SO₂ emissions react in the atmosphere with ammonia to form fine particles (PM_{2.5}, in the form of ammonium sulfate) which has been linked to heart and lung disease. We quantify the mortality benefits associated with the emissions reductions and value these benefits using alternative estimates of the value per statistical life (VSL) transferred to India from higher income countries. The net benefits vary widely, reflecting differences in the size of the exposed population, meteorological conditions and the fact that less costly seawater units can be installed in coastal areas. Based solely on mortality benefits, the scrubber passes the benefit-cost test at all but the two least-densely populated locations when we apply a VSL equal to 100 times per capita income. At a VSL of 53 times per capita income, the scrubber passes the benefit-cost test at 5 of the 8 locations. Net benefits are highest in the densely populated north, which includes the poorest Indian states. Because we have not quantified the morbidity nor ecological benefits, locations with a benefit-cost ratio below one should not be interpreted as failing a benefit-cost test. Were these benefits monetized, the net benefits of scrubbing could be positive at all locations. Our analysis, however, may provide guidance in prioritizing the installation of scrubbers, especially given that morbidity benefits are correlated with some determinants of mortality benefits.

Standardized Sensitivity Analysis in BCA: An Education Case Study; *Dean Jamison, University of California - San Francisco*

Benefit-cost analyses of education in low- and middle-income countries have historically used the effect of education on future wages as an estimate of its benefits. In addition to wage increases, strong evidence points to (female) education reducing both under-five and adult mortality rates. A full benefit-cost analysis of education policies would add the value of mortality risk reduction to wage increases. In this case study, we utilize multiple plausible approaches for valuing mortality risk reductions and perform a health-inclusive assessment of education investments. We test the sensitivity of our results to range of value per statistical life (VSL) estimates, expressed as the value per standardized mortality unit (VSMU) where a SMU is equivalent to willingness to pay for a 1 in 10,000 mortality risk reduction. We also consider the sensitivity of the results to adjustments for age and to alternative discount rates. Our analysis addresses one additional year of schooling in lower-middle-income countries incremented to their current mean number of years of schooling. Regardless of the approach used to value mortality risk reductions, we find that such an increase yields positive net benefits. More than half of the benefits of education come from increased wages, with the remainder resulting from the change in mortality risks. However, the value for mortality risk reductions varies more than the value of total benefits, given the uncertainties in these estimates. We also compare the results of our benefit-cost analysis with the results of a cost-effectiveness analysis. The former has the advantage of allowing analysts to aggregate the value of different outcomes, in this case both effects on earnings and effects on mortality risks.

Contribution of Water Resources Development and Environmental Management to Uganda's Economy; *James E. Neumann, Industrial Economics; Collins Amanywa, Ugandan Ministry of Water and Environment; Kenneth M. Strzepek, MIT and Harvard University*

Building on an ongoing engagement with the Ugandan Ministry of Water and Environment (MWE), we describe a case study that illustrates the application of a computable general equilibrium model to assess economy-wide costs and benefits of a specific investment program for water resources development and environmental management (including coincident health implications) We also compare these results to those from a traditional welfare economic benefits estimation approach. Most sectors of the Ugandan economy rely on environmental quality and the stock of natural resources goods and services for enhancing their productivity, providing the necessary raw materials, and reducing the cost of public expenditure for providing the services in those sectors. The economy-wide modeling assessment seeks to value these goods and services through a series of impact channels which trace raw resources such as arable land, water (as rivers and lakes), wetlands, and forests from their sources, through MWE and private management, and into the economy. The results show that all sectors of the economy benefit substantially from the MWE investments, and these investments are very efficient, with benefits greatly exceeding investment costs. Further, this GDP growth benefits households substantially as incomes and consumption increase over time, which leads to alleviation of poverty. Using the traditional welfare economic benefits estimation approach, we find that the overall benefits are comparable to the GDP gains but are dominated by the avoided mortality component of economic benefits.

➤ **5.B: Economic Assessments of Health Disparities and Health Disparities Research**

Chair: Sue Hamann, National Institute of Health/ National Institute of Dental and Craniofacial Research

Discussants: Joe Cordes, George Washington University; Robin Yabroff, American Cancer Society

Presentations:

Evaluating Economic and Non-Economic Outcomes of Publicly-Funded Biomedical Research; *Sara Dodson, National Institute of Health/ National Institute of Allergy and Infectious Diseases*

Econometric Methods for Measuring the Burden of Health Inequalities; *Patrick Richard, Uniformed Services University*

Designing BCA Studies for Oral Health Disparities Research; *Sue Hamann, National Institute of Health/ National Institute of Dental and Craniofacial Research*

➤ **5.D: Food Safety Regulatory Analysis in a Global Setting (2)**

There is growing interest in food safety in low and middle income countries and in building capacity to manage foodborne illness in low and middle income countries. Recent WHO global burden of foodborne disease estimate show that the burden of foodborne disease is borne disproportionately by low income countries. With expanding trade in food, there is also interest in better understanding and managing the food safety impacts of food trade in high income countries. This session is focused on research needed to build better manage food safety in a global setting.

Chair: Sandra Hoffmann, U.S. Department of Agriculture Economic Research Service

Discussant: Aliya Sassi, U.S. Food and Drug Administration

Presentations:

Estimating Trade Flow When Foreign Countries Gain Food Safety Equivalency to Export Agricultural Products to the U.S. by a Gravity-Based Trade Model; *Jason Grant, Flora Tsui, and Bryan Macculloch, U.S. Department of Agriculture Food Safety and Inspection Service*

Service Imported meat, poultry, and egg products must meet all safety standards applicable to similar products produced in the United States. In doing so, foreign meat, poultry and egg products food regulatory systems may apply equivalent sanitary measures to eliminate or abate food safety hazards if those measures provide the same level of public health protection achieved by U.S. measures. The concept that different sanitary measures can achieve the same level of protection is called equivalence. FSIS evaluates foreign meat, poultry, and egg products food regulatory system equivalence through a comprehensive process. With more and more countries applied for access into the U.S. markets, it is critical for policymakers to understand the possible economic implications from granting these exporters access. However, assessing the implications of authorizing new exporters is challenging. Standard trade models (such as GTAP and GSIM), are employed to assess changes in trade costs but are generally not well designed for assessing new market access. For regulatory equivalence and new market access, APHIS, FSIS and researchers at the Virginia Tech researched and developed a trade model that may assess the economic effects by (1) predicting the potential volume of certain agricultural commodities to be traded between countries; and (2) assessing the effects of this new market access on domestic prices, consumer and producer surplus, and employment. A gravity model is developed to answer the first question: What would the import volume be for specific agricultural products in the absence of regulatory restrictions on specific countries? After constructing a global database of SPS/regulatory measures, geographical metrics, and historical trade volume between countries, the econometric model can be used to predict the amount of new trade which could occur given authorization for market access.

Estimating Welfare Changes from Importing Agricultural Commodities Using the Simplified Plus Version of the Baseline Analysis System Model; *Charlotte Ham, Setsuko Hoffman, and Ken Forsythe, U.S. Department of Agriculture Animal and Plant Health Inspection Service*

APHIS OMB peer reviewed Baseline Analysis System (BAS) Model was developed for the purpose of systematically analyzing the trade impacts of rulemaking. The model has been used to evaluate changes from status quo and is considered a marginal analysis. BAS is a non-spatial, partial equilibrium, net trade model that deals with import actions and can be used to estimate price, quantity, and welfare effects due to a particular economic change. With respect to trade issues, the Simplified version of the model can be used in the economic analysis for actions that would allow for the importation of additional commodities. The Simplified version was developed for use when data to run the full BAS model is limited and the commodity's trade market share is not expected to be significant (i.e., the US price does not affect the world price). By restricting the analysis to import impacts of one commodity by one importing country, the model can run on more readily available data, allowing for more routine, replicable and rapid analysis. The Simplified Plus Version expands on the Simplified version with the addition of cross commodity effects and trade displacement. Applications of the Simplified Plus version will be provided. Complete documentation of the overall model is available in An Economic Model for Routine Analysis of the Welfare Effects of Regulatory Changes, v3.00, USDA APHIS Veterinary Services, Centers for Epidemiology and Animal Health, July 2009, draft manuscript.

JIFSAN's Training and Monitoring and Evaluation Program: Case Study of GAP's Training in Latin America; *Clare Narrod and Xiaoya Dou, Joint Institute for Food Safety and Applied Nutrition, University of Maryland*

Capacity building is one of the non-regulatory tools that the Food and Drug Administration (FDA) has available to help strengthen its efforts in preventing food safety problems in the global supply chain. The Food Safety Modernization Act is the first time Congress charged the FDA to comprehensively address international food safety capacity building as well as implement an associated monitoring and evaluation (M&E) plan. The Joint Institute for Food Safety and Applied Nutrition (JIFSAN) is FDA's Center of Excellence for food safety capacity abroad. JIFSAN works to roll out produce safety training that satisfies the requirements in the Produce Safety Rule (PSR) in Latin America. Under the PSR, at least one supervisor or responsible party for a farm must successfully complete food safety if they want to export to the US. In 2017, JIFSAN started rolling out the training in Latin America and implementing a M&E program. The JIFSAN trainees, once successfully become Lead Trainers, will train additional sets of producers under requirement. By the end of 2018, nearly 500 individuals from Latin America will have been trained in the PSR. This presentation discusses the initial efforts, the M&E work that has taken place, future M&E efforts, and the public private partnerships that have emerged to further the effort in the region.

➤ **5.E: Estimating Costs**

Chair: Rachel Lange, U.S. Food and Drug Administration

Discussant: Tomeka Williams, MITRE Corporation

Presentations:

Quasi-Fixed Labor Costs in Burden and Social Cost Calculations; *William Wheeler, Environmental Protection Agency*

Analysts often use worker compensation measures to calculate the burden of regulation on employers and the social costs of those regulations (equating compensation to the value of the marginal product of labor). However, current practice regarding the inclusion of fringe benefits and overhead in cost estimates is inconsistent across and even within agencies, as the General Accounting Office has recently noted in the context of Information Collection Requests (ICRs) although the issue extends to Regulatory Impact Analyses (RIAs). OMB's 1999 draft ICR guidance suggests that overhead should be included in financial burden estimates, although Circular A-4 only mentions wages. EPA's ICR Handbook recommends the inclusion of overhead costs, but EPA's Guidelines for Preparing Economic Analyses are silent.

OMB 1999 draft guidance lists as examples of overhead costs 'office supplies and services, including office space, furniture, heat and air conditioning, electricity, a telephone and telephone service, a personal computer, printer and photocopier access, and various office supplies.' The Department of Health and Human Services lists 'administrative personnel issues (e.g., human resources activities such as hiring, performance reviews, personnel transfers, affirmative action programs), writing administrative guidance documents, office expenses (e.g., space rental, utilities, equipment costs), and outreach and general training (e.g., employee development).' Some of these costs are obviously fixed per employee and do not vary by hours worked. For example, the costs of hiring an employee are sunk once that employee is brought on board; and in most workplaces, office space is assigned for long time periods.

One stumbling block to reaching clarity on this issue is that standard economic models of profit maximization include wages per unit of labor but not fixed costs per employee. We present a model of profit maximization-standard in labor economics-in which some labor costs are quasi-fixed, that is, they vary by the number of employees and not by the number of hours worked. Solving this model, the value of the marginal product of an extra employee is the wage cost of that employee plus the fixed cost of that employee. The value of the marginal product of an extra hour is the wage cost times the number of employees affected. Thus, that the marginal cost to the firm of change in labor usage depends on if the change is in hours worked or in the number of employees. If the change is solely because of changes in hours and not the number of workers, the fixed costs (of overhead and fringe benefits) per employee should not be included in the social cost calculation, although they could remain in burden calculations.

We present calculations based on the Bureau of Labor Statistics Employer Costs of Employee Compensation (June 2018, all workers) indicating that just over 20 percent of employee compensation could be considered quasi-fixed costs. As we proceed with this research, we intend to dig into a more complicated cost estimate (such as EPA's Greenhouse Gas Reporting Program) for a more complete example of the impact of considering quasi-fixed costs.

Stated and Revealed Pollution Abatement Costs Revisited; *Carl Pasurka, Environmental Protection Agency*

Systematic efforts were initiated in the 1970s to determine the direct compliance costs incurred by firms due to pollution abatement. During this time, surveys of the cost of inputs assigned to pollution abatement emerged as the primary method used to estimate pollution abatement costs in the United States and other countries. In the United States, the 'Pollution Abatement Cost(s) and Expenditures' (PACE) survey (U.S. Department of Commerce) estimated pollution abatement costs borne by U.S. manufacturing industries for 1973 through 1994 (excluding 1987), with additional surveys in 1999 and 2005 when it was discontinued. Despite the widespread use of surveys, there remain lingering concerns about their accuracy.

Färe et al. (2003) and Pizer and Kopp (2005) refer to survey estimates of pollution abatement costs as 'stated costs' or 'reported costs,' while costs developed by joint production models, which are constructed from data that reflect the actual behavior of producers, were viewed as 'revealed costs.' Within the Pizer and Kopp theoretical framework, pollution abatement costs are determined by computing the difference between the minimum production costs with pollution abatement (i.e., the regulated technology) and without pollution abatement (i.e., the unregulated technology).

In this paper, we reimagine the Pizer and Kopp cost functions with cost functions that model the joint production of good and bad outputs with weak disposability. Following Ball et al. (2005), we propose a nonparametric cost function that models the joint production of good and bad outputs to identify the cost of inputs assigned to pollution abatement model (Revealed Costs). This allows us to determine the cost of inputs assigned to pollution abatement by comparing the difference in the cost of inputs used by production technologies constructed with two different sets of assumptions – one in which the bad outputs are freely disposable (i.e., the unregulated technology) and another in which the bad outputs are not freely disposable (i.e., the regulated technology). The estimates of the input costs when bad outputs are not freely disposable compared to input costs when bad outputs are freely disposable constitutes the revealed cost of pollution abatement incurred by power plants. Finally, our model is operationalized using a panel dataset of 94 coal-fired electric power plants in the United States from 2000-2005. Preliminary results show input costs increase 5 percent due to SO₂ not being freely disposable. The results also reveal the regulated technology sometimes uses less of an input than the unregulated technology.

Federal Agencies' Compliance with Public Cost Burden Estimation Requirements of the Paperwork Reduction Act; *Ronald Bird, George Washington University*

The Paperwork Reduction Act (1995) requires federal agencies to estimate the public cost burden (time and dollar equivalent) of requirements for the individuals, businesses, institutions or state/local/tribal governments to keep records, submit information, or provide information to third parties. These estimates must be submitted to the Office of Information and Regulatory

Affairs(OIRA)for review, approval and assignment of a control number (if approved), and no information collection requirement created under statute or administrative regulation can be legally enforced without an OIRA-issued control number. This requirement was intended to control the proliferation of federal regulatory-related information collection and reporting burdens imposed on the public (so-called regulatory "red-tape") and to encourage efficient and cost-effective design of information collection instruments. Despite widespread discussion and concerns about the economic impact of regulations in the aggregate, it is surprising that relatively little attention has focused on the information collection burden aspect of the regulatory landscape. This paper is intended to bring attention to the issue of information collection burden and, hopefully, encourage interest and further research by other benefit-cost economists. This paper will consider the questions of whether the Paperwork Reduction Mandate has been effectively administered, whether it has achieved its stated purpose, and how the administration of the program could be improved to better achieve that purpose. The analysis will (1) present aggregate information tabulated from OIRA's public database of the 9,000+ existing approved federal information collection programs, and (2) present in-depth details based on examination of a random sample of information collection program items drawn from that master file. The paper will examine the accuracy, completeness, empirical basis, and replicability of agencies' estimates of information collection burdens. Final tabulations are not complete, but preliminary results indicate that required time burden and dollar cost estimates are entirely missing from a significant proportion of information collections approved by OIRA, that burden estimates are often incomplete or inaccurate, that no empirical basis is provided for estimation of many critical burden parameters, and that most burden estimates are not provided with sufficient detail to facilitate independent replication. Despite the statutory requirement that information collections be reviewed and subjected to re-approval every three years, there are few examples of agencies conducting retrospective analyses using experiments or surveys to test the validity of assumptions made in their burden estimation analyses. The paper will present recommendations for improving the practice and administration of federal agencies' burden estimations under the Paperwork Reduction Act, and recommendations for improving OIRA's administrative performance. The sample data examined will be made available electronically to attendees to facilitate their own research or reply.

➤ **5.F: Benefits and Costs of Water Quality**

Chair: Nathalie Simon, Environmental Protection Agency

Presentations:

Benefit-Cost Analysis of Water Quality Improvement; *Krishna Poudel, Missouri Department of Natural Resources*

Ecosystem services (ES) are realized and consumed but poorly valued if any. Total willingness to pay is the function of use values, non-use values and options values arise from ES. Riparian ecosystem is a fulcrum to healthy environment and sustainable economic wellbeing.

Recreationists maximize their utility in various facets of water based activities. Full body recreation demands high quality water than partial or other uses. Cost (investment) to uphold ecosystem functions is a necessary component at present in order to avoid large sum of future loss. Objective of the water quality standard rule make/change is to ensure welfare of the society is improved. This can be measured through utility function. For long enduring water quality improvement program, we can write our objective function as to maximize net present value of net returns from all ecosystem services. Benefit of regulatory changes and its impact in the community are multivariable. It is innocuous to assume that after the improvement of total environment, an economically rational agent would prefer to consume more amounts of services in both situation: increasing or constant price. The change in societal benefit derived from improved water ambient over the period of time in a designated space due to changes in value of services derived from improved quality of the water resources via reducing pollutant loadings must not decrease with any rule(s) making/changing for water quality improvement over time. A biophysical structure (e.g. wetland) exhibits the functions (e.g. slow passage of run-off water, pollutants deposition) with ecosystem services (e.g. flood protection, watershed pollution reduction) displays bundles of used, unused and option values. These all values if translated monetarily, the benefits, would certainly outweigh the necessary cost incurred during the watershed conservation project and programs. Benefits arise due to public health improvement, local economic activities, outdoor recreational activities support healthy environment and sustained economy. We observed social benefit cost ratio greater than one in a 12 acre wetland restoration projects adjacent to Moreau River in Jefferson City, Missouri.

Benefits and Costs of Preventing Childhood Lead Poisoning from Drinking Water- A Case Study in New York State; *Ying Zhou, Centers for Disease Control and Prevention*

Introduction:

Early childhood lead exposure can impair neurobehavioral development. Current research indicates that there is no safe threshold for blood lead levels (BLL) in children. The New York State Department of Health (NYSDOH) implemented two public health actions (PHAs) to reduce lead exposure in children. First, in 2016, NYSDOH initiated lead testing and remediation for drinking water in public schools. Second, in 2017, NYSDOH created the lead service line replacement program (LSLRP) to replace the residential pipes connecting homes to the municipal water mains. In this study, we estimated the costs and potential health benefits of these two PHAs in 3 cities in New York State-Albany, Troy, and Schenectady.

Method:

For the first project, the costs included water quality testing of all qualified drinking water outlets in all public schools and remediation costs for outlets that tested above 15 ppb for lead. For the second project, we estimated that there are about 4,600 houses built before 1939 with children under 6, which potentially require service line replacement. The cost of replacement ranges from \$2,000 to \$5,000 per house. To project health benefits, we assumed drinking water contributes 10% to 20% of the total lead exposure among children whose lead exposure could be reduced from these two PHAs. Given that both actions were recently implemented, we projected the benefits of reduced lead exposure based on 1) increase in lifetime earnings due

to higher IQ, and 2) reduction in costs of healthcare, special education and crime as well as other intangible impacts.

Result:

Between 2010 and 2016, among children under 6 years of age in Albany, Troy, and Schenectady, respectively, average BLLs were 0.93, 2.21, and 2.20 $\mu\text{g}/\text{dL}$. For water testing and remediation in public schools, the cost ranges from \$0.38 to \$0.99 million. For LSLRP, the cost is about \$9 to 23 million. The benefits of reduced lead exposure attributed to the two PHAs include increase in lifetime earnings of \$22 to \$114 million, and reduction in the health care costs of \$0.08 to 0.13 million, special education cost of \$0.16 to 0.42 million, crime cost of \$0.20 to \$0.47 million, as well as the intangible costs of \$2.2 to \$3.3 million. The combined net benefit of these two actions ranges from \$0.6 to \$109 million.

Conclusion:

The benefits of these two PHAs are projected to outweigh their costs. After full implementation of these actions, future work will collect data on BLLs in children in the 3 cities in New York State to further refine the benefit estimates.

Estimating the Benefits to Florida Households from Avoiding Another Gulf Oil Spill Using the Contingent Valuation Method; *John Whitehead, Appalachian State University*

The BP/Deepwater Horizon oil spill began on April 20, 2010, and continued spilling crude oil into the Gulf of Mexico for approximately 3 months before the well was capped. Reports from the National Incident Command indicate that 4.9 million barrels of oil were spilled into the Gulf of Mexico, making it the worst oil spill in U.S. history. This study contains an estimation of the economic benefits to Florida households from avoiding another BP/Deepwater Horizon-type oil spill in the Gulf of Mexico. The estimate was generated using the contingent valuation method (CVM) with primary data collected through a web-based survey conducted in September 2011. The sample includes 2,047 address-based and opt-in panel adult respondents living in Florida. Respondents were asked whether they would vote for a program that would prevent damages from a similar spill if it cost them a specified amount of money. To ensure that the CVM scenario was similar to the actual oil spill, respondents were reminded of the cause, magnitude, location, and duration of the spill, and were told that the proposed program's objective was to reduce environmental impacts from another large oil spill in the Gulf of Mexico. To narrow the focus of economic values considered in the study, respondents were told that the questions focused only on the environmental impacts of the oil spill, and were shown a series of photographs showing oil spill impacts on marine birds, sea turtles, and mammals. Several internal tests of validity are conducted on the CVM results. The first is to determine whether, as the dollar amount households were asked to pay increased, their likelihood of voting for the program declined. The second is to test for 'scope' effects, specifically that respondents' likelihood of voting for the program increased with the proposed level of protection (i.e., damages avoided). The third is to estimate the income elasticity of willingness to pay. We find that both samples (address-based and opt-in) pass the cost test. We find that only the address-based sample passes the scope test. We find that the income elasticity is significantly larger for

the address-based sample. In general, we conclude that the address-based sample data exhibits greater internal validity. We examine the sensitivity of the address-based results to the method of estimating willingness to pay (parametric and nonparametric) and with and without a certainty correction for hypothetical bias. We aggregate the estimates and conduct sensitivity analysis to determine the benefits of avoiding another BP/Deepwater Horizon-type oil spill in the Gulf of Mexico. A comparison of our results to the estimate provided in the Natural Resource Damage Assessment for the state of Florida is made.

The Use of Retrospective BCA to Assess the Long-Term Effects of Infrastructures in the Water and Waste Sectors; *Chiara Pancotti, Centre for Industrial Studies*

A retrospective is an opportunity to learn and improve. It is time set aside to reflect on past events and behaviours. With this in mind, an international consortium led by CSIL (Centre for Industrial Studies) has recently developed an evaluation framework to carry out the retrospective assessment of ten big infrastructures in the water and waste sectors. This was part of a study carried out on behalf of the European Commission.

The original contribution of this evaluation framework is represented by the combination of the retrospective benefit-cost approach with a qualitative analysis, which tries to elaborate on the mechanisms explaining the projects' performance and its key determinants. Specifically, the retrospective Benefit-cost analysis (BCA) is used to quantify the benefits and costs of the projects, then an extensive field work and interaction with relevant stakeholders were carried out to reconstruct the project history, to assess the wider, non-quantifiable effects as well as to interpret the key determinants of the observed project performance.

More specifically, this evaluation study required to evaluate projects in operation from at least 5 years, placing - de-facto - the assessment in an intermediate viewpoint in comparison to the whole projects' time horizon. This intermediate perspective poses some challenges to the treatment of key elements of the BCA, for example, the choice of an appropriate reference scenario, the definition of the relevant project 'boundaries', as well as the choice of the key parameters such as the social discount rate or the conversion factors.

The presentation, which refers to real case histories, illustrates the potential of retrospective BCA to assess long-term impacts of major infrastructure projects and discusses some methodological implications related to its use. It argues that ex-post CBA, when appropriately implemented and integrated with qualitative evidence, is an extremely powerful tool for supporting decision-making processes and for policy learning.

➤ **5.G: The Wide Reach of Benefit-Cost Analysis**

Chair: Glenn Jenkins, Queen's University

Presentations:

The Great Indian Demonetization Experiment: Exploring the Benefits and Costs; *Partha Ray, Indian Institute of Management Calcutta*

On November 8, 2016 the Prime Minister of India Mr Narendra Modi announced the demonetization of all INR 500 and INR 1000 banknotes in India to 'break the grip of corruption and black money'. Accordingly, nearly 86 per cent of currency with the public amounting to INR 14.18 trillion was scrapped overnight. This announcement has evoked extreme reactions from various quarters of India. Predictably the ruling party welcomed it wholeheartedly and the opposition has termed it as some sort of an unmitigated disaster. In fact, in recent past there has been hardly any economic policy in India that has attracted so much attention in media and public attention. Even after two years, opinions about the benefit and cost associated with the great Indian demonetization experiment do differ grossly. It is in this context that this paper aims to make a secondary data-based holistic assessment of the benefits and the costs of demonetization in India. Specifically, the paper aims to look at four distinct issues. First, it traces the evolution of currency in circulation in India during the period 2016 – 2018 and its associated costs as revealed from the balance sheet of the Reserve Bank of India (RBI). Second, it looks into the monetary policy measures to handle the fallout of demonetization and their associated costs and benefits. Third, estimates regarding the temporary adverse impact on output / GDP is focused. Fourth, possible / potential benefits regarding (a) increase in digital payments; and (b) improvement in tax collection is assessed. The analysis is expected to arrive at the metrics of costs and benefits of the demonetization experiment in India.

A Cost-Benefit Analysis of the Millennium Challenge Corporation's Procurement Modernization Program in Indonesia; *Jean Lee, Millennium Challenge Corporation; Brian Epley, Millennium Challenge Corporation*

We present the results of a retrospective cost-benefit analysis of the Millennium Challenge Corporation's Procurement Modernization project in Indonesia. The Procurement Modernization project provided training and mentorship for staff, mentorship in organizational change, assistance with framework contracting, an electronic data warehouse, and other services to government procurement units in Indonesia. The program selected 44 procurement units in Indonesia for participation in the program, at different levels of government and in a range of geographies. Our close-out ERR is an internal evaluation that includes estimates of program impacts based on real ex-post data. We calculate estimates of program impacts by differencing measures of outcomes for treated and comparison units and select comparison units using nearest neighbor matching. In summary, there are two major benefit streams in the model. First, we consider whether improvements in the procurement process led to improvements in value-for-money net of any loss in surplus/profit to firms, using the Delphi method in focus groups in procurement service units (PSUs) and spending units (SUs). To obtain estimates of the value-for-money accruing to the government with a representative construction procurement, we asked about the final cost to the government (net of any cost overruns) of a typical construction procurement and for the same representative procurement, asked what the final value of the goods delivered would be under their current operating procedures. Winning vendors were surveyed to determine the profit margin had been on their

project, to offset benefits which might come at the expense of firms. Finally, we consider efficiency improvements, which could allow for additional procurements to occur on the margin, or which could reduce the need for local governments to hire additional staff. We find evidence for the former hypothesis, and therefore drop the latter to minimize the risk of double-counting. We estimate a 12.6 percent economic rate of return for this investment.

Can Cost-Benefit Analysis Tell Whether Sport and Cultural Events are Worth it for Hosting Cities? *Jerome Massiani, Ca' Foscari University*

Sport and cultural events have long been seen as an opportunity to foster local development. This view has however been more and more challenged in the last decades calling for independent and rigorous assessments.

In this context CBA, together with CGE, have been increasingly used to provide policy guidance and may tomorrow challenge the dominant position that Input-Output has held for long in this area.

More than twenty events have now been assessed with this approach, although many of them in documents that were subject only to limited peer review (this includes some master thesis, or some consultancy reports) and a more limited number of papers in scientific journals. Yet no systematic and critical analysis of this area of application is available. The purpose of the proposed contribution is to partly fill in this gap. It will review existing publication and investigate their possible limitations. Interestingly, one notes that these works are usually not published in evaluation journals but rather, whenever published in scientific papers, in sport economics reviews. This reinforces the need of critical examination by the profession.

The proposed contribution is to our best knowledge the first review of this type.

On the whole, existing studies provide a negative evaluation of sport and cultural events with a large majority of negative Net Present Value for host communities.

These studies, however, are moderately convincing. We find that many studies violate well established recommendations in the field of CBA (like computation of cost/benefit ratios without univocal distinction of benefit increase vs cost decrease), and are unclear about important underlying assumptions (like the definition of the relevant territory), and are discussible by many aspects (for instance considering visitors expenditures as a benefit, without consideration of the corresponding production costs).

We suggest guidelines for such studies, hoping that they can provide support in this incipient field, and contribute to establish the credibility of benefit-cost analysis in this area as well.

Gujarat's Prohibition Policy: A Case for Social Cost-Benefit Analysis; *Siddhartha Rastogi, Indian Institute of Management Indore*

Alcohol ban has been a socially and politically sensitive idea in India. Many states have tried a prohibition, particularly since 2015. However, most bans have been short-lived due to alcohol's revenue power. The only exception is Gujarat, which has a continued prohibition policy since 1961. However, lately, there is a growing clout within the state that wants to abolish the ban. Amidst the debates of allowing free flow of liquor through the state vs. maintaining status-quo or even tightening up the ban, the state government eased the prohibition in the year 2007 by allowing serving the liquor in Special Economic Zones and by increasing the access to liquor consumption permits. On one hand, this move was welcomed by corporate bodies and some sections of the society; on the other, it was widely criticized and condemned by veteran Gandhians, women and human rights organizations and by the opposition parties of the local assembly.

Despite substantial financial losses due to ban, the supporters of the ban argue for a more stringent ban due to the fears of an increase in crime rates, incidents of drunk-driving, and fall in the status of women. Against all the arguments of the supporters of prohibition, the supporters of abolition argue that liquor is anyway available in the market for a premium and the prohibition serves bootleggers and smugglers only, for they reap rich dividends from the ban.

We propose to study the costs of liquor prohibition as well as that of abolition in economic terms. We would use the social cost-benefit approach to enumerate social costs in economic terms. We shall be considering the social cost-benefit approach for this comparison, so as not to confuse the financial consequences as the only outcome but to consider the long-term impacts of the policy on the state of affairs. Preliminary results seem to indicate a mixed result with significant financial gains accompanied by significant social issues, the quantification or monetization of which is arguable and can tilt the balance of results.

Session 6: Friday March 15, 2019, 10:45 – 12:15

➤ 6.A: Benefit-Cost Analysis in Low-and Middle-Income Countries: Illustrative Case Studies and Future Research Needs (2)

Chair: James K. Hammitt, Harvard University

Discussant: Dean Jamison, University of California, San Francisco; Lisa A. Robinson, Harvard University

Presentations:

Benefit-Cost Analysis of Community-Led Total Sanitation Campaigns: Incorporating the Results from Recent Randomized Control Trials and Other Evaluations; *Mark Radin, University of North Carolina; Marc Jeuland, Duke University; Hua Wang, Remin University; Dale Whittington, University of North Carolina*

Ending open defecation remains an important challenge for the water, sanitation, and hygiene sector, but governments have limited options for addressing it. The development of a Community-Lead Total Sanitation (CLTS) at the beginning of the 21st century offered a solution. CLTS was thought to be a low-cost approach that delivered open-defecation free communities. Recent randomized control trials of CLTS campaigns have found substantial increases in latrine coverage, but have not found evidence that CLTS leads to open-defecation free communities. This paper analyzes the economic costs and benefits of a CLTS campaign in a hypothetical region in sub-Saharan Africa based on findings from recent evaluations. The changes in time use associated with the campaigns are valued using estimates that are a percentage of the local wage. Mortality risk reductions are valued using a value of statistical life (VSL) estimate transferred from high income countries and morbidity risk reductions are valued using a cost-of-illness approach. We assume this intervention targets 200 villages and 10,000 people. We also analyzed the benefits with and without a positive sanitation externality that would confer health benefits to an entire village when latrine coverage surpasses a set threshold. We perform a one-way sensitivity analysis testing CLTS effectiveness by changing the distribution of latrine uptake across the villages and a Monte Carlo simulation varying all parameters. Our analysis shows that a CLTS intervention would pass a benefit-cost test in many situations. However, we find benefit-cost ratios that are not as favorable as many previous studies suggest. We also find that the model is sensitive to baseline conditions, including the VSL, time spent traveling to open defecate, and the costs of illness. Researchers could better support policymakers by identifying where the benefits of CLTS will exceed costs.

Comparing the Application of CEA and BCA to Tuberculosis Control Interventions in South Africa; *Thomas Wilkinson, University of Cape Town; Fiammetta Bozzani, London School of Hygiene and Tropical Medicine; Anna Vassall, London School of Hygiene and Tropical Medicine; Michelle Remme, London School of Hygiene and Tropical Medicine; Edina Sinanovic, University of Cape Town*

Achieving ambitious targets to address the global tuberculosis (TB) epidemic requires consideration of the likely impact of competing interventions for improved identification of patients with TB. Benefit-cost analysis (BCA) and cost-effectiveness analysis (CEA) are two approaches to economic evaluation that assess the costs and effects of competing alternatives. However, the differing theoretical basis and methodological approach to CEA and BCA is likely to result in alternative analytical outputs and potentially different policy interpretations. We conducted a BCA in the South African setting by converting an existing CEA of 10 mutually exclusive TB control strategies that combine individual interventions, included scaling-up screening interventions at primary health clinics and improving diagnostic access and follow up. Local estimates of the value of statistical life (VSL) and value of statistical life year (VSLY) were calculated using the benefits transfer approach and combined with estimates of disability-adjusted life years (DALYs) to estimate the value of reduced mortality and morbidity. The BCA results indicates that over a 30-year period, all interventions are likely to result in substantial gains compared to existing interventions depending on the VSL estimate used. CEA and BCA results identified cough triage for TB treatment referral in all people who are HIV positive as cost-saving and yielding positive health benefits, and an intervention to increase diagnostic

coverage and outcome follow-up combined with a structured TB symptoms screen in primary health care facilities was estimated to have the highest net benefits. Further work is required to guide the appropriate analytical approach, interpretation and policy recommendations in the South African policy perspective and context.

Benefit-Cost Analysis of a Package of Early Childhood Interventions to Improve Nutrition in Haiti; *Brad Wong, Copenhagen Consensus Center; Mark Radin, University of North Carolina*

Haiti has the poorest human development indicators in the Western hemisphere. The available funds to address the country's myriad challenges are not particularly large and thus spending available money efficiently is critical for its future development. This study involves a benefit-cost analysis of a package of interventions targeting pregnant women and children that can improve nutrition outcomes in Haiti. This package of interventions has been assessed as one of the most effective uses of development funds in multi-sector prioritization exercises. Using the Lives Saved Tool (LiST), I estimate that this package can prevent approximately 55,000 cases of child stunting, 7,600 babies being born with low birth weight and 28,000 cases of maternal anemia annually, if it can be scaled up to cover 90 percent of the target population. These nutrition improvements will avoid 1,830 under-5 deaths, 80 maternal deaths and 900,000 episodes of child illness every year. The paper tests the effects of various methodological choices on the valuation of avoided mortality, avoided morbidity and changes in lifetime productivity. In the base case scenario, benefits substantially exceed costs, yielding significant net benefits. However, the package is unlikely to be the best use of a marginal gourde in Haiti with other studies documenting significantly higher benefit-cost ratios for alternative early childhood and nutrition interventions. Additional sensitivity analyses find substantial variation in the results.

➤ **6.B: Benefit-Cost Analysis in Labor Policy**

Chair: Don Kenkel, Cornell University

Discussant: Clayton Masterman, Vanderbilt Ph.D. Program in Law and Economics

Presentations:

Opting Out of Workers' Compensation Insurance: Non-Subscription in Texas and Its Cost and Benefit Effects; *Thomas Kniesner, Claremont Graduate University*

Texas is the only state that does not mandate that employers carry WC coverage. We employ a quasi-experimental design to examine the cost and benefit effects of switching from traditional workers' compensation (WC) to a non-subscription program in Texas. Specifically, we compare before and after effects of switching to non-subscription for employees in Texas to contemporaneously measured before and after differences for non-Texas-based employees. Importantly, we study large self-insured companies operating the same business in multiple states in the US; hence the non-Texas operations represent the control sites for the Texas

treatment sites. The resulting difference-in-differences estimation technique allows us to control for any companywide factors that might be confounded with switching to non-subscription. The analysis also controls for injury characteristics, employment characteristics, industry, and individual characteristics such as gender, age, number of dependents, and marital status. Outcomes include number of claims reported, indemnity payments, medical expenditures, time to return to work, claim denials, and amount of litigation. The data include 26 switcher companies 2004-2016, yielding 846,750 injury incidents. Regression findings suggest that indemnity and medical payments fall substantially and return to work increases. Claim denials increase, but litigation is largely unchanged.

Rethinking Law School Tenure Standards; *Kyle Rozema, University of Chicago Law School*

We study the implications of stricter tenure standards in law schools. To do so, we construct a novel dataset of the articles and citations of 1,720 law professors who were granted tenure at top 100 law schools between 1970 and 2007. We first show that pre-tenure research records---number of articles published, placement of those articles, and their citations---are highly predictive of future academic impact, as measured by citations to their articles published after tenure. We then form predictions of law professors' future academic impact based only on information available at the time of their tenure decision. Using these predictions, we run simulations to assess the costs and benefits of stricter tenure standards. Of faculty members who would not have been granted tenure under stricter standards, only around 5 percent would have had a greater future academic impact than their counterfactual replacements. Moreover, even a modest increase in tenure denial rates of 10 percentage points would increase the academic impact of the median professor at law schools by over 50 percent.

Estimating the Benefits of Research on the Causes and Prevention of Work-Related Injury and Illness; *Tim Bushnell, National Institute for Occupational Safety and Health; Rene Pana-Cryan, National Institute for Occupational Safety and Health*

The National Institute for Occupational Safety and Health has recently begun to support economic assessments of selected research initiatives. This is being done as part of a broader attempt to more systematically assemble evidence on the impact of research, both as a tool to assist with priority setting and program planning, and as a way of better understanding and demonstrating the general value of NIOSH research. There are well-known difficulties in estimating the value of research, and these make it impractical to assess the economic value of many of the research programs or projects that NIOSH undertakes. The wide diversity of research topics and types also precludes a single, overall assessment of the economic value of NIOSH research. Thus, we first address the question of how to identify, select, and define the boundaries of individual case studies of the economic value of NIOSH research. Second, we address the question of the usefulness of conducting case studies of economic assessment in the context of other, less quantitative assessments that are being conducted, in turn, for all of the major research programs in NIOSH.

The ultimate goal of most NIOSH research is to reduce the number and severity of injuries and illnesses for which work is a sole or contributing cause. And the principle focus is on research that leads to prevention of injuries and illnesses through reducing exposures to hazards or harmful substances. Thus, a case study typically starts with a focus on estimating a reduction in exposure due to a specific prevention measure, for a defined worker population. Challenges and solutions for doing this will be outlined, with examples drawn from the three case studies published by the RAND Corporation in 2018 and the three that are expected to be published by RAND in 2019.

Another key component of the case studies is estimation of the percentage contribution of NIOSH research to implementation of a given prevention measure. Exposure reduction is generally undertaken by employers, who obtain information, guidance, and technology from many parties, only one of which is NIOSH. We will outline methods used to estimate reasonable ranges for percent attribution to NIOSH, including interviews with key stakeholders, and construction of timelines for research, dissemination, and implementation activities. A related component of the case studies is formulation of an explicit counterfactual scenario in which NIOSH is not present. The assumption is that, eventually, without NIOSH research, similar information would eventually become available from another source. We will illustrate how these counterfactuals were defined in case studies so far undertaken.

Given the initial set of experiences with case studies of economic benefits of NIOSH research, we see more clearly the data and information needs for doing additional case studies. NIOSH has begun to examine whether better information to support case studies might be collected in the course of proposal development and research, as well as through more systematic tracking of relevant workplace conditions after research efforts are completed.

➤ **6.C: Frontiers in Benefit-Cost Analysis of Environmental Policies**

Chair: Tim Brennan, University of Maryland – Baltimore County

Presentations:

Epistemic Limits of Cost-Benefit Analysis in Environmental Policymaking; *David Adelman, University of Texas at Austin School of Law*

This project takes a critical look at the epistemic limits of benefit-cost analysis by focusing on an area of environmental policy, the Clean Air Act, in which it is widely acknowledged to have been most effective. The project combines a detailed assessment of benefit-cost analyses in Clean Air rulemaking with data on the air pollutants of greatest concern nationally-integrating data from the Toxics Release Inventory, National Emissions Inventory, and National Air Toxics Assessment. We find that, for pragmatic and epistemic reasons, a disproportionate share of the benefits of Clean Air regulations rest on the harms associated with particulate matter (PM), which is frequently an important co-pollutant in major Clean Air regulations. Perhaps unsurprisingly, the numerous scientific studies on the harms associated with PM are increasingly being subjected

to criticism and the principal that co-pollutants can be considered at all in benefit-cost analyses is being similarly challenged. The changing landscape of federal regulation is therefore exposing the limits of current benefit-cost practices and the degree to which their success is contingent on the existence of a select group of pervasive pollutants that are relatively easy to monitor, that have large impacts on human health, and for which exceptionally robust scientific studies exist. In short, the success of benefit-cost analysis under the Clean Air Act rests on the unique status of PM and is not generalizable to other pollutants or environmental programs. The project will present the empirical grounding for our claims and their implications for the role of benefit-cost analysis as the inventory of air pollutants shifts over time and if the challenges to the reliance on PM in Clean Air rulemaking were to succeed. We will argue that the role of conventional benefit-cost analysis is likely to shrink substantially and that more epistemically modest methods should be adopted, which center on feasibility analysis and draw directly on the insights from the literature on bounded rationality.

Altruism, Endogenous Risk and the Value of Reduced Mortality; Mark Dickie, University of Central Florida

An important use of benefit-cost analysis is to evaluate policies affecting human health or safety. Benefits of public health and safety policies typically are measured based on individuals' marginal willingness to pay for small reductions in their own risks of illness, injury or death, exclusive of any amount that people might be willing to pay to reduce risks to other persons (with the possible exception of members of the same household). Survey and experimental evidence, however, suggests that many people are willing to pay to improve the health or safety of persons outside their own households. The question of whether and how social benefit-cost analysis should account for the willingness to pay for risk reductions received by others has been investigated theoretically by Bergstrom (1982, 2006), Jones-Lee (1991, 1992), Johansson (1994) and others for situations in which the risk faced is exogenous (i.e., the probability of harm is not influenced by individual behavior). But in many situations, risk is endogenous (i.e., influenced by individual behavior) and little is known about how to account for altruism when risk is endogenous. This paper establishes the implications of endogenous risk for measuring economic benefits of reduced mortality in the presence of altruism. The issue is important because the treatment of altruistic willingness to pay can substantially affect measured benefits even when the degree of altruism is relatively modest.

When risk is exogenous, Bergstrom (1982) showed that altruistic willingness to pay should be ignored in benefit-cost analysis if altruism is non-paternalistic or 'benevolent,' (i.e., the altruist respects preferences of others). If altruism is paternalistic (i.e., not respecting preferences of others), on the other hand, Jones-Lee (1991) showed that altruistic willingness to pay affects social benefits. He further showed that benefits equal the sum of purely self-interested benefits and altruistic willingness to pay if and only if altruism is 'safety-focused,' meaning the altruist's only concern for the well-being of others is for their safety.

This paper shows that when risk is endogenous, the appropriate accounting for altruism depends not only on the type of altruism, but on the degree of substitution between public and

individual risk-reducing efforts, and individuals' behavioral responses to policy. The conclusion that benevolent altruism should be ignored continues to hold, but the appropriate accounting for paternalistic altruism differs from the case of exogenous risk. The difference arises because behavioral responses to policy cause changes in risks and in consumption of market goods that then affect the welfare of paternalistic altruists. The welfare effects of behavioral adjustments must be included to fully reflect altruistic benefits. In general, behavioral responses may increase or decrease the altruistic 'add-on' to self-interested benefits. But if altruism is safety-focused and behavior is offsetting (i.e., individuals make less effort to reduce risk when policy improves safety), the increment to benefits from altruism is smaller than if risk is exogenous. In the extreme case that behavior fully offsets safety improvements from policy, even safety-focused altruism should be ignored in benefit-cost analysis.

Integrating Fundamental Uncertainty into Benefit-Cost Analysis for the Assessment of Deep-Seabed Mining; *David Good, Indiana University – Bloomington; Kerry Krutilla, Indiana University – Bloomington; Mike Toman, World Bank; Tijen Arin, World Bank*

Once seen as a speculative possibility, deep-sea mining is becoming a reality. Over the past decade, Pacific Island countries have issued more than 300 exploratory leases, and the International Seabed Authority (ISA) has issued more than 30 exploratory leases for international waters. Exploratory activities have turned up large and relatively concentrated sources of manganese, silver, gold, cobalt, nickel, zinc, and rare earth elements in several kinds of formations. These include massive sulfides (SMS) deposited in the vicinity of hydrothermal vents; manganese nodules, lying on the surface of abyssal plains; and cobalt-rich crusts on the surfaces of sea mounts.

Notwithstanding the potential commercial promise, seabed mining faces technical, financial, and political challenges. Stakeholder concerns include the effects of maritime industrial activities on local economies and cultures, and the potential environmental consequences of seabed mining. Knowledge of the structure (including the degree of biodiversity), function, and ecosystems services provided in the submarine areas identified for seabed mining is limited, and baseline environmental monitoring is lacking. Few pilot projects been conducted so there is not much information available to evaluate the performance of mining operations. The capacity of local institutions to regulate and monitor impacts, and conduct enforcement actions, has also been questioned. The evolution of markets for minerals that will be extracted from deep seabeds is another significant uncertainty.

This World Bank-sponsored research evaluates the way institutional, economic, and environmental uncertainty can be incorporated into benefit-cost analysis to support Pacific Island countries making decisions about lease applications for mining deep seabeds. The study evaluates different decision structures that can be integrated into benefit cost analysis, including precautionary approaches, adaptive management strategies, and value of information methods, including real options. Decision-support tools for the assessment of fundamental uncertainty are also considered, such as Robust Decision Making (RDM), decision scaling, information-gap, and many-objective robust decision making.

This review suggests a paradigm for conducting benefit-cost analysis in the presence of the fundamental uncertainties associated with deep-seabed mining. This paradigm is then used to assess an ex ante benefit-cost study of seabed mining, sponsored by the European Union (EU). This EU-sponsored analysis provisionally concludes that seabed mining of massive sulfides and manganese nodules is likely to payoff for countries granting mining leases, but that mining cobalt crusts is not likely to be profitable. We conclude that the uncertainty evaluation conducted in this BCA is not sufficient to support these conclusions. Best-practice recommendations are then offered to increase the value of information that benefit-cost analysis can provide to decision-makers evaluating lease applications for deep-seabed mining.

The Economics of Regulatory Repeal; Arthur Fraas, Resources for the Future; *Alan Krupnick, Resources for the Future*

The goal of this presentation is to analyze the potential impacts on industry and the public of a set of recent energy-related regulations if these rules were to be eliminated or modified. These impacts include cost savings to industry and forgone environmental and health benefits from changes to regulations (as costs and benefits are defined in Circular A-4). We have conducted six in-depth benefit-cost analyses of rules that were chosen to illustrate a variety of technical challenges and opportunities that arise when conducting benefit-cost analyses to support the repeal or modification of the rules. The six rules we analyzed—one EPA rule, 2 PHMSA rules, and 3 DOI rules—were chosen to include a diverse set of energy-related types of rules and regulatory impact analyses (RIAs) and are not meant to suggest relative importance or that they are of particular interest to the Trump administration.

We then compare results across the six individual analyses with four main objectives. First, we compare the cost savings and benefits forgone from repealing the six rules under several scenarios. Second, we assess different criteria for prioritizing rule repeal—comparing the prioritization based on cost savings, a metric emphasized by the Trump administration, or net benefits, the metric preferred by economists. Next, we discuss lessons learned from conducting these benefit-cost analyses. Finally, we discuss modification and selective repeal as alternatives to full repeal and lessons learned from analyzing modifications in our six reports.

We show that the rankings are vastly different depending on whether one uses a cost savings or a benefit-cost criteria. In addition, we show that conducting RIAs should be thought of more as a 'soft test,' as changing one input can dramatically change the conclusion about the net benefits of the rule (or repeal or modification of the rule). We find that every rule in our study has at least one possible adjustment that makes it look favorable or unfavorable to repeal. We would also encourage agencies to consider modifications or selective repeal, rather than full repeal of a rule. We find instances where modifying (in particular, relaxing) a rule could increase net benefits (or, at the very least, maintain positive net benefits). This alternative could be preferable to repealing the rule altogether if certain provisions of the rule prove more net beneficial than others.

➤ **6.D: Exploring Forms of Regulation and their Impacts on Outcomes and Effectiveness**

The study of regulation incorporates alternative ways of regulating as a crucial component of benefit-cost analysis. Considering the different 'regulatory forms' that regulation might take and evaluating how regulatory forms affect outcomes is useful for advancing systematic analysis of benefits, costs, and alternatives. Limited research exists on classifying and comparing regulatory forms. This panel advances that research agenda by introducing novel methods of classifying regulatory forms, evaluating empirical differences among regulatory forms, assessing the impact of particular regulatory forms, and analyzing how certain regulatory forms might inform predictions regarding the efficacy of procedural controls on the rulemaking process.

Chair: Linda Abbott, U.S. Department of Agriculture

Presentations:

Economic and Social Regulation Revisited; *Brian Mannix, George Washington University*

In the early 1970s, as he was developing the Center for the Study of American Business (now the Weidenbaum Center) at Washington University, the late Murray Weidenbaum distinguished two main types of regulation. He called them economic and social regulation. The decade that followed saw a dramatic (and bipartisan) cutback in economic regulation in the U.S., including the deregulation of airlines, railroads, buses, pipelines, telecommunications, and crude oil and oil products. At the same time social regulation dramatically expanded. Weidenbaum's dichotomy was quickly adopted as a fundamental distinction by economists, lawyers, political scientists, and other observers of the regulatory process. Yet the basis for the distinction has always been unclear. What do we mean when we say that regulation serves an economic or a social purpose, and why is that so important? Prior attempts to answer this question have been unsatisfactory, because they do not provide much insight into why the two types of regulation seem so different. This paper will offer an alternative explanation based on the form of regulation, rather than its nominal purpose. Generally, what we call economic regulation will place constraints on the extensive margin (e.g., allowing a fixed number of taxis to operate), while social regulation will place constraints on the intensive margin (e.g., limiting grams of pollution per mile traveled). Thus, a license or permit from an economic regulatory agency is inherently exclusive and rivalrous, whereas a permit from a social regulator is not rivalrous if EPA approves one car that meets a certain standard, it will approve them all. The paper uses price theory to explore the implications of this formal distinction, finding that the constraints imposed by economic regulation can be mapped onto a Marshallian demand curve, while those imposed by social regulation map instead onto an output-compensated factor market demand curve. This analysis helps to explain the prevalence of rent-seeking in economic regulation, as well as other distinctions such as the tendency of economic regulation to be vested in an independent commission, its tendency to proceed by adjudication rather than rulemaking, and other familiar features.

Does the Form of Regulation Matter? An Empirical Analysis of Regulation and Land Productivity Growth; Zhoudan Xie, George Washington University

Economists have long studied the relationship between regulation and productivity, and generally argue that regulation has a negative impact on productivity growth. However, few studies have examined the cumulative impact of regulation on agricultural productivity, and none has distinguished among different forms of regulation. Although different forms of regulation particularly alternatives to traditional command-and-control regulation are extensively discussed in the literature in terms of their effectiveness in achieving regulatory objectives, their impacts on productivity have not been systematically examined. Using an innovative dataset covering 25 agricultural industries for the period of 1971–2017, the paper examines the relationship between growth in different forms of regulation and growth in land productivity. In particular, the paper attempts to answer two questions: (1) What is the relationship between growth in agriculture-related regulation and growth in agricultural productivity in general? (2) Does the relationship vary depending on the form of regulation? The findings suggest that growth in total regulation has a negative relationship with land productivity growth, and the relationship differs depending on the form of regulation. Growth in some forms of regulation (e.g. command-and-control, entry and exit) have a negative relationship with yield growth, while the others (e.g. transfer, information-based) have a positive relationship.

Evaluating the Impact of Certificate-of-Need Laws on Hospital Outcomes; Mark Febrizio, George Washington University

Certificate-of-need (CON) laws currently exist in 35 states and the District of Columbia. Despite CON laws objective of controlling health care costs, expenditures on medical care have continued to rise. Because CON laws act as supply restrictions on health care and barriers to entry for the hospital industry, they may affect financial outcomes in hospitals. Some existing studies deal with state-level samples or pooled time series cross-section analysis rather than firm-level data (e.g., Salkever and Bice 1976; Grabowski et al. 2003; Stratmann and Russ 2014). Furthermore, few studies examine how changes in CON laws affect outcomes in states (e.g., Grabowski et al. 2003; Ho et al. 2009; Ho and Ku-Goto 2012). This paper creates a large panel dataset at the hospital level from publicly available cost reports produced by the Centers for Medicare and Medicaid Services (CMS) and analyzes CON laws impact on costs, revenues, and profitability using multivariate regression with fixed effects. Using difference-in-differences estimation, the paper also examines how deregulation in Maine in terms of a significant net-reduction in the types of services covered by CON laws may have impacted costs, revenues, and profitability for hospitals in the state. Using fixed effects regression analysis and hospital-level data permits better ways of controlling for unobserved characteristics that change among states and over time. This paper adds insight into the results of reducing CON restrictions in states, and it offers evidence about the effectiveness of CON laws and the long-term implications of modifying or removing them. The multivariate regression analysis suggests no strong relationship between CON laws and outcomes, indicating that CON laws might not produce their intended benefits. The difference-in-differences analysis provides evidence that

deregulation in Maine may be negatively associated with hospital profitability measures. If reducing the number of CON laws in Maine increased competitive forces, the negative association is consistent with the hypothesis that hospital profitability may decline when the market becomes more contestable.

Regulating Agencies' Benefit-Cost Analysis; *Stuart Shapiro, Rutgers*

Regulating Agencies Benefit-cost analysis is often viewed by political scientists as a mechanism used by political principals to control bureaucratic agents. Other such tools include required procedures that agencies must follow when writing regulations such as notice and comment rulemaking, executive and judicial review of regulations, and the recent executive orders requiring agencies to adhere to a regulatory budget and to eliminate two regulations for every new regulation they promulgate. Yet much like political principals attempt to use various tools to control regulatory agencies actions, these same agencies employ instruments to influence the decisions of private agents, especially firms. The methods used include means-based regulation, performance standards, management-based regulation, market instruments, and voluntary programs. Despite the parallel nature of these principal-agent problems, few (if any) have looked at whether there are lessons from the one attempt by principals to control agents for the other. In this paper, we do just that, applying insights from the literature studying how regulators channel firm behavior to the question of how political principals can influence agencies through regulatory procedures. We draw analogies between various types of procedural controls and different forms of regulation and use lessons from research on the effectiveness of regulatory policy to make predictions regarding the efficacy of procedural controls on the rulemaking process itself. Often procedural controls such as benefit-cost analysis are implemented with little regard for how they may be best designed to achieve their goals. Agencies adapt to their procedural environments just as firms adapt to their regulatory environments. As a result, evidence suggests that many of the procedural constraints imposed on agencies over the years have not achieved their purposes, instead ending up relegated to little more than check boxes on the list of items agencies must consider in promulgating rules. In this paper, we consider if and how variations on more innovative approaches used to control regulated entities behavior, such as market instruments and management-based regulation, might be employed to improve the design of procedures as mechanisms to foster better rules.

➤ **6.E: New Methods for BCA**

Chair: Glenn Blomquist, University of Kentucky

Presentations:

Assessing the Risk of U.S. Maritime Accidents; *Fatima Zouhair; Douglas Scheffler*

The U.S. Coast Guard (USCG) is responsible for promulgating regulations that prevent maritime accidents or mitigate their effects, which include loss of life, property damage, and pollution.

Research and analysis of these accidents can provide critical information to decision makers and policy makers alike.

However, the characteristics of these accidents are complex. Major types of maritime accidents are groundings; collisions between two moving vessels; allusions, which involve a vessel striking a stationary object such as bridge or dock; sinking; capsizing; and fires. Vessels involved in range from the smaller towboats and tugs to the largest tankers and container ships. The accidents occur on both the coastal areas under U.S. control and the inland rivers, bays, and waterways. The USCG is conducting a study to assess the impact of vessel characteristics on vessel accidents. The research will be based on Fault Tree Analysis and Bayesian Network using accident data from the Coast Guard's Marine Information for Safety and Law Enforcement (MISLE) database. The included variables are: vessel type, preceding events, accident type, weather condition, location, human factor, vessel age, vessel size, gross tonnage, and time of the accident. The study covers vessel accidents from 1991 through 2016 for vessel accidents. The research outcomes aims at helping safety policy makers in developing regulations that promote safety by identifying vessel characteristics that will have the largest impact in reducing the potential risk while minimizing costs.

Using Machine Learning to Assess Heterogeneity in the Cost-Effectiveness of Health Care Programs; Mikael Svensson, University of Gothenburg

Traditionally, benefit-cost (BCA) and cost-effectiveness (CEA) studies report results based on differences in average costs and average benefits between programs. The focus on "average effects" overlook the fact that for many public programs, health care treatments, etc., the costs and benefits will differ in important ways across the population of interest.

When heterogeneity is assessed in applied BCA/CEA studies it is typically done by splitting the population of interest in sub-groups based on pre-determined (or, more problematic, ex-post) sub-groups based on economic and demographic characteristics. It is well known that this poses a number of problems when analyzing individual-level data, related to e.g. multiple hypothesis testing, lack of power to detect important differences, and the fact that we often don't know what characteristics drive heterogeneity.

In this study we apply novel machine learning techniques, a form of artificial intelligence, to assess heterogeneity in the cost-effectiveness of a health care program. We use data from a randomized controlled trial (RCT) carried out at the university hospital in Gothenburg (Sweden) in patients with peripheral arterial disease (PAD). We use random forests techniques developed to assess heterogeneity in treatment effects and extend these methods to assess heterogeneity in the cost-effectiveness of the intervention.

We find a few individual characteristics significantly related to higher/lower benefits and costs of the health care program, and thus the cost-effectiveness. We demonstrate how the findings can be used for e.g. stratified reimbursement decisions or cost-sharing to move beyond the "one-size-fits-all" approach of only looking at the average cost-effectiveness.

A Head Start for Every Runner: On Using Experimental and QuasiExperimental Evidence to Forecast Policy Impacts; *Daniel Wilmoth, U.S. Small Business Administration*

Analyzing the costs and benefits of policy options requires forecasting their impacts. In making such forecasts, economists often rely on evidence from experimental and quasi-experimental research. Randomized controlled trials and related research designs are powerful tools for identifying causal relationships. However, identifying the effects of an intervention on participants in an experiment is not sufficient for identifying the effects of the intervention when applied to an entire population. One key issue to consider when assessing evidence from experimental and quasi-experimental research is that, for many interventions and outcomes of policy interest, effects are mediated through social interactions subsequent to treatment. For example, an intervention modeling some education program may provide treated students with an advantage relative to their untreated peers. Improvements in relative performance may change the expectations of treated students, as well as those of their teachers and caregivers, in ways that improve subsequent outcomes. However, a general implementation of the new education program could not improve the relative performances of all students. Indeed, the relative performances of students must, on average, remain constant. Therefore, any improvements in outcomes observed in the experiment that were mediated through improvements in relative performance would not be realized when the program was implemented for the entire population. Mediation through changes in relative performance may also be relevant for other policy areas, including economic development, labor, and social welfare. When forecasting the impacts of policy options, and when designing research to inform policy decisions, economists should consider not only the effects observed in experimental and quasi-experimental research but also the mechanisms through which those effects are mediated.

Nonlinearity in Cost and Benefit Functions of Short-Term Repeated Consumer Decisions; *Amit Sharma, Penn State University*

(1) What research question(s) are you trying to answer?

There is growing evidence of how we evaluate costs and benefits to make decisions. For instance, in their study, Bastena, Bieleb, Hauke, Heekerenb, and Fiebach (2010) found that our brain combines the neural benefits and cost signals to evaluate a difference based neural representation of the net value to make a decision. While interest in the net value approach of comparing cost and benefits is increasing, much of this understanding is centered around linear functions of net value. Nonlinearity in net value functions has been investigated in cost-benefit analysis of project-based decisions (Arasteh & Aliahmadi, 2014). This approach could be equally informative in individual decision making context. This study explores the constraints under which net value estimates would be nonlinear and also conducts a preliminary operationalization of these constraints in evaluating individual decision making. The research question this study focuses on is as follows: How does the nonlinearity of net value estimates impact individual decision making?

(2) Does the paper present new data or new analysis of existing data?

The net present value (NPV) approach is a well-recognized method of comparing the anticipated costs and benefits discounted at an appropriate discounting rate (Kane, 1989). This study identifies the constraints in the NPV model that would yield nonlinear estimates of net value. This assessment is made by simulating data using standard NPV modeling software. The resulting constraints that lead to nonlinear net value functions, including the modeling constraints are then presented in between-subject study design to individual respondents for assessment. The outcome variables include individuals' decision and risk preferences, and time effort needed to evaluate linear versus nonlinear net value contexts. Therefore this study uses simulated data and primary data from individual responses.

(3) What is novel about this research?

Net value assessment provides a promising approach to assess how individuals create tradeoffs between costs and benefits in making decisions. Our study evaluates how decision making would be impacted when the net value estimates are nonlinear. This line of investigation could be of value when particularly assessing decision making in dynamic environments, and when the assumptions related to resources needed for such nonlinear net value assessment are relaxed.

(4) What did you find?

The preliminary assessment suggests that net value estimates can indeed be nonlinear by even relaxing some of the most basic constraint assumptions. We anticipate that individuals' assessment of linear versus nonlinear net value estimates would be different. Such findings would have implications on our understanding of how individuals process information that is associated with nonlinear versus linear net value estimates.

➤ **6.F: Wetland Benefits from Definitional Changes of Waters of the United States**

In 2015, the EPA and the Army Corps of Engineers finalized a rule revising the definition of the regulatory term 'waters of the United States.' This term identifies waters which are, and are not, subject to the Clean Water Act (CWA). The economic analysis for this rule, referred to as the Clean Water Rule (CWR), estimated the number of surface water miles and wetland acres that could now be subject to the CWA. The agencies estimated that the total quantified benefits of the CWR of about \$350 million (2014 dollars). The largest component of these benefits was due to wetland mitigation, which was estimated at \$306 million. At the time, the agencies concluded that the benefits of the CWR exceed the costs. In 2017, EPA and the Army Corps of Engineers published a proposed rule to revise the definition of 'waters of the United States,' and reapply the definition of 'waters of the United States' as it existed before the 2015 Clean Water Rule (CWR). In the economic analysis for that rule, the agencies choose to not monetized wetlands benefits from this proposal and presented them as qualitative benefits. They justified this decision by stating that they 'believe the cumulative uncertainty in this context is too large to include quantitative estimates in the main analysis for this proposed rule.' This panel will address the estimation of wetland benefits from definitional changes of 'Waters of the United States,' such as those done in 2015 and 2017. The panel will include

experts on wetlands benefits and benefit transfer and will address appropriate wetlands benefit transfer techniques for national-level rule making, meta-regression to estimate wetland benefits, and forgone wetlands benefits from a redefinition of Waters of the U.S.

Chair: Charles Griffiths, Environmental Protection Agency

Discussants: William Wheeler, Environmental Protection Agency;
Chris Dockins, Environmental Protection Agency

Presentations:

Considerations for Appropriate Wetlands Benefit Transfer for National-Level Rule Making; *John Whitehead, Appalachian State University*

In its original economic WOTUS analysis, EPA-Army (2015) identified 10 studies that provided 22 wetland benefit estimates. The agencies divided the estimates into forested wetlands and emergent wetlands and found the geometric means of the estimates. The agencies used these point estimates (single dollar value/acre) from the existing studies to develop an overall point estimate for wetland mitigation benefits nationwide in their benefit analysis. In their 2017 analysis, the agencies chose to not present monetized benefits because of the age of the CVM studies, which were all conducted before 2000. The agencies criticized the early studies for not conducting validity tests, in particular a scope test. However, several of these studies did conduct a scope test. In addition, several conducted other important validity tests. Another concern now expressed by the agencies is the stability of these values over time (i.e., temporal reliability), but the contingent valuation literature has found that, in general, environmental values are stable over time. In addition, the effects of changes in environmental attitudes or other factors can be evaluated and quantified. In this presentation, I address these issues. When we consider the wetlands CVM literature more broadly, we find that there are models that estimate systematic differences in wetland values across study period and study methods. More recent studies reveal that systematic differences that can be used to develop more accurate wetland mitigation benefits for national level rule making.

Waters of the United States: Upgrading Wetland Valuation via Benefit Transfer; *Elena Besedin, ICF International; Klaus Moeltner, Virginia Tech*

To better understand the value of wetland protection and inform the resource management decisions at the state level, this paper synthesizes information from existing wetland valuation studies as current as 2016 and presents new econometric tools to improve the valuation of wetlands via benefit transfer. The metadata are drawn from 17 stated preference studies that estimate per household WTP for preserving or restoring wetlands in the United States, and combine primary study information with data from external sources (e.g., baseline wetland area). We also take advantage of recent advances in meta-regression modeling and computation of predicted benefits via the econometric framework proposed in Moeltner (2018) within the context of valuing surface water quality changes via BT. The Bayesian Nonlinear

Meta-Regression Model (BNL-MRM) developed in that study satisfies fundamental theoretical properties, such as sensitivity to scope and adding-up (AU). The study adds to the BT and valuation literature by providing the first application of a utility-theoretic, nonlinear MRM to a wetland context, using newly compiled and updated meta-data. On the econometric side, we illustrate how the Moeltner (2018) framework lends itself naturally to a probabilistic comparison of candidate MRMs.

Foregone Wetland Benefits from the Waters of the U.S. Redefinition; *Charles Griffiths, Matt Massey, and Chris Moore, Environmental Protection Agency*

In late 2018, The U.S. Environmental Protection Agency (EPA) and Department of the Army proposed a revision to the definition of Waters of the United States (WOTUS). This action would redefine Waters of the United States to its definition prior to a 2015 WOTUS rule and potentially revise it even further. If finalized, this rule will result in some wetland acres becoming non-jurisdictional under the Clean Water Act. As a result, some newly non-jurisdictional wetland acres may be disturbed or developed without any corresponding wetland mitigation to offset the losses. This will result in foregone benefits from these wetland acres. In this paper, we apply the results from a recent meta-analysis of wetlands benefits (Moeltner 2018) to publicly available data from the 2025 WOTUS rule to estimate the foregone benefits from a redefinition of the Waters of the U.S.

Session 7: Friday March 15, 2019, 2:00 – 3:30pm

➤ 7.A: International Experiences in Regulatory Reform

Chair: Susan Dudley, The George Washington University Regulatory Studies Center

Panel:

Carl Creswell, UK Better Regulation Executive;
Joseph Dunne, European Parliament Research Service;
Celine Kaufmann, Organization for Economic Cooperation and Development;
Jeannine R. Ritchot, Regulatory Affairs Sector at Treasury Board of Canada Secretariat; Ana Maria Zarate Moreno, InterAmerican Development Bank

➤ 7.B: Benefit-Cost Analysis in Education Policy

Chair: Lynn Karoly, RAND

Discussant: Michael Hirsch, Washington State Institute for Public Policy

Presentations:

Comparison of Benefit-Cost and Cost-Effectiveness Results Across 5 Youth Education and Training Programs; *David Long, Princeton Policy Associates*

The proposed paper compares benefit-cost and cost-effectiveness results across five education and training programs targeted to disadvantaged youth populations. All five programs were evaluated with randomized control trials (RCTs) that collected comparable data on the treatment and control groups. This comparison shows striking differences in the policy conclusions that are drawn depending on (a) whether benefit-cost or cost-effectiveness results are used, and (b) which impacts or outcomes are used in cost-effectiveness ratios. These differences have several implications for education and training policy as well as for the use of benefit-cost and cost-effectiveness analysis.

The paper describes a benefit-cost analysis of the YouthBuild program conducted with MDRC researchers using data from an RCT funded by the U.S. Department of Labor. The survey and records data used in the analysis cover more than 70 YouthBuild programs across the U.S. The results of this analysis were compared to the benefit-cost results from RCTs of two comparable programs: Job Corps (conducted by Mathematica Policy Research) and ChalleNGe (conducted by RAND, using data from MDRC). I also conducted a cost-effectiveness analysis of YouthBuild, comparing cost-per-impact and cost-per-outcome ratios across these three programs as well as two others targeted to similar youth populations: Youth Corps (evaluated by Abt Associates) and Jobstart (evaluated by MDRC).

The Department of Labor originally wanted MDRC to conduct a cost-effectiveness analysis in the YouthBuild evaluation, not a benefit-cost analysis. However, both types of analysis could be done with the data collected. Ultimately, the cost-effectiveness comparison was replaced by the benefit-cost analysis based on the recommendation of the technical review committee for the evaluation. Thus, while the final MDRC report contains only the benefit-cost analysis, the results of both analyses are available and have received careful review. A comparison of these results is instructive, indicating how sensitive policy conclusions can be to evaluation measures as a body of rigorous evidence is built in an important policy area over a 25-year period.

CBA for Higher Education Diplomas: A First Assessment of the French Case; *Pierre Courtioux, EDHEC Business School*

This communication aims at presenting and discussing a methodology used to estimate the value of French Higher Education diploma (Chéron and Courtioux [2018]). This specific evaluation is a piece of a larger framework that is developed in the Quinet report [2018, forthcoming]

In the specific framework presented here, the computation of social value is based on the identification of wage premium for different education level (two-year degrees, three year degrees, five-year degrees, etc.) and different fields (Sciences, Arts and Literature, etc.). It also includes unemployment differences over the life cycle and a large definition of fiscal returns (income tax, social contribution, VAT). This framework is also used to compute the social cost of

repeating and drop-out in higher education (the drop out level is very high for French higher education). This framework is also used to compute the lost in social benefit corresponding to a postponement of education latter in the life cycle.

This is generally admitted that returns to education investments are higher when they correspond to early intervention in the life cycle. This assertion is discussed for higher education investments in the French case. Results show that the socio-economic benefits for a tertiary degree completion is high: around 90,000 € for a Master at the university, more than 200,000 € for engineering schools, around 100,000 € for a two-year or a three-year degree. Even when one takes into account the pedagogical costs this benefit remains substantial. However, repeating and drop-out decrease substantially this value. For two-year vocational degrees we estimate a loss of 30-35%. We show that in this framework, developing higher education continuous vocational training may be a strategy that pays.

Using Benefit-Cost Analysis to Address Significant Disproportionality in Special Education;
Richard Belzer, Regulatory Checkbook

In 2004, Congress revised and amended the Individuals with Disabilities Education Act (IDEA) to deal with what was perceived as a pressing national problem: the overrepresentation of minority children in special education. In particular, Congress directed State Education Agencies (SEAs) to determine if significant disproportionality based on race and ethnicity is occurring in the Local Education Agencies (LEAs) within their jurisdictions. If significant disproportionality was determined to be present, an LEA would be subjected to statutory financial penalties.

Congress did not define 'significant disproportionality' and left to the States the responsibility for defining the term and managing the phenomenon. However, in 2016 the Department promulgated the Equity in IDEA Rule (81 FR 92376). This Rule replaced State flexibility and discretion with a mandatory design standard. In 2018, the Department delayed the Rule's effective date and announced it was reconsidering how to proceed (83 FR 31306).

The Equity in IDEA Rule has several technical problems and significant deficiencies in its economic analysis. Technical problems include (1) the prescribed use of deterministic ratios that cannot account for uncertainty in identification, placement, and discipline, variability across local education agencies within each State, or variability within a local education agency; (2) a requirement to calculate these ratios without controlling for known confounders; (3) a requirement that States define significant disproportionality as only upper-bound thresholds for these ratios; and (4) no attention given to under-representation as a potential manifestation of significant disproportionality. These deficiencies made it likely that significant disproportionality would be determined by chance, and LEAs would be incentivized to establish de facto but unlawful racial and ethnic quotas in special education to avoid it. Key deficiencies in the economic analysis include (1) a limited focus on administrative costs to SEAs and LEAs instead of the Rule's opportunity costs on children; (2) an ambiguously defined regulatory baseline; (3) a lack of regulatory alternatives; and (4) the absence of credible estimates of the Rule's benefits and costs.

This paper provides a benefit-cost framework for revising the Equity in IDEA Rule based on conventional regulatory analysis. The objective function is defined as minimizing the sum of present value costs of false positive and false negative determinations in identification and placement. Benefits thus consist of the reduction in present value costs using the Equity in IDEA Rule as the baseline. In terms of regulatory structure, the design standard for significant disproportionality in the Equity in IDEA Rule would be supplanted by a performance standard. This would eliminate the perverse incentive to comply by establishing de facto quotas, and create desirable incentives for creativity and innovation. A safe harbor is developed to show one way States could comply with the performance standard.

A key product of this work is the identification of data and analyses that are needed to populate the benefit-cost model. Despite the passage of 15 years since Congress enacted its directive, these data still do not exist. A crash research program is recommended to fill these data gaps and conduct the necessary analyses.

➤ **7.C: Energy Projects**

Chair: Emily Galloway, U.S. Food and Drug Administration

Presentations:

Case Study: BCA Flaws in Attempting to Optimize a Regional Electricity Transmission Market;
Scott Rubin, Law Office of Scott J Rubin

The PJM Interconnection runs the largest regional electricity market in the United States, covering parts of 13 states and the District of Columbia. In 2014, PJM created a new process to review "Market Efficiency" transmission projects; that is, projects whose sole benefit is to remove bottlenecks that keep the next lowest-cost power from serving the next increment of demand. Bottlenecks create a suboptimal condition where some higher-cost units generate electricity while some lower-cost units are under-utilized.

The selection of Market Efficiency projects is based in large measure on power market simulations extrapolated out to 15 years. The results of the simulations are used to calculate a discounted present value of benefits from the project that is compared to a discounted present value of project costs. PJM's protocol, as approved by the Federal Energy Regulatory Commission, requires that a project have a benefit:cost ratio of 1.25 or higher in order to be eligible for selection.

PJM's procedures also require revised simulations and a recalculation of the b:c ratio each year until the project is built to ensure that changes in market conditions have not affected the economics of a selected project.

This presentation will review and evaluate the BCA used by PJM to select the first Market Efficiency project in 2016, the Independence Energy Project that would build two new transmission lines and two new substations in Pennsylvania and Maryland.

There are three major findings from this review. First, PJM's definitions of "benefits" and "costs" exclude effects on utilities that would have their power costs increase as a result of a project. Including those increasing-cost utilities in the BCA changes the results significantly and results in a true b:c ratio < 1.0 . Second, power markets are dynamic, and the results of market simulations change dramatically over a short period of time, significantly affecting BCA results. Third, markets are so fluid that some utilities that originally benefited from a project are harmed by a project when a new simulation is run just a year or two later.

An Integrated Appraisal of a Wind Farm; *Glenn Jenkins, Queen's University*

Concerns over climate change have been driving the expansion of wind farms across Ontario. By displacing output from other power sources – such as gas fired plants – wind farms can reduce total greenhouse gas emissions. Wind also has very low operating costs, partly because the fuel – wind – is free. But do the economic benefits of wind generation outweigh the economic costs? In this paper, we estimate the displacement of existing power suppliers within Ontario – nuclear, hydro, gas, biofuel, and solar – and convert that into resource savings. Using this information, we investigate the economic viability of the Wind Farm through an integrated investment appraisal framework. The analysis is conducted from the perspective of the wind farm owner, the displaced power plant owners, the domestic consumer and the government. The reduction in CO₂ emissions is treated as positive externality generated by the wind farm, but enjoyed by the world. We conclude that the present value of the benefits – fuel savings, and export revenue – are less than the present value of the costs – capital investment, operating costs and decommissioning expense. The only stakeholder who might benefit is the wind farm owner. Overall, the resources used to build and operate the wind farm could be put to better use elsewhere in the Canadian economy.

Self-generation, Willingness to Pay for Electricity Reliability and Incomplete Property Rights; *Majid Hashemi, Clemson University;*

Gender, Electricity, and Poverty: Distributional Effects of Power Sector Reforms in West Africa; *Francis Mulangu, Millennium Challenge Corporation*

The high cost of electricity in West Africa is a binding constraint to private investment. To alleviate the constraint, governments and donors have intervened in infrastructure development 'Hard investment' and policy upgrading and capacity building investment 'Soft investment'. Evidence of the impact of 'hard investment' have been extensively discussed in the literature, and the seminal work of work of Calderón and Servén (2004) and the more recent application of experimental tools to the power sector in Lee et al. (2018), Chaplin et al. (2017) and Lenz et al. (2017) currently lead the debate. Evidence of the impacts of power sector 'Soft investment' in developing countries is rather contentious and the earlier work of Besant-Jones

(2006) and the most recent work of Jamasb et al. (2017), Trimble (2016), Bensch et al. (2016), and the extensive literature review of Bacon (2018) provides a good discussion of the on-going debate. Among the soft investment, regulatory strengthening is an indispensable interventions which will ensure financial viability of the sector and support its expansion by attracting private sector investment (Besant-Jones, 2006).

Changes in tariffs are the main welfare indicators used to evaluate the impact of soft investment on end users, and a number of papers have provided evidence of this relationship among developing countries. However, tariff changes do not tell us much about the welfare implications given the heterogeneous nature of electricity users.

Using the consumer surplus approach, the paper attempts to contribute to the literature by providing intra-households effects of regulatory reforms in Ghana and Senegal. The paper argues that power sector regulatory rules will affect households through two steps. First, the policy will affect end users' tariff rates. This relationship will be taken as exogenously determined in the present paper. Second, the impact of the price change on end users will depend on the weight of electricity expenditures on end users' expenditure's basket. Many other household outcomes such as wage, education, and health can also be affected by the change in tariff rates. However, we consider them as of second order and limit our analysis to only first order effects.

The results reveal that regulatory tariff rules will have effects that vary across income, gender, and location of end users. This level of disaggregation of the analysis of effects of power sector reforms on end user is a first, to the best of our knowledge. We also note a difference in the magnitude of the effect across Ghana and Senegal. We also noted differences in the dynamics of the effect within the two countries. The poverty implications are small but significant as the rules will reduce poverty rate by 0.10% and 0.22% in Ghana and Senegal, respectively.

➤ **7.D: Economic Analysis at Independent Agencies: Progress and Challenges**

Independent regulatory agencies are not currently subject to executive orders governing economic analysis and review of new regulations. But they may face increasing pressure to improve their economic analysis that informs regulatory and enforcement decisions in the future due to court decisions, legislation, or executive orders. The Securities and Exchange Commission, for example, has since 2012 undertaken significant efforts to improve its economic analysis of regulations as a result of court decisions. The Federal Communications Commission has committed to conducting regulatory impact analysis for regulations whose economic impact exceeds \$100 million annually and is reorganizing its economists into a separate office to facilitate more objective analysis. In this roundtable, senior economists from several independent agencies will explain the role of economic analysis at their agencies, outline the organizational structure of economists and how this facilitates the production and use of economic analysis, and suggest some remaining challenges agencies face to stimulate discussion and feedback from the audience.

Chair: Jerry Ellig, GWU Regulatory Studies Center

Panel:

Giulia McHenry, Federal Communications Commission;
Timothy Daniel, Federal Trade Commission;
William Brennan, Surface Transportation Board;
Amy Edwards, U.S. Securities and Exchange Commission

➤ **7.E: Overcoming Challenges in Regulatory Impact Analysis**

Chair: Sofie Miller, U. S. Department of Energy

Discussant: Dan Lawver, U.S. Department of Health and Human Services

Presentations:

Overcoming Data Gaps: A Case Study; *Paul Reeder, Employment and Social Development Canada*

The On Board Trains Occupational Safety and Health Regulations (OTOSH) were amended in 2015 to provide greater protection against noised induced hearing loss to federal employees working on trains while in operation. The regulations lowered the maximum permissible level of sound to 87 A-weighted decibels (dBA) for an eight-hour period. Previously, the maximum was eight hours at a level of 87 dBA or more, but less than 90 dBA, meaning an employee could be exposed to close to 90 dBA over an 8 hour period.

Assessing the costs and benefits of this regulatory change presented many challenges. While assessing costs to employers was relatively easy, estimating benefits would prove more difficult. The number of occupational-related hearing loss injuries was not available, as most do not result in time away from work and detailed injury data in Canada is only available for injuries that result in time-away from work. The challenge was to find a reliable estimate of the number of reduced hearing loss injuries expected in the absence of any data for these types of injuries. Usually estimates of the number of reduced injuries rely on anticipated percentage reductions from current injuries that are expected to result from the regulatory change.

The presentation will show how this challenge was overcome, by utilizing data from several sources in order to develop a mathematical model which could reliably estimate the expected number of reduced cases of hearing loss flowing from the introduction of the new regulation. By using data on average levels of noise exposure on Canadian locomotives, combined with data from the National Institute of Occupational Health and Safety on the additional risk of hearing impairment related to the level of sound in the workplace, it was possible to determine the excess risk reduced (found to be 5.9%). In turn, by multiplying the level of excess risk with data from the Centre for Disease Control, showing the congenital risk of hearing loss in the

general population (9.3%) and employment data for the rail sector from Statistics Canada, it was possible to determine the number of reduced hearing loss injuries in the federal jurisdiction expected from the implementation of the new regulation.

The noise level survey found exposure levels at 85.5 dBA in winter and 89.6 dBA in summer, for an average of 87.6 dBA over a 12 month period. The levels in winter were directly related to windows on the locomotives being closed. As a result, the easiest and most cost effective way to comply with the new sound level limits was to ensure windows were closed. It was expected that the new regulation would limit overall exposures to 85.5 dBA. The reduction in excess risk (5.9%) is based on average exposure levels decreasing from 87.6 dBA to 85.5 dBA.

The number of reduced hearing loss injuries was determined by considering the at-risk population, (locomotive conductors and engineers in the federal jurisdiction), factoring in the baseline risk (9.3%), and subsequently applying the excess risk multiplier.

Parameter Uncertainty in Regulatory Impact Analysis; Aaron Kearsley, U.S. Food and Drug Administration

Circular A-4 encourages cost-benefit practitioners "to develop estimates that capture the distribution of plausible outcomes" in addition to reporting expected-value estimates. While regulatory impact analyses (RIAs) routinely report upper and lower bounds on cost and benefit estimates, these often do not explicitly correspond to A-4's suggested 95 and 5 percent confidence bounds, or do so only with a few unstated, potentially implausible, assumptions. This presentation outlines a rigorous treatment of uncertainty when parameter estimates are used to derive costs and benefits, and discusses the sensitivity of estimates in published RIAs to different assumptions and treatments of uncertainty.

Implementing an Accounting Framework to Measure Outcomes for a New Policy Directive: Challenges and Lessons Learned; Deborah Aiken, U.S. Department of Transportation; Ross Rutledge, National Highway Traffic Safety Administration

Beginning with President Reagan's Executive Order 12291, reinforced by President Clinton's Executive order 12866, the role of analysis in regulatory decisions has become well-established. Recently, President Trump's Executive Order 13771 added two additional sets of requirements. First, it requires that agencies remove two regulations for each new regulation issued. Second, it requires agencies to set a cost allowance each year to cap the cost of new regulations. While the policy implications of these new requirements been the subject of considerable discussion, the purpose of this presentation is to discuss the specific challenges that the new requirements create for regulatory analysts tasked with implementing the executive order. In particular, we discuss the difficulties in creating an accounting framework to measure results and in communicating and interpreting the actual numbers to policy officials.

➤ **7.G: Stated Preference**

Chair-Discussant: Dan Acland, University of California, Berkeley

Presentations:

Willingness to Pay to Improve Patient Medication Information: A Stated Preference Study;
Bern Dealy, U.S. Food and Drug Administration

Pharmacists typically dispense prescription drugs with leaflets containing information about the specific medication a patient receives. These leaflets vary in format, length, content, and readability for the same prescription drug at different pharmacies, and for different prescription drugs at the same pharmacy. Previous research has found that most patients favor standardization of this form of medication information; however, standardization is costly, and there are no known studies that estimate what patients would be willing to pay for this standardization. This study uses the contingent valuation survey method to investigate how consumers value standardized information in the retail pharmacy setting. Specifically, this study presents previously unpublished contingent valuation survey data composed of 525 federal government employee respondents. The survey design included a double-bounded advisory referendum elicitation format where respondents were presented with examples of alternative prescription drug information formats. Overall, this study finds that the willingness to pay for standardized drug information exceeds the estimated costs associated with standardizing prescription drug information. This finding is robust across a wide variety of econometric specifications.

The Willingness-to-pay (WTP) for Fundamental Science as a 'Public Good': A Survey to French Citizens; *Massimo Florio, University of Milan*

The European Organization for Nuclear Research (CERN) produces knowledge advances about the nature and the origins of the Universe, which can be considered a 'public good'. The provision of such public good is financed by the contributions of its Member States. Taxpayers are ultimately the funders of CERN's investment projects. This paper was motivated by the need to know whether and to what extent citizens are willing to pay for fundamental particle physics research at CERN and for a new particle accelerator project that can follow the High Luminosity-Large Hadron Collider (HL-LHC) research programme and increase the probability of new discoveries.

To meet these objectives, we conducted a large-scale contingent valuation (CV) survey addressed to a sample of 1,005 French citizens aged 18 years and older. The survey was launched in February 2018 in France (one of the two CERN host states) after a design and a pilot phase lasted two years (2016-2018) and during which several stakeholders with different expertise were involved. Among the issues considered in the paper, there are:

- The design features of the double-bounded dichotomous choice (DBDC) CV survey, including the contingent scenarios and the elicitation procedure to estimate the WTP for future investments in particle physics research;

- The administration of the survey to a representative national sample of French citizens with different modalities of data collection. The survey was in compliance with French and international laws of respect of the privacy and anonymity, including an informed consent approved by the Ethic Committee of the University of Milan that each respondent signed before starting the survey. Moreover, photos and a video were submitted to respondents to make them familiar with the 'good' under evaluation;
- The estimation of individual WTPs with an elicitation format based on both DBDC questions and open-ended maximum questions;
- Issues related to reliability and validity of the estimates obtained such as scope tests and robustness tests to different model specifications and statistic techniques.

We estimated two WTPs:

1. The unconditional average maximum WTP for CERN investments in a new particle physics research infrastructure amounts to EUR 13.5 per person per annum;
2. The bounded conditional average WTP from the double-bounded questions is EUR 4 per person per annum. It is a non-maximum WTP and it is calculated by accounting for the socioeconomic characteristics and interests and opinions of respondents.

Our results have implications for policy making and benefit-cost analysis (BCA) research. From the policy perspective, we compared the estimated WTPs with the actual contribution that French taxpayers currently pay to CERN in the form of taxation. This actual annual contribution (2017) amounts to EUR 2.7 per person; therefore, the WTP is at least a factor 1.5 higher than such contribution. From the BCA viewpoint, we pointed to a curiosity-driven existence value for fundamental science. We argue that this kind of experiment (first time in the world for a scientific public good) was a pilot investigation and could be replicated in other CERN Member States and/or for other scientific public goods.

Publication Selection Biases in Stated Preference Estimates of the Value of a Statistical Life;

Clayton Masterman, Vanderbilt Ph.D. Program in Law and Economics

This research presents the first meta-analysis documenting the extent of publication selection biases in stated preference estimates of the value of a statistical life (VSL). A weighted least squares analysis controlling for publication selection biases finds that such biases account for more than 90% of the mean value of published stated preference estimates of the VSL. Quantile regression results demonstrate that the bias varies across the VSL distribution, as bias-adjusted stated preference VSL's are between 6.8% and 89.7% smaller than the published values. In subsequent analyses, we compare publication selection biases based on publication type, the type of risk used to calculate the VSL, the income level of the country the VSL was calculated in, and whether the estimates are high quality. The bias is greatest for the largest VSL estimates, possibly because the high-income estimates from the U.S. serve as an anchor for

the VSL in other higher income countries. VSL estimates from lower income countries exhibit less bias, but remain unreliable for benefit-cost analysis. Unlike labor market estimates of the VSL, there is no evidence of any subsample of VSL estimates that is free of publication selection bias. Because stated preference estimates exhibit significant biases, policymakers may wish to rely on benefit-transfer methods to calculate a VSL for benefit-cost analysis.

Monetizing Bowser: A Contingent Valuation of the Statistical Value of Dog Life; *David Weimer, University of Wisconsin – Madison; Hank Jenkins-Smith, University of Oklahoma*

Households in the United States spend about \$70 billion annually on pets. Dogs, the most common pet, can be found in 48 percent of households. An important shadow price in the analysis of policies affecting human mortality is the value of statistical life (VSL), which is imputed from how people make decisions involving tradeoffs between small mortality risks and other goods. The value of statistical dog life (VSDL) is also an important, but until now unavailable, shadow price for use in regulation of such goods as pet foods and environmental toxins. Additionally, an estimate of the VSDL would have uses outside the regulatory process in valuing programs involving zoeyia, in setting tort awards for wrongful dog death, and in property divisions in divorce settlements where joint custody of dogs is not feasible. In order to estimate the VSDL we conducted a contingent valuation of a national sample of dog owners that elicited willingness to pay for changes in mortality risk for pet dogs. Specifically, respondents were asked about willingness to pay for a vaccine that would reduce the risk of canine influenza. The design included both quantity (different magnitudes of risk reduction from the offered vaccine) and quality (differences in nature of death from the influenza) treatments as scope tests. It also included treatments involving spillover effects to other dogs and a priming question about disposable income. The presentation will provide estimates of VSDL from this study.

-----**END**-----