
Literature Report

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Abstract

Menus of price-quantity contracts for inducing the truth in environmental regulation

- Journal of Environmental Economics and Management---2017---Ratna K. Shrestha

Many authors have proposed mechanisms to induce regulated polluting firms to truthfully reveal their private information. This paper proposes an alternative scheme in which the regulator offers each firm a menu of linear price-quantity contracts; faced with this menu, each firm's dominant strategy is to truthfully report its private information and self-select the contract that is ex post efficient. The proposed menu schedule that is more elastic than the firm's residual marginal damage function engenders a positive quantity effect, thereby counterbalancing the firm's incentive to misreport prompted by the linearity of price. Due to its built-in price quantity structure, the scheme performs as designed regardless of the elasticities of marginal damage and demand functions.

Economic impacts of climate change on agriculture: The importance of additional climatic variables other than temperature and precipitation

- Journal of Environmental Economics and Management---2017---Peng Zhang,Junjie Zhang,Minpeng Chen

Climate change shifts the distributions of a set of climatic variables, including temperature, precipitation, humidity, wind speed, sunshine duration, and evaporation. This paper explores the importance of those additional climatic variables other than temperature and precipitation. Using the county-level agricultural data from 1980 to 2010 in China, we find that those additional climatic variables, especially humidity and wind speed, are critical for crop growth. Therefore, omitting those variables is likely to bias the predicted impacts of climate change on crop yields. In particular, omitting humidity tends to overpredict the cost of climate change on crop yields, while ignoring wind speed is likely to underpredict the effect. Our preferred specification indicates that climate change is likely to decrease the yields of rice, wheat, and corn in China by 36.25%, 18.26%, and 45.10%, respectively, by the end of this century.

Highway toll and air pollution: Evidence from Chinese cities

- Journal of Environmental Economics and Management---2017---Shihe Fu,Yizhen Gu

Most highways in urban China are tolled to finance their construction. During the eight-day National Day holiday in 2012, highway tolls were waived nationwide for passenger vehicles. We use this to identify the effects of highway tolls on air pollution. Using daily pollution and weather data for 98 Chinese cities in 2011 and 2012 and employing both a regression discontinuity design and differences-in-differences method with the 2011 National Day holiday as a control, we find that eliminating tolls increases pollution by 20% and decreases visibility by one kilometer. We also estimate that the toll elasticity of air pollution is -0.15 . These findings complement the scant literature on the environmental impact of road pricing.

On the environmental consequences of intra-industry trade

- Journal of Environmental Economics and Management---2017---Jayjit Roy

In the trade and environment debate, the relevance of examining the impact of a location's intra-industry trade (IIT) on environmental quality cannot be overemphasized, in part, due to the increasing prominence of such trade and the paucity of related empirical evidence. Although existing studies largely indicate overall trade to be pro-environment, the consequences of IIT may differ owing to greater varieties of intermediate and final goods, easier technology diffusion via trade in similar goods, productivity gains from within-sector reallocations, and increased innovation. However, identification of the causal effect is plagued by the potential endogeneity of IIT attributable to crucial unobservables and measurement error. In this light, utilizing an instrumental variables strategy and data on multiple environmental indicators from roughly 200 countries over 2000-2005, we investigate IIT's impact on the environment. To measure IIT, we rely on two indexes of within-industry specialization based on

changes in and levels of sector-level trade. Regardless of the indicator of IIT or environmental performance, across several sets of instruments, we mostly find (i) IIT to benefit the environment, (ii) overall trade to be less pro-environment than IIT, and (iii) concerns over endogeneity to be relevant.

Transaction costs, communication and spatial coordination in Payment for Ecosystem Services Schemes

- Journal of Environmental Economics and Management---2017---Simanti Banerjee,Timothy Cason,Frans de Vries,Nick Hanley

Agricultural producer participation and spatial coordination of land use decisions are key components for enhancing the effective delivery of ecosystem services from private land. However, inducing participation in Payment for Ecosystem Services schemes for coordinating land management choices is challenging from a policy design perspective owing to transaction costs associated with participation. This paper employs a laboratory experiment to investigate the impact of such costs on participation and land use in the context of an Agglomeration Bonus (AB) scheme. The AB creates a coordination game with multiple Nash equilibria related to alternative spatially-coordinated land use patterns. The experiment varies transaction costs between two levels (high and low), which affects the risks and payoffs of coordinating on the different equilibria. Additionally, an option to communicate is implemented between neighbors arranged on a local network to facilitate spatial coordination. Results indicate a significant difference in participation and performance under high and low transaction costs, with lower uptake and performance when transaction costs are high. These effects are, however, impacted by transaction costs faced in the past. Communication improves both AB participation rates and performance with the effect being greater for participants facing high transaction costs.

Negotiating environmental agreements under ratification constraints

- Journal of Environmental Economics and Management---2017---Sonja Köke, Andreas Lange

We analyze the impact of ratification constraints on the optimal terms of international environmental agreements (IEAs). For this, we combine the literature on IEAs with the public choice literature on two-level games. By also incorporating uncertain preferences of the pivotal voter in the ratification stage, we make several important contributions: (i) we contribute to a more realistic modeling of the temporal structure of international agreements, (ii) we show a surprising, yet intuitive non-monotonic relationship between the optimal commitment level and the variance of ratification decisions, (iii) we identify reasons to expect a larger number of countries to join international negotiations than predicted by most of the coalition formation literature based on a representative agent model. Ratification constraints thereby can improve the welfare gains from stable international agreements.

Prevention and cleanup of dynamic harm under environmental liability

- Journal of Environmental Economics and Management---2017---Tim Friehe, Eric Langlais

This paper explores incentives for accident prevention and cleanup when firms are subject to environmental liability. In our two-period setup, the level of environmental harm in the second period depends on first-period harm when cleanup was incomplete. Under strict liability, in the first period, firms with a positive probability of going out of business before the second period have inadequate prevention and cleanup incentives. The fundamental disconnect between private incentives and social optimality cannot be remedied by using a multiple of harm as the level of compensation. Under negligence with a causation requirement, incentive problems remain; however, under negligence without such a requirement, first-best incentives may emerge, and using a multiple of harm as the level of compensation can ensure the efficient solution.

The effect of low emission zones on air pollution and infant health

- Journal of Environmental Economics and Management---2017---Markus Gehrsitz

This paper investigates the effect of low emission zones on air quality and birth outcomes in Germany. The staggered introduction of the policy measure creates a credible natural experiment and a natural control group for births and air pollution measurements in cities that enact low emission zones. I show that the introduction of the most restrictive type of low emission zone decreases average levels of fine particulate matter by about 4 percent and by up to 8 percent at a city's highest-polluting monitor. Low emission zones also reduce the number of days per year on which legal pollution limits are exceeded by three. However, these reductions are too small to translate into substantial improvements in infant health. My results are not driven by changes in maternal or city specific characteristics, and are robust to variations in specification and to the choice of control group.

EU air pollution regulation: A breath of fresh air for Eastern European polluting industries?

- Journal of Environmental Economics and Management---2017---Igor Bagayev, Julie Lochard

Does air quality regulation in the European Union (EU) foster polluting activity in emerging and developing countries? In this paper, we propose an original variable that evaluates regulation stringency, based on the EU Air Quality Framework Directive. Focusing on the underlying mechanism and controlling for endogeneity in the relation between regulation and trade, we provide robust evidence that EU countries implementing more stringent air pollution regulations import relatively more in pollution-intensive sectors from developing and emerging countries in Europe and Central Asia.

The effect of environmental regulation on plant-level product mix: A study of EPA's Cluster Rule

- Journal of Environmental Economics and Management---2017---Aaron A. Elrod, Arun S. Malik

This paper examines the effect of the U.S. Environmental Protection Agency's Cluster Rule on the product-mix decisions of plants in the pulp, paper, and paper-board industries. The Cluster Rule combines regulatory requirements from the Clean Air Act and Clean Water Act that are based on plants altering their production processes away from chlorine-based bleaching agents. In addition to, or instead of, altering production processes, plants may plausibly comply with the regulation by reducing output of bleached products or dropping some of these products entirely. Using a difference-in-difference-in-differences approach, we find evidence that plants facing both air and water Cluster Rule regulation (treatment group) are more likely to drop bleached products relative to unbleached products compared to plants facing only air Cluster Rule regulation (control group). Furthermore, we find evidence that plants in the control group alter their product mixes toward bleached products.

The effects of summer heat on academic achievement: A cohort analysis

- Journal of Environmental Economics and Management---2017---Hyunkuk Cho

This paper analyzed the effect of summer heat on academic achievement. Summer heat can negatively affect student learning, as previous studies have shown that high temperatures in laboratory settings have a negative effect on cognitive abilities. For this analysis, the test scores of five different cohorts were combined with city-level daily temperature data. To control for unobserved heterogeneity, the test scores of students within the same school were compared over time (school-fixed effects estimation). Summer heat negatively affected student test scores. Specifically, an additional day with a maximum daily temperature exceeding 34°C (93.2°F)

during the summer, relative to a day with a maximum temperature between 28°C (82.4°F) and 30°C (86°F), decreased the scores of math and English tests by 0.0042 and 0.0064 standard deviations, respectively. No significant effects were found on the reading test scores. In addition, these effects were larger in relatively cooler cities, but did not differ based on gender. Finally, the previous year's summer also had negative effects on the current year's test scores.

Jobs and climate policy: Evidence from British Columbia's revenue-neutral carbon tax

- Journal of Environmental Economics and Management---2017---Akio Yamazaki

This paper examines the employment impact of British Columbia's revenue-neutral carbon tax implemented in 2008. While all industries appear to benefit from the redistributed tax revenues, the most carbon-intensive and trade-sensitive industries see employment fall with the tax, while clean service industries see employment rise. By aggregating across industries I find the BC carbon tax generated, on average, a small but statistically significant 0.74 percent annual increases in employment over the 2007–2013 period. This paper provides initial evidence showing how a revenue-neutral carbon tax may not adversely affect employment.

Valuing environmental amenities through inverse optimization: Theory and case study

- Journal of Environmental Economics and Management---2017---Mo Zhou

Amenity values of private forests are implicit but play a critical role in decision and policy making. This study presents an innovative valuation approach integrating techniques of operations research and economic theory of pricing environmental goods. A forest planning problem was inverted through altering its reward function of timber values so that the observed harvesting behavior became optimal. The discrepancy between the original and new rewards uncovered amenities values which were linked to forest attributes via hedonic models. This method was applied to a case study of

the U.S. southern pine region. Depending on forest conditions, total economic values of amenities varied from zero to just under one thousand dollar per ha. At a discount rate of 3%, a typically managed forest generated on average \$243 ha⁻¹ of amenities values per annum, more than twice of harvested timber values. Structural diversity and density of large pine trees were the key determinants to preserving forests for environmental amenities.

Do water saving technologies save water?

Empirical evidence from North China

- Journal of Environmental Economics and Management---2017---Qiuqiong Huang,Jinxia Wang,Yumin Li

This paper describes the extent of water saving technologies usage and evaluates their impacts on water use, water productivity, total irrigated sown area and crop mix in North China. A set of panel data collected at the household and plot levels is used in empirical analysis. Water saving technologies are categorized into traditional technologies, household-based technologies and community-based technologies. By 2007, traditional technologies and household-based technologies are used in almost all sample villages. However, the shares of sown area on which water saving technologies are used are still fairly low. Econometric analysis using plot level fixed effects show that using water saving technologies can reduce crop water use and improve the productivity of water. The positive effects are generated mainly through the use of household-based or community-based technologies. The use of water saving technologies does not have statistically significant impacts on total irrigated sown area and crop mix.

Valuing nonfatal health risk as a function of illness severity and duration: Benefit transfer using QALYs

- Journal of Environmental Economics and Management---2017---James Hammitt,Kevin Haninger

We estimate willingness to pay for small reductions

in the risk of suffering nonfatal health conditions using a stated-preference survey fielded to an internet panel that is representative of the adult US population. Health conditions are described using a generic health utility system (EQ-5D). Estimated WTP is proportional to the stated reduction in probability of illness and independent of small differences in baseline risk, consistent with conventional economic theory, and is an increasing but highly concave function of the severity and duration of the illness. WTP to reduce nonfatal health risks can be estimated as a function of the severity and duration of the effect, but the relationship is not linear as assumed by the common practice of multiplying the expected QALY gain by a constant monetary value per QALY. WTP to reduce risk to another person in the household is significantly larger than to reduce risk to oneself, approximately 150 percent larger for an adult and 200 percent larger for a child.

The social costs of second-best policies:

Evidence from agricultural GHG mitigation

- Journal of Environmental Economics and Management---2017---Cloé Garnache,Pierre R. Mérel,Juhwan Lee,Johan Six

This paper investigates the social costs of second-best agricultural greenhouse gas (GHG) mitigation policies. Adjustments along the land use and input intensity margins are represented within a regionalized optimization model of California crop production calibrated to economic and agronomic information. Second-best policies relying on spatially aggregated GHG emission factors lead to small abatement efficiency losses, while policies targeting a single GHG lead to moderate losses. In contrast, policies targeting a single input entail large abatement efficiency losses, which nonetheless can be reduced by combining instruments.

Is Chinese trade policy motivated by environmental concerns?

- Journal of Environmental Economics and Management---2017---Sabrina Eisenbarth

This paper analyses whether China's export VAT rebates and export taxes are driven by environmental concerns. Since China struggles to enforce environmental regulation, trade policy can be used as a second-best environmental policy. In a general equilibrium model it is possible to show that the second-best export tax increases in a product's pollution intensity. The empirical analysis investigates whether the export tax equivalent of partial VAT rebates and export taxes are higher for products which are more pollution intensive along several dimensions. The results indicate that the VAT rebate rates are set in a way that discourages exports of water pollution intensive, SO₂ intensive and energy intensive products from 2007 on. Moreover, the conservation of natural resources such as minerals, metals, wood products and precious stones seems to be a key determinant of China's export VAT rebate rates. There is little evidence that export taxes are motivated by environmental concerns.

Is energy efficiency capitalized into home prices? Evidence from three U.S. cities

- Journal of Environmental Economics and Management---2017---Margaret Walls,Todd Gerarden,Karen Palmer,Xian Fang Bak

We test for evidence that energy efficiency features are capitalized into home prices in three U.S. metropolitan areas. Using hedonic regressions and multiple matching procedures, we find that Energy Star certification is associated with higher sales prices in two of the markets: the Research Triangle region of North Carolina and Portland, Oregon. We find that local "green" certifications in Portland and in Austin, Texas, are also associated with higher prices and that the estimated price impacts are larger than those from Energy Star. Matching on observables proves to be important in some cases, reducing the estimated impacts compared with models without matching. We calculate the implied energy savings from the estimated premiums and find that, in the Research Triangle market, the Energy Star premiums approximately equal the savings that program is designed to achieve, but in Portland, the premiums are slightly greater than the program's

savings due to low energy costs in the region.

Analyzing the effectiveness of international environmental policies: The case of the Kyoto Protocol

- Journal of Environmental Economics and Management---2017---Christian Almer,Ralph Winkler

We study the effectiveness of emission targets under the Kyoto Protocol with respect to reducing CO₂ emissions. Using country-level and US state-level panel data and employing the synthetic control method, we find very little evidence for an emission reduction effect for the major emitters among the Annex B countries with binding emission targets. More generally, we also show that evaluating the effectiveness of international environmental policies at the country level comes with a number of empirical challenges that may invalidate findings based on more traditional panel data approaches.

Evidence of variable discount rates and non-standard discounting in mortality risk valuation

- Journal of Environmental Economics and Management---2017---Rebecca McDonald,S.M. Chilton,M.W. Jones-Lee,H.R.T. Metcalf

Time discounting is central to the valuation of future health and mortality risks in public sector allocative decision-making, particularly for environmental policies with delayed health impacts. Using a Risk-Risk trade-off survey, we elicit discount rates for fatality risks and establish discounting functional forms on both a sample and an individual level. We find wide variation in implicit discount rates for fatality risk between individuals, as well as between-individual heterogeneity in discounting functional forms. In aggregate, the sample is best characterised by subadditive discounting. Our work has implications for the academic investigation of intertemporal choice involving mortality risks, and potentially for the evaluation of policy options with delayed mortality risk outcomes. A thought experiment

cautions against the standard practice of assuming that exponential discounting characterises society's time preferences.

Temporal displacement of environmental crime: Evidence from marine oil pollution

- Journal of Environmental Economics and Management---2017---Ben Vollaard

We provide evidence for temporal displacement of illegal discharges of oil from shipping, a major source of ocean pollution, in response to a monitoring technology that features variation in the probability of conviction by time of day. During the nighttime, evidence collected by Coast Guard aircraft using radar becomes contestable in court because the nature of an identified spot cannot be verified visually by an observer on board of the aircraft. Seasonal variation in time of sunset is used to distinguish evasive behavior from daily routines on board. Using data from surveillance flights above the Dutch part of the North Sea during 1992–2011, we provide evidence for a sudden increase in illegal discharges after sunset across the year. Our results show that even a tiny chance of getting caught and a mild punishment can have a major impact on behavior.

The effects of license plate-based driving restrictions on air quality: Theory and empirical evidence

- Journal of Environmental Economics and Management---2017---Wei Zhang,C.-Y. Cynthia Lin Lawell,Victoria I. Umanskaya

A typical driving restriction prohibits drivers from using their vehicles on given weekdays, based on the last digits of their vehicles' license plates. A number of cities in developing countries have used license plate-based driving restrictions as a policy for reducing urban air pollution and traffic congestion. This paper develops a theoretical model of the effects of license plate-based driving restrictions on air quality that combines an economic model with information about the sources and atmospheric chemistry of different air pollutants.

We then draw upon suggestive empirical evidence from license plate-based driving restrictions implemented in Bogotá, Colombia. Consistent with our theory model, we find suggestive empirical evidence that under certain circumstances, due to substitution, the purchase of a second car, the use of alternative modes of transportation, and/or atmospheric chemistry, it is possible for license plate-based driving restrictions to increase air pollution. Also consistent with our theory, we find that license plate-based driving restrictions may have different effects on different air pollutants, reflecting heterogeneity in the sources and atmospheric chemistry of the pollutants. In particular, owing to atmospheric chemistry, it is possible for a license plate-based driving restriction to cause a significant decrease in NO and a significant increase in NO₂, NO_x, and O₃.

Does the presence of wind turbines have negative externalities for people in their surroundings? Evidence from well-being data

- Journal of Environmental Economics and Management---2017---Christian Krekel,Alexander Zerrahn

Throughout the world, governments foster the deployment of wind power to mitigate negative externalities of conventional electricity generation, notably CO₂ emissions. Wind turbines, however, are not free of externalities themselves, particularly interference with landscape aesthetics. We quantify these negative externalities using the life satisfaction approach. To this end, we combine household data from the German Socio-Economic Panel Study (SOEP) with a novel panel dataset on over 20,000 installations. Based on geographical coordinates and construction dates, we establish causality in a difference-in-differences design. Matching techniques drawing on exogenous weather data and geographical locations of residence ensure common trend behaviour. We show that the construction of wind turbines close to households exerts significant negative external effects on residential well-being, although they seem both spatially and temporally limited, being restricted to about 4000m around households and decaying after five years at the latest. Ro-

bustness checks, including view shed analyses based on digital terrain models and placebo regressions, confirm our results.

Wireless alerts for extreme weather and the impact on hazard mitigating behavior

- Journal of Environmental Economics and Management---2017---Jeffrey S. Ferris,David Newburn

Wireless alerts delivered through mobile phones are a recent innovation in regulatory efforts toward preparation for extreme weather events including flash floods. In this article, we use difference-in-differences models of the number of car accidents from days with government issued alerts for flash flood events in Virginia. We find that wireless alert messages for flash flood warnings reduced car accidents by 15.9% relative to the counterfactual with non-wireless alert protocols. We also use a regression discontinuity model to analyze hourly traffic volume data immediately before and after a flash flood warning message is issued. We find that traffic volume is reduced by 3.1% immediately following the issuance of a wireless alert relative to before the alert. These results imply that wireless alert messages effectively reduce exposure to hazards associated with extreme weather.

Efficiency and environmental impacts of electricity restructuring on coal-fired power plants

- Journal of Environmental Economics and Management---2017---Hei Sing Chan,Harrison Fell,Ian Lange,Shanjun Li

We investigate the efficiency and environmental impacts of electricity market restructuring by examining changes in fuel efficiency, cost of coal purchases, and utilization among coal-fired power plants based on a panel data set from 1991 to 2005. Our study focuses exclusively on coal-fired power plants and uses panel data covering several years after implementation of restructuring. The estimation compares how investor-owned (IOs) plants in states with restructuring changed their

behavior relative to IOs in states without. Our analysis finds that restructuring led to: (1) a 1.4 percent improvement in fuel efficiency, (2) an 8 percent decrease in unit cost of heat input, and (3) a lower capacity factor even after adjusting for cross-plant generation re-allocation due to cost reductions. The estimates imply that restructuring has led to nearly 15 percent savings in operating expenses and up to 7.5 percent emissions reduction among these plants.

Does the conservation of land reduce development? An econometric-based landscape simulation with land market feedbacks

- Journal of Environmental Economics and Management---2017---Katherine Y. Zipp,David Lewis,Bill Provencher

We use an econometrically-based landscape simulation to investigate the effect of conservation on the net change in local development – the amount of land directly protected from development minus the amount of development that may occur on neighboring unprotected private land in response to conservation. First, we use spatial-panel data from Wisconsin to estimate parcel-level subdivision probabilities and density expectations, controlling for the endogenous location of open space. Second, we use these subdivision probabilities and density expectations in a landscape simulation model. Our simulation results indicate that 57% of conserved open space created between 1978 and 2009 generated close to zero net change in local development. This suggests that conserved open space mostly reallocated development in a small neighborhood (in a half-mile radius) rather than altering the total amount of development. We explore the landscape conditions that may lead to conservation having either a positive or negative effect on local development.

International environmental agreements for local and global pollution

- Journal of Environmental Economics and Management---2017---Michael Günther,Tim Hellmann

Increasing concerns about climate change have given rise to the formation of International Environmental Agreements (IEAs) as a possible solution to limit global pollution effects. In this paper, we study the stability of IEAs in a repeated game framework where we restrict to strategies which are simple and invariant to renegotiation. Our main contribution is that we characterize necessary and sufficient conditions for stability of an IEA when pollution has both a global and local effect. Local pollution spillovers are represented by a network structure. We find that stable IEAs exist if the network structure is balanced. Too large asymmetries in the degree of local spillovers may, however, lead to non-existence of stable structures. We also discuss the implications of our results for welfare. The generality of our approach allows for several applications, in particular the provision of public goods.

Uncovering context-induced status quo effects in choice experiments

- Journal of Environmental Economics and Management---2017---Malte Oehlmann,Jürgen Meyerhoff,Petr Mariel,Priska Weller

In this study five design dimensions are varied systematically investigating context-induced status quo effects in choice experiments. Additionally, two structural complexity measures, entropy and the number of attribute level changes, are used to capture status quo effects from the similarity between alternatives and the number of trade-offs. A crucial finding is that the frequency of status quo choices is negatively associated with the number of alternatives indicating preference matching effects. By contrast, the probability of choosing the status quo increases with a higher number of choice tasks, a wider level range, and the similarity between alternatives. Status quo choices are further affected by the current environmental situation perceived by respondents. We also find that marginal and non-marginal welfare estimates are significantly affected by the choice design. One key finding is that the most used choice task format in environmental economics, i.e., two hypothetical and a status quo alternative, is likely to increase the propensity to choose the status

quo option.

Ambiguity, reasoned determination, and climate-change policy

- Journal of Environmental Economics and Management---2017---Robert G. Chambers,Tigran Melkonyan

This paper examines climate-change benefit-cost analysis in the presence of scientific uncertainty in the form of ambiguity. The specific issue addressed is the robustness of benefit-cost analyses of climate-change policy alternatives to relaxation of Savage's original axioms. Two alternatives to subjective expected utility (SEU) are considered: maximin expected utility (MEU) and incomplete expected utility (IEU). Among other results, it is demonstrated that polar opposite recommendations can emerge in an ambiguous decision setting even if all agree on Society's rate of time preference, Society's risk attitudes, the degree of ambiguity faced, and the scientific primitives. We show that, for a simple numerical simulation of our model, an MEU decision maker favors policies which immediately tackle climate change while an IEU decision prefers "business as usual". "Each agency shall assess the costs and benefits of the intended regulation, and recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its cost." Executive Order 12866 of the US President.

The effects of adaptation measures on hurricane induced property losses: Which FEMA investments have the highest returns?

- Journal of Environmental Economics and Management---2017---Meri Davlasheridze,Karen Fisher-Vanden,Henry Klaiber

This paper evaluates the relative effectiveness of FEMA expenditures on hurricane induced property losses. We find that spending on FEMA ex-ante mitigation and planning projects leads to greater reductions in property losses than spending on ex-post adaptation

programs – specifically, a one percent increase in annual spending on ex-ante risk reduction and warning projects reduces damages by 0.21 percent while a one percent increase in ex-post recovery and clean-up spending reduces damages by 0.12. Although both types of program spending are effective, we find the marginal return from spending on programs that target long-term mitigation and risk management to be almost twice that of spending on ex-post recovery programs. With the predicted increases in the frequency and severity of North Atlantic hurricanes in the future, our findings suggest there are important potential gains that could be realized from the further diversification of FEMA spending across project categories.

Domestic politics and the formation of international environmental agreements

- Journal of Environmental Economics and Management---2017---Carmen Marchiori, Simon Dietz, Alessandro Tavoni

We investigate the effect of domestic politics on international environmental policy by incorporating into a classic stage game of coalition formation the phenomenon of lobbying by special-interest groups. In doing so, we contribute to the theory of international environmental agreements, which has overwhelmingly assumed that governments make decisions based on a single set of public-interest motivations. Our results suggest that lobbying on emissions may affect the size of the stable coalition in counterintuitive ways. In particular, a powerful business lobby may increase the government's incentives to sign an agreement, by providing it with strong bargaining power with respect to that lobby at the emission stage. This would result in lower total emissions when the number of countries involved is not too large. We also show that things change radically when lobbying bears directly on the membership decisions, suggesting that both the object and timing of lobbying matter for the way in which membership decisions, emissions and welfare are affected.

Are policy incentives for solar power effective? Evidence from residential installations in the Northeast

- Journal of Environmental Economics and Management---2017---Christine Lasco Crago, Ilya Chernyakhovskiy

State incentives for solar power have grown significantly in the past several years. This paper examines the effectiveness of policy incentives to increase residential solar photovoltaic (PV) capacity. We use county-level panel data and control for demographic characteristics, solar resources, and pro-environmental preferences. Results show that among financial incentives, rebates have the most impact with an additional \$1 per watt rebate increasing annual PV capacity additions by close to 50%. Factors that affect financial returns to solar PV such as electricity price and solar insolation are also found to be significant. Results also point to a significant positive relationship between hybrid vehicle sales and residential PV capacity growth, indicating the importance of pro-environmental preferences as a predictor of solar PV demand. Back of the envelope calculations suggest that the cost of carbon mitigation through rebates is around \$184 per ton of CO₂.

Choice set formation for outdoor destinations: The role of motivations and preference discrimination in site selection for the management of public expenditures on protected areas

- Journal of Environmental Economics and Management---2017---Mara Thiene, Joffre Swait, Riccardo Scarpa

Effective public expenditure currently dominates the management focus of many protected areas. This calls for explicit modeling of constraints and motivations that, respectively, obstruct and stimulate visits to selected outdoor destinations. Choice set formation is the result of screening and/or inclusion of specific sites (alternatives) to form the set of sites considered in real choices. Evidence shows that the omission of a structural representation of choice set formation is harmful

to econometric inference. Yet, the literature has largely ignored the underlying behavioral phenomenon. We show, using a discrete choice experiment involving selection among seven recreational sites in an Italian national park, that choice set formation is behaviorally relevant, even after controlling for preference discrimination. Motivations (why visit?) are important determinants of preliminary site screening for choice set inclusion, as well as site selection, justifying the additional value of such modeling extension.

The cost of endangered species protection: Evidence from auctions for natural resources

- Journal of Environmental Economics and Management---2017---Branko Bošković,Linda Nøstbakken

This paper examines the effect that endangered species regulation has on natural resource development. Specifically, we use data from competitive auctions to estimate the effect that land-use regulation protecting endangered caribou in the Canadian province of Alberta has on the price producers pay for the right to extract oil. We exploit a regression discontinuity design to evaluate how prices differ along regulation boundaries that constrain resource development. The auction format and the regulation discontinuity allow us to measure the total cost of the regulation. We find that producers pay 24% less on average for oil leases that are regulated and that the total net present value cost of the regulation exceeds \$1.15 billion for leases sold between 2003 and 2012, all of which is borne by the government. In spite of these costs, the populations of endangered caribou remain in widespread decline.

Using virtual environments to improve the realism of choice experiments: A case study about coastal erosion management

- Journal of Environmental Economics and Management---2017---Yvonne Matthews,Riccardo Scarpa,Dan Marsh

Choice experiment surveys are commonly used to assess the general public's willingness to pay for different

levels of environmental quality. However, respondents need to understand what they are valuing or they will make potentially wrong assumptions based on different experiences and frames of reference. Three-dimensional computer generated models or Virtual Environments (VE) have so far seen little use in economics research, probably due to the complexity and cost of developing and delivering them to study participants. The few studies that have used them find that VE are superior to static image presentations in helping people evaluate complex data. For this study we developed virtual environments for a choice experiment about coastal erosion management using free, easy-to-use software and Google Earth© satellite imagery and presented these to respondents as video tours. Our results indicate that the VE treatment reduced choice error, reduced left-right bias and improved respondent engagement and retention when compared with static images. There were also differences in WTP between the two groups.

Environmental policies and productivity growth: Evidence across industries and firms

- Journal of Environmental Economics and Management---2017---Silvia Albrizio,Tomasz Kozluk,Vera Zipperer

This paper investigates the impact of changes in environmental policy stringency on industry- and firm-level productivity growth in a panel of OECD countries. To test the strong version of the Porter Hypothesis (PH), we extend a neo-Schumpeterian productivity model to allow for effects of environmental policies. We use a new environmental policy stringency (EPS) index and let the effect of countries' environmental policies vary with the pollution intensity of the industry and with the countries' and firms' technological advancement. A tightening of environmental policy is associated with a short-term increase in industry-level productivity growth in the most technologically-advanced countries. This effect diminishes with the distance to the global productivity frontier, eventually becoming insignificant. For the average firm, no evidence of PH is found. However, the most productive firms see a temporary boost in productivity growth, while the less productive ones

experience a productivity slowdown.

When is increasing consumption of common property optimal? Sorting, congestion and entry in the commons

- Journal of Environmental Economics and Management---2017---Jonathan Hughes, Daniel Kaffine

First-best pricing or assignment of property rights for rival and non-excludable goods is often infeasible. In a setting where the social planner cannot limit total use, we show that common-property resources can be over or under-consumed. This depends on whether the external benefits of reallocating users to less congested resources outweigh the additional costs imposed by new entrants. Importantly, we show that it may be optimal to encourage consumption of some common property resources. Our results have important implications for settings ranging from fisheries and forestry to recreational demand and transportation.

What ails the European Union's emissions trading system?

- Journal of Environmental Economics and Management---2016---Stephen Salant

The European Union has adopted economists' idea of curbing carbon emissions by establishing markets where bankable emissions allowances can be traded. Implicit in proofs that cap-and-trade minimizes the expected discounted cost of capping emissions, however, is that the regulator not intervene once the market is established. Otherwise market participants encounter uncertainties beyond what a social planner faces. This paper discusses the equilibrium that results when private agents bank tradable allowances in the face of ongoing risk of future regulatory intervention and shows that the cap will be achieved at unnecessarily high cost even if no regulatory intervention actually occurs. Evidence that such risks are currently distorting EU ETS comes from the depressed current spot price, from the findings of Schopp and Neuhoﬀ (2014) that speculators require multiples of the riskless rate of interest to bank

permits, and from the sensitivity of prices to votes and announcements about proposed future regulatory changes.

Emissions trading systems with cap adjustments

- Journal of Environmental Economics and Management---2016---Sascha Kollenberg, Luca Taschini

Emissions Trading Systems (ETSs) with fixed caps lack provisions to address systematic imbalances in the supply and demand of permits due to changes in the state of the regulated economy. We propose a mechanism which adjusts the allocation of permits based on the current bank of permits. The mechanism spans the spectrum between a pure quantity instrument and a pure price instrument. We solve the firms' emissions control problem and obtain an explicit dependency between the key policy stringency parameter—the adjustment rate—and the firms' abatement and trading strategies. We present an analytical tool for selecting the optimal adjustment rate under both risk-neutrality and risk-aversion, which provides an analytical basis for the regulator's choice of a responsive ETS policy.

Procrastinating reform: The impact of the market stability reserve on the EU ETS

- Journal of Environmental Economics and Management---2016---Grischa Perino, Maximilian Willner

We study the impact of the market stability reserve (MSR) on price and emission paths of the EU ETS. From 2019 onwards, the MSR will adjust the number of allowances auctioned as a function of the size of the surplus, i.e. in times of a large surplus it shifts the issue date of allowances into the future. In a perfectly competitive allowance market the MSR only affects price and emission paths if the baseline equilibrium becomes unfeasible. If the MSR is binding, prices increase in the short run but drop in the medium run relative to the baseline. The MSR increases price variability if uncertainty over future allowance demand is resolved while there is a surplus. The long run

cap is unaffected by both the MSR and overlapping climate policies. This contrasts the EU's objectives of improving the resilience of the EU ETS and increasing synergies with overlapping climate policies.

Comparing policies to confront permit over-allocation

- Journal of Environmental Economics and Management---2016---Harrison Fell

Instability in cap-and-trade markets, particularly with respect to permit price collapses, has been an area of concern for regulators. To that end, several policies, including hybrid price-quantity mechanisms and the newly introduced “market stability reserve” (MSR) systems, have been introduced and even implemented in some cases. I develop a stochastic dynamic model of a cap-and-trade system, parameterized to values relevant to the European Union's Emission Trading System (EU ETS) to analyze the performance of these policies aimed at adding stability to the system or at least at reducing perceived over-allocations of permits. Results suggest that adaptive-allocation mechanisms such as a price collar or MSR can reduce permit over-allocations and permit price volatility in a more cost-effective manner than simply reducing scheduled permit allocations. However, it is also found that the performance of these adaptive allocation policies, and in particular the MSR, are greatly affected by assumed discount rates and policy parameters.

Reprint of: Price and quantity collars for stabilizing emission allowance prices: Laboratory experiments on the EU ETS market stability reserve

- Journal of Environmental Economics and Management---2016---Charles Holt, William Shobe

We report on laboratory experiments, with financially motivated participants, comparing alternative proposals for managing the time path of emission allowance prices in the face of random firm-specific and market-level structural shocks. Market outcome measures such as social surplus and price variability are improved by

the use of a price collar (auction reserve price and soft price cap). Comparable performance enhancements are not observed with the implementation of a quantity collar that adjusts auction quantities in response to privately held inventories of unused allowances. In some specifications, the quantity collar performed worse than no stabilization policy at all. The experiment implemented a specific set of structural elements, and extrapolation to other settings should be done with caution. Nevertheless, an examination of the observed behavioral patterns and deviations from optimal behavior suggests that a price collar has an important (although perhaps not exclusive) role to play in constructing an effective market stability policy.

Measuring the rebound effect with micro data: A first difference approach

- Journal of Environmental Economics and Management---2016---Bruno De Borger, Ismir Mulalic, Jan Rouwendal

We provide estimates of the rebound effect for car transport in Denmark, using a rich data set with individual household data on car use, fuel efficiency, and car as well as household characteristics. A demand model is estimated in first differences; the availability of households in the sample that replaced their car during the period of observation combined with information on their driving behaviour before and after the car switch allows us to identify the rebound effect. Endogeneity is taken into account by using appropriate instruments. Results include the following. First, we reject the ‘conventional’ formulation in which only fuel cost per kilometre matters. Second, the selection equation confirms that higher fuel prices induce households to switch car. Third, the results suggest the presence of a rebound effect that is on the lower end of the estimates available in the literature. Specifically, our best estimate of the rebound effect is some 7.5–10%. Fourth, the fuel price sensitivity of the demand for kilometres appears to be declining with household income, but we do not find a significant impact of income on the rebound effect. Finally, simulation results indicate that the small rebound effect and changes in car charac-

teristics in response to higher fuel prices imply that – compared to the reference scenario – higher fuel prices lead to a substantial reduction in both the demand for kilometres and in demand for fuel.

The effect of air pollution on mortality in China: Evidence from the 2008 Beijing Olympic Games

- Journal of Environmental Economics and Management---2016---Guojun He, Maoyong Fan, Maigeng Zhou

By exploiting exogenous variations in air quality during the 2008 Beijing Olympic Games, we estimate the effect of air pollution on mortality in China. We find that a 10 percent decrease in PM10 concentrations reduces the monthly standardized all-cause mortality rate by 8 percent. Men and women are equally susceptible to air pollution risks. The age groups for which the air pollution effects are greatest are children under 10 years old and the elderly.

The effect of competition on toxic pollution releases

- Journal of Environmental Economics and Management---2016---Daniel H. Simon, Jeffrey Prince

We examine how competition affects toxic industrial releases, using five years of data from thousands of facilities across hundreds of industries. Our main result indicates that competition reduces toxic releases at the facility level. On average, each percentage-point reduction in the Herfindahl Index (HHI) results in a nearly two-percent reduction in a facility's toxic releases. At the same time, we find no evidence that competition increases aggregate pollution. Further analysis sheds some light on the mechanisms through which firms reduce pollution releases due to increased competition. In particular, we find suggestive evidence that this relationship is due to both reduced output and increases in abatement. We find no evidence that our result is driven by: consumer aversion to pollution, regulations changing with competition, or technologies introduced by new firms. Taken together, our results

indicate that competition may be good, at least for public health in areas near polluting facilities, and fail to provide support for the hypothesis that competition leads to more socially undesirable behavior.

Do plants' emissions respond to ambient environmental quality? Evidence from the clean water act

- Journal of Environmental Economics and Management---2016---Lopamudra Chakraborti

In this paper we show that plants respond to downstream ambient water quality after controlling for permitted levels of pollution. We find if past water quality declines by one percent, plants reduce current pollution by 0.35 percent. The magnitude of this coefficient is comparable to the coefficient on permitted discharge levels i.e. regulatory stringency itself. Results are consistent with two mechanisms. First, a decline in water quality may lead to more stringent permits that would raise the cost of abatement of a plant significantly. Second, the plant is likely to be subject to increased public pressure in response to poor water quality. Indeed, as expected, the impact of water quality becomes stronger in locations with higher median household income, higher percent carpooling to work, or lower percent of manufacturing employment but surprisingly with lower median age of residents, lower percent with bachelor's degree or higher percent of families with children.

Firm behavior under quantity controls: The theory of virtual quantities

- Journal of Environmental Economics and Management---2016---Dale Squires

The theory of virtual quantities, the dual to virtual prices, provides a framework to analyze competitive multiproduct firm behavior under multiple quantity controls on inputs and outputs, including command-and-control quotas and transferable property rights. The framework addresses the firm's reactions to regulatory controls, impacts of adding or dropping quantity

controls, inferring unrationed from rationed production, and conversion from command-and-control quotas to cap-and-trade systems with transferable property rights and secondary market behavior. The paper develops reasons for failure of quasi-concavity of technology, extends the elasticity of intensity properties, and integrates the virtual price and virtual quantity frameworks. Virtual quantities are applied to assess potential firm responses to quantity controls and a potential transferable property right in a Malaysian fishery.

Cross-country electricity trade, renewable energy and European transmission infrastructure policy

- Journal of Environmental Economics and Management---2016---Jan Abrell,Sebastian Rausch

This paper develops a multi-country multi-sector general equilibrium model, integrating high-frequency electricity dispatch and trade decisions, to study the effects of electricity transmission infrastructure (TI) expansion and renewable energy (RE) penetration in Europe for gains from trade and carbon dioxide emissions in the power sector. TI can benefit or degrade environmental outcomes, depending on RE penetration: it complements emissions abatement by mitigating dispatch problems associated with volatile and spatially dispersed RE but also promotes higher average generation from low-cost coal if RE production is too low. Against the backdrop of European decarbonization and planned TI expansion, we find that emissions increase for current and targeted year-2020 levels of RE production and decrease for year-2030 targets. Enhanced TI yields sizeable gains from trade that depend positively on RE penetration, without creating large adverse impacts on regional equity.

Conservation policies: Who responds to price and who responds to prescription?

- Journal of Environmental Economics and Management---2016---Casey Wichman,Laura Taylor,Roger von Haefen

The efficiency properties of price and nonprice instruments for conservation in environmental policy are well understood. However, there is little evidence comparing the effectiveness of these instruments, especially when considering water resource management. We exploit a rich panel of residential water consumption data to examine heterogeneous responses to both price and nonprice conservation policies during times of drought while controlling for unobservable household characteristics. Our empirical models suggest that among owners of detached, single-family homes in six North Carolina municipalities, relatively low-income households are more sensitive to price and relatively high-consumption households are less sensitive to price. However, prescriptive policies such as restrictions on outdoor water use result in uniform responses across income levels, while simultaneously targeting reductions from households with irrigation systems and historically high consumption.

Climate variability and international migration: The importance of the agricultural linkage

- Journal of Environmental Economics and Management---2016---Ruohong Cai,Shuaizhang Feng,Michael Oppenheimer,Mariola Pytlikova

While there is considerable interest in understanding the climate-migration relationship, particularly in the context of concerns about global climatic change, little is known about its underlying mechanisms. In the paper, we combine a rich panel data on annual bilateral international migration flows with an extensive data on climate variability across the countries to investigate in-depth the climate-migration link. We find a positive and statistically significant relationship between temperature and international outmigration only in the most agriculture-dependent countries, consistent with the widely documented adverse impact of temperature on agricultural productivity. Further, the temperature-migration relationship is nonlinear and resembles the nonlinear temperature-yield relationship. In addition, migration flows to current major destinations are especially temperature-sensitive. Policies to address issues related to climate-induced international

migration would be more efficient if focused on the agriculture-dependent countries and especially people in those countries whose livelihoods depend on agriculture.

How certain are we about the certainty-equivalent long term social discount rate?

- Journal of Environmental Economics and Management---2016---Mark C. Freeman, Ben Groom

Theoretical arguments for using a term structure of social discount rates (SDR) that declines with the time horizon have influenced government guidelines in the US and Europe. The certainty equivalent discount rate that often underpins this guidance embodies uncertainty in the primitives of the SDR, such as growth. For distant time horizons the probability distributions of these primitives are ambiguous and the certainty equivalent itself is uncertain. Yet, if a limited set of characteristics of the unknown probability distributions can be agreed upon, ‘sharp’ upper and lower bounds can be defined for the certainty-equivalent SDR. Unfortunately, even with considerable agreement on these features, these bounds are widely spread for horizons beyond 75 years. So while estimates of the present value of intergenerational impacts, including the social cost of carbon, can be bounded in the presence of this ambiguity, they typically remain so imprecise as to provide little practical guidance.

Emissions cap or emissions tax? A multi-sector business cycle analysis

- Journal of Environmental Economics and Management---2016---Yazid Dissou, Lilia Karnizova

We develop a multi-sector business cycle model to analyze stochastic implications of reducing CO₂ emissions with carbon permits or with carbon taxes in the presence of multiple sources of macroeconomic uncertainty. The model is calibrated to reflect the U.S. experience. As in previous studies, using a single-sector version

of our model, we find that the cap regime generates lower volatility of real variables than the tax regime, but the latter may be preferable from the welfare perspective. Still, our multi-sector analysis points to the importance of the origin of the shocks in the ranking of the two instruments and to the desirability of going beyond a single-sector analysis in evaluating their merits. We find no significant difference between the cap and the tax regimes when shocks come from non-energy sectors. In contrast, the cap has lower volatility but higher welfare costs than the tax for the shocks to energy production.

Coalition formation in fisheries with potential regime shift

- Journal of Environmental Economics and Management---2016---Steve Miller, Bruno Nkuiya

A system can undergo rapid regime shift in which the growth of natural resources suddenly and permanently declines. We examine how the threat of such a shift alters the strategic management of a common pool renewable resource. We consider exogenous and endogenous threats and examine their effects on both incentives to join a coalition and harvest decisions. We find that an exogenous threat of reduced resource growth may cause the coalition to grow in size, and, perhaps of most interest, we identify conditions under which members of the stable coalition reduce harvest while non-members increase harvest in response to the threat. In contrast, an exogenous threat of total stock collapse may destabilize coalitions, resulting in higher harvest from former members, but reduced harvest by non-members. When the threat of either type of shift is endogenous, the threat of regime shift can induce stable coalitions with more than two members. In particular, we identify cases in which the first best (full cooperation) is sustained as an equilibrium outcome. Finally, we find that the relation between the magnitude of the shift and the size of stable coalitions may be negative.

Incentives, green preferences, and private provision of impure public goods

- Journal of Environmental Economics and Management---2016---Casey Wichman

Pro-environmental preferences are being used increasingly in environmental policy. In this paper, I consider the role of heterogeneous green preferences for private provision of environmental goods that have both private and public characteristics. Under different assumptions of information available to a regulator, I characterize equilibrium properties of several mechanisms. I find incentive-compatible Nash equilibria that provide socially optimal public goods provision when the regulator can enforce individual consumption contracts, as well as when reported consumption contracts are supplemented with group penalties. Throughout the paper, I ground the exposition with examples of consumer behavior in the context of green electricity programs and goal setting for energy conservation.

Not fully charged: Welfare effects of tax incentives for employer-provided electric cars

- Journal of Environmental Economics and Management---2016---Alexandros Dimitropoulos, Jos van Ommeren, Paul Koster, Piet Rietveld

More than 15 million cars are provided as fringe benefits by employers in Europe. The company car market is the driving force of changes in European car fleets and one of the main channels for the penetration of low emission vehicles. Policies in support of low emission vehicles through this channel have been popular. This paper introduces an approach to estimate the welfare effects of policies linking company car tax base rates with vehicles' environmental impact. The approach is applied to evaluate the effects of tax advantages for electric company cars in the Netherlands. We find that the welfare losses caused by these policies are substantial, and even outweigh the foregone tax revenue. This result also holds if we assume that there are substantial future benefits from the adoption of electric company cars, e.g. in terms of positive network

externalities, technological innovation and concomitant environmental benefits.

Optimal timing of carbon capture policies under learning-by-doing

- Journal of Environmental Economics and Management---2016---Jean-Pierre Amigues, Gilles Lafforgue, Michel Moreaux

Using a standard Hotelling model of resource exploitation, we determine the optimal energy consumption paths from three options: dirty coal, which is non-renewable and carbon-emitting; clean coal, which is also non-renewable but carbon-free thanks to carbon capture and storage (CCS); and solar energy, which is renewable and carbon-free. We assume that the atmospheric carbon stock cannot exceed an exogenously given ceiling. Taking into account learning-by-doing in CCS technology, we show the following results: (i) clean coal exploitation cannot begin before the outset of the carbon constrained phase and must stop strictly before the end of this phase; (ii) the energy price path can evolve non-monotonically over time; and (iii) when the solar cost is low enough, an unusual energy consumption sequence along with solar energy is interrupted for some time and replacement by clean coal may exist.

Does localized imitation drive technology adoption? A case study on rooftop photovoltaic systems in Germany

- Journal of Environmental Economics and Management---2016---Johannes Rode, Alexander Weber

The purpose of this paper is to illuminate the spatio-temporal diffusion of rooftop household photovoltaic installations in Germany and to test whether localized imitation drives their adoption. Our study is based on a unique data set of some 576,000 household photovoltaic systems installed in Germany through 2009. We employ an epidemic diffusion model which includes a spatial dimension, and control for temporal and spatial heterogeneity. According to our results, imitative

adoption behavior is highly localized and an important factor for the diffusion of household photovoltaic systems.

Forest loss, monetary compensation, and delayed re-planting: The effects of unpredictable land tenure in China

- Journal of Environmental Economics and Management---2016---Stephen Salant,Xueying Yu

Over the past 65 years, forest tenure in China has oscillated unpredictably between private and village property regimes. This policy-induced uncertainty has distorted the harvesting decisions of individuals granted rights to grow trees and has lowered the value of China's forest output. We provide an analytical framework for assessing these effects quantitatively. Understanding the consequences of this policy-induced uncertainty is particularly important since China is currently engaged in an ambitious plan to increase its domestic supply of timber. To conduct this analysis, we extend the literature on forestry economics when there is a risk of loss due to forest fire or pests. We (1) take account of the possibility that replanting can only resume after an interval of uncertain length (with immediate replanting as a special Case); (2) investigate the effects of compensation for such losses based only on the net value of the stand of trees at the time of the loss; and (3) compare it to compensation that would leave the wealth and rotation decisions of the farmer unaffected by the presence of uncertainty.

International environmental agreements with consistent conjectures

- Journal of Environmental Economics and Management---2016---Alejandro Gelves,Matthew McGinty

We introduce consistent conjectures into Barrett (1994) canonical model of international environmental agreements. The existing literature assumes inconsistent Nash conjectures, despite the fact that policymakers recognize that abatement levels are strategic substitutes and increases in abatement generate carbon leak-

age. With consistent conjectures much of the conventional wisdom is reversed. The non-cooperative abatement level is below the Nash equilibrium. The difference between Nash and consistent conjectures is greatest when benefits are large and costs are small. We find that large coalitions cannot form. However, small coalitions can result in substantial increases in abatement relative to the non-cooperative outcome.

Second-best carbon taxation in the global economy: The Green Paradox and carbon leakage revisited

- Journal of Environmental Economics and Management---2016---Frederick (Rick) van der Ploeg

Acceleration of global warming resulting from a future carbon tax is large if the price elasticities of oil demand are large and that of oil supply is small. The fall in the world interest rate weakens this weak Green Paradox effect, especially if intertemporal substitution is weak. Still, social damages from greenhouse gases drop if the fall in oil supply and cumulative emissions is strong enough. If the current carbon tax is set too low, the second-best future carbon tax is set below the first best too to mitigate adverse Green Paradox effects. Unilateral second-best optimal carbon taxes exceed the first-best taxes due to an import tariff component. The intertemporal terms of trade effects of the future carbon tax increase current and future tariffs and those of the current tax lower the current tariff. Finally, carbon leakage and globally altruistic and unilateral second-best optimal carbon taxes if non-Kyoto oil importers price carbon too low are analysed in a three-country model of the global economy.

Warm glow from green power: Evidence from Australian electricity consumers

- Journal of Environmental Economics and Management---2016---Chunbo Ma,Michael Burton

Green electricity products are increasingly made available to consumers in many countries in order to address a number of environmental and social concerns.

Most of the literature on this green electricity market focuses on consumers' characteristics and product attributes that could affect participation. However, the contribution of this environmental consumerism to the overall environmental good does not depend on participation alone. The real impact relies on market participation for green consumers (the proportion of green consumers) combined with the level of green consumption intensity – the commitment levels, or proportion of consumption that is green. We design an online interface that closely mimics the real market decision environment for electricity consumers in Western Australia and use an error component model to analyze consumers' choice of green electricity products and their commitment levels. We show that product attributes have limited impact on the choice of green products; however, there is still great potential for better participation by improving the design of green electricity programs. When green products are selected, most respondents select the minimum commitment possible, and this is insensitive to the premium being charged on green power, suggesting that we are largely observing a buy-in 'warm glow' for carbon mitigation.

Politics matters: Regulatory events as catalysts for price formation under cap-and-trade

- Journal of Environmental Economics and Management---2016---Nicolas Koch,Godefroy Grosjean,Sabine Fuss,Ottmar Edenhofer

This paper investigates how the political process of making cap adjustments has shaped market outcomes in the world's largest cap-and-trade system – the EU ETS. Capitalizing on an event study method that incorporates an econometric technique designed to handle parameter instability and model uncertainty, we assess the news-implied price response to 29 hand-collected announcements about the EU ETS supply schedule. Our findings document a high market responsiveness to political events and reveal how market participants view the evolution of cap stringency in the light of a particular announcement. We provide evidence that a sequence of strong event-induced price drops evolve

in the backloading decision process, which is consistent with the interpretation that market participants' confidence in the political support for reform, and probably the EU ETS in general, has been unsettled. We also document positive price reactions to the 2020 and 2030 policy packages, but not the 2050 roadmaps.

Toward a delineation of the circumstances in which cooperation can be sustained in environmental and resource problems

- Journal of Environmental Economics and Management---2016---Daan van Soest,Jan Stoop,Jana Vyrastekova

Play in standard laboratory Public Good games suggests that on average, humans are quite prone to cooperate. Yet cooperation is often absent in real world social dilemmas, including many environmental problems. We propose that this discrepancy arises because in the Public Good game, the worst freeriders can do is to not contribute to the public account, while in many real world environmental situations freeriders can even appropriate contributions made by others before the public good is produced. We introduce the Claim Game that modifies the Public Good game by allowing for appropriating the contributions of others before the public good is produced. The impact of such possible takings on public good production is dramatic. No public good is produced, not even in the initial stages of interaction. We link our findings to the relevance of common pool games for modeling environmental problems, and stress the need to experimentally test environmental institutions within harsher social dilemmas than the standard Public Good game.

Valuation of expectations: A hedonic study of shale gas development and New York's moratorium

- Journal of Environmental Economics and Management---2016---Andrew Boslett,Todd Guilfoos,Corey Lang

This paper examines the local impacts of shale gas development (SGD). We use a hedonic framework and

exploit a discrete change in expectations about SGD caused by the New York State moratorium on hydraulic fracturing. Our research design combines difference-in-differences and border discontinuity, as well as underlying shale geology, on properties in Pennsylvania and New York. Results suggest that New York properties that were most likely to experience both the financial benefits and environmental consequences of SGD dropped in value 23% as a result of the moratorium, which under certain assumptions indicates a large and positive net valuation of SGD.

Thanks but no thanks: A new policy to reduce land conflict

- Journal of Environmental Economics and Management---2016---Martin Dufwenberg,Gunnar Köhlin,Peter Martinsson,Haileselassie Medhin

Land conflicts in developing countries are costly both directly and through increased land degradation. An important policy goal is to create respect for borders. This often involves mandatory, expensive interventions. We propose a new policy design, which in theory promotes neighborly relations at low cost. A salient feature is the option to by-pass regulation through consensus. The key idea combines the insight that social preferences transform social dilemmas into coordination problems with the logic of forward induction. As a first, low-cost pass at empirical evaluation, we conduct an experiment among farmers in the Ethiopian highlands, a region exhibiting features typical of countries where borders are often disputed.

Vertical fiscal externalities and the environment

- Journal of Environmental Economics and Management---2016---Christoph Böhringer,Nicholas Rivers,Hidemichi Yonezawa

We show that imposition of a state-level environmental tax in a federation crowds out pre-existing federal taxes. We explain how this vertical fiscal externality can lead unilateral state-level environmental policy to generate a welfare gain in the implementing state, at the expense of other states, even absent any environmental benefits.

Using a computable general equilibrium model of the Canadian federation, we show that vertical fiscal externalities can be the major determinant of the welfare change following environmental policy implementation by a state government. Our numerical simulations indicate that – as a consequence of vertical fiscal externalities – state governments can reduce greenhouse gas emissions by over 20 percent without any net cost to themselves.

A simple formula for the social cost of carbon

- Journal of Environmental Economics and Management---2016---Inge van den Bijgaart,Reyer Gerlagh,Matti Liski

The social cost of carbon (SCC) is the monetized damage from emitting one unit of CO₂ to the atmosphere, often obtained from computational Integrated Assessment Models (IAMs). We develop a closed-form formula that approximates the SCC for a general economy, and then explore the capacity of the analytical approach to capture the key SCC drivers and thus to replicate the results of the deterministic IAMs. The formula explains the parameter-driven SCC variation of a mainstream IAM without a systematic bias. The sensitivity analysis identifies and measures the performance limits of the closed-form formulas. We then use the analytic formula to structurally interpret a distribution of SCCs from deterministic IAMs, and develop an analytical breakdown and quantification of how different sets of parameters contribute to the SCC distribution. This allows the user of the formula to evaluate where particular parameter choices tend to place the resulting SCC outcome in the distribution of outcomes for the universe of deterministic IAMs.

Environmental pollution and biodiversity: Light pollution and sea turtles in the Caribbean

- Journal of Environmental Economics and Management---2016---Michael Brei,Agustín Pérez-Barahona,Eric Strobl

We examine the impact of pollution on biodiversity by studying the effect of coastal light pollution on the sea

turtle population in the Caribbean. To this end we assemble a panel data set of sea turtle nesting activity and satellite-derived measures of nighttime light. Controlling for the surveyor effort, the local economic infrastructure, and spatial spillovers, we find that nighttime light significantly reduces the number of sea turtle nests. According to data on replacement costs for sea turtles raised in captivity, our result suggests that the increase in lighting over the last two decades has resulted in the loss of close to 1800 sea turtles in the Caribbean, worth up to \$288 million. Incorporating our empirical estimates into a stage-structured population model, we discover that the dynamic effect of nighttime light on future generations of sea turtles is likely to be much larger, with a cost of approximately \$2.8 billion for Guadeloupe alone. More generally, our study provides a new approach to valuing the cost of environmental pollution associated with species extinction.

Time delay, complexity and support for taxation

- Journal of Environmental Economics and Management---2016---Silvia Tiezzi, Erte Xiao

People often experience the benefits of taxation over time. We design an intertemporal market experiment with negative externalities to examine how delaying the benefits of taxation affects support for taxes. We find that when negative externalities occur immediately, people learn to adopt Pigouvian taxes, which are aimed at reducing negative externalities and restoring market efficiency. By contrast, when negative externalities are delayed, people are less receptive to taxation. This effect persists over time. Our data reveal that the strong negative delay effect can be explained in large part by narrow bracketing and the increased perceived complexity of the environment, rather than by time discounting per-se. We argue and demonstrate that increasing the transparency of intertemporal tradeoffs can effectively promote support for taxation.

Can indifference make the world greener?

- Journal of Environmental Economics and Management---2016---Johan Egebark, Mathias Ek-

ström

We conducted a natural field experiment to evaluate two resource conservation programs. One intervention consisted of a moral appeal message asking university employees to cut back on printing in general, and to use double-sided printing whenever possible. The other intervention tested whether people's tendency to stick with pre-set alternatives is applicable to resource use: at random points in time we changed the default setting on the university printers, from single-sided to double-sided printing. Whereas the moral appeal had no impact, the default change cut paper use by 15 percent. Further analysis adds two important insights. First, we show that defaults influence behavior also in the longer run. Second, we present results indicating that resource efficient defaults have the advantage of avoiding unintended behavioral responses. Overall, our findings send a clear message to anyone concerned about resource conservation: there are potentially large gains to be made from small interventions.

An empirical study of federal law versus local environmental enforcement

- Journal of Environmental Economics and Management---2016---Eric Sjöberg

A potential problem with local enforcement of national legislation is the varying degrees of implementation that the decentralized structure may create. To study the severity of this problem, induced by the mismatch of local and national incentives, I look at the enforcement of the Swedish Environmental Code which is enforced at the local level. I measure enforcement in terms of environmental fines issued in each of Sweden's 290 municipalities. I argue that the Green Party values the tradeoff between business friendliness and environmental concerns differently from other parties. Using both a difference-in-differences approach and IV, I find that municipalities with the Green Party in the ruling coalition issue more fines than other municipalities. This is problematic from an efficiency and equality perspective. The result suggests that politicians do not only affect environmental policy, but also that for

a given policy, they can affect the outcome through implementation and enforcement.

Endogenous vs. exogenous regulations in the commons

- Journal of Environmental Economics and Management---2016---Anna Lou Abatayo, John Lynham

It is widely believed that there is strong experimental evidence to support the idea that exogenously imposed regulations crowd out the intrinsic motivations of common pool resource (CPR) users to refrain from over-harvesting. We introduce a novel experimental design that attempts to disentangle potential confounds in previous experiments. A key feature of our experimental design is to have the exact same regulations chosen endogenously as those that are imposed exogenously. When we compare the same regulations chosen endogenously to those externally imposed, we observe no differences in extraction levels among CPR users in a laboratory experiment. We also observe no differences between weak external regulations and no regulations, after controlling for a potential confound. However, when we add communication to our endogenous treatment, we observe significant behavioral differences between endogenous regulations with communication and exogenous regulations without communication. Our results suggest that externally imposed regulations do not crowd out intrinsic motivations in the lab and they confirm that communication facilitates cooperation to reduce extraction.

Long-run changes in radiative forcing and surface temperature: The effect of human activity over the last five centuries

- Journal of Environmental Economics and Management---2016---Theologos Dergiades, Robert Kaufmann, Theodore Panagiotidis

We test two hypotheses that are derived from the anthropogenic theory of climate change. The first postulates that a growing population and increasing economic activity increase anthropogenic emissions of

radiatively active gases relative to natural sources and sinks, and this alters global biogeochemical cycles in a way that increases the persistence of radiative forcing and temperature. The second postulates that the increase in the persistence of radiative forcing transmits a stochastic trend to the time series for temperature. Results indicate that the persistence of radiative forcing and temperature changes from $I(0)$ to $I(1)$ during the last 500 years and that the $I(1)$ fingerprint in radiative forcing can be detected in a statistically measureable fashion in surface temperature. As such, our results are consistent with the physical mechanisms that underlie the theory of anthropogenic climate change.

Polluting thy neighbor: Unintended consequences of China's pollution reduction mandates

- Journal of Environmental Economics and Management---2016---Hongbin Cai, Yuyu Chen, Qing Gong

This paper studies how the pollution reduction mandates imposed by China's central government in 2001 triggered unanticipated responses from its provinces. We apply the difference-in-differences-in-differences (DDD) method to a unique dataset on industry-level activities in counties along 24 major rivers in China from 1998 through 2008. We find that the most downstream county of a province has up to 20 percent more water-polluting activities than otherwise identical counties since 2001. Moreover, we find that the enforcement of pollution fee collection is more lenient in the most downstream county of a province, and that private firms contribute more to the downstream effect than state-owned enterprises and foreign firms. These findings are consistent with the hypothesis that the provincial governments respond to the pollution reduction mandates by shifting their enforcement efforts away from the most downstream county.

Impacts of climate change on agriculture: Evidence from China

- Journal of Environmental Economics and Management---2016---Shuai Chen, Xiaoguang

To move China's climate policy forward, improved analyses of climate impacts on economic sectors using rigorous methodology and high quality data are called for. We develop an empirical framework, using fine-scale meteorological data, to estimate the link between corn and soybean yields and weather in China. We find that (i) there are nonlinear and inverted U-shaped relationships between crop yields and weather variables; (ii) global warming has caused an economic loss of about \$820 million to China's corn and soybean sectors in the past decade; and (iii) corn and soybean yields are projected to decline by 3–12% and 7–19%, respectively, by 2100.

Coasean bargaining in the presence of Pigouvian taxation

- Journal of Environmental Economics and Management---2016---Ian MacKenzie, Markus Ohndorf

Coasean arguments against the Pigouvian perspective are well established. A central tenet in this criticism argues that a Pigouvian tax may be a source of inefficiency: if parties were to bargain in the presence of a Pigouvian tax, (allocative) inefficiencies would occur—the so-called Buchanan–Stubblebine–Turvey Theorem. By analyzing a Coasean environment where the appropriation of property rights is costly, we show Coasean bargaining in the presence of a pre-existing (Pigouvian) tax may be superior. This has implications for policy where dual regulatory environments exist, such as regulation at the state and federal level, as well as environmental liability and litigation.

Tax versus emissions trading scheme in the long run

- Journal of Environmental Economics and Management---2016---Takayoshi Shinkuma, Hajime Sugeta

In this paper we compare the performance of emission taxes and tradable permits under free market entry

when firms face idiosyncratic ex ante cost uncertainty. We show that under auctioned permits insufficient entry occurs, while under a linear emission tax scheme, depending on parameters, market entry can be either excessive or insufficient. Our long-run analysis thus contrasts with Spulber's (1985) equivalence result and also modifies Weitzman's result in favor of an ETS in that the superiority of a tax over an ETS is not guaranteed, even when the Weitzman condition favors a tax. We also show that an ETS is superior to a tax scheme when the entry cost is low and the magnitude of uncertainty/asymmetric information and the size of the output market are large.

Impact of foot-and-mouth disease status on deforestation in Brazilian Amazon and cerrado municipalities between 2000 and 2010

- Journal of Environmental Economics and Management---2016---Maria S. Bowman

Deforestation in the Brazilian Amazon released approximately 5.7 billion tons of CO₂ to the atmosphere between 2000 and 2010, and 50–80% of this deforestation was for pasture. Most assume that increasing demand for cattle products produced in Brazil caused this deforestation, but the empirical work to-date on cattle documents only correlations between cattle herd size, pasture expansion, cattle prices, and deforestation. This paper uses panel data on deforestation and foot-and-mouth disease (FMD) status—an exogenous demand shifter—to estimate whether changes in FMD status caused new deforestation in municipalities in the Brazilian Amazon and cerrado biomes during the 2000–2010 period. Results suggest that, on average, becoming certified as FMD-free caused a temporary spike in deforestation in the 2 years after a municipality became FMD-free, but caused subsequent deforestation to decline relative to infected municipalities during the 2000–2010 period.

Valuation of small and multiple health risks: A critical analysis of SP data applied to food and water safety

- Journal of Environmental Economics and Management---2016---Henrik Andersson, Arne Hole, Mikael Svensson

This study elicits individual risk preferences in the context of an infectious disease using choice experiments. A main objective is to examine scope sensitivity using a novel approach. Our results suggest that the value of a mortality risk reduction (VSL) is highly sensitive to the survey design. Our results cast doubt on the standard scope sensitivity tests in choice experiments, but also on the validity and reliability of VSL estimates based on stated-preference studies in general. This is important due to the large empirical literature on non-market evaluation and the elicited values' central role in policy making.

Corporate governance and green innovation

- Journal of Environmental Economics and Management---2016---Mario Daniele Amore, Morten Bønnedsen

We study the relationship between corporate governance and firms' environmental innovation. Exploiting changes in antitakeover legislation in the US, we show that worse governed firms generate fewer green patents relative to all their innovations. This negative effect is greater for firms with a smaller share of institutional ownership, with a smaller stock of green patents, and with more binding financial constraints. Investigating regulatory and industry variations, we also find more pronounced effects for firms operating in states with lower pollution abatement costs, and in sectors less dependent on energy inputs. Overall, our results suggest that ineffective corporate governance may constitute a major obstacle to environmental efficiency.

Models-as-usual for unusual risks? On the value of catastrophic climate change

- Journal of Environmental Economics and Management---2015---Antoine Bommier, Bruno Lanz, Stéphane Zuber

We study the role of intertemporal preference representations in a model of economic growth, stock pollutant and endogenous risk of catastrophic collapse. We contrast two polar instances of risk-sensitive preferences: the traditional "discounted utility" model, which imposes a positive rate of pure time preference and risk neutrality with respect to intertemporal utility, and multiplicatively separable preferences, which display risk aversion in that dimension but no pure time preferences. We show that both representations of preferences can rationalize the same economy when there is no collapse risk associated with pollution. Once we introduce a collapse risk whose hazard rate depends on the pollution stock, multiplicatively separable preferences are associated with a much higher value of catastrophic risk reduction, and a more stringent policy response. A relatively high discount rate may thus be compatible with large emissions abatement in the face of a low probability large impact event, reflecting preferences for catastrophic risk reduction.

Salience of carbon taxes in the gasoline market

- Journal of Environmental Economics and Management---2015---Nicholas Rivers, Brandon Schaufele

We demonstrate that the carbon tax imposed by the Canadian province of British Columbia caused a decline in short-run gasoline demand that is significantly greater than would be expected from an equivalent increase in the market price of gasoline. That the carbon tax is more salient, or yields a larger change in demand than equivalent market price movements, is robust to a range of specifications. As a result of the large consumer response to the tax, we calculate that during its first four years, the tax reduced carbon dioxide emissions from gasoline consumption by 2.4 million tonnes.

Fishermen, markets, and population diversity

- Journal of Environmental Economics and Management---2015---Sunny L. Jardine,James Sanchirico

Fishing impacts biodiversity on multiple levels, potentially resulting in unintended feedbacks to the economic performance of the fishery over time. For example, targeting observable traits within a population can impact genetic diversity and targeting valuable species can impact biodiversity at the ecosystem level. The bioeconomic literature, however, has given little attention to the effect of fishing on population diversity, even though population diversity contributes to ecosystem services and estimates of population extinction rates are three orders of magnitude higher than species extinction rates. Here we develop a stochastic bioeconomic model that links the harvest of multiple salmon populations in a single commercial fishery to the trajectory of population diversity in a salmon stock complex. We parameterize our model with biological and economic data from the Copper River Chinook salmon fishery. We show that markets can incentivize the degradation of population diversity, reducing inframarginal fishery rents, and increasing variability in economic returns. We also show that second-best management can conserve population diversity and improve welfare. Furthermore, depending on fishermen's time preferences, this management strategy is potentially self-financing.

Optimal abatement of carbon emission flows

- Journal of Environmental Economics and Management---2015---Michel Moreaux,Cees Withagen

We study optimal carbon capture and storage (CCS) from point sources, taking into account damages incurred from the accumulation of carbon in the atmosphere and exhaustibility of fossil fuel reserves. High carbon concentrations call for full CCS, meaning zero net emissions. We identify conditions under which partial or no CCS is optimal. In the absence of CCS the CO₂ stock might be inverted U-shaped. With CCS

more complicated behavior may arise. It can be optimal to have full capture initially, yielding a decreasing stock, then partial capture while keeping the CO₂ stock constant, and a final phase without capture but with an inverted U-shaped CO₂ stock. We also introduce the option of adaptation and provide a unified theory regarding the optimal use of CCS and adaptation.

An integrated model of regional and local residential sorting with application to air quality

- Journal of Environmental Economics and Management---2015---Timothy Hamilton,Daniel Phaneuf

We examine the interconnectedness of demand for regionally and locally varying public goods using a residential sorting model. We propose a version of the model that describes household choices at the city (MSA) level and, conditional on city, the neighborhood (census tract) level. We use a two-stage budgeting argument to develop an empirically feasible sorting model that allows us to estimate preferences for regionally varying air quality while accounting for sorting at the local level. Our conceptual and empirical approach nests previous sorting models as special cases, allowing us to assess the importance of accounting for multiple spatial scales in our predictions for the cost of air pollution. Furthermore our preferred specification connects the city and neighborhood sorting margins to the upper and lower elements of a nested logit model, thereby establishing a useful correspondence between two stage budgeting and nested logit estimation. Empirically we find that estimates from a conventional model of sorting across MSAs imply a smaller marginal willingness to pay for air quality than estimates from our proposed model. We discuss how the difference is attributable in part to the omitted variable problems arising when tract level sorting is ignored.

Do energy prices influence investment in energy efficiency? Evidence from energy star appliances

- Journal of Environmental Economics and Management---2015---Grant Jacobsen

I examine whether electricity prices influence the likelihood that consumers purchase high efficiency appliances by using state-year panel data on electricity prices and the proportion of sales of new appliances that involve high efficiency “Energy Star” models. I find no evidence that electricity prices affect the propensity for consumers to choose high efficiency appliances. Point estimates are extremely small and precisely estimated. The findings suggest that price-based energy policies may be limited in the extent to which they increase investment in residential energy efficiency, which has been considered one of the lowest cost opportunities for reducing carbon emissions.

The Weitzman price corner

- Journal of Environmental Economics and Management---2015---Andrew L. Goodkind, Jay S. Coggins

The standard theoretical approach to comparing price and quantity policies is strictly interior. We extend the comparison to account for the possibility of corner outcomes, where a polluting industry responds to a tax by abating either completely or not at all. We show that, when the uncertainty in marginal costs is high, the inclusion of corner outcomes confers an extra and unnoticed advantage upon an emissions tax. In situations where the standard approach would recommend a quantity policy, the possibility of corners can reverse that recommendation.

SMART-SREC: A stochastic model of the New Jersey solar renewable energy certificate market

- Journal of Environmental Economics and Management---2015---Michael Coulon, Javad Khazaei, Warren B. Powell

Markets for solar renewable energy certificates (SRECs) are gaining in prominence in many states, stimulating growth of the US solar industry. However, SREC market prices have been extremely volatile, causing high risk to participants and potentially less investment in solar power generation. Such concerns necessitate the development of realistic, flexible and tractable models

of SREC prices that capture the behavior of participants given the rules that govern the market. We propose an original stochastic model called SMART-SREC to fill this role, building on established ideas from the carbon pricing literature, and including a feedback mechanism for generation response to prices. We calibrate the model to the New Jersey market and backtest it, analyzing parameter sensitivity and demonstrating its ability to reproduce historical dynamics. Finally, we run simulations to investigate the role and impact of regulatory parameters, thus providing insight into the crucial role played by market design.

Declining discount rates and the Fisher Effect: Inflated past, discounted future?

- Journal of Environmental Economics and Management---2015---Mark C. Freeman, Ben Groom, Ekaterini Panopoulou, Theologos Pantelidis

Uncertain and persistent real interest rates underpin one argument for using a declining term structure of social discount rates in the Expected Net Present Value (ENPV) framework. Despite being controversial, this approach has influenced both the Inter-Agency Working Group on Cost-Benefit Analysis and the UK government’s guidelines on discounting. We first clarify the theoretical basis of the ENPV approach. Then, rather than following previous work which used a single series of U.S. Treasury bond returns, we treat nominal interest rates and inflation as co-integrated series and estimate the empirical term structure of discount rates via the ‘Fisher Effect’. This nests previous empirical models and is more flexible. It also addresses an irregularity in previous work which used data on nominal interest rates until 1950, and real interest rates thereafter. As we show, the real and nominal data have very different time series properties. This paper therefore provides a robustness check on previous discounting advice and updated methodological guidance at a time when governments around the world are reviewing their guidelines on social discounting. The policy implications are discussed in the context of the Social Cost of Carbon, nuclear decommissioning and

public health.

Enforcing the Clean Water Act: The effect of state-level corruption on compliance

- Journal of Environmental Economics and Management---2015---Katherine K. Grooms

This paper uses an event study to examine the transition from federal to state management of the Clean Water Act (CWA). I find that, overall, the transition from federal to state control has little effect on facility compliance, measured by the violation rate. However, states with a long run prevalence of corruption see a large decrease in the violation rate after authorization relative to states without corruption. Alternative specifications support these findings. I explore whether the response to transition to state control differs across political ideology, GDP and income per capita, government size, environmental preferences and government management performance. None of these alternative state level characteristics seem to account for the observed difference.

Transboundary pollution game with potential shift in damages

- Journal of Environmental Economics and Management---2015---Bruno Nkuiya

Complex systems exposed to pollution may suddenly and permanently shift to a dangerous regime. This paper studies a dynamic game among countries that face the prospect of such a shift. Each country derives some flow utility from its own emissions, which are chosen unilaterally. But flow emissions by all countries increase the pollution stock in the world. In addition to generating global damages such as global warming, the pollution stock may trigger an irreversible and abrupt jump in global damages or catastrophe at an unknown date in the future. We ask whether endogenous and exogenous threats of such a jump in damages or catastrophe mitigate the tragedy of the commons and examine their implications on welfare. Our analysis yields different emission responses to these threats as compared to the related literature that focuses only on

the single-polluter case. For example, when the hazard rate is exogenous and countries commit to nonlinear strategies, we find that the threat of a possible jump in damages or catastrophe may induce a lower or larger emission level and initial welfare due to multiple equilibria. These results are maintained when the hazard rate endogenously depends on emission decisions.

Directing technical change from fossil-fuel to renewable energy innovation: An application using firm-level patent data

- Journal of Environmental Economics and Management---2015---Joëlle Noailly, Roger Smeets

In this paper we provide an analysis of directed technical change in the sector of electricity generation. We rely on patent data in fossil-fuel (FF) and renewable energy (REN) technologies for 5471 European firms over the 1978–2006 period. The novelty of our approach is in the focus on firms' heterogeneity in driving technological change. We make a distinction between small specialized firms, which innovate in only one type of technology, and large mixed firms, which innovate in both technologies, to analyse how REN patents can replace FF ones at the sector level both through a shift in innovation activities within existing firms and through firms' entry and exit. We use zero-inflated count data estimation techniques to identify the factors that affect specialized versus mixed firms' patenting behaviour both at the intensive (i.e., levels of innovation) and extensive (i.e., technological entry) margins. We further investigate the implications of our firm-level estimations for reducing the gap between REN and FF innovation at the aggregate level. We establish two key findings: (1) a decrease in the FF-REN technology gap mainly comes about through technological entry of specialized REN firms following an increase in REN market size; (2) increases in FF prices, FF market size, and FF knowledge stocks all increase the technology gap by increasing mixed firms' FF innovation rates. An important implication of our results is that policies aimed at increasing REN innovation should focus on helping small firms to start and sustain innovation in the long-run.

The social and ecological determinants of common pool resource sustainability

- Journal of Environmental Economics and Management---2015---Erik Kimbrough,Alexander Vostroknutov

We study a dynamic common pool resource game in which current resource stock depends on resource extraction in the previous period. Our model shows that for a sufficiently high regrowth rate, there is no commons dilemma: the resource will be preserved indefinitely in equilibrium. Lower growth rates lead to depletion. Laboratory tests of the model indicate that favorable ecological characteristics are necessary but insufficient to encourage effective CPR governance. Before the game, we elicit individual willingness to follow a costly rule. Only the presence of enough rule-followers preserves the resource given favorable ecological conditions.

Optimal policy instruments for externality-producing durable goods under present bias

- Journal of Environmental Economics and Management---2015---Garth Heutel

When consumers exhibit present bias, the standard solution to market failures caused by externalities—Pigouvian pricing—is suboptimal. I investigate policies aimed at externalities for present-biased consumers. Optimal policy includes an instrument to correct the externality and an instrument to correct the present bias. Either instrument can be an incentive-based policy (e.g. a tax on fuel economy) or a command-and-control policy (e.g. a fuel economy mandate). Under consumer heterogeneity, a command-and-control policy may dominate an incentive-based policy. Calibrated to the US automobile market, simulation results suggest that the second-best gasoline tax is 3–30% higher than marginal external damages. The optimal price policy includes a gasoline tax set about equal to marginal external damages and a fuel economy tax that increases the price of an average non-hybrid car by about \$550–\$2200 relative to the price of an average hybrid car.

The “second dividend” and the demographic structure

- Journal of Environmental Economics and Management---2015---Frederic Gonand,Pierre-André Jouvét

The demographic structure of a country influences economic activity. The “second dividend” modifies growth. Accordingly, in general equilibrium, the second dividend and the demographic structure are interrelated. This paper aims at assessing empirically the “second dividend” in a dynamic, empirical and intertemporal setting that allows for measuring its impact on growth, its intergenerational redistributive effects, and its interaction with the demographic structure. The paper uses a general equilibrium model with overlapping generations, an energy module and a public finance module that distinguishes between non-ageing-related public spending and a pension regime. Policy scenarios compare the consequences of different scenarios of recycling a carbon tax through lower proportional income taxes rather than higher public lump-sum expenditures. They are computed for two countries with different demographics (France and Germany). Results suggest that the magnitude of the “second dividend” is significantly related with the demographic structure. The more concentrated the demographic structure on cohorts with higher income and saving rate, the stronger the effect on capital supply of the second dividend. The second dividend weighs on the welfare of relatively aged working cohorts. It fosters the wellbeing of young working cohorts and of future generations. The more concentrated the demographic structure on aged working cohorts, the higher the intergenerational redistributive effects of the second dividend.

Learning and climate feedbacks: Optimal climate insurance and fat tails

- Journal of Environmental Economics and Management---2015---David Kelly,Zhuo Tan

We study the effect of potentially severe climate change on optimal climate change policy, accounting for learn-

ing and uncertainty in the climate system. In particular, we test how fat upper tailed uncertainty over the temperature change from a doubling of greenhouse gases (the climate sensitivity), affects economic growth and emissions policy. In addition, we examine whether and how fast uncertainties could be diminished through Bayesian learning. Our results indicate that while overall learning is slow, the mass of the fat tail diminishes quickly, since observations near the mean provide evidence against fat tails. We denote as “tail learning” the case where the planner rejects high values of the climate sensitivity with high confidence, even though significant uncertainty remains. Fat tailed uncertainty without learning reduces current emissions by 38% relative to certainty, indicating significant climate insurance, or paying to limit emissions today to reduce the risk of very high temperature changes, is optimal. However, learning reduces climate insurance by about 50%. The optimal abatement policy is strongly influenced by the current state of knowledge, even though greenhouse gas (GHG) emissions are difficult to reverse. Once the mass of the fat tail diminishes, the remaining uncertainty is largely irrelevant for optimal emissions policy.

Three reasons to use annual payments in contingent valuation surveys: Convergent validity, discount rates, and mental accounting

- Journal of Environmental Economics and Management---2015---Kevin Egan, Jay Corrigan, Daryl F. Dwyer

We present three arguments for using ongoing annual payments in contingent valuation (CV) surveys that estimate the benefit of a long-lasting environmental improvement. First, by matching the duration of the payments with the duration of the environmental benefits, survey respondents are spared from performing complicated present value calculations. Second, willingness to pay (WTP) estimates from CV surveys that include ongoing annual payments best match WTP estimates obtained using travel cost surveys. Third, respondents are less likely to face binding mental budget constraints with ongoing annual payments than

with a larger one-time payment. In addition, respondents’ discount rates may be estimated by collecting non-hypothetical, individual time preference data as part of the valuation survey.

Environmental policy and misallocation: The productivity effect of intensity standards

- Journal of Environmental Economics and Management---2015---Trevor Tombe, Jennifer Winter

Firm-level idiosyncratic policy distortions misallocate resources between firms, lowering aggregate productivity. Many environmental policies create such distortions; in particular, output-based intensity standards (which limit firms energy use or emissions per unit of output) are easier for high-productivity firms to achieve. We investigate the productivity effect of intensity standards using a tractable general-equilibrium model featuring multiple sectors and firm-level heterogeneity. Qualitatively, we demonstrate that intensity standards are always inferior to uniform taxes, as they misallocate both dirty and clean inputs across firms and sectors, which lowers productivity. Quantitatively, we calibrate the model to US data and show that these productivity losses can be large.

Green, greener, greenest: Eco-label gradation and competition

- Journal of Environmental Economics and Management---2015---Yuanhao Li, Klaas van 't Veld

This paper analyzes two common features of markets in which eco-label programs certify that products are “green” : gradation—single programs offering multiple certification standards (e.g., platinum, gold, silver)—and competition—multiple programs vying to certify to their respective standards. We find that, depending on whether programs are sponsored by industry, environmental groups, or a government, they have strikingly different incentives to grade or compete. Industry sponsors are indifferent about both; environmentalist

sponsors optimally grade or compete with other environmentalist sponsors only if consumer preferences for green consumption are skewed in a specific way; and government sponsors' decisions depend on the relative importance of private vs. public benefits generated by the green market. We find also that it is no accident that green markets frequently have an environmentalist program competing with an industry one. For each of the cases examined, our analysis is consistent with casual empirical evidence.

Gone with the wind: Valuing the visual impacts of wind turbines through house prices

- Journal of Environmental Economics and Management---2015---Stephen Gibbons

This study provides quantitative evidence on the local benefits and costs of wind farm developments in England and Wales, focussing on their visual environmental impacts. In the tradition of studies in environmental, public and urban economics, housing sales prices are used to reveal local preferences for views of wind farm developments. Estimation is based on quasi-experimental research designs that compare price changes occurring in places where wind farms become visible, with price changes in appropriate comparison groups. These groups include places close to wind farms that became visible in the past, or where they will become operational in the future and places close to wind farms sites but where the turbines are hidden by the terrain. All these comparisons suggest that wind farm visibility reduces local house prices, and the implied visual environmental costs are substantial.

Stock market and deterrence effect: A mid-run analysis of major environmental and non-environmental accidents

- Journal of Environmental Economics and Management---2015---Cécile Carpentier, Jean-Marc Suret

We analyze the stock market reaction to 161 major environmental and non-environmental accidents, reported on the front page of the New York Times for

half a century. To determine if the market induces a real deterrence effect, we extend the event windows up to one year. On average, the market reacts negatively and enduringly to the announcement of an accident. However, this average effect is largely driven by the airline industry and by government interventions. The estimated average compounded abnormal return following environmental accidents does not differ from zero after one year. This does not exclude, in severe events affecting large firms, huge losses in equity value, but the significant negative cumulative abnormal returns estimated immediately after an environmental accident in previous studies do not persist. Our results suggest that in a market driven by institutional investors, the deterrence effect is likely to be weak.

Discounting and relative consumption

- Journal of Environmental Economics and Management---2015---Olof Johansson-Stenman, Thomas Sterner

We analyze optimal social discount rates when people derive utility from relative consumption, i.e. their own consumption level relative to the consumption level of others. We compare the social, private, and conventional Ramsey rates. Assuming a positive growth rate, we find that (1) the social discount rate exceeds the private discount rate if the importance of relative consumption increases with consumption, and that (2) the social discount rate is lower than the Ramsey rate given quasi-concavity in own and others' consumption and risk aversion with respect to others' consumption. Numerical calculations demonstrate that the latter difference may be substantial and have important implications for long run environmental issues such as global warming.

On sustainability and social welfare

- Journal of Environmental Economics and Management---2015---Marc Fleurbaey

This paper proposes to define sustainability in terms of leaving it possible for future generations to sustain certain defined targets. It is shown that variants of

genuine savings and the ecological footprint can then serve as indicators of sustainability. The link between sustainability and intergenerational welfare is examined, and it is shown how to incorporate indicators of sustainability into a social welfare measure, including risk in the analysis.

Do environmental right-to-know laws affect markets? Capitalization of information in the toxic release inventory

- Journal of Environmental Economics and Management---2015---Ralph Mastromonaco

This paper investigates how information contained in the U.S. Environmental Protection Agency's Toxic Release Inventory (TRI) program, one of the largest environmental right-to-know programs, affects prices in the housing market. I use a strengthening of the reporting requirements for the chemical lead in 2001 as exogenous variation to test for housing price changes near existing firms who must now report. Using a difference-in-differences specification, I find that listing an existing firm in the Toxic Release Inventory lowers housing prices up to 11% within approximately 1 mile. The results suggest that housing market participants do capitalize into prices at least some information conveyed by the TRI program.

Spatial interactions in habitat conservation: Evidence from prairie pothole easements

- Journal of Environmental Economics and Management---2015---Chad Lawley, Wanhong Yang

We examine the role of spatial interactions in conservation easements placed on prairie pothole habitat in western Canada. One of the goals of the conservation easement program we study is to protect contiguous habitat. We identify endogenous spatial interactions among conservation easements and government protected land, independent of spatially correlated landscape features and local economic shocks that influence easement enrollment. We present evidence that easements increase the likelihood of subsequent easements

on neighboring land. Government-protected land appears to have little effect on the location of conservation easements. These results imply that conservation agencies have leveraged past conservation investment to enroll more contiguous habitat in permanent easements through a combination of targeting and positive social interactions among neighboring landowners.

Pigou meets Mirrlees: On the irrelevance of tax distortions for the second-best Pigouvian tax

- Journal of Environmental Economics and Management---2015---Bas Jacobs, Ruud de Mooij

This paper extends the Mirrlees (1971) model of optimal income redistribution with optimal corrective taxes to internalize consumption externalities. Using general utility structures and exploring both linear and non-linear taxes, it is demonstrated that the optimal second-best tax on an externality-generating good should not be corrected for the marginal cost of public funds, since it equals one in the optimal tax system. In the optimum, distortions of income taxes are equal to marginal redistributive gains. If the government does not have access to a non-distortionary marginal source of finance, the marginal cost of public funds can be either larger or smaller than one depending on subjective preferences for income redistribution. The optimal second-best corrective tax is then either higher or lower than the Pigouvian level. The findings in this paper generalize and amend prior results based on representative-agent models, shedding new light on the weak double-dividend hypothesis, and on the welfare gains of recycling revenue from environmental taxes.

A cultural model of private provision and the environment

- Journal of Environmental Economics and Management---2015---Emeline Bezin

This paper analyses an overlapping generations model of environmental externalities and capital accumulation where private contributions to environmental quality are motivated by a desire to socialize others into environmental attitudes. In this framework, the formation

of environmental preferences is the result of a cultural transmission process depending on the extent of private contributions. In the short run, we show that three equilibria may arise: a first one where all green agents contribute to the environment, a second one where nobody contributes to the environment and a third interior one. We show that the capital-accumulation process and the change in preferences that occur in this economy lead the interior equilibrium to be selected, in which some, but not all, green agents contribute to the environment. The model thus provides an economic rationale for the gap between the number of people who care about the environment and the number who adopt pro-environmental behaviours. We also show that the fraction of contributors rises with capital, so that we explain the negative relationship between this gap and country income. Last, we show that this gap is particularly detrimental for welfare, and analyse the impact of a number of public policies.

Competitive investment in clean technology and uninformed green consumers

- Journal of Environmental Economics and Management---2015---Aditi Sengupta

In a market where consumers and the regulatory authorities are not fully informed about the actual production technology or environmental performance of firms that engage in strategic competition, I study the effect of environmental consciousness of consumers on firms' incentive to invest in cleaner technology. Firms compete in prices and may signal their environmental performance to uninformed consumers through prices. I also analyze the effect of an expected liability on firms in this setting. Compared to full information, incomplete information generates higher strategic incentive to invest in cleaner technology particularly when consciousness and/or expected liability are not too high. Requiring mandatory disclosure of technology or environmental performance may discourage such investment. Even though consumers and the regulator are uninformed, competition has a positive effect (relative to monopoly) on the incentive to invest.

Terminating links between emission trading programs

- Journal of Environmental Economics and Management---2015---William A. Pizer, Andrew Yates

Links between emission trading programs are not immutable, as highlighted by New Jersey's exit from the Regional Greenhouse Gas Initiative in 2011. This raises the question of what to do with existing permits that are banked for future use—choices that have consequences for market behavior in advance of, or upon speculation about, delinking. We consider two delinking policies. One differentiates banked permits by origin, the other treats banked permits the same. We describe the price behavior and relative cost-effectiveness of each policy. Treating permits differently generally leads to higher costs, and may lead to price divergence, even with only speculation about delinking.

Optimal health and environmental policies in a pollution-growth nexus

- Journal of Environmental Economics and Management---2015---Min Wang, Jinhua Zhao, Joydeep Bhattacharya

This paper shows how policies aimed at insuring health risks and those intended to improve the environment are (and should be) deeply intertwined. In the model economy inspired by recent Chinese experience, pollution raises the likelihood of future, poor health prompting households to save more so as to self-insure against anticipated medical expenses. Increased household saving generates more capital while capital use by firms generates more pollution. Along the transition, such a “pollution-growth nexus” may be attractive from a capital-accumulation perspective; however, rising pollution, via the health channel, hurts welfare. Both insurance and environmental policies affect capital accumulation and can have additional dynamic benefits. The availability of private health insurance to top up pay-as-you-go coverage of medical bills along with a Pigouvian tax on emissions and a profit tax can replicate the first best.

Partial identification of amenity demand functions

- Journal of Environmental Economics and Management---2015---Congwen Zhang, Kevin Boyle, Nicolai Kuminoff

This paper presents a new hedonic framework for reduced form estimation of the demand for spatially delineated nonmarket amenities. We begin from a conventional model of market equilibrium where an amenity is conveyed to homeowners by virtue of their residential location choices. Different housing markets may have different hedonic price functions due to variation across markets in the joint distribution of preferences, income, regulations, and technology. In this setting, taste-based sorting within and across markets confounds point identification of reduced form descriptions for amenity demand curves. However, we demonstrate that basic knowledge of the sorting process is sufficient to construct instruments that identify bounds on demand curves. Bounds on demand curves can be translated into ranges of welfare measures for non-marginal changes in amenities. We find these ranges to be potentially informative in a demonstrative application to evaluating the benefits of improved lake water clarity in the Northeast.

Scrapping for clean air: Emissions savings from the BC SCRAP-IT program

- Journal of Environmental Economics and Management---2015---Werner Antweiler, Sumeet Gulati

British Columbia's innovative Accelerated Vehicle Retirement program (BC SCRAP-IT) offers a unique set of incentives which are aimed at achieving a high level of emissions reductions. The program supports alternative forms of transportation: public transit, membership in ride-share or car-share programs, and/or the purchase of a bicycle. However, it is not known whether the program constitutes an efficient allocation of government funding, or how the scheme compares to more basic programs offering only cash subsidies.

Using a novel dataset combining data from BC SCRAP-IT with British Columbia's AirCare emissions testing program, we find that BC SCRAP-IT results in substantial emissions reductions and that this type of incentives scheme compares favourably with previous subsidy-only schemes. On average, emissions reductions per vehicle are equivalent to a benefit of C\$566, whereas the average program payout is C\$886 per participant. We discuss policy implications and suggest a number of options to improve the efficiency of AVRP programs.

Equilibrium resource management with altruistic overlapping generations

- Journal of Environmental Economics and Management---2015---Ivar Ekeland, Larry Karp, Ussif Sumaila

We imbed a classic fishery model, where the optimal policy follows a Most Rapid Approach Path to a steady state, into an overlapping generations setting. The current generation discounts future generations' utility flows at a rate possibly different from the pure rate of time preference used to discount their own utility flows. The resulting model has non-constant discount rates, leading to time inconsistency. The unique Markov Perfect equilibrium to this model has a striking feature: provided that the current generation has some concern for the not-yet born, the equilibrium policy does not depend on the degree of that concern.

Optimal learning on climate change: Why climate skeptics should reduce emissions

- Journal of Environmental Economics and Management---2015---Sweder van Wijnbergen, Tim Willems

Climate skeptics typically argue that the possibility that global warming is exogenous, implies that we should not take additional action towards reducing emissions until we know what drives warming. This paper however shows that even climate skeptics have an incentive to reduce emissions: such a directional change generates information on the causes of global

warming. Since the optimal policy depends upon these causes, they are valuable to know. Although increasing emissions would also generate information, that option is inferior due its irreversibility. We show that optimality can even imply that climate skeptics should actually argue for lower emissions than believers.

Indoor air quality and academic performance

- Journal of Environmental Economics and Management---2015---Tess Stafford

I examine the effect of school indoor air quality (IAQ) on academic outcomes. I utilize a quasi-natural experiment, in which IAQ-renovations were completed at virtually every school in a single Texas school district at different points in time, combined with a panel of student-level data to control for many confounding factors and thereby uncover the causal effect of IAQ-renovations on academic outcomes. Results indicate that performance on standardized tests significantly improves while attendance is unresponsive to improvements in IAQ. Rough calculations suggest that IAQ-renovations may be a more cost-effective way to improve standardized test scores than class size reductions.

Designing efficient markets for carbon offsets with distributional constraints

- Journal of Environmental Economics and Management---2015---Antonio Bento,Ravi Kanbur,Benjamin Leard

This paper presents an assessment of the relative efficacy of three key instruments – baselines, trade ratios and limits - which are under policy discussion in the design of carbon offset programs. We rank the instruments by their implications for total emissions, economic efficiency, and efficiency gain relative to a distributional transfer from capped to uncapped sectors. We find that the baseline is the best instrument for maximizing welfare as it directly reduces the share of offsets that are non-additional and that second-best policies do not sacrifice much welfare relative to the standard first-best policy prescription.

Harvest efficiency and fishery discards under harvest uncertainty and trading restrictions

- Journal of Environmental Economics and Management---2015---Rajesh Singh,Quinn Weninger

We study harvesting efficiency and the problem of discards under harvest uncertainty in a fishery that is managed with quotas. With only idiosyncratic harvest uncertainty, we show that frictionless post-harvest quota trade can achieve full efficiency and eliminate quota-overage discards completely. In the absence of such trade, we deduce an ad valorem tax/subsidy that eliminates discards while delivering a desired aggregate harvest target. Alternatively, we show that a hybrid policy, i.e., a combined quota and landings fee, can implement a manager's aggregate target harvest level efficiently and without discards. When harvest shocks, in addition, have a fishery-wide common component, post-harvest quota trading per se cannot eliminate discards; policy intervention in the form of either landing taxes or a hybrid scheme is needed. Given the prevalence of trading restrictions in many quota-managed fisheries worldwide, our paper offers important policy advice.

Revealing climate change opinions through investment behavior: Evidence from Fukushima

- Journal of Environmental Economics and Management---2015---Zhen Lei,Anastasia V. Shcherbakova

In this study we present a novel research approach to obtaining behavior-based evidence of regional climate change attitudes, using the 2011 Fukushima nuclear plant incident as a natural experiment. Our approach allows us to produce the first non-survey-based empirical evidence of a trans-Atlantic divide in public opinion on the environment and climate change that investors assign to fossil-based and renewable energy. This value is based on the perceived potential of these fuel types to substitute for nuclear generation in the aftermath of the Fukushima crisis. We carry out an event study to examine differences in abnormal returns of global

coal and renewable energy companies on European and American stock exchanges. We find that investors trading on U.S. markets exhibit a significantly more favorable perception of coal stock profitability, while investors trading on European exchanges display a more favorable perception about profitability of renewable energy stocks.

Environmental policy and macroeconomic dynamics in a new Keynesian model

- Journal of Environmental Economics and Management---2015---Barbara Annicchiarico,Fabio Di Dio

This paper studies the dynamic behavior of an economy under different environmental policy regimes in a New Keynesian model with nominal and real uncertainty. We find the following results: (i) an emissions cap policy is likely to dampen macroeconomic fluctuations; (ii) staggered price adjustment alters significantly the performance of the environmental policy regime put in place; (iii) the optimal environmental policy response to shocks is strongly influenced by the degree to which prices adjust and by the monetary policy reaction.

North–south trade in reusable goods: Green design meets illegal shipments of waste

- Journal of Environmental Economics and Management---2015---Sophie Bernard

In a stylized model of international trade, firms in the North indirectly export second-hand products to a representative firm in the South to be reused as intermediate goods, with potential trade gains. The level of reusability of waste products – or green design – is a crucial choice variable in the North. This is because, in the presence of imperfect international monitoring, non-reusable waste can be illegally mixed with reusable waste. I explore the driving forces for illegal waste movement, with a particular focus on local waste regulations such as the EU's Directive on Waste Electrical and Electronic Equipment. Under mild conditions, it is shown that increasingly stringent regulations in the North can induce Northern firms to

reduce product reusability. Consequently, the flow of non-reusable waste to the South increases, magnifying the pollution haven effect.

Health shocks and natural resource management: Evidence from Western Kenya

- Journal of Environmental Economics and Management---2015---Maria Damon,Joshua Graff Zivin,Harsha Thirumurthy

Poverty and altered planning horizons brought on by the HIV/AIDS epidemic can change individual discount rates, altering incentives to conserve natural resources. Using longitudinal household survey data from Western Kenya, we estimate the effects of health status on investments in soil quality, as indicated by households' agricultural land fallowing decisions. We first show that this effect is theoretically ambiguous: while health improvements lower discount rates and thus increase incentives to conserve natural resources, they also increase labor productivity and make it more likely that households can engage in labor-intensive resource extraction activities. We find that household size and composition are predictors of whether the effect of health improvements on discount rates dominates the productivity effect, or vice-versa. Since households with more and younger members are better able to reallocate labor to cope with productivity shocks, the discount rate effect dominates for these households and health improvements lead to greater levels of conservation. In smaller families with less substitutable labor, the productivity effect dominates and health improvements lead to greater environmental degradation

Discounting, inequality and economic convergence

- Journal of Environmental Economics and Management---2015---Christian Gollier

The aim of this paper is to examine the impact of inequalities and economic convergence on the efficient discount rate when international credit and risk-sharing markets are inefficient. We consider an economy in

which initial consumption levels and growth expectations are heterogeneous. In the benchmark case in which relative inequalities are permanent and relative risk aversion is constant, inequalities do not affect the discount rate. We derive necessary and sufficient conditions under which permanent inequalities reduce the discount rate. We also show that the anticipation of economic convergence raises the efficient discount rate when relative prudence is larger than unity.

Government green procurement spillovers: Evidence from municipal building policies in California

- Journal of Environmental Economics and Management---2014---Timothy Simcoe, Michael Toffel

We study how government green procurement policies influence private-sector demand for similar products. Specifically, we measure the impact of municipal policies requiring governments to construct green buildings on private-sector adoption of the US Green Building Council's Leadership in Energy and Environmental Design (LEED) standard. Using matching methods, panel data, and instrumental variables, we find that government procurement rules produce spillover effects that stimulate both private-sector adoption of the LEED standard and investments in green building expertise by local suppliers. These findings suggest that government procurement policies can accelerate the diffusion of new environmental standards that require coordinated complementary investments by various types of private adopter.

Weather, salience of climate change and congressional voting

- Journal of Environmental Economics and Management---2014---Evan Herrnstadt, Erich Muehlegger

Climate change is a complex long-run phenomenon. The speed and severity with which it is occurring is difficult to observe, complicating the formation of beliefs for individuals. We use Google search intensity

data as a proxy for the salience of climate change and examine how search patterns vary with unusual local weather. We find that searches for "climate change" and "global warming" increase with extreme temperatures and unusual lack of snow. Furthermore, we demonstrate that effects of abnormal weather extend beyond search behavior to observable action on environmental issues. We examine the voting records of members of the U.S. Congress from 2004 to 2011 and find that members are more likely to take a pro-environment stance on votes when their home state experiences unusual weather.

Experimental tests of water quality trading markets

- Journal of Environmental Economics and Management---2014---Luke Jones, Christian Vossler

Many watersheds in the U.S. have established water quality trading programs to help realize cost-effective reductions in water pollution; however, the success of these programs has been limited. This study highlights some of the unique features of water-based credit trading markets that may explain the lack of success, and uses laboratory experiments to isolate their effects. In particular, we compare two forms of a baseline-and-credit institution, a Pigouvian tax/subsidy regulation, and – characteristic of air quality programs – a textbook cap-and-trade regulation. Across these institutions we examine the effects of abatement technology adoption. We find that a baseline-and-credit program, when it requires firms to make upfront investments to generate tradable credits, is less efficient than cap-and-trade and tax/subsidy institutions. Furthermore, we find that when efficient trading requires costly technology adoption, institutions that involve inter-firm trading, including cap-and-trade, are less efficient than the tax/subsidy.

Evidence of an “Energy-Management Gap” in U.S. manufacturing: Spillovers from firm management practices to energy efficiency

- Journal of Environmental Economics and Management---2014---Gale Boyd,E Curtis

In this paper we merge a well-cited survey of firm management practices into confidential plant level U.S. Census manufacturing data to examine whether generic, i.e. non-energy specific, firm management practices, “spillover” to enhance energy efficiency in the United States. For U.S. manufacturing plants we find this relationship to be more nuanced than prior research on UK plants. Most management techniques are shown to have beneficial spillovers to energy efficiency, but an emphasis on generic targets, conditional on other management practices, results in spillovers that increase energy intensity. Our specification controls for industry specific effects at a detailed 6-digit NAICS level and finds the relationship between management and energy use to be strongest for firms in energy intensive industries. We interpret the empirical result that generic management practices do not necessarily spillover to improved energy performance as evidence of an “energy management gap.”

Utility rebates for ENERGY STAR appliances: Are they effective?

- Journal of Environmental Economics and Management---2014---Souvik Datta,Sumeet Gulati

We estimate the impact of utility cash rebates on the market share of ENERGY STAR appliances by exploiting the variation in timing and size of rebates across US states. We find that a dollar increase in the population-weighted utility rebate raises the share of ENERGY STAR qualified clothes washers by 0.4%, but does not affect dishwasher and refrigerator shares. Using information on energy saved by an ENERGY STAR appliance and assuming a redemption rate of 40%, the cost per tonne of carbon saved is about \$140 for the clothes washers rebate program. The corresponding cost of a megawatt hour saved, about \$28, is

lower than the estimated cost of building and operating an additional power plant and the average on-peak spot price. We conclude that the ENERGY STAR clothes washers rebate program is, on average, a cost-effective way for utilities to reduce electricity demand.

The environmental effects of crop price increases: Nitrogen losses in the U.S. Corn Belt

- Journal of Environmental Economics and Management---2014---Nathan Hendricks,Sumathy Sinnathamby,Kyle Douglas-Mankin,Aaron Smith,Daniel Sumner,Dietrich H. Earnhart

High corn prices cause farmers to plant more corn on fields that were planted to corn in the previous year, rather than alternating between corn and soybeans. Cultivating corn after corn requires greater nitrogen fertilizer and some of this nitrogen flows into waterways and causes environmental damage. We estimate the effect of crop prices on nitrogen losses for most fields in Iowa, Illinois, and Indiana using crop data from satellite imagery. Spatial variation in these high-resolution estimates highlights the fact that the environmental effects of agriculture depend not only on what is grown, but also on where and in what sequence it is grown. Our results suggest that the change in corn and soybean prices due to a billion gallons of ethanol production expands the size of the hypoxic zone in the Gulf of Mexico by roughly 30 square miles on average, although there is considerable uncertainty in this estimate.

‘Effortless Perfection:’ Do Chinese cities manipulate air pollution data?

- Journal of Environmental Economics and Management---2014---Dalia Ghanem,Junjie Zhang

This paper uses unique data on daily air pollution concentrations over the period 2001–2010 to test for manipulation in self-reported data by Chinese cities. First, we employ a discontinuity test to detect evidence consistent with data manipulation. Then, we propose a panel matching approach to identify the conditions under which irregularities may occur. We find that about 50% of cities reported dubious PM10 pollution

levels that led to a discontinuity at the cut-off. Suspicious data reporting tends to occur on days when the anomaly is least detectable. Our findings indicate that the official daily air pollution data are not well behaved, which provides suggestive evidence of manipulation.

Risk aversion and adaptive management: Insights from a multi-armed bandit model of invasive species risk

- Journal of Environmental Economics and Management---2014---Michael R. Springborn

This article explores adaptive management (AM) for decision-making under environmental uncertainty. In the context of targeting invasive species inspections of agricultural imports, I find that risk aversion increases the relative value of AM and can increase the rate of exploratory action. While calls for AM in natural resource management are common, many analyses have identified modest gains from this approach. I analytically and numerically examine the distribution of outcomes from AM under risk neutrality and risk aversion. The inspection decision is framed as a multi-armed bandit problem and solved using the Lagrangian decomposition method. Results show that even when expected gains are modest, asymmetry in the distribution of outcomes has important implications. Notably, AM can serve to buffer against large losses, even if the most likely outcome is a small loss.

Effect of audits on the extent of compliance with wastewater discharge limits

- Journal of Environmental Economics and Management---2014---Dietrich Earnhart, Donna Ramirez Harrington

This study explores the effect of environmental self-audits (“audits”), which represent an important type of environmental management system practice, on the extent of facilities’ compliance with wastewater discharge limits. Theoretically, audits may (1) improve compliance by enhancing the effectiveness of treatment technologies and pollution prevention methods, (2) undermine compliance by distracting facilities’

personnel with audit-related administrative burdens, or (3) not influence compliance because these effects neutralize each other. By examining the extent of compliance, our study’ s results reflect both improvement toward and beyond compliance. By assessing compliance with multiple pollutants separately, our study examines whether audits influence the control of different pollutants uniformly. Lastly, we employ a dynamic panel estimator, which allows us to explore whether facilities adjust their discharges dynamically, while controlling for any inertia in facilities’ pollution control systems. Our study empirically examines the U.S. chemical manufacturing sector between 1999 and 2001 using survey and publicly available EPA data.

Carbon leakage and capacity-based allocations: Is the EU right?

- Journal of Environmental Economics and Management---2014---Guy Meunier, Jean-Pierre Ponsard, Philippe Quirion

Competitiveness and carbon leakage are major concerns for the design of CO₂ emissions permits markets. In the absence of a global carbon tax and of border carbon adjustments, output-based allocation is a third-best solution and is actually implemented (Australia, California, New Zealand). The EU has followed a different route; free allowances are allocated to existing or new capacities in proportion to a benchmark, independent of actual production. This paper compares these two schemes in a formal setting and shows that the optimal one is in fact a combination of both schemes, or output-based allocation alone if uncertainty is limited. A key assumption of our analysis is that the short-term import pressure depends both on the existing capacities and the level of demand, which is typical in capital intensive and internationally traded sectors. A calibration of the model is used to discuss the EU scheme for the cement sector in the third phase of the EU-ETS (2013–2020). This allows for a quantification of various policies in terms of welfare, investment, production, company profits, public revenues and leakage.

Necessity as the mother of invention: Innovative responses to natural disasters

- Journal of Environmental Economics and Management---2014---Qing Miao,David Popp

How do innovators respond to the shock of a natural disaster? Do natural disasters spur technical innovations that can reduce the risk of future hazards? This paper examines the impact of three types of natural disasters—floods, droughts and earthquakes—on the innovation of their respective mitigation technologies. Using patent and disaster data, our study is the first to empirically examine adaptation responses across multiple sectors at the country level. Considering the potential endogeneity of disaster damages, we use meteorological and geophysical data to create hazard intensity measures as instrumental variables. Overall, we show that natural disasters lead to more risk-mitigating innovations, while the degree of influence varies across different types of disasters and technologies.

Environmental policy and exports: Evidence from Chinese cities

- Journal of Environmental Economics and Management---2014---Laura Hering,Sandra Poncet

We study environmental regulation and its role for trade in China. Specifically, we assess the effectiveness of an environmental policy in China that introduced stricter regulations on sulfur dioxide (SO₂) emissions in targeted cities. To identify the causal effect of this policy on exports, we use sectoral export data for a panel of Chinese cities and exploit variations in exports between cities and sectors, over time, and, in a second step, between firm types. We find a relative fall in sectoral exports in targeted cities after the implementation of the policy, which is sharper the more polluting the industry. Further, we find that the observed effect is mainly driven by privately owned firms, whereas exports of state-owned firms seem to be unaffected by the new policy. This finding is consistent with the preferential political treatment of state-owned firms in China.

Private politics and environmental management

- Journal of Environmental Economics and Management---2014---Sonam Gupta,Robert Innes

We study determinants and effects of two types of private political actions (PPAs) against S&P 500 companies: environmental boycotts and shareholder proxy proposals. We consider effects on the firms' adoption of environmental management systems (EMS) and the environmental protocol, ISO 14001. We find that PPAs have a significant impact on firms' environmental management decisions and, consistent with Baron (2009), that a company's likelihood of experiencing a PPA is higher if it is a "receptive target" that has a reputation for social responsibility.

Assessing energy price induced improvements in efficiency of capital in OECD manufacturing industries

- Journal of Environmental Economics and Management---2014---Jevgenijs Steinbuks,Karsten Neuhoff

To assess how capital stocks adapt to energy price changes, it is necessary to account for the impacts on different vintages of capital and to account separately for price-induced and autonomous improvements in the energy efficiency of capital stock. The results of econometric analysis for five manufacturing industries in 19 OECD countries between 1990 and 2005 indicate that higher energy prices resulted in smaller energy use due to both improved energy efficiency of capital stock and reduced demand for the energy input. The investment response to energy prices varied considerably across manufacturing industries, being more significant in energy-intensive sectors. The results of policy simulations indicate that a carbon tax can deliver significant reductions in energy consumption in the medium run with modest declines in energy-using capital stock.

Promoting clean energy investment: An empirical analysis of property assessed clean energy

- Journal of Environmental Economics and Management---2014---A. Justin Kirkpatrick,Lori S. Benneer

From 2008 to 2010 a handful of Property-Assessed Clean Energy (PACE) programs offered property-secured loans to homeowners for residential clean energy investments. This analysis uses difference-in-differences models and synthetic counterfactual models to estimate the effect of three California PACE programs on residential photovoltaic installations. While PACE programs do not offer superior terms to other solar financing options, we find that PACE financing increases solar installations by approximately 3.8watts per owner-occupied household per quarter, a 108% increase over the mean watts per owner-occupied household.

The value of familiarity: Effects of knowledge and objective signals on willingness to pay for a public good

- Journal of Environmental Economics and Management---2014---Jacob LaRiviere,Mikolaj Czajkowski,Nick Hanley,Margrethe Aanesen,Jannike Falk-Petersen,Dugald Tinch

We design and conduct a field experiment in which treated subjects receive a precise and objective signal regarding their knowledge about a public good before estimating their WTP for it. We find that the causal effect of objective signals about the accuracy of a subject's knowledge for a public good can dramatically affect their valuation for it: treatment caused a significant increase of \$85-\$129 in WTP for well-informed individuals. We find no such effect for less informed subjects. Our results imply that WTP estimates for public goods are not only a function of true information states of the respondents but beliefs about those information states.

State-variable public goods and social comparisons

- Journal of Environmental Economics and Management---2014---Thomas Aronsson,Olof Johansson-Stenman

The optimal provision of a state-variable public good, where the global climate is the prime example, is analyzed in a model where people care about their relative consumption. We consider both keeping-up-with-the-Joneses preferences (where people compare their own current consumption with others' current consumption) and catching-up-with-the-Joneses preferences (where people compare their own current consumption with others' past consumption) in an economy with two productivity types, overlapping generations, and optimal nonlinear income taxation. The extent to which the conventional rules for provision of state-variable public goods (a dynamic analog of the Samuelson rules) ought to be modified is shown to clearly depend on the strength of the relative concerns of both kinds, but also on the preference elicitation format.

Dynamic resource management under the risk of regime shifts

- Journal of Environmental Economics and Management---2014---Hiroaki Sakamoto

This paper provides a framework through which a dynamic resource management problem with potential regime shifts can be analyzed both in a strategic environment and from a social planner's perspective. Based on a fairly general model, a condition for a precautionary policy is discussed. By applying the framework to a common-property resource problem with a linear production technology, we illustrate how the qualitative as well as quantitative nature of equilibrium is altered due to the possibility of regime shifts. In particular, when the risk is endogenously affected by the players' behavior, potential regime shifts can facilitate the precautionary management of resources as long as the resource stock is in good shape. As the

stock of resource becomes scarce, however, the precautionary effect vanishes and more aggressive resource exploitation emerges. The impacts of irreversibility on the equilibrium behavior are highlighted. It is also shown that there can exist a resource-depletion trap in which a regime shift, once it happens, triggers a continuous decline of resource stock no matter which regime materializes in the subsequent periods.

Valuation of human health: An integrated model of willingness to pay for mortality and morbidity risk reductions

- Journal of Environmental Economics and Management---2014---Shelby Gerking, Mark Dickie, Marcella Veronesi

This paper develops and applies an integrated model of mortality and morbidity valuation that is consistent with the principles of welfare economics. To obtain the integrated model, the standard one-period expected utility model of one person facing the prospect of either being alive or dead is extended to incorporate (1) a third health state (sick) with a utility level that is intermediate to utility if healthy and utility if dead, (2) a family perspective in which a parent makes choices about risk exposure both for herself and for a child, and (3) a multi-period framework that allows for possible parent/child differences in illness latency. Monetary benefits of health risk reduction obtained from the integrated model are compared with those that would be computed using the standard model. The integrated model then is applied using data obtained from two field studies of skin cancer and leukemia to demonstrate how it can be used to estimate health benefits of reduced illness and death risks.

Can decentralized planning really achieve first-best in the presence of environmental spillovers?

- Journal of Environmental Economics and Management---2014---Harrison Fell, Daniel Kaffine

It is generally accepted that decentralized policy choice in the presence of interjurisdictional spillovers is inefficient.

Strikingly, Ogawa and Wildasin (2009) find that in a model with heterogeneous jurisdictions, interjurisdictional capital flows, and interjurisdictional environmental damage spillovers, decentralized planning outcomes are equivalent to that under a centralized planner. We first show the critical importance of two key assumptions (no retirement of capital, fixed environmental damages per unit of capital) in obtaining this result. Second, we consider a more general model allowing for capital retirement and abatement activities and show that the outcome of a decentralized market generally differs from the solution of a centralized planner's social welfare-maximizing problem.

The socially optimal recycling rate: Evidence from Japan

- Journal of Environmental Economics and Management---2014---Thomas C. Kinnaman, Takayoshi Shinkuma, Masashi Yamamoto

This paper estimates the average social cost of municipal waste management as a function of the recycling rate. Social costs include all municipal costs and revenues, costs to recycling households to prepare materials estimated with an original method, external disposal costs, and external recycling benefits. Results suggest average social costs are minimized with recycling rates well below observed and mandated levels in Japan. Cost-minimizing municipalities are estimated to recycle less than the optimal rate. These results are robust to changes in the components of social costs, indicating that Japan and perhaps other developed countries may be setting inefficiently high recycling goals.

Price controls and banking in emissions trading: An experimental evaluation

- Journal of Environmental Economics and Management---2014---John Stranlund, James Murphy, John Spraggon

We present results from laboratory emissions markets designed to investigate the effects of price controls and permit banking on limiting permit price risk. While

both instruments reduce between-period price volatility and within-period price dispersion, combining price controls and permit banking yields important benefits. Banking alone produces high permit prices in earlier periods that fall over time, but the combined policy produces lower initial prices and lower volatility. However, banking, price controls, and the combination all produce higher between-period emissions volatility. Hence, for emissions markets that seek to control flow pollutants with strictly convex damages, efforts to limit permit price risk can result in higher expected damage.

Brown backstops versus the green paradox

- Journal of Environmental Economics and Management---2014---Thomas O. Michielsen

Anticipated climate policies are ineffective when fossil fuel owners respond by shifting supply intertemporally (the green paradox). This mechanism relies crucially on the exhaustibility of fossil fuels. We analyze the effect of anticipated climate policies on emissions in a simple model with two fossil fuels: one scarce and dirty (e.g. oil), the other abundant and dirtier (e.g. coal). We derive conditions for a ‘green orthodox’: anticipated climate policies may reduce current emissions. The model can also be used to analyze spatial carbon leakage. Calibrations suggest that intertemporal carbon leakage (from 0% to 8%) is a relatively minor concern.

The value of information for integrated assessment models of climate change

- Journal of Environmental Economics and Management---2014---Stephen C. Newbold, Alex Marten

We estimate the value of information (VOI) for three key parameters of climate integrated assessment models (IAMs): marginal damages at low temperature anomalies, marginal damages at high temperature anomalies, and equilibrium climate sensitivity. Most empirical studies of climate damages have examined temperature anomalies up to 3°C, while some recent theoretical studies emphasize the risks of “climate catastrophes,”

which depend on climate sensitivity and on marginal damages at higher temperature anomalies. We use a new IAM to estimate the VOI for each parameter over a range of assumed levels of study precision based on prior probability distributions calibrated using results from previous studies. We measure the VOI as the maximum fixed fraction of consumption that a social planner would be willing to pay to conduct a new study before setting a carbon tax. Our central results suggest that the VOI is greatest for marginal damages at high temperature anomalies.

Innovation and the dynamics of global warming

- Journal of Environmental Economics and Management---2014---Ralph Winter

Global warming and the carbon cycle are a dynamic system with positive feedbacks. Fossil fuels are exhaustible resources. These two facts mean that innovation in clean energy technology, rather than mitigating global warming, can lead to a permanently higher temperature path. This paper explores the impact of innovation in the simplest model linking the economic theory of exhaustible resources with positive feedback dynamics in the carbon cycle.

Durable goods and long-run electricity demand: Evidence from air conditioner purchase behavior

- Journal of Environmental Economics and Management---2014---David Rapson

I estimate a dynamic structural model of demand for air conditioners, the most energy-intensive home appliance in the US. The model explores the links between demand for durable goods and expected changes in key attributes: energy efficiency and price. I incorporate expectations explicitly as a feature of the choice setting, and use parameter estimates from the model to calculate durable good demand elasticities with respect to energy efficiency, electricity price, and price of the durable itself. These estimates fill a large gap in the literature, and also shed light on consumer behavior in this setting. Results indicate that consumers are

forward-looking and value the stream of future savings derived from energy efficiency.

The influence of individuals in forming collective household preferences for water quality

- Journal of Environmental Economics and Management---2014---Cam Rungie,Riccardo Scarpa,Mara Thiene

Preference for water quality and its nonmarket valuation can be used to inform the development of pricing policies and long term supply strategies. Tap water quality is a household concern. The objective status quo of water provision varies between households and not between individuals within households, while charges are levied on households not individuals. Individual preferences differ from collective preferences. In households where there are two adults, we examine the preferences of each separately and then as a couple in collective decisions. We show the level of influence each has in developing the collective decision process. We use discrete choice experiments to model preference heterogeneity across three experiments on women, men and on both. We propose a random utility model which decomposes the error structure in the utility of alternatives so as to identify the individual influence in collective decisions. This approach to choice data analysis is new to environmental economics.

A new meta-analysis on the WTP/WTa disparity

- Journal of Environmental Economics and Management---2014---Tuba Tunçel,James Hammitt

This study reports a new meta-analysis of papers that elicit willingness-to-pay (WTP) and willingness-to-accept compensation (WTA) measures of value for the same good. We investigate the effects of type of good and several survey-design features on the WTP/WTA disparity, measured as the logarithm of the ratio of mean WTA to mean WTP. Confirming Horowitz and McConnell's (2002) pioneering meta-analysis, we find the disparity is smaller for ordinary private goods than for public and non-market goods, that it is not solely

an artifact of using hypothetical transactions or other weak experimental or survey methods, and that it is smaller for studies using student subjects. In addition, we find that the disparity is smaller when subjects have experience valuing the good in real markets or through repeated experimental trials. In contrast to Horowitz and McConnell, we find the disparity is significantly smaller in studies using incentive-compatible elicitation mechanisms. The disparity is smaller in more recent studies, an effect that is attributable only in part to changes in study characteristics.

Do EPA regulations affect labor demand?

Evidence from the pulp and paper industry

- Journal of Environmental Economics and Management---2014---Wayne Gray,Ron Shadbegian,Chunbei Wang,Merve Meral

Any opinions and conclusions expressed herein are those of the author(s) and do not necessarily represent the views of the U.S. Census Bureau or the U.S. Environmental Protection Agency. All results have been reviewed to ensure that no confidential information is disclosed. We thank Wang Jin and Shital Sharma for excellent research assistance; we also thank Jim Davis at the Boston Research Data Center for his continued help, and Reed Walker and participants at the 2011 AERE Summer Conference and the Environmental Economics seminar at Harvard University's Kennedy School for helpful comments. Any remaining errors are ours.

Alternative transportation fuel standards:

Welfare effects and climate benefits

- Journal of Environmental Economics and Management---2014---Xiaoguang Chen,Haixiao Huang,Madhu Khanna,Hayri Önal

This paper develops an integrated model of the fuel and agricultural sectors to analyze the welfare and greenhouse gas emission (GHG) effects of the existing Renewable Fuel Standard (RFS), a Low Carbon Fuel Standard (LCFS) and a carbon price policy. The conceptual framework shows that these policies differ in

the incentives they create for the consumption and mix of different types of biofuels and in their effects on food and fuel prices and GHG emissions. We also simulate the welfare and GHG effects of these three policies which are normalized to achieve the same level of US GHG emissions. By promoting greater production of food-crop based biofuels, the RFS is found to lead to a larger reduction in fossil fuel use but also a larger increase in food prices and a smaller reduction in global GHG emissions compared to the LCFS and carbon tax. All three policies increase US social welfare compared to a no-biofuel baseline scenario due to improved terms-of-trade, even when environmental benefits are excluded; global social welfare increases with a carbon tax but decreases with the RFS and LCFS due to the efficiency costs imposed by these policies, even after including the benefits of mitigating GHG emissions.

A ban on one is a boon for the other: Strict gasoline content rules and implicit ethanol blending mandates

- Journal of Environmental Economics and Management---2014---Soren Anderson, Andrew Elzinga

Ethanol and methyl-tertiary butyl ether (MTBE) were close substitutes in the gasoline additives market until MTBE was banned due to the concerns about groundwater contamination, leading to a sudden and dramatic substitution toward ethanol as an alternative oxygenate and octane-booster. We use variation in the timing of MTBE bans across states to identify their effects on gasoline prices. We find that state bans increased reformulated gasoline prices by 3–6 cents in non-Midwestern states for which the bans were binding, with larger impacts during times of high ethanol prices relative to MTBE and crude oil. We find qualitatively similar, yet smaller effects for conventional gasoline. We argue on the basis of a simple conceptual model and supporting empirical evidence that these bans functioned as implicit ethanol blending mandates in areas that were previously using MTBE to comply with strict environmental constraints. Overall, our results are consistent with the theoretical prediction that mandating

a minimum market share for a more costly alternative fuel—either directly, or implicitly through a ban on the preferred conventional fuel—will inevitably increase fuel prices in a competitive market.

Crime, weather, and climate change

- Journal of Environmental Economics and Management---2014---Matthew Ranson

This paper estimates the impact of climate change on the prevalence of criminal activity in the United States. The analysis is based on a 30-year panel of monthly crime and weather data for 2997 US counties. I identify the effect of weather on monthly crime by using a semi-parametric bin estimator and controlling for state-by-month and county-by-year fixed effects. The results show that temperature has a strong positive effect on criminal behavior, with little evidence of lagged impacts. Between 2010 and 2099, climate change will cause an additional 22,000 murders, 180,000 cases of rape, 1.2 million aggravated assaults, 2.3 million simple assaults, 260,000 robberies, 1.3 million burglaries, 2.2 million cases of larceny, and 580,000 cases of vehicle theft in the United States.

Conspicuous conservation: The Prius halo and willingness to pay for environmental bona fides

- Journal of Environmental Economics and Management---2014---Steven E. Sexton, Alison L. Sexton

This paper develops a theory of conspicuous conservation, a phenomenon related to conspicuous consumption in which individuals seek status through displays of austerity amid growing concern about environmental protection. We identify a statistically and economically significant conspicuous conservation effect in vehicle purchase decisions and estimate a mean willingness to pay for the green signal provided by the distinctively designed Toyota Prius in the range of \$430–4200 depending upon the owner's location. Results are related to the growing literature on green markets and suggest that policy should target less conspicuous conservation

investments that will be under-provided relative to those that confer a status benefit.

Cost-effective unilateral climate policy design: Size matters

- Journal of Environmental Economics and Management---2014---Christoph Böhringer,Carolyn Fischer,Knut Einar Rosendahl

Given the bleak prospects for a global agreement on mitigating climate change, pressure for unilateral abatement is increasing. A major challenge is emissions leakage. Border carbon adjustments and output-based allocation of emissions allowances can increase effectiveness of unilateral action but introduce distortions of their own. We assess antileakage measures as a function of abatement coalition size. We first develop a partial equilibrium analytical framework to see how these instruments affect emissions within and outside the coalition. We then employ a computable general equilibrium model of international trade and energy use to assess the strategies as the coalition grows. We find that full border adjustments rank first in global cost-effectiveness, followed by import tariffs and output-based rebates. The differences across measures and their overall appeal decline as the abatement coalition grows. In terms of cost, the coalition countries prefer border carbon adjustments; countries outside the coalition prefer output-based rebates.

Those outsiders: How downstream externalities affect public good provision

- Journal of Environmental Economics and Management---2014---Jason Delaney,Sarah Jacobson

Some policy problems pit one group's interests against another's. One group may determine provision of a project (such as a dam) that benefits group members but hurts others. We introduce a model of such projects. In-group members may contribute to a common fund that benefits them as a public good. Benefits from the project may vary within the group. Provision has negative downstream externalities: contribu-

tions hurt agents outside the in-group ("Outsiders"), rendering them anti-social. Many models of social preferences predict that such externalities should reduce provision, although conditional cooperation or a preference for in-group members may counteract this. We test this model with a lab experiment using Outsiders with whom the in-group members have more and less contact. With homogeneous in-group benefits, the presence of negative downstream externalities reduces contributions by half when they have closer contact with Outsiders but not at all when they have had no contact. We introduce a rotating high-return position that allows subjects to trade favors. In this setting, contributions of non-privileged members diminish slightly when faced with the negative externality given closer contact with Outsiders, and not at all with less contact. Reciprocal giving occurs whether or not Outsiders are present.

Saving power to conserve your reputation? The effectiveness of private versus public information

- Journal of Environmental Economics and Management---2014---Magali Delmas,Neil Lessem

Environmental damage is often an unseen byproduct of other activities. Disclosing environmental impact privately to consumers can reduce the costs and/or increase the moral benefits of conservation behaviors, while publicly disclosing such information can provide an additional motivation for conservation - cultivating a green reputation. In a unique field experiment in the residence halls at the University of California - Los Angeles, we test the efficacy of detailed private and public information on electricity conservation. Private information was given through real-time appliance level feedback and social norms over usage, and public information was given through a publicly visible conservation rating. Our analysis is based on 7,120 daily observations about energy use from heating and cooling, lights and plug load for 66 rooms collected over an academic year. Our results suggest that while private information alone was ineffective, public information combined with private information motivated a 20

percent reduction in electricity consumption achieved through lower use of heating and cooling. Public information was particularly effective for above median energy users.

Cars on crutches: How much abatement do smog check repairs actually provide?

- Journal of Environmental Economics and Management---2014---Pierre Mérel,Aaron Smith,Jeffrey Williams,Emily Wimberger

Not as much abatement as has been presumed. Smog check programs aim to curb tailpipe emissions from in-use vehicles by requiring repairs whenever emissions, measured at regular time intervals, exceed a certain threshold. Using data from California, we estimate that on average 41% of the initial emissions abatement from repairs is lost by the time of the subsequent inspection, normally two years later. Our estimates imply that the cost per pound of pollution avoided is an order of magnitude greater for smog check repairs than alternative policies such as new-vehicle standards or emissions trading among industrial point sources.

Environmental policies, competition and innovation in renewable energy

- Journal of Environmental Economics and Management---2014---Lionel Nesta,Francesco Vona,Francesco Nicolli

We investigate the effect of environmental policies on innovation under different levels of competition. Using information regarding renewable energy policies, competition and green patents for OECD countries since the late 1970s, we develop a pre-sample mean count-data econometric specification that accounts for the endogeneity of policies. We find that renewable energy policies are more effective in fostering green innovation in countries with liberalized energy markets. We also find that environmental policies are crucial only in the generation of high-quality green patents, whereas competition enhances the generation of low-quality green patents.

What floats your boat? Preference revelation from lotteries over complex goods

- Journal of Environmental Economics and Management---2014---Jonathan K. Yoder,Adrienne M. Ohler,Hayley Chouinard

We examine a type of lottery used to distribute some publicly held resource access rights. The lottery provides participants with the opportunity to choose among a set of simple gambles over multi-attribute goods. Participant choices result in an endogenous distribution of success rates over gambles that reflects tradeoffs between the relative desirability of the available goods and the probability of winning. When lottery winnings are multi-attribute goods, lottery outcomes provide sufficient information to estimate hedonic prices, marginal utility, and marginal rates of substitution among attributes. We develop a model for characterizing preferences from this information set. We apply our model to Idaho's Four Rivers White-water Recreation Lottery, which allows applicants to apply for one permit among a large set of alternative river/day combinations that provide varying river and weather characteristics. This lottery structure shows promise as a foundation for economic experiments for preference revelation.

Carbon abatement in the fuel market with biofuels: Implications for second best policies

- Journal of Environmental Economics and Management---2014---Christine Lasco Crago,Madhu Khanna

A carbon tax on fuel would penalize carbon intensive fuels like gasoline and shift fuel consumption to less carbon intensive alternatives like biofuels. Since biofuel production competes for land with agricultural production, a carbon tax could increase land rents and raise food prices. This paper analyzes the welfare effect of a carbon tax on fuel consisting of gasoline and biofuel in the presence of a labor tax, with and without a biofuel subsidy. The market impacts of a carbon tax are also compared with that of a subsidy. Findings show that

if a carbon tax increases biofuel demand, the tax interaction effect due to higher fuel prices is exacerbated by higher land rent and food prices and greater erosion of the carbon tax base. Thus, the second best optimal carbon tax for fuel is lower with biofuel in the fuel mix, especially if biofuel is subsidized.

Are energy efficiency standards justified?

- Journal of Environmental Economics and Management---2014---Ian Parry,David Evans,Wallace Oates

This paper develops an analytical framework for comparing the welfare effects of energy efficiency standards and pricing policies for reducing gasoline, electricity, and nationwide carbon emissions. The model is parameterized with US data and includes key externalities in the energy/transportation sectors and possible underinvestment in energy efficiency due to “misperceptions” over energy savings. Even with large misperceptions, the extra welfare gains from complementing efficient pricing policies with energy efficiency standards are zero for reducing gasoline and 5 percent for reducing electricity. And when viewed as substitutes, these standards forgo 60 percent or more of the potential welfare gains from corresponding pricing policies. A combination of energy efficiency and emissions standards is more than three times as costly as carbon pricing when there is no misperception over energy savings, and even with large misperceptions, combining carbon pricing with gasoline/electricity taxes is better than combining it with energy efficiency standards.

Strategic exploitation with learning and heterogeneous beliefs

- Journal of Environmental Economics and Management---2014---Maxime Agbo

We study the effect of learning with heterogeneous beliefs on the exploitation of a renewable common-pool resource. To that end, we extend the Great Fish War model of Levhari and Mirman (1980) to a learning environment in which several agents interact strategically and learn about the distribution of the stochastic

evolution of the resource. We find that the effect of anticipation of learning with heterogeneous beliefs is twofold. First, the anticipation of learning makes future payoffs more uncertain, which induces the agents to decrease present exploitation due to the precautionary motive. Second, under heterogeneity of beliefs, there is a differential informational externality that induces the agents to increase or decrease present exploitation. We also perform a comparative analysis on the Cournot–Nash equilibrium with learning by studying the effect of optimism and riskiness on resource exploitation.

The principal–agent model with multilateral externalities: An application to climate agreements

- Journal of Environmental Economics and Management---2014---Carsten Helm,Franz Wirl

We consider contracting of a principal with an agent if multilateral externalities are present. The motivating example is that of an international climate agreement given private information about the willingness-to-pay (WTP) for emissions abatement. Due to multilateral externalities the principal uses her own emissions besides subsidies to incentivize the agent and to assure his participation. Optimal contracts equalize marginal abatement costs and, thus, can be implemented by a system of competitive permit trading. Moreover, optimal contracts can include a boundary part (i.e., the endogenous, type dependent participation constraint is binding), which is not a copy of the outside option of no contract. Compared to this outside option, a contract can increase emissions of the principal for types with a low WTP, and reduce her payoff for high types. Subsidies can be constant or even decreasing in emission reductions, and turn negative so that the agent reduces emissions and pays the principal.

Social networks and non-market valuations

- Journal of Environmental Economics and Management---2014---William Neilson,Bruno Wichmann

This paper considers the role of social networks in the non-market valuation of public goods. In the model individuals derive utility both from their own direct enjoyment of the public good and from the enjoyment of those in their network. We find that network structure almost always matters, both for utility and for valuation. The network increases aggregate valuation when it assigns higher importance, that is, stronger connections, to individuals with higher private values for the public good. The model provides a theoretical foundation for the idea of opinion leaders who have disproportionate influence over their communities. Specifically, opinion leaders are individuals assigned high importance by the network, and projects favored by opinion leaders tend to be favored by the network as a whole. The model can also guide future empirical studies by enabling a more structural approach to non-market valuation in a socially connected group.

Testing genuine savings as a forward-looking indicator of future well-being over the (very) long-run

- Journal of Environmental Economics and Management---2014---David Greasley,Nick Hanley,Jan Kunas,Eoin McLaughlin,Les Oxley,Paul Warde

Genuine Savings (GS) have been much used in recent years as an indicator of a country's sustainability. According to some theorists (e.g. Arrow et al., 2012), under certain conditions a country with a positive level of GS should experience non-declining future utility, given the assumption of unlimited substitutability among all forms of capital (sometimes called "weak" sustainability). This paper reports the first very long-run tests of GS (also called comprehensive investment or adjusted net savings) as a forward-looking indicator of future well-being. We assemble data for British capital back to 1765, and construct several net investment measures which are used as indicators of two alternative measures of future well-being: consumption per capita and real wages. An allowance for a "value of time" due to exogenous technological progress is included in some GS measures, and we demonstrate the

importance of this measure and the choice of discount rate over the very long-run. On the whole, our results do not reject the postulated relationship between GS and future well-being, and show GS can be a forward looking indicator of future well-being for periods of up to 100 years.

Does efficient irrigation technology lead to reduced groundwater extraction? Empirical evidence

- Journal of Environmental Economics and Management---2014---Lisa Pfeiffer,C.-Y. Cynthia Lin Lawell

Encouraging the use of more efficient irrigation technology is often viewed as an effective, politically feasible method to reduce the consumptive use of water for agricultural production. Despite its pervasive recommendation, it is not clear that increasing irrigation efficiency will lead to water conservation in practice. In this paper, we evaluate the effect of a widespread conversion from traditional center pivot irrigation systems to higher efficiency dropped-nozzle center pivot systems that has occurred in western Kansas. State and national cost-share programs subsidized the conversion. On an average, the intended reduction in groundwater use did not occur; the shift to more efficient irrigation technology has increased groundwater extraction, in part due to shifting crop patterns.

Carbon leakage: Grandfathering as an incentive device to avert firm relocation

- Journal of Environmental Economics and Management---2014---Robert Schmidt,Jobst Heitzig

Emission allowances are sometimes distributed for free in an early phase of a cap-and-trade scheme to reduce adverse effects on the profitability of firms. This paper investigates whether grandfathering can also be used to avert the relocation of firms to countries with lower carbon prices. We show that under certain conditions, relocation can be averted in the long run, even if the grandfathering scheme is phased out over time and

immediate relocation is profitable in its absence. This requires that the permit price triggers sufficient investments into low-carbon technologies or abatement capital that create a lock-in effect which makes relocation unprofitable.

Capitalizing property rights insecurity in natural resource assets

- Journal of Environmental Economics and Management---2014---Corbett Grainger, Christopher J. Costello

Property rights are commonly touted as a solution to common pool resource problems. In practice, however, the security of property rights over natural resources varies substantially; this may affect returns to ownership and asset values. We use an analytical model to examine the effects of insecure property rights to natural resources on the market value of assets. We then use a unique dataset of fisheries from three countries to examine empirically how differences in property rights affect market outcomes. We find significant asset market capitalization of insecurity arising from (1) ownership disputes, (2) illegal extraction from resource stocks, and (3) the possibility of government revocation of rights.

The optimal time path of clean energy R&D policy when patents have finite lifetime

- Journal of Environmental Economics and Management---2014---Reyer Gerlagh, Snorre Kverndokk, Knut Einar Rosendahl

We study the optimal time path for clean energy innovation policy. In a model with emission reduction through clean energy deployment, and with R&D increasing the overall productivity of clean energy, we describe optimal R&D policies jointly with emission pricing policies. We find that while emission prices can be set at the Pigouvian level independently of innovation policy, the optimal level of R&D subsidies and patent lifetime change with the stages of the climate problem. In the early stages of clean energy

development, innovators find it more difficult to capture the social value of their innovations. Thus, for a given finite patent lifetime, optimal clean energy R&D subsidies are initially high, but then fall over time. Alternatively, if research subsidies are kept constant, the optimal patent lifetime should initially be long and fall over time.

Enforcement and price controls in emissions trading

- Journal of Environmental Economics and Management---2014---John Stranlund, L. Joe Moffitt

This paper examines how enforcement affects the structure and performance of emissions trading programs with price controls under uncertainty about firms' abatement costs. The analysis highlights how an enforcement strategy can cause abatement-cost risk to be transmitted to enforcement costs via the price of permits. When this occurs, accommodating the effect of abatement-cost risk with an optimal policy results in higher expected emissions and lower expected permit price than their second-best optimal values. However, it is possible to design an enforcement strategy that shields enforcement costs from abatement-cost risk by tying sanctions directly to permit prices. This enforcement strategy stabilizes enforcement effort, the optimal permit supply and price controls are independent of enforcement costs, and the policy produces the second-best optimal outcome.

Air pollution and children's respiratory health: A cohort analysis

- Journal of Environmental Economics and Management---2014---Timothy Beatty, Jay Shimshack

This paper uses a large database of multiple birth cohorts to study relationships between air pollution exposure and non-infant children's respiratory health outcomes. We observe several years of early-life health treatments for hundreds of thousands of English children. Three distinct research designs account for poten-

tial socioeconomic, behavioral, seasonal, and economic confounders. We find that marginal increases in carbon monoxide and ground-level ozone are associated with statistically significant increases in children's contemporaneous respiratory treatments. We also find that carbon monoxide exposure over the previous year has an effect on children's health that goes above and beyond contemporaneous exposure alone.

Using revealed preferences to estimate the Value of Travel Time to recreation sites

- Journal of Environmental Economics and Management---2014---Carlo Fezzi,Ian Batementman,Silvia Ferrini

The opportunity Value of Travel Time (VTT) is one of the most important elements of the total cost of recreation day-trips and arguably the most difficult to estimate. Most studies build upon the theoretical framework proposed by Becker (1965) by using a combination of revealed and stated preference data to estimate a value of time which is uniform in all activities and under all circumstances. This restriction is relaxed by DeSerpa's (1971) model which allows the value of saving time to be activity-specific. We present the first analysis which uses actual driving choices between open access and toll roads to estimate a VTT specific for recreation trips, thereby providing a value which conforms to both Becker's and DeSerpa's theoretical models. Using these findings we conduct a Monte Carlo simulation to identify generalizable results for subsequent valuation studies. Our results indicate that 3/4 of the wage rate provides a reasonable approximation of the average VTT for recreation trips, while the commonly implemented assumption of 1/3 of the wage rate generates downward biased results.

Value of time: Speeding behavior and gasoline prices

- Journal of Environmental Economics and Management---2014---Hendrik Wolff

'Value of Time' (VOT) is a key parameter in economics and policy. This paper presents an alterna-

tive method to estimate VOT by analyzing an hourly dataset on drivers speeding behavior as a function of the gasoline price. Our identification strategy is novel as it is based on the intensive margin. In comparison, previous studies reveal VOT on the extensive margin, but choice alternatives have multiple attributes thereby potentially confounding estimates. Consistent with the range of the prior literature, we find a VOT of about 50% of the wage rate and analyze sources of bias from accidents and traffic tickets. These bias functions suggest that previous stated preference VOT estimates are likely downward whereas previous revealed preference estimates are likely upward biased.

What do consumers believe about future gasoline prices?

- Journal of Environmental Economics and Management---2013---Soren Anderson,Ryan Kellogg,James Sallee

A full understanding of how gasoline prices affect consumer behavior frequently requires information on how consumers forecast future gasoline prices. We provide the first evidence on the nature of these forecasts by analyzing two decades of data on gasoline price expectations from the Michigan Survey of Consumers. We find that average consumer beliefs are typically indistinguishable from a no-change forecast, justifying an assumption commonly made in the literature on consumer valuation of energy efficiency. We also provide evidence on circumstances in which consumer forecasts are likely to deviate from no-change and on significant cross-consumer forecast heterogeneity.

The private and social economics of bulk electricity storage

- Journal of Environmental Economics and Management---2013---Richard Carson,Kevin Novan

The ability to store excess intermittent renewable electricity is increasingly being seen as a key option for integrating large quantities of renewable capacity. However, intermittent energy sources currently account for

very small amounts of total generation. Despite this fact, policymakers have begun implementing requirements that will dramatically increase the amount of bulk storage capacity. This paper examines the social benefits provided by bulk storage in the Texas electricity market, which has a large amount of renewable capacity relative to other states, but still quite limited renewable penetration. We focus on the impact of arbitraging electricity across time—a major service of bulk storage. Using current storage technologies, we demonstrate that electricity arbitrage will increase daily CO₂ emissions by an average of 0.19 tons for each MWh stored. In addition, daily SO₂ emissions will increase by an average of 1.89pounds/MWh while NO_x emissions will fall by an average of 0.15pounds/MWh.

The promise of Beijing: Evaluating the impact of the 2008 Olympic Games on air quality

- Journal of Environmental Economics and Management---2013---Yuyu Chen,Ginger Zhe Jin,Naresh Kumar,Guang Shi

To prepare for the 2008 Olympic Games, China adopted a number of radical measures to improve air quality. Using the officially reported air pollution index (API) from 2000 to 2009, we show that these measures improved the API of Beijing during and a little after the Games, but a significant proportion of the effect faded away by October 2009. For comparison, we also analyze an objective and indirect measure of air quality at a high spatial resolution – aerosol optical depth (AOD), derived using the data from NASA satellites. The AOD analysis confirms the real but temporary improvement in air quality, it also shows a significant correlation between air quality improvement and the timing and location of plant closure and traffic control. These results suggest that it is possible to achieve real environmental improvement via stringent policy interventions, but for how long the effects of these interventions will last will largely depend on the continuation of the interventions.

Do voluntary pollution reduction programs (VPRs) spur or deter environmental innovation? Evidence from 33/50

- Journal of Environmental Economics and Management---2013---Carmen Carrion-Flores,Robert Innes,Abdoul G. Sam

We study whether a government-sponsored voluntary pollution reduction program (VPR) promotes or deters the development of new environmental technologies that yield future emission reduction benefits. Using a panel of 127 U.S. manufacturing industries defined by 3-digit SIC classifications over the 1989–2004 period, we estimate impacts of industry-level participation in the 33/50 program, a VPR initiated by government regulators in 1991, on industry-level rates of environmental patenting. We find that higher rates of 33/50 program participation are associated with significant reductions in the number of successful environmental patent applications five to nine years after the program ended.

Improved source, improved quality? Demand for drinking water quality in rural India

- Journal of Environmental Economics and Management---2013---Katrina Jessoe

This paper tests the hypothesis that the expansion of improved drinking water supplies in rural India reduced household expenditure on water quality, offsetting some of the quality benefits from source protection. I estimate demand for in-home treatment using geological characteristics to predict a household's drinking water source. The probability of treatment and in particular boiling reduces by 18–27 percentage points in response to source protection, offsetting 4% of the water quality gains and saving households 0.5–1% in monthly expenditure. Behavioral choices partly counteract the water quality gains from source protection.

Wildfire smoke and health impacts: A closer look at fire attributes and their marginal effects

- Journal of Environmental Economics and Management---2013---Klaus Moeltner,Man-Keun

Existing studies on the economic impact of wildfire smoke have focused on single fire events or entire seasons without considering the marginal effect of daily fire progression on downwind communities. Neither approach allows for an examination of the impact of even the most basic fire attributes, such as distance and fuel type, on air quality and health outcomes. Improved knowledge of these effects can provide important guidance for efficient wildfire management strategies. This study aims to bridge this gap using detailed information on 24 large-scale wildfires that sent smoke plumes to the Reno/Sparks area of Northern Nevada over a 4-year period. We relate the daily acreage burned by these fires to daily data on air pollutants and local hospital admissions. Using information on medical expenses, we compute the per-acre health cost of wildfires of different attributes. We find that patient counts can be causally linked to fires as far as 200–300 miles from the impact area. As expected, the marginal impact per acre burned generally diminishes with distance and for fires with lighter fuel loads. Our results also highlight the importance of allowing for temporal lags between fire occurrence and pollutant levels.

Does the stock market value the inclusion in a sustainability stock index? An event study analysis for German firms

- Journal of Environmental Economics and Management---2013---Ulrich Oberndorfer,Peter Schmidt,Marcus Wagner,Andreas Ziegler

This paper empirically analyzes the effect of the inclusion of German corporations in the Dow Jones STOXX Sustainability Index (DJSI STOXX) and the Dow Jones Sustainability World Index (DJSI World) on stock performance. In order to receive robust estimation results, we apply an (short-term) event study approach that is based on both a modern asset pricing model, namely the three-factor model according to Fama and French [24], and additionally a t-GARCH(1,1) model. Our empirical results suggest that stock markets may penalize the inclusion of a firm

in sustainability stock indexes. This finding is mainly driven by a strongly negative effect of the inclusion in the DJSI World. In contrast, we do not find significant average cumulative abnormal returns for the inclusion in the DJSI STOXX. This suggests that the inclusion in a more visible sustainability stock index may have larger negative impacts.

Estimating population dynamics without population data

- Journal of Environmental Economics and Management---2013---Robert G. Chambers,Vangelis Tzouvelekas

We develop a biologically correct cost system for production systems facing invasive pests that allows the estimation of population dynamics without a priori knowledge of their true values. We apply that model to a data set for olive producers in Crete and derive from it predictions about the underlying population dynamics. Those dynamics are compared to information on population dynamics obtained from pest sampling with extremely favorable results.

Do environmental regulations disproportionately affect small businesses? Evidence from the Pollution Abatement Costs and Expenditures survey

- Journal of Environmental Economics and Management---2013---Randy Becker,Carl Pasurka,Ron Shadbegian

This paper examines whether the impact of environmental regulations differs by the size of the business. We consider the net effect of statutory, enforcement, and compliance asymmetries by estimating the relationship between plant size and pollution abatement expenditures, using establishment-level data on U.S. manufacturers from the Census Bureau's Pollution Abatement Costs and Expenditures (PACE) survey and from its Annual Survey of Manufactures and Census of Manufactures. We model establishments' pollution abatement operating costs (PAOC) per unit of economic activity as a function of establishment size,

industry, state, and year. Our results show that PAOC intensity increases with establishment and firm size.

Can pollution tax rebates protect low-wage earners?

- Journal of Environmental Economics and Management---2013---Don Fullerton,Holly Monti

Pollution taxes are believed to burden low-income households that spend a greater than average share of income on pollution-intensive goods. Some proposals offset that effect by returning revenue to low-income workers via reduced labor tax. We build analytical general equilibrium models with both high-skilled and low-skilled labor, and we solve for the change in real net wage of each group. Decomposition shows the separate effects of the tax rebate, higher product prices, and the changes in relative wage rates. We also include numerical examples. Even though the pollution tax injures both types of labor, in most cases we find that returning all of the revenue to low-skilled workers is still not enough to offset higher product prices. Changes in relative wage rates may further hurt low-skilled labor. Protecting low-income workers is possible in this model only if they are defined as those below a relatively low wage threshold, but we discuss many possible elaborations of this model that could affect those results.

Crediting uncertain ecosystem services in a market

- Journal of Environmental Economics and Management---2013---Michael Springborn,Boon-Ling Yeo,Juhwan Lee,Johan Six

The margin of safety (MOS) approach is an increasingly prevalent tool for ensuring the integrity of market-based programs for providing ecosystem services. Overcrediting is reduced by setting aside mean estimates of uncertain services in favor of a more conservative estimate. Like many environmental policy problems, ecosystem service markets involve the aggregation of uncertainty over multiple scales, e.g. from landowners to market intermediaries to the overall market. We

examine how the MOS instrument affects, and is affected by, an ecosystem services market. We show that the common bottom-up approach of imposing risk preferences at a local, disaggregated level—held over from earlier development in the context of toxics and command and control-style health risk regulation—leads to several unintended consequences. Furthermore, discounting landowner services can actually increase their profits, conditional on the elasticity of credit demand. We illustrate theoretical insights with an empirical application to greenhouse gas offset crediting in agriculture.

Discounting under uncertainty: Disentangling the Weitzman and the Gollier effect

- Journal of Environmental Economics and Management---2013---Christian Traeger

The uncertainty of future economic development affects the term structure of discount rates and, thus, the intertemporal weights that are to be used in cost benefit analysis. The U.K. and France have recently adopted a falling term structure to incorporate uncertainty and the U.S. is considering a similar step. A series of publications discusses the following concern: a seemingly analogous argument used to justify falling discount rates can also justify increasing discount rates. We show that increasing and decreasing discount rates mean different things, can coexist, are created by different channels through which risk affects evaluation, and have the same qualitative effect of making long-term payoffs more attractive.

Discounting for personal and social payments: Patience for others, impatience for ourselves

- Journal of Environmental Economics and Management---2013---Gregory Howard

The market rate of return on private investment is often used as the discount rate when conducting cost-benefit analysis (CBA) of public projects. I argue that the decision to invest pits current consumption against future consumption, both of which accumulate to the private decision maker. Public projects, on the

other hand, provide benefits that accrue to society in general. To examine the appropriateness of discount rates based on returns to private investment, this paper considers lab experiments designed to test whether individuals discount personal and social benefits at different rates. Personal benefits are captured through personal monetary payments, while social benefits are captured through anonymous donations to charitable organizations. I jointly elicit time and risk preferences and find that subjects discount charitable contributions at significantly lower rates than personal payments.

Minimax regret discounting

- Journal of Environmental Economics and Management---2013---Terrence Iverson

The paper considers an environmental policy decision in which the appropriate approach for discounting future costs and benefits is unknown. Uncertainty about the discount rate is formulated as a decision under Knightian uncertainty. To solve this, we employ minimax regret, a decision criterion that is much less conservative than the related criterion maximin—in particular, it can be shown to implement a “proportional response” in that it equally balances concern about the mistake of doing too little with that of doing too much. Despite the criterion’s balanced nature, the minimax regret solution mimics a policy that maximizes the present discounted value of future net benefits with an effective (certainty-equivalent) discount rate that declines over time to the lowest possible rate. In addition to reinforcing Weitzman’s (1998) original limiting result, the approach generates concrete policy advice when decision makers are unable to specify a prior over possible discount rates. We apply it to the Stern–Nordhaus discounting debate and find that the effective discount rate converges to the Stern rate in just under 200 years.

A density projection approach for non-trivial information dynamics: Adaptive management of stochastic natural resources

- Journal of Environmental Economics and Management---2013---Michael Springborn, James Sanchirico

We demonstrate a density projection approximation method for solving resource management problems with imperfect state information. The method expands the set of partially-observed Markov decision process (POMDP) problems that can be solved with standard dynamic programming tools by addressing dimensionality problems in the decision maker’s belief state. Density projection is suitable for uncertainty over both physical states (e.g. resource stock) and process structure (e.g. biophysical parameters). We apply the method to an adaptive management problem under structural uncertainty in which a fishery manager’s harvest policy affects both the stock of fish and the belief state about the process governing reproduction. We solve for the optimal endogenous learning policy—the active adaptive management approach—and compare it to passive learning and non-learning strategies. We demonstrate how learning improves efficiency but typically follows a period of costly short-run investment.

Learning abatement costs: On the dynamics of the optimal regulation of experience goods

- Journal of Environmental Economics and Management---2013---Beat Hintermann, Andreas Lange

We study the introduction of new technologies when their costs are subject to idiosyncratic uncertainty and can only be fully learned through individual experience. We set up a dynamic model of clean experience goods that replace old polluting consumption options and show how optimal regulation evolves over time. In our base setting where social and private learning incentives coincide, the optimal tax on the polluting consumption is increasing over time. We show, however, that if social and private learning incentives diverge because the private discount rate exceeds the social discount rate, it may be optimal to temporarily increase the tax rate beyond net marginal external damages to induce more learning before reducing the tax rate to the steady state level. Alternatively, one could complement the tax with subsidies for first-time users which can be phased out over time. Similar results apply if consumers have

biased expectations. We therefore give a rationale for introductory subsidies on new, clean technologies and non-monotonic tax paths from a perspective of consumer learning.

Water sharing agreements sustainable to reduced flows

- Journal of Environmental Economics and Management---2013---Stefan Ambec,Ariel Dinari, Daene McKinney

By signing a water sharing agreement (WSA), countries agree to release an amount of river water in exchange for a negotiated compensation. We examine the vulnerability of such agreements to reduced water flows. Among all WSAs that are acceptable to riparian countries, we find out the one which is self-enforced under the most severe drought scenarios. The so-called upstream incremental WSA assigns to each country its marginal contribution to its followers in the river. Its mirror image, the downstream incremental WSA, is not sustainable to reduced flow at the source. Self-enforcement problems can be solved by setting water releases and compensations contingent to water flow. We apply our analysis to the Aral Sea Basin. We compute the upstream incremental compensations for the Bishkek agreement and assess its vulnerability with historical flows.

Tax evasion and optimal environmental taxes

- Journal of Environmental Economics and Management---2013---Antung Anthony Liu

This paper introduces a new argument to the debate about the role of environmental taxes in modern tax systems. Some environmental taxes, particularly taxes on gasoline or electricity, are more difficult to evade than taxes on labor or income. When the tax base is shifted in a revenue-neutral manner toward these environmental taxes, the result is a net reduction in the amount of tax evasion. Using a carbon tax as a motivating example, the “tax evasion effect” is shown to sharply reduce the welfare cost of controlling emissions. A simple computable general equilibrium

model suggests that the impact of considering tax evasion can be large: costs are lowered by 28% in the United States, by 89% in China, and by 97% in India. In countries with high levels of pre-existing tax evasion, a carbon tax will pay for itself through improvements in the efficiency of the tax system.

Market design in cap and trade programs: Permit validity and compliance timing

- Journal of Environmental Economics and Management---2013---Stephen Holland, Michael R. Moore

Cap and trade programs have considerable heterogeneity in permit validity and compliance timing. For example, permits have different validities across time (e.g., banking, borrowing, and seasons) and space (e.g., zonal restrictions), and compliance timing can be annual, in overlapping cycles, or in multi-year periods. We discuss nine prominent cap and trade programs along these dimensions and construct a general model of permit validity and compliance timing. We derive sufficient conditions under which abatement is invariant to compliance timing, i.e., compliance timing cannot smooth abatement cost shocks. Under these conditions, (i) expected compliance costs are invariant, (ii) the variance of compliance costs increases with the delayed compliance, (iii) equilibrium prices may not be unique, and (iv) the delayed compliance equilibrium may rely on “degenerate” prices not determined by marginal abatement costs. We demonstrate the model’s broad applicability by illustrating different types of temporal permit validity.

Renewable electricity policies, heterogeneity, and cost effectiveness

- Journal of Environmental Economics and Management---2013---Harrison Fell, Joshua Linn

Renewable electricity policies promote investment in renewable electricity generators and have become increasingly common around the world. Because of intermittency and the composition of other generators in the power system, the value of certain renewable –

particularly wind and solar – varies across locations and technologies. This paper investigates the implications of this heterogeneity for the cost effectiveness of renewable electricity policies. A simple model of the power system shows that renewable electricity policies cause different investment mixes. Policies also differ according to their effect on electricity prices, and both factors cause the cost effectiveness to vary across policies. We use a detailed, long-run planning model that accounts for intermittency on an hourly basis to compare the cost effectiveness for a range of policies and alternative parameter assumptions. The differences in cost effectiveness are economically significant, where broader policies, such as an emissions price, outperform renewable electricity policies.

Climate and international trade policies when emissions affect production possibilities

- Journal of Environmental Economics and Management---2013---Christos Kotsogiannis, Alan Woodland

In this paper, we develop a model of international trade and climate change in which emission discharges arising from production have a feedback effect on national production sectors by impacting upon effective factor endowments. With this context, the objectives are, first, to provide a general characterization of Pareto-efficient climate and trade policies and, second, to examine the possibility – starting from non-Pareto-efficient equilibria – for Pareto-improving environmental policies. We provide conditions under which several particular reforms of carbon taxes are welfare improving.

Flattening the carbon extraction path in unilateral cost-effective action

- Journal of Environmental Economics and Management---2013---Thomas Eichner, Rüdiger Pethig

Internalizing the global negative externality of carbon emissions requires the flattening of the extraction path of world fossil energy resources (=world carbon emissions). We consider governments with

sign-unconstrained emission taxes at their disposal and seeking to prevent world emissions from exceeding some binding aggregate emission ceiling in the medium term. Such a ceiling policy can be carried out either in full cooperation or by a sub-global climate coalition. Unilateral action has to cope with carbon leakage and high costs, which makes a strong case for choosing a policy that implements the ceiling in a cost-effective way. In a two-country, two-period general equilibrium model with a non-renewable fossil-energy resource, we characterize the unilateral cost-effective ceiling policy and compare it with its fully cooperative counterpart. We show that with full cooperation there exists a cost-effective ceiling policy in which only first-period emissions are taxed at a rate that is uniform across countries. In contrast, the cost-effective ceiling policy of a sub-global climate coalition is characterized by emission regulation in both periods. The share of the total stock of energy resources owned by the sub-global climate coalition turns out to be a decisive determinant of the sign and magnitude of unilateral cost-effective taxes.

Strategic climate policy with offsets and incomplete abatement: Carbon taxes versus cap-and-trade

- Journal of Environmental Economics and Management---2013---Jon Strand

This paper provides a first analysis of a “policy bloc” of fossil fuel importers which implements an optimal climate policy, faces a (non-policy) fringe of other fuel importers, and an exporter bloc, and purchases offset from the fringe. We compare a carbon tax and a cap-and-trade scheme for the policy bloc, in either case accompanied by an efficient offset mechanism for reducing emissions in the fringe. The policy bloc is shown to prefer a tax over a cap, since only a tax reduces the fuel export price and by more when the policy bloc is larger. Offsets are also more favorable to the policy bloc under a tax than under a cap. The optimal offset price under a carbon tax is below the tax rate, while under a cap and free quota trading the offset price must equal the quota price. The domestic

carbon and offset prices are both higher under a tax than under a cap when the policy bloc is small. When the policy bloc is larger, the offset price can be higher under a cap. Fringe countries gain by mitigation in the policy bloc, more under a carbon tax since the fuel import price is lower.

Political influence on non-cooperative international climate policy

- Journal of Environmental Economics and Management---2013---Wolfgang Habla,Ralph Winkler

We analyze non-cooperative international climate policy in a setting of political competition by national interest groups. In the first stage, countries decide whether to link their domestic emission permit markets to an international market, which only forms if it is supported by all countries. In the second stage, countries non-cooperatively decide on the number of tradable emission allowances. In both stages, special interest groups try to sway the government in their favor. We find that (i) both the choice of regime and the levels of domestic and global emissions only depend on the aggregate levels of organized stakes in all countries and not on their distribution among individual interest groups and (ii) an increase in lobbying influence by a particular lobby group may backfire by inducing a change towards the lobby group's less preferred regime.

Climate treaties and approaching catastrophes

- Journal of Environmental Economics and Management---2013---Scott Barrett

If the threshold that triggers climate catastrophe is known with certainty, and the benefits of avoiding catastrophe are high relative to the costs, treaties can easily coordinate countries' behavior so as to avoid the threshold. Where the net benefits of avoiding catastrophe are lower, treaties typically fail to help countries cooperate to avoid catastrophe, sustaining only modest cuts in emissions. These results are unaffected by uncertainty about the impact of catastrophe. By contrast, uncertainty about the catastrophic threshold

normally causes coordination to collapse. Whether the probability density function has "thin" or "fat" tails makes little difference.

Build it, but will they come? Evidence from consumer choice between gasoline and sugarcane ethanol

- Journal of Environmental Economics and Management---2013---Alberto Salvo,Cristian Huse

How consumers might switch from gasoline and diesel to alternative energy sources is not known, since the availability of alternatives is currently very limited. To bridge this gap, we exploit exogenous variation in ethanol prices at Brazil's pumps and uncover substantial consumer heterogeneity in the choice between long-established gasoline and an alternative that is similarly available and usable: sugarcane ethanol. We observe roughly 20% of flexible-fuel motorists choosing gasoline when gasoline is priced 20% above ethanol in energy-adjusted terms (\$/mile) and, similarly, 20% of motorists choosing ethanol when ethanol is priced 20% above gasoline. We use transaction-level data to explore "non-price" characteristics which differentiate the two goods in the minds of different groups of consumers. Our findings suggest—and a counterfactual illustrates—that switching away from gasoline en masse, should this be desired, would require considerable price discounts to boost voluntary adoption, in the US and elsewhere.

Fuel prices and new vehicle fuel economy—Comparing the United States and Western Europe

- Journal of Environmental Economics and Management---2013---Thomas Klier,Joshua Linn

Several recent papers have documented an effect of fuel prices on new vehicle fuel economy in the United States. This paper estimates the effect of fuel prices on average new vehicle fuel economy for the eight largest European markets. The analysis spans the years 2002–2007 and uses detailed vehicle registration and specification data to control for policies, consumer preferences, and other

potentially confounding factors. We find fuel prices to have a statistically significant effect on average new vehicle fuel economy in Europe. The effect estimated for Europe is much smaller than comparable estimates for the United States.

Intergenerational aspects of ecotax reforms – An application to Germany

- Journal of Environmental Economics and Management---2013---Wolfgang Habla,Kerstin Roeder

In a model of overlapping generations and majority voting, we analyze an ecotax reform consisting of the tax rate and the budgetary rule. Revenue can be recycled through a lump-sum transfer or a reduction in pension contributions. Our theoretical results as well as the calibration of our model to the German economy show that the median voter's preferred tax rate may exceed the efficient rate. This holds whenever income of the decisive voter is sufficiently high compared to the average income, as rich individuals benefit more from a reduction in pension contributions than they are harmed by an increase in ecotaxes. The calibration confirms that the median voter prefers the earmarking of tax revenue for reductions in pension contributions to the alternative lump-sum transfer. This is quite an accurate prediction of the situation in Germany. Aging of society as expected for Germany lowers the ecotax in the political equilibrium below its optimal level.

Intertemporal links in cap-and-trade schemes

- Journal of Environmental Economics and Management---2013---Aur lie Slechten

In a two-period general equilibrium model, I study the effects of intertemporal emission permit trading in a cap-and-trade scheme when firms' investments in abatement have long-term effects. To meet their caps, firms optimally choose levels of trading and investment in each period by equalizing the marginal benefit of abatement to the marginal cost of abatement in each period. The fact that investments have long-term effects introduces new effects: investments

in period 1 have both an additional benefit (the reduction of emissions in period 2) and an additional cost (the decrease in abatement opportunities in period 2). This changes the standard condition of equalization of marginal costs across periods for cost-effectiveness. Without intertemporal trading, some investments in period 1 are entirely driven by second-period abatement needs. In that case, allowing intertemporal trading may reduce investment in period 1 as some long-term investments are substituted by intertemporal permit trading. Descriptive evidence from the EU Emissions Trading System (ETS) illustrates this potential effect.

Environmental policy with collective waste disposal

- Journal of Environmental Economics and Management---2013---Stephen Hamilton,Thomas W. Sproul,David Sunding,David Zilberman

Centralized collection and disposal is an integral component of waste management strategies for many solid and liquid wastes, and carbon capture and storage is currently being considered for gaseous waste. In this paper we show how collective waste disposal systems introduce essential changes in the design of optimal environmental policy. Absent collective disposal, an optimal environmental policy imposes relatively stringent regulations on polluters in regions where local environmental damage functions are "high" ; however, under collective waste disposal, the optimal environmental policy level increases monotonically over distance from the disposal site, and this is true irrespective of the degree of spatial heterogeneity in local environmental damage functions. We characterize the optimal spatial pattern of environmental policy levels under collective waste disposal and identify optimal membership size for waste disposal networks comprised of homogeneous producers.

Re-evaluating the role of energy efficiency standards: A behavioral economics approach

- Journal of Environmental Economics and Management---2013---Tsvetan Tsvetanov,Kathleen Segerson

The economic models that prescribe Pigovian taxation as the first-best means of reducing energy-related externalities are typically based on the neoclassical model of rational consumer choice. Yet, consumer behavior in markets for energy-using durables is generally thought to be far from efficient, giving rise to the concept of the “energy-efficiency gap.” This paper presents a welfare analysis of energy policies that is based on a behavioral model of temptation and self-control, introduced by Gul and Pesendorfer [23,24]. We find that, in the presence of temptation, (i) Pigovian taxes alone do not yield a first-best outcome, (ii) when viewed as substitutes, energy efficiency standards can dominate Pigovian taxes, and (iii) a policy combining standards with a Pigovian tax can yield higher social welfare than a Pigovian tax alone, implying that the two instruments should be viewed as complements rather than substitutes.

The regulation of a spatially heterogeneous externality: Tradable groundwater permits to protect streams

- Journal of Environmental Economics and Management---2013---Yusuke Kuwayama,Nicholas Brozović

Groundwater pumping can reduce the flow of surface water in nearby streams. In the United States, recent awareness of this externality has led to intra- and inter-state conflict and rapidly-changing water management policies and institutions. Although the marginal damage of groundwater use on stream flows depends crucially on the location of pumping relative to streams, current regulations are generally uniform over space. We use a population data set of irrigation wells in the Nebraska portion of the Republican River Basin to analyze whether adopting spatially differentiated groundwater pumping regulations leads to significant reductions in farmer abatement costs and costs from damage to streams. We find that regulators can generate most of the potential savings in total social costs without accounting for spatial heterogeneity. However, if regulators need to increase the protection of streams significantly from current levels, spatially differentiated

policies will yield sizable cost savings.

The additionality problem with offsets: Optimal contracts for carbon sequestration in forests

- Journal of Environmental Economics and Management---2013---Charles Mason,Andrew J. Plantinga

Carbon offsets are a frequently discussed tool for reducing the costs of an emissions reduction policy. However, offsets have a basic problem stemming from asymmetric information. Sellers of offsets have private information about their opportunity costs, leading to concerns about whether offsets are additional. Non-additional offsets can undermine a cap-and-trade program or, if the government purchases them directly, result in enormous government expenditures. We analyze contracts for carbon sequestration in forests that mitigate the asymmetric information problem. Landowners are offered a menu of two-part contracts that induces them to reveal their type. Under this scheme, the government is able to identify ex post how much additional forest each landowner contributes and minimize ex ante its expenditures on carbon sequestration. To explore the performance of the contracting scheme, we conduct a national-scale simulation using an econometric model of land-use change. The results indicate that for an increase in forest area of 61 million acres, government expenditures are \$5.3 billion lower under the contracting approach compared to a uniform subsidy offered to all landowners. This compares to an increase in private opportunity costs of just \$110 million dollars under the contracts. Thus, the contracting scheme is preferable from society’s perspective.

Complementarity, impatience, and the resilience of natural-resource-dependent economies

- Journal of Environmental Economics and Management---2013---Martin Quaas,Daan van Soest,Stefan Baumgärtner

We study how society’s preferences affect the resilience of economies that depend on more than one type of natural resource. In particular, we analyze whether

the degree of complementarity of natural resources in consumer preferences may give rise to multiple steady states and path dependence even when resources are managed optimally. We find that, for a given social discount rate, society tends to be less willing to buffer exogenous shocks if resource goods are complements in consumption than if they are substitutes. The stronger the complementarity between the various types of natural resources, the less resilient the economy is, and even more so the higher is the social discount rate.

Innovation and diffusion of clean/green technology: Can patent commons help?

- Journal of Environmental Economics and Management---2013---Bronwyn Hall, Christian Helmers

This paper explores the characteristics of 238 patents on 90 inventions contributed by major multinational innovators to the “Eco-Patent Commons”, which provides royalty-free access to third parties to patented innovations on green technologies. We compare the pledged patents to other patents in the same technologies or held by the same multinationals to investigate the motives of the contributing firms as well as the potential for such commons to encourage innovation and diffusion of climate change related technologies. We find pledged patents to protect environmentally friendly technologies and to be of similar value as the average patent in a pledging firm’s patent portfolio but of lower value than other patents in their class. Our analysis of the impact of the patent commons on diffusion of patented technologies suggests that making patents accessible royalty-free did not result in any significant increase in diffusion as measured by citing patents. This study, therefore, indirectly provides evidence on the role of patents in the development and diffusion of green technologies.

Can household consumers save the wild fish? Lessons from a sustainable seafood advisory

- Journal of Environmental Economics and Management---2013---Eric Hallstein, Sofia Villas-Boas

Conservation organizations seeking to reduce over-fishing and promote better fishing practices have increasingly turned to market-based mechanisms such as environmental sustainability labels (eco-labels) in order to shift patterns of household consumption. This paper presents an analysis of consumer response to an advisory for sustainable seafood adopted by a regional supermarket in the United States. The advisory consisted of a label in which one of three traffic light colors was placed on each fresh seafood product to inform consumers about its relative environmental sustainability. Green meant “best” choice, yellow meant “proceed with caution,” and red meant “worst choice”. Using a unique product-level panel scanner data set of weekly sales and taking advantage of the random phase-in of the advisory by the retailer, we apply a difference-in-differences identification strategy to estimate the effect of the advisory on overall seafood sales as well as the heterogeneous impact of the advisory by label color and whether the seafood met additional health-related criteria. We find evidence that the advisory led to a statistically significant 15.3% decline in overall seafood sales, a statistically significant 34.9% decline in the sale of yellow labeled seafood, and a statistically significant 41.3% decline in the sale of yellow labeled seafood on a mercury safe list. We find no statistically significant difference in sales of green or red labeled seafood.

Valuing nature in a general equilibrium

- Journal of Environmental Economics and Management---2013---Jared Carbone, V. Smith

We explore the consequences of modeling the demand for environmental quality improvements as a fully integrated part of a general equilibrium demand system in an applied general equilibrium (or CGE) analysis. Demand for non-market goods depends on a full range of relative prices as well as environmental outcomes. We simulate the effects of reducing two air pollutants to improve human health and three ecosystem services provided to households. The ecosystem services make non-separable contributions to household utility. We find that willingness to pay measures of use-based ecosystem services are impacted by changes in demand

for complementary market goods. Demand for these goods shifts due to pollution reductions that enhance ecosystem services. Partial equilibrium estimates of these use values can be measured with substantial error if they fail to account for the general equilibrium adjustments caused by pollution. Over 300 calibrations of the model identify the model features important to these errors. We find that effects on ecosystem services associated with non-use values have important implications for the feedback effects on use related measures of economic tradeoffs. This is due to how our model integrates market and non-market effects, reflecting the non-market services importance to general equilibrium market outcomes.

What can we learn from benefit transfer errors? Evidence from 20 years of research on convergent validity

- Journal of Environmental Economics and Management---2013---Sapna Kaul, Kevin Boyle, Nicolai Kuminoff, Christopher Parmeter, Jaren Pope

We develop a nonparametric approach to meta-analysis and use it to identify modeling decisions that affect benefit transfer errors. The meta-data describe the results from 31 empirical studies testing the convergent validity of benefit transfers. They evaluated numerous methodological procedures, collectively reporting 1071 transfer errors. Our meta-regressions identify several important findings, including: (1) the median absolute error is 39%; (2) function transfers outperform value transfers; (3) transfers describing environmental quantity generate lower transfer errors than transfers describing quality changes; (4) geographic site similarity is important for value transfers; (5) contingent valuation generates lower transfer errors than other valuation methods; and (6) combining data from multiple studies tends to reduce transfer errors.

Economics of additionality for environmental services from agriculture

- Journal of Environmental Economics and Management---2013---John K. Horowitz, Richard

Just

We present a model of additionality for offsets sold from agriculture to industrial sector sources regulated by cap-and-trade. We consider a potential policy where agricultural sources would not be covered by cap-and-trade requirements but would be eligible to receive offsets whenever their emissions fall below a policy-specified baseline, and would not be penalized for emissions above their baseline. Major results are: (1) The optimal baseline should be set above the average counterfactual emissions of participating farms, an unexpected result that has been missing from the literature. (2) The optimal trading ratio should be greater than one (a ton of offsets counts for less than a ton of covered emissions) even under emissions certainty. Previous research has justified such trading ratios by emissions uncertainty. (3) Emissions uncertainty does not justify a change in the baseline if the accompanying emissions model is unbiased. (4) An optimal combination of policies is to subsidize offsets and tighten the baseline relative to the no-subsidy case.

Prices vs quantities with multiple pollutants

- Journal of Environmental Economics and Management---2013---Stefan Ambec, Jessica Coria

We examine the choice of policy instruments (price, quantity or a mix of the two) when two pollutants are regulated and firms' abatement costs are private information. Whether abatement efforts are complements or substitutes is key determining the choice of policies. When pollutants are complements, a mixed policy instrument with a tax on one pollutant and a quota on another is sometimes preferable even if the pollutants are identical in terms of benefits and costs of abatement. Yet, if they are substitutes, the mixed policy is dominated by taxes or quotas.

Contagious cooperation, temptation, and ecosystem collapse

- Journal of Environmental Economics and Management---2013---Andries Richter, Daan van

Real world observations suggest that social norms of cooperation can be effective in overcoming social dilemmas such as the joint management of a common pool resource—but also that they can be subject to slow erosion and sudden collapse. We show that these patterns of erosion and collapse emerge endogenously in a model of a closed community harvesting a renewable natural resource in which individual agents face the temptation to overexploit the resource, while a cooperative harvesting norm spreads through the community via interpersonal relations. We analyze under what circumstances small changes in key parameters (including the size of the community, and the rate of technological progress) trigger catastrophic transitions from relatively high levels of cooperation to widespread norm violation—causing the social-ecological system to collapse.

Does cleanup of hazardous waste sites raise housing values? Evidence of spatially localized benefits

- Journal of Environmental Economics and Management---2013---Shanti Gamper-Rabindran, Christopher Timmins

Economists often rely on publicly available data provided at coarse geographical resolution to value spatially localized amenities. We propose a simple refinement to the hedonic method that accommodates this reality: specifically, we measure localized benefits from the cleanup of hazardous waste sites at the sub-census tract level by examining the entire within-tract housing value distribution, rather than simply focusing on the tract median. Our point estimates indicate that the cleanup leads to larger appreciation in house prices at the lower percentiles of the within-tract house value distribution than at higher percentiles. Though not statistically different from one another, the estimates are monotonically ordered from 24.4% at the 10th percentile, 20.8% at the median and 18.7% at the 90th percentile, respectively. We confirm these results in two ways. First, our analysis using restricted access census

block data finds comparable results that cleanup leads to a 14.7% appreciation in the median block-level housing values. Second, our analysis of proprietary housing transactions data show that cheaper houses within a census tract are indeed more likely to be closer to a hazardous waste site, explaining the greater impacts they receive from the cleanup process.

Changes in implicit flood risk premiums: Empirical evidence from the housing market

- Journal of Environmental Economics and Management---2013---Okmyung Bin, Craig Landry

Hedonic valuation models have shown that sales prices can capitalize property risk factors, such as flood zone; properties facing lower risk sell at a premium, all else being equal. Previous research has indicated that price differentials reflecting risk of flooding become much larger in the wake of a storm. We re-examine these findings for Pitt County, North Carolina, using multiple storm events within a difference-in-differences framework, and we compare flood zone price differentials for a more recent sample of property sales. Prior to Hurricane Fran in 1996, we detect no market risk premium for the presence in a flood zone, but we find significant price differentials after major flooding events, amounting to a 5.7% decrease after Hurricane Fran and 8.8% decrease after Hurricane Floyd. Results from a separate model that examines more recent data covering a period without significant storm-related flood impacts indicate a significant risk premium ranging between 6.0% and 20.2% for homes sold in the flood zone, but this effect is diminishing over time, essentially disappearing about 5 or 6 years after Hurricane Floyd. The lack of a persistent effect suggests that buyers' and sellers' risk perceptions may change with the prevalence of hazard events and that homebuyers are unaware of flood risks and insurance requirements when bidding on properties.

Dynamics of indirect land-use change: Empirical evidence from Brazil

- Journal of Environmental Economics and Management---2013---Saraly Andrade de

The expansion of a given land use may affect deforestation directly if forests are cleared to free land for this use, or indirectly, via the displacement of other land-use activities from non-forest areas towards the forest frontier. Unlike direct land conversion, indirect land-use changes affecting deforestation are not immediately observable. They require the linking of changes occurring in different regions. This paper empirically assesses the possible indirect effects of sugarcane expansion in Brazil's state of São Paulo, on forest conversion decisions in the country's Amazon region. Further, it examines the evidence for a mechanism through which these effects might materialize, namely a displacement of cattle ranching activities from São Paulo state to the Amazon. The results suggest a positive relationship between sugarcane expansion and deforestation. This indirect land-use effect is shown to be a dynamic process materializing over 10–15 years.

Wind power development in the United States

- Journal of Environmental Economics and Management---2013---Claudia Hitaj

This paper analyzes the drivers of wind power development in the United States, focusing on government renewable energy incentives and access to the electricity grid. The effects of wind capacity, electricity transmission line coverage and grid regulation, as well as state and federal subsidies from 1998 to 2007 are estimated via random effects Tobit, Probit, and ordinary least squares instrumental variables regression. The results indicate that the federal production tax credit, state-level sales tax credit and production incentives play an important role in promoting wind power. In addition, higher wind power penetration levels can be achieved by bringing more parts of the electricity transmission grid under independent system operator regulation. This paper concludes that state and federal government policies play a significant role in wind power development both by providing financial support and by improving physical and procedural access to the electricity grid.

Do national borders matter? Intranational trade, international trade, and the environment

- Journal of Environmental Economics and Management---2013---Carol McAusland, Daniel Millimet

We develop a theoretical model identifying channels through which trade impacts the environment. First, trade decouples some of regulation's costs from its benefits, prompting demand for stringent environmental regulations. Second, trade provides consumers with access to new varieties of goods; the associated income (substitution) effect raises (lowers) demand for strict regulation. The model predicts (1) international trade to be more environmentally beneficial than intranational trade due to a stronger decoupling effect, and (2) both intra and international trade to be pro-environment unless substitution effects are sufficiently strong. Using data on intra and international trade for the US and Canada, along with several environmental outcomes, we find robust evidence that international trade has a statistically and economically beneficial causal effect on environmental quality, while intranational trade has a harmful impact. This pattern is consistent with a moderate-sized substitution effect along with a stronger decoupling effect of international trade.

Protectionism versus risk in screening for invasive species

- Journal of Environmental Economics and Management---2013---Chad Lawley

I examine the extent to which enforcement of a biosecurity import restriction – US border inspections for foreign pests and diseases – is used as a protectionist trade barrier. The parameters of a structural model of border inspection are estimated using a detailed dataset documenting the outcome of US agricultural border inspections. I find that inspections are conducted in a manner that places an implied welfare weight on domestic producers (relative to consumers) ranging from 1 to 1.63. I also find evidence that the inspection

agency takes terms of trade into account when inspecting agricultural imports. These results suggest that border inspections are used as a protectionist non-tariff barrier.

The value of adaption: Climate change and timberland management

- Journal of Environmental Economics and Management---2013---Christopher Guo,Christopher Costello

Adaptation to exogenous change occurs on both intensive and extensive margins. Whether and how one accounts for human adaptation directly affects estimates of the economic consequences of environmental change, estimates that are both critical in informing policy decisions and notoriously difficult to value. This paper introduces and applies an analytical framework for placing an economic value on adaptation. We explore the issue first in a stylized model that facilitates making concrete generalizations about the kinds of adaptations that generate high or low economic value. We then test the soundness of our insights by incorporating learning and adaptive decision-making into a structural dynamic forestry model where climate change is imposed exogenously and agents respond optimally. Using downscaled climate projections integrated with site- and species-specific timber productivity data, we estimate the economic value of adaptation to climate change within the California timber industry. We find on the intensive margin, changing the rotation intervals will yield a low value of adaptation, but on the extensive margin, replanting more suitable tree species can yield significant value.

Empowering neighbors versus imposing regulations: An experimental analysis of pollution reduction schemes

- Journal of Environmental Economics and Management---2013---Timothy Cason,Lata Gangadharan

This paper presents an experimental study of two mechanisms that influence incentives to reduce ambient pol-

lution levels. In the formal mechanism individuals face a penalty if the group generates total pollution that exceeds a specified target, whereas in the informal mechanism individuals can choose to incur costs to punish each other after observing their group members' emissions. We examine the effectiveness of these mechanisms, in isolation and in combination. The results suggest that the formal targeting mechanism is significantly more effective than informal peer punishment in reducing pollution and increasing efficiency. Peer punishment however improves the performance of the formal mechanism.

Evaluating “Cash-for-Clunkers” : Program effects on auto sales and the environment

- Journal of Environmental Economics and Management---2013---Shanjun Li,Joshua Linn,Elisheba Spiller

“Cash-for-Clunkers” was a \$3 billion program that attempted to stimulate the U.S. economy and improve the environment by encouraging consumers to retire older vehicles and purchase fuel-efficient new vehicles. We investigate the effects of this program on new vehicle sales and the environment. Using Canada as the control group in a difference-in-differences framework, we find that, of the 0.68 million transactions that occurred under the program, the program increased new vehicle sales only by about 0.37 million during July and August of 2009, implying that approximately 45 percent of the spending went to consumers who would have purchased a new vehicle anyway. Our results cannot reject the hypothesis that there is little or no gain in sales beyond 2009. The program will reduce CO₂ emissions by only 9–28.2 million tons based on upper and lower bounds of the estimate of the program effect on sales, implying a cost per ton ranging from \$92 to \$288 even after accounting for reduced criteria pollutants.

Fuel price increases and the timing of changes in household driving decisions

- Journal of Environmental Economics and Management---2013---Melanie Cozad,Jacob LaR-

Using the oil price increase of 1979 as a natural experiment and several event study specifications, this paper finds evidence that the oil spike induced significant decreases in carbon emissions on both the intensive (miles driven) and extensive (auto fuel efficiency) margins. Further, it appears that substitution on the intensive margin occurred instantaneously whereas extensive margin substitution occurred with a significant lag. Given the timing of the changes, the results appear robust to the implementation of Corporate Average Fuel Economy (CAFE) standards over the same time period. These findings have important implications for estimating demand elasticities for durable goods with respect to energy prices and the price elasticity of fuels themselves.

The value of water as an urban club good: A matching approach to community-provided lakes

- Journal of Environmental Economics and Management---2013---Joshua K. Abbott, Henry Klaiber

Community-provided urban lakes located in arid environments provide significant amenities to residents but require large quantities of water to maintain lake levels. We use matching techniques to recover the average capitalized value of lakes above the costs of maintenance by comparing transactions in lake communities to observationally similar transactions in surrounding communities. We differentiate between adjacent and non-adjacent houses to recover heterogeneous treatment effects and allow estimates to vary across communities. Importantly, we consider the role of imperfect matching on spatially and temporally varying unobservable variables in our choice of estimator and the appropriate set of potential control properties. Our results suggest that the capitalized value of lakes is heterogeneous with a mean estimate of \$6500 an acre-foot. Our results provide estimates of the changes in water prices that would make this form of development unprofitable, illustrating the linkage between water pricing policy and the water intensity of development.

Impact of a randomized controlled trial in arsenic risk communication on household water-source choices in Bangladesh

- Journal of Environmental Economics and Management---2013---Lori Benneer, Alessandro Tarozi, Alexander Pfaff, Soumya Balasubramanya, Kazi Matin Ahmed, Alexander van Geen

We conducted a randomized controlled trial in rural Bangladesh to examine how household drinking-water choices were affected by two different messages about risk from naturally occurring groundwater arsenic. Households in both randomized treatment arms were informed about the arsenic level in their well and whether that level was above or below the Bangladesh standard for arsenic. Households in one group of villages were encouraged to seek water from wells below the national standard. Households in the second group of villages received additional information explaining that lower-arsenic well water is always safer and these households were encouraged to seek water from wells with lower levels of arsenic, irrespective of the national standard. A simple model of household drinking-water choice indicates that the effect of the emphasis message is theoretically ambiguous. Empirically, we find that the richer message had a negative, but insignificant, effect on well-switching rates, but the estimates are sufficiently precise that we can rule out large positive effects. The main policy implication of this finding is that a one-time oral message conveying richer information on arsenic risks, while inexpensive and easily scalable, is unlikely to be successful in reducing exposure relative to the status-quo policy.

Do property rights promote investment but cause deforestation? Quasi-experimental evidence from Nicaragua

- Journal of Environmental Economics and Management---2013---Zachary D. Liscow

Many policymakers argue that property rights decrease deforestation. Some theoretical papers also make this prediction, arguing that property rights decrease

discount rates applied to a long-term investment in forestry. However, the effect is theoretically ambiguous. The paper takes a novel instrumental variables approach based on Nicaragua's agrarian reform to test for the effect, using a new dataset—Nicaragua's 2001 agricultural census. It finds that property rights significantly increase deforestation. The model, supported by the data, suggests a likely mechanism for this relationship: property rights increase investment, increasing agricultural productivity and therefore the returns to deforestation.

Social integration, participation, and community resource management

- Journal of Environmental Economics and Management---2013---Carina Cavalcanti,Stefanie Engel,Andreas Leibbrandt

This paper studies the relevance of individual social integration and participation for cooperation during a partly successful environmental program that we implemented in several traditional fishing communities in Brazil. The findings show that fishermen who are more integrated into the social network of their community, and fishermen who participated in the development of this environmental program, cooperate more during this program. We also find that perceptions about the necessity of the program play an important role for cooperation. These results provide empirical evidence for the role of social integration, participation, and perceptions for community resource management.

The economic impact of natural resources

- Journal of Environmental Economics and Management---2013---Torben Mideksa

This paper explores the economic impact of natural resource endowment using quantitative comparative – case – study. Focusing on the Norwegian economy, due to availability of good quality data, the paper thoroughly examines the impact of petroleum endowment. Although the result suggests that the impact varies from year to year, it remains positive and very large. On average, about 20% of the annual GDP per

capita increase is due to the endowment of petroleum resources such as oil, natural gas, natural gas liquids, and condensate. Examinations based on sensitivity test, robustness test, dose-response test, and various falsification tests suggest that the finding is robust to alternative explanations.

The carbon dioxide emissions of firms: A spatial analysis

- Journal of Environmental Economics and Management---2013---Matthew Cole,Robert Elliott,Toshihiro Okubo,Ying Zhou

In order to gain a greater understanding of firms' 'environmental behaviour' this paper explores the factors that influence firms' emissions intensities and provides the first analysis of the determinants of firm level carbon dioxide (CO₂) emissions. Focussing on Japan, the paper also examines whether firms' CO₂ emissions are influenced by the emissions of neighbouring firms and other possible sources of spatial correlation. Results suggest that size, the capital–labour ratio, R&D expenditure, the extent of exports and concern for public profile are the key determinants of CO₂ emissions. Local lobbying pressure, as captured by regional community characteristics, does not appear to play a role, however emissions are found to be spatially correlated. This raises implications for the manner in which the environmental performance of firms is modelled in future.

On welfare frameworks and catastrophic climate risks

- Journal of Environmental Economics and Management---2013---Antony Millner

Recent theoretical work in the economics of climate change has suggested that climate policy is highly sensitive to 'fat-tailed' risks of catastrophic outcomes (Weitzman, 2009) [68]. Such risks are suggested to be an inevitable consequence of scientific uncertainty about the effects of increased greenhouse gas concentrations on climate. Criticisms of this controversial result fall into three categories: The first suggests that

it may be irrelevant to cost benefit analysis of climate policy, the second challenges the fat-tails assumption, and the third questions the behavior of the utility function assumed in the result. This paper analyses these critiques and suggests that those in the first two categories have formal validity, but that they apply only to the restricted setup of the original result, which may be extended to address their concerns. They are thus ultimately unconvincing. Critiques in the third category are shown to be robust however they open up new ethical and empirical challenges for climate economics that have thus far been neglected—how should we ‘value’ catastrophes as a society? I demonstrate that applying results from social choice to this problem can lead to counterintuitive results, in which society values catastrophes as infinitely bad, even though each individual’s utility function is bounded. Finally, I suggest that the welfare functions traditionally used in climate economics are ill-equipped to deal with climate catastrophes in which population size changes. Drawing on recent work in population ethics I propose an alternative welfare framework with normatively desirable properties, which has the effect of dampening the contribution of catastrophes to welfare.

Participation games and international environmental agreements: A non-parametric model

- Journal of Environmental Economics and Management---2013---Larry Karp,Leo Simon

We examine the size of stable coalitions in a participation game that has been used to model international environmental agreements, cartel formation, R&D spillovers, and monetary policy. The literature to date has relied on parametric examples; based on these examples, a consensus has emerged that in this kind of game, the equilibrium coalition size is small, except possibly when the potential benefits of cooperation are also small. In this paper, we develop a non-parametric approach to the problem, and demonstrate that the conventional wisdom is not robust. In a general setting, we identify conditions under which the equilibrium coalition size can be large even when

potential gains are large. Contrary to previously examined leading special cases, we show that reductions in marginal abatement costs in an international environmental game can increase equilibrium membership, and we provide a measure of the smallest reduction in costs needed to support a coalition of arbitrary size.

Competition for environmental aid and aid fungibility

- Journal of Environmental Economics and Management---2013---Costas Hadjiyiannis,Panos Hatzipanayotou,Michael Michael

Aid from environmentally conscious donors to developing recipients has long been thought of as a very promising way of preserving the global environment. However, aid is fungible and recipients cannot commit to using it for the purpose it was intended. We analyze competition for aid games with aid fungibility and cross-border pollution to gain insights on how to allocate environmental aid more efficiently. We set up a two stage game of two recipients receiving aid from a donor interested in minimizing pollution. Recipients cannot commit on the use of aid but they can commit on the infrastructure necessary to use aid for pollution abatement. We find that the success of competition for aid games depends critically on the degree of cross-border pollution. This determines whether it is more efficient to set up such games between recipients with little (or a lot of) cross-border pollution between them.

How much green for the buck? Estimating additional and windfall effects of French agro-environmental schemes by DID-matching

- Journal of Environmental Economics and Management---2013---Sylvain Chabé-Ferret,Julie Subervie

Agro-environmental schemes (AES), which pay farmers to adopt greener practices, are increasingly important components of environmental and agricultural policies both in the US and the EU. Here we study the French implementation of the EU AES program. We estimate additional and windfall effects of five AESs

for a representative sample of individual farmers using difference-in-difference (DID) matching. We derive the statistical assumptions underlying DID-matching from a structural household model and we argue that the economics of the program make it likely that these assumptions hold in our data. We test the implications of the identifying assumptions, provide a lower bound using triple-difference matching, test for crossover effects and insert our estimates of both additionality and windfall effects into a cost-benefit framework. We find that the AESs promoting crop diversity have inserted one new crop into the rotation but on a small part of the cropped area. We also find that the AES subsidizing the planting of cover crops has increased cover crops by 10ha on the average recipient farm at the expense of almost 7ha of windfall effect. This AES does not appear to be cost effective. In contrast, we find that the AES subsidizing grass buffer strips could be socially efficient despite large windfall effects. We finally estimate that the AES subsidizing conversion to organic farming has low windfall effects and high additionality.

Strategic exploitation of a common-property resource under uncertainty

- Journal of Environmental Economics and Management---2013---Elena Antoniadou, Christos Koulovatianos, Leonard Mirman

We construct a game of noncooperative common-resource exploitation which delivers analytical solutions for its symmetric Markov-perfect Nash equilibrium. We examine how introducing uncertainty to the natural law of resource reproduction affects strategic exploitation. We show that the commons problem is always present in our example and we identify cases in which increases in risk amplify or mitigate the commons problem. For a specific class of games which imply Markov-perfect strategies that are linear in the resource stock (our example belongs to this class), we provide general results on how payoff-function features affect the responsiveness of exploitation strategies to changes in riskiness. These broader characterizations of games which imply linear strategies (appearing in

an Online Appendix) can be useful in future work, given the technical difficulties that may arise from the possible nonlinearity of Markov-perfect strategies in more general settings.

The trouble with voluntary emissions trading: Uncertainty and adverse selection in sectoral crediting programs☆☆
Special thanks to Suzi Kerr, Lawrence Goulder, Michael Wara, Arthur van Benthem, Lee Schipper, Chris Barrington-Leigh and two anonymous reviewers for helpful suggestions and comments on earlier drafts. I appreciate assistance with the predictive modeling from Mark Bryan and Vera Troeger. I also thank Sonny Kim and Kenny Gillingham for assistance with the GCAM modeling runs, and the Joint Global Change Research Institute for making GCAM available. This research was completed while I was an assistant professor in the Department of Geography and McGill School of Environment, McGill University. I acknowledge support from a U.S. Department of Transportation Eisenhower Graduate Fellowship, a William C. and Jeanne M. Landreth IPER Fellowship, and a David and Lucille Packard Foundation Stanford Graduate Fellowship

- Journal of Environmental Economics and Management---2013---Adam Millard-Ball

Sectoral crediting has been proposed as a way to scale up project-level carbon offset programs, and provide sector-wide incentives for developing countries to reduce greenhouse gas emissions. However, simulations presented here suggest that information asymmetries and large uncertainties in predicting counterfactual business-as-usual (BAU) emissions are likely to render sectoral crediting an extremely unattractive mechanism in practice, at least for the transportation sector. The regulator faces a tradeoff between efficiency and transfers/environmental damage when setting the crediting baseline in relation to uncertain BAU emissions. A generous baseline promotes efficiency, as more developing countries participate and implement abatement measures. However, a generous baseline also produces large

volumes of non-additional offsets, which lead to either increased global emissions, or transfers between developed and developing countries if developed country emission reduction targets are made more stringent in order to leave global emissions unchanged. I show that any crediting baseline that encourages a non-negligible number of countries to participate in a sectoral crediting mechanism results in environmental damage or transfers that are likely to be too high to be politically feasible.

The long-run impact of nuclear waste shipments on the property market: Evidence from a quasi-experiment

- Journal of Environmental Economics and Management---2013---Kishore Gawande,Hank Jenkins-Smith,May Yuan

We use evidence from a quasi-experiment – the shipping of radioactive spent nuclear fuel by train through South Carolina – to assess whether many years of incident-free transport of nuclear waste no longer negatively affects market valuation of properties along the route. Using Charleston County (SC) property sales data over 13 years we find, to the contrary, that the negative impact of the nuclear waste shipments on property values continues to be felt over the long run. The perception of risk from nuclear waste transport appears to be resilient. We contribute methodologically by comparing well-defined treatment and control groups of properties to estimate the average treatment effect of the nuclear waste shipment program. The results are affirmed in both a pooled cross-section sample, as well as a panel data sample of repeated property sales.

Greenhouse gas emissions, waste and recycling policy

- Journal of Environmental Economics and Management---2013---Kaylee Acuff,Daniel Kaffine

This paper examines least-cost policies for waste reduction, incorporating upstream greenhouse gas externalities associated with the production of consumption

goods from various materials. In particular, we decompose the effect of deposit/refund, advance disposal fees, and recycling subsidies on upstream greenhouse gas emissions. We find that the benefits of reducing greenhouse gas emissions are of the same order as or larger than the benefits of reducing solid waste disposal, implying larger optimal total waste reduction than previous studies. Furthermore, the least-cost intervention levels will be material-specific and vary substantially across materials. Finally, despite the reductions in emissions implied by increased recycling rates, direct recycling subsidies are more costly and generate less emissions reductions than a deposit/refund or advance disposal fee.

Demand for health risk reductions

- Journal of Environmental Economics and Management---2013---Trudy Cameron,J.R. DeShazo

A choice model based on utility in a sequence of prospective future health states permits us to generalize the concept of the value of statistical life (VSL). Our representative national survey asks individuals to choose between costly risk-reducing programs and the status quo in randomized stated choice scenarios. Our model allows for separate marginal utilities for discounted net income and avoided illness years, post-illness years, and lost life-years. Our estimates permit calculation of overall willingness to pay to reduce risks for a wide variety of different prospective illness profiles. These can be benchmarked against the standard VSL as a special case.

Preference elicitation under oath

- Journal of Environmental Economics and Management---2013---Nicolas Jacquemet,Robert-Vincent Joule,Stéphane Luchini,Jason Shogren

Eliciting sincere preferences for non-market goods remain a challenge due to the discrepancy between hypothetical and real behavior and false zeros. The gap arises because people either overstate hypothetical values or understate real commitments or a combination

of both. Herein we examine whether the traditional real-world institution of the solemn oath can improve preference elicitation. Applying the social psychology theory on the oath as a truth-telling-commitment device, we ask our bidders to swear on their honour to give honest answers prior to participating in an incentive-compatible second-price auction. The oath is an ancillary mechanism to commit bidders to bid sincerely in a second-price auction. Results from our induced valuation testbed treatments suggest that the oath-only auctions outperform all our other auctions (real and hypothetical). In our homegrown valuation treatments eliciting preferences for dolphin protection, the oath-only design induced people to treat as binding both their experimental budget constraint (i.e., lower values on the high end of the value distribution) and participation constraint (i.e., positive values in place of the zero bids used to opt-out of auction). Based on companion treatments, we show the oath works through an increase in the willingness to tell the truth, due to a strengthening of the intrinsic motivation to do so.

When does environmental regulation facilitate entry-deterring practices

- Journal of Environmental Economics and Management---2013---Ana Espinola-Arredondo,Felix Munoz-Garcia

This paper evaluates the welfare benefits of introducing environmental regulation in a market that is subject to the threat of entry. We consider complete and incomplete information settings, where potential entrants use the regulator's tax policy and the incumbent's output decisions in order to infer the incumbent's cost structure. When the regulator is absent, we show that firms' entry-deterring practices increase pollution relative to complete information. Hence, under certain conditions, environmental regulation becomes more beneficial in incomplete than in complete information contexts. Our results, therefore, identify under which cases an under- or over-estimation of the welfare benefits of environmental regulation arises from ignoring the information setting in which firms interact. We also examine how

this estimation error increases as firms become more symmetric in their production costs.

Trade and the greenhouse gas emissions from international freight transport

- Journal of Environmental Economics and Management---2013---Anca Cristea,David Hummels,Laura Puzzello,Misak Avetisyan

We collect extensive data on worldwide trade by transportation mode and use this to provide detailed comparisons of the greenhouse gas emissions associated with output versus international transportation of traded goods. International transport is responsible for 33 percent of world-wide trade-related emissions, and over 75 percent of emissions for major manufacturing categories. Including transport dramatically changes the ranking of countries by emissions per dollar of trade. We systematically investigate whether trade inclusive of transport can lower emissions. In one quarter of cases, the difference in output emissions is more than enough to compensate for the emissions cost of transport. Finally, we examine how likely patterns of global trade growth will affect modal use and emissions. Full liberalization of tariffs and GDP growth concentrated in China and India lead to transport emissions growing much faster than the value of trade, due to trade shifting toward distant trading partners.

On equilibrium in resource markets with scale economies and stochastic prices

- Journal of Environmental Economics and Management---2012---Charles Mason

In this paper, I show the existence and the characteristics of equilibrium in a non-renewable resource market where extraction costs are non-convex and market price is subject to stochastic shocks, an empirically relevant setting. In my model firms may be motivated to hold inventories to facilitate production smoothing, which allows them to continue producing at a smooth pace at any instant when extraction ceases, e.g. when reserves are exhausted. This aspect of the model then supports a competitive equilibrium in the presence of non-convex

Endogenous growth, asymmetric trade and resource dependence

- The aggregate income of oil-exporting countries relative to that of oil-poor countries has been remarkably constant in recent decades, despite the existence of structural gaps in productivity growth rates. This stylized fact is rationalized in an endogenous growth model of asymmetric trade where resource-poor and resource-rich economies display productivity differences but stable income shares due to terms-of-trade dynamics. The model yields two testable predictions that deserve empirical scrutiny: (i) the asymmetric impact, between exporters and importers, of national taxes on resource use on income shares and (ii) the inverse relation between terms-of-trade dynamics and total factor productivity growth.

This paper assesses the long term impacts of an international transfer called the Reduced Emissions from Deforestation and Degradation (REDD) mechanism, which aims at preserving tropical forests of the recipient economy. This two-sector economy faces a dilemma between economic growth and deforestation. The rural sector can substitute reproducible capital for agricultural land whereas the manufacturing sector only requires capital. The model shows that the REDD mechanism has a non-monotonic effect on steady state welfares. For low transfer schemes, the agricultural output increases with the transfer even though less land

Substitution between biofuels and fossil fuels: Is there a green paradox?

- We show that (i) subsidies for renewable energy policies with the intention of encouraging substitution away from fossil fuels may accentuate climate change damages by hastening fossil fuel extraction, and that (ii) the opposite result holds under some specified conditions. We focus on the case of subsidies for renewable resources produced under increasing marginal costs, and assume that both the renewable resources and the fossil fuels are currently in use. Such subsidies have a direct effect and an indirect effect working in opposite directions. The direct effect is the reduction in demand for fossil fuels at any given price. The indirect effect is the reduction in the current equilibrium price for fossil fuels, which tends to increase the amount of fossil fuels demanded. Whether the sum of the two effects will actually result in an earlier or later date of exhaustion of the stock of fossil fuels depends on the curvature of the demand curve for energy and of the supply curve for the renewable substitute.

In the absence of a CO₂ tax, the anticipation of a cheaper renewable backstop increases current emissions of CO₂. Since the date at which renewables are phased in is brought forward and more generally future emissions of CO₂ will decrease, the effect on global

warming is unclear. Green welfare falls if the backstop is relatively expensive and full exhaustion of fossil fuels is optimal, but may increase if the backstop is sufficiently cheap relative to the cost of extracting the last drop of fossil fuels plus marginal global warming damages as then it is attractive to leave more fossil fuels unexploited and thus limit CO₂ emissions. We establish these results by analyzing depletion of non-renewable fossil fuels followed by a switch to a clean renewable backstop, paying attention to timing of the switch and the amount of fossil fuels remaining unexploited. We also discuss the potential for limit pricing when the non-renewable resource is owned by a monopolist. Finally, we show that if backstops are already used and more backstops become economically viable as the price of fossil fuels rises, a lower cost of the backstop will either postpone fossil fuel exhaustion or leave more fossil fuel in situ, thus boosting green welfare. However, if a market economy does not internalize global warming externalities and renewables have not kicked in yet, full exhaustion of fossil fuel will occur in finite time and a backstop subsidy always curbs green welfare.

Announcing climate policy: Can a green paradox arise without scarcity?

- Journal of Environmental Economics and Management---2012---Sjak Smulders, Yacov Tsur, Amos Zemel

Unintended consequences of a pre-announced climate policy are studied within a framework that allows for competition between polluting and clean energy sources. We show that early announcement of a carbon tax gives rise to a “green-paradox,” in that it increases emissions in the interim period (between announcement and actual implementation), irrespective of the scarcity of fossil fuels. The paradoxical outcome is driven by consumption-saving tradeoffs facing households who seek to smooth consumption over time and holds both when the announced implementation date is taken as a credible threat and when households are skeptical about the (political) will or capability of the government to implement the policy as announced.

Emissions standards and ambient environmental quality standards with stochastic environmental services

- Journal of Environmental Economics and Management---2012---Stephen Hamilton, Till Requate

Many important environmental policies involve some combination of emission controls and ambient environmental quality standards, for instance SO₂ emissions are capped under Title IV of the U.S. Clean Air Act Amendments while ambient SO₂ concentrations are limited under National Ambient Air Quality Standards (NAAQS). This paper examines the relative performance of emissions standards and ambient standards when the natural environment provides stochastic environmental services for assimilating pollution. For receiving media characterized by greater dispersion in the distribution of environmental services, the optimal emissions policy becomes more stringent, whereas the optimal ambient policy generally becomes more lax. In terms of economic performance, emissions policies are superior to ambient policies for relatively non-toxic pollutants, whereas ambient standards welfare dominate emissions standards for sufficiently toxic pollutants. In the case of combined policies that jointly implement emissions standards and ambient standards, we show that the optimal level of each standard relaxes relative to its counterpart in a unilateral policy, allowing for greater emissions levels and higher pollution concentrations in the environmental medium.

Multiple receptor ambient monitoring and firm compliance with environmental taxes under budget and target driven regulatory missions

- Journal of Environmental Economics and Management---2012---Gregory Colson, Luisa Menapace

We analyze the potential for an environmental monitoring agency under different regulatory missions to use multiple measures of ambient pollution levels to induce firm compliance via endogenously determined

probabilistic firm-level inspections of polluting activities. Departing from previous analyses, we consider a framework where the regulator has multiple, rather than a single, measures of ambient pollution in a setting where many firms are subject to a self-reported emissions tax that is not perfectly enforceable. Under a budget-driven mission, we show that a regulator can fruitfully utilize the added information from multiple ambient monitoring receptors to induce improved environmental compliance through the creation of strategic interactions among firms. Additionally, our results provide new evidence on the relative efficiency of budget- vs. target-driven environmental enforcement missions.

Implementing optimal taxes using tradable share permits

- Journal of Environmental Economics and Management---2012---Helge Berglann

This paper presents a simple system for efficient regulation under asymmetric information. Each firm's income is controlled by a tax that depends on the firm's own output and on a parameter construed as a share permit. These "shares of total expected output" lower a firm's tax burden and are acquired in a competitive market. By employing this scheme, the planner only requires knowledge of marginal damage to induce the first-best outcome. Relative to a traditional cap-and-trade approach the system increases expected social welfare.

Verifiable and non-verifiable anonymous mechanisms for regulating a polluting monopolist

- Journal of Environmental Economics and Management---2012---James Prieger,Nicholas Sanders

Optimal regulation of a polluting natural monopolist must correct for both external damages and market power to achieve a social optimum. Existing non-Bayesian regulatory methods require knowledge of the demand function, while Bayesian schemes require

knowledge of the underlying cost distribution. We introduce mechanisms adapted to use less information. Our Price-based Subsidy (PS) mechanisms give the firm a transfer that matches or approximates the incremental surplus generated each period. The regulator need not observe the abatement activity or know the demand, cost, or damage functions of the firm. All of the mechanisms induce the firm to price at marginal social cost, either immediately or asymptotically.

Community pressure for green behavior

- Journal of Environmental Economics and Management---2012---Anthony Heyes,Sandeep Kapur

The desire to avoid rousing community hostility may encourage firms to behave in an environmentally responsible manner. Firms may engage in corporate social responsibility (CSR) to maintain community support and/or to regain the support of a community where it has been lost. It has been conjectured that such 'informal regulation' could effectively replace formal intervention in some settings, and usefully complement it in others. We explore these conjectures with mixed results. Informal regulation is necessarily less efficient than a well-designed formal alternative and the pattern of green behavior induced by the threat of community hostility may increase or decrease welfare. The existence of community pressure may increase or decrease the optimal calibration of a formal intervention (in this case an environmental tax) and may complement or detract from the incentives generated by an optimally calibrated tax.

Threshold management in a coupled economic–ecological system

- Journal of Environmental Economics and Management---2012---Yong Chen,Ciriyam Jayaprakash,Elena Irwin

Economic analysis of optimal ecosystem management in the presence of a threshold has typically ignored the potential for induced behavioral responses. This paper contributes to the literature on non-convex ecosystem

management by considering the implications of a particular behavioral response in a regional economy – that of amenity-led growth – to changes in ecosystem services generated by a lake ecosystem subject to a eutrophication threshold. The essential policy challenge is to achieve optimal levels of lake nutrients and urbanization given that improvements to water quality will induce additional migration and urbanization in the region with attendant ecological impacts. We show that policies that ignore the recursive relationship between urbanization and water quality unintentionally exacerbate boom-bust cycles of regional growth and decline and risk pushing the system towards long-run economic decline. In contrast, the optimal policy accounts for the behavioral feedbacks to improved ecosystem services, and balances regional growth and ecological degradation.

Does more stringent environmental regulation induce or reduce technology adoption? When the rate of technology adoption is inverted U-shaped

- Journal of Environmental Economics and Management---2012---Grischa Perino, Till Requate

We show that for a broad class of technologies the relationship between policy stringency and the rate of technology adoption is inverted U-shaped. This happens when the marginal abatement cost (MAC) curves of conventional and new technologies intersect, which invariably occurs when emissions are proportional to output and technological progress reduces emissions per output. This outcome does not result from policy failure. On the contrary, in social optimum, the relationship between the slope of the marginal damage curve and the rate of technology adoption is also inverted U-shaped. Under more general conditions, these curves can look even more complicated (e.g., such as inverted W-shaped).

Investment in cleaner technology and signaling distortions in a market with green consumers

- Journal of Environmental Economics and Management---2012---Aditi Sengupta

I analyze the pricing and investment behavior of a firm that signals the environmental attributes of its production technology through its price to uninformed environmentally conscious consumers. I then analyze the effect of change in environmental regulation on the signaling outcome and the firm's ex ante incentive to invest in cleaner technology. When regulation is weak, a firm signals cleaner technology through higher price; in this case, the firm earns lower profit when it has cleaner technology and thus, has no incentive to invest in cleaner technology. The price charged by the clean firm declines sharply beyond a critical level of regulation. When regulation is sufficiently stringent, the firm with cleaner technology charges lower price but earns higher signaling profit, and ex ante the firm has positive incentive to invest in cleaner technology. With weak regulation, the incentive of the firm to directly disclose its environmental performance rather than signal it through price is increasing in the level of regulation; the opposite holds when regulation is sufficiently stringent.

Enforcement of vintage differentiated regulations: The case of new source review

- Journal of Environmental Economics and Management---2012---James B. Bushnell, Catherine D. Wolfram

We analyze the effects of the New Source Review (NSR) environmental regulations on coal-fired electric power plants. Regulations that grew out of the Clean Air Act of 1970 required new electric generating plants to install costly pollution control equipment but exempted existing plants. Plants lost their exemptions if they made “major modifications.” We examine whether this caused firms to invest less in grandfathered plants, possibly leading to lower efficiency and higher emissions. We find evidence that heightened NSR enforcement reduced capital investment at vulnerable plants. However, we find no discernible effect on other inputs or emissions.

Stars and standards: Energy efficiency in rental markets

- Journal of Environmental Economics and Management---2012---Ingrid Burfurd,Lata Gangadharan,Veronika Nemes

Evidence suggests that rental properties are often associated with lower levels of energy efficiency than owner-occupied buildings. Policy makers are increasingly concerned about this energy efficiency gap. In this paper, we investigate the energy investments made and the market efficiency gains associated with different policy interventions at the point of lease. We introduce key features of the housing rental market in the laboratory and examine four policy options: mandatory information on energy efficiency, voluntary information, mandatory minimum standards, and a ‘cost-share’ treatment (i.e., landlords pay a share of the tenants’ energy bill). We find that enabling landlords to post the energy efficiency of their properties increases investment in energy efficiency. Voluntary information achieves efficiency levels comparable to those under a mandatory programme but may lead to lower levels of tenant participation. Mandatory minimum standards lead to higher investments in energy efficiency, but also reduce the number of properties available for lease. Cost-sharing leads to low market efficiency levels, perhaps due to the uncertainty landlords face regarding the energy bill of their tenants.

Disentangling preferences and expectations in stated preference analysis with respondent uncertainty: The case of invasive species prevention

- Journal of Environmental Economics and Management---2012---Bill Provencher,David Lewis,Kathryn Anderson

Contingent valuation typically involves presenting the respondent with a choice to pay for a program intended to improve future outcomes, such as a program to place parcels into conservation easement, or a program to manage an invasive species. Deducing from these data the value of the good (or bad) at the core of

the program – the welfare gain generated by a parcel of conserved land, for instance, or the loss incurred by a species invasion – often is not possible because respondent preferences are conflated with their expectations about future environmental outcomes in the absence of the program. This paper formally demonstrates this conundrum in the context of a standard contingent valuation survey, and examines the use of additional survey data to resolve it. The application is to the prevention of lake invasions by Eurasian Watermilfoil (*Myriophyllum spicatum*), an invasive aquatic plant that is present in many lakes in the northern U.S. and Canada and a possible threat to many more. Respondents are shoreline property owners on lakes without Eurasian Watermilfoil. The estimated per-property welfare loss of a lake invasion is \$30,550 for one model and \$23,614 for another, both of which are in reasonable agreement with estimates obtained from a recent hedonic analysis of Eurasian Watermilfoil invasions in the study area [16], and from a companion contingent valuation survey of shoreline property owners on already-invaded lakes.

Soft and hard price collars in a cap-and-trade system: A comparative analysis

- Journal of Environmental Economics and Management---2012---Harrison Fell,Dallas Burtraw,Richard D. Morgenstern,Karen Palmer

We use a stochastic dynamic framework to compare price collars (price ceilings and floors) in a cap-and-trade system with uncertainty in the level of baseline emissions and costs. We consider soft collars, which provide limited volume of additional emission allowances (a reserve) at the price ceiling, and hard collars, which provide an unlimited supply of additional allowances, thereby preventing allowance prices from exceeding the price ceiling. Conversely, allowances are removed from the market if prices fall to the floor. We find that increasing the size of the reserve strictly lowers expected net present values of compliance costs; however, there is a diminishing effect as the allowance reserve is expanded. Most of the expected cost savings are achieved with a modest reserve. Consequently, a rather

limited soft price collar could provide considerable assurance about cost while preventing the possibility that emissions could spiral out of control.

Comparing policies to combat emissions leakage: Border carbon adjustments versus rebates

- Journal of Environmental Economics and Management---2012---Carolyn Fischer, Alan Fox

We explore conditions determining which anti-leakage policies might be more effective complements to domestic greenhouse gas emissions regulation. We consider four policies that could be combined with unilateral emissions pricing to counter effects on international competitiveness: a border charge on imports, a border rebate for exports, full border adjustment, and domestic output-based rebating. Each option faces different potential legal hurdles in international trade law; each also has different economic impacts. While all can support competitiveness, none is necessarily effective at reducing global emissions. Nor is it possible to rank order the options; effectiveness depends on the relative emissions rates, elasticities of substitution, and consumption volumes. We illustrate these results with simulations for the energy-intensive sectors of three different economies, the United States, Canada and Europe. Although most controversial, full border adjustment is usually most effective, but output-based rebating for key manufacturing sectors can achieve many of the gains.

Global warming: Prices versus quantities from a strategic point of view

- Journal of Environmental Economics and Management---2012---Franz Wirl

This paper investigates how the choices of the instruments affect the interactions in a stock externality game (global warming) between cartelized fossil fuel suppliers and consumers. More precisely, the paper studies the equilibria in Markov strategies in a dynamic game with each player choosing either the quantity or

the price strategy including short-run first mover advantages. Indeed OPEC and its opponent IEA have tried both instruments in the past and play currently in quantities. Given such a non-competitive setting, both players should prefer the price instrument. Therefore, both players are expected to switch back to price and tax policies if global warming will be treated effectively.

Tax-versus-trading and efficient revenue recycling as issues for greenhouse gas abatement

- Journal of Environmental Economics and Management---2012---John Pezzey, Frank Jotzo

We give empirical welfare results for global greenhouse gas emission abatement, using the first multi-party model to include both tax-versus-trading under uncertainties, and revenue recycling. Including multiple, independent parties greatly reduces the welfare advantage of an emissions tax over emissions (permit) trading in handling abatement-cost uncertainties, from that shown by existing, single-party literature. But a previously ignored and much bigger advantage of a tax, from better handling uncertainties in business-as-usual emissions, greatly boosts the overall tax-versus-trading advantage. Yet the degree to which each mechanism is used to raise and recycle revenue efficiently by lowering distortionary taxes – rather than recycle revenue as lump sums, or not raise revenue by giving tax thresholds or free permits – may in turn dominate any tax-versus-trading advantage. Choosing the best greenhouse abatement mechanism should thus consider the issues of tax-versus-trading and efficient revenue recycling together.

Market power in water markets

- Journal of Environmental Economics and Management---2012---Erik Ansink, Harold Houba

We model market power in water markets as multi-market Cournot competition with a river structure. Suppliers are connected through water balances, which imposes resource constraints, and they are connected

to heterogeneous water users via a water delivery infrastructure. Our model captures a wide range of specific water market structures. We establish conditions for existence of an equilibrium and we assess the effects of market power on water extraction, delivery, and water prices. Although the monopoly case is similar to standard economic theory, three other specific water market structures illustrate that standard intuition has to be revisited.

Trade and the environment with pre-existing subsidies: A dynamic general equilibrium analysis

- Journal of Environmental Economics and Management---2012---Claustre Bajona,David Kelly

Countries that wish to erect trade barriers have a variety of instruments at their disposal. In addition to tariffs and quotas, countries can offer tax relief, low interest financing, reduced regulation, and other subsidies to domestic industries facing foreign competition. In a trade agreement, countries typically agree to reduce not only tariffs but also subsidies. We consider the effect of a free trade agreement on pollution emissions. We show that while reducing tariffs may indeed increase output and pollution, reductions in some subsidies required by the trade agreement reduce pollution in general equilibrium for reasonable parameter values. Reducing subsidies has three effects on pollution: (1) reducing subsidies to firms reduces pollution-causing capital accumulation, (2) if subsidized firms are more pollution intensive, then reducing subsidies moves capital and labor from more to less pollution intensive firms, and (3) reducing subsidies concentrates production in more productive firms, increasing output and thus pollution. We derive straightforward conditions for which (1) and (2) outweigh (3). We then calibrate the model to China in 1997, and find that pollution has a more elastic response to reducing subsidies than to reducing tariffs. While a 5% reduction in tariffs increases all pollutants by approximately 1%, a 5% reduction in subsidies reduces pollution by 1.8–11.6%, depending on the pollutant. The reductions in pollu-

tion occur without any environmental side agreements or abatement policy changes.

Endangered species conservation on private land: Assessing the effectiveness of habitat conservation plans

- Journal of Environmental Economics and Management---2012---Christian Langpap,Joe Kerkvliet

Habitat conservation plans (HCPs) have become a key instrument for implementation of the Endangered Species Act (ESA) on private land. However, there is no systematic analysis of their effectiveness in promoting endangered species recovery. This paper is the first to provide a comprehensive analysis of the impact of HCPs on species recovery status. We find evidence that HCPs have a significant positive impact on species recovery. Our results also suggest that the recovery benefits are larger when species have relatively larger plans. However, we fail to find strong evidence that multi-species plans covering more species are more effective than plans which include fewer species.

Groundwater pumping and spatial externalities in agriculture

- Journal of Environmental Economics and Management---2012---Lisa Pfeiffer,C.-Y. Cynthia Lin Lawell

We investigate the behavior of farmers who share an underground aquifer. In the case where seepage may occur the resource is nonexclusive, giving rise to a spatial externality whereby pumping by one user affects others nearby. Theoretically, these externalities are potentially important causes of welfare loss. Using a unique spatial data set of groundwater users in western Kansas, we are able to empirically measure the physical and behavioral effects of groundwater pumping by neighbors. To address the simultaneity of neighbors' pumping, we use the neighbors' permitted water allocation as an instrument for their pumping. We estimate that 2.5% of the total groundwater extracted each year in western Kansas is over-extraction due to the effects

of spatial externalities. Individuals who own multiple wells internalize their own externality by trading off pumping at one well for pumping at another.

The impact of voluntary programs on polluting behavior: Evidence from pollution prevention programs and toxic releases

- Journal of Environmental Economics and Management---2012---Linda Bui, Samuel Kapon

We investigate how a class of voluntary environmental initiatives known as pollution prevention (“P2”) programs affect toxic pollution. We construct a data base of federal and state-level P2 programs and exploit variation in adoption dates and program characteristics to study their effects on facility-level releases. We find convincing evidence that these mechanisms alter polluter behavior. In particular, we find that (1) state P2 programs had a significant impact on average facility level toxic releases, reducing annual releases by 11–15%; (2) for every \$100,000 of federal matching funds awarded for state P2 activities, average facility level releases in the recipient state declined on the order of 1–1.5%; (3) P2-induced reductions are significantly enhanced by information spillovers, diffused primarily via industry networks rather than geographic proximity; (4) facilities respond to technical assistance programs by reducing toxic releases, but only for substances that are not simultaneously regulated by formal command and control strategies; and (5) facilities respond to filing fees and non-reporting penalties by altering their toxic releases, but only for chemicals that are easily monitored by regulators.

Inciting protocols

- Journal of Environmental Economics and Management---2012---Thijs Dekker, Herman R.J. Vollebergh, Frans de Vries, Cees Withagen

This paper studies patenting decisions by firms in relation to the negotiation and signing of the Helsinki and Oslo protocol as part of the Convention on Long-Range Transboundary Air Pollution. We use a uniquely constructed patent data set on SO₂ abatement technologies

filed in 15 signatory and non-signatory countries in the period 1970–1997. The data distinguish between so-called ‘mother’ patents, or original inventions, and ‘family’ patents, which represent the same invention but are patents filed in foreign countries. Our analysis suggests that not only local environmental regulations matter for patenting decisions. International environmental agreements provide incentives for additional inventive activity in and the diffusion of knowledge towards signatory countries by reducing investment uncertainty for inventing firms.

Trading wastes

- Journal of Environmental Economics and Management---2012---Derek Kellenberg

The international trade of waste products is large and has grown substantially in the past decade. While a sizeable literature has flourished around the notion of international pollution havens (the movement of goods production with polluting by-products to low environmental regulation countries), this paper is the first to explicitly test the hypothesis that differences in environmental regulation across countries can create international waste haven effects (the exporting of physical waste by-products, rather than goods production, to low environmental regulation countries). Using bilateral waste trade data and an index of environmental stringency for 92 countries, compelling evidence is found that waste imports increase for a country whose environmental regulations deteriorate vis-à-vis its trading partner, implying that differences in environmental standards play an important role in international waste trade flows for some country pairs.

Trade, production fragmentation, and China's carbon dioxide emissions

- Journal of Environmental Economics and Management---2012---Erik Dietzenbacher, Jiansuo Pei, Cuihong Yang, 裴建锁

An input–output framework is adopted to estimate China's carbon dioxide (CO₂) emissions as generated by its exports in 2002. More than one half of China's

exports are related to international production fragmentation. These processing exports generate relatively little value added but also relatively little emissions. We argue that existing estimates of the CO₂ content of China's exports are significantly biased because production fragmentation has not been taken into account appropriately. Using a unique tripartite input–output table, we are able to distinguish processing exports from normal exports. Our results show that China's emissions as embodied in its exports are overestimated by more than 60% if the distinction between processing exports and normal exports is not made. Another finding is that each Yuan of value added generated by processing exports leads to 34% less CO₂ emissions than a Yuan of value added generated by normal exports.

Policy for the adoption of new environmental monitoring technologies to manage stock externalities

- Journal of Environmental Economics and Management---2012---Katrin Millock, Angels Xabadia, David Zilberman

With the development of modern information technologies, relying on nanotechnologies and remote sensing, a number of systems can be envisaged that allow for monitoring of the negative externalities generated by producers, consumers or travelers—road pricing schemes or individual emission meters for automobiles are two examples. We analyze a dynamic model of stock pollution when the regulator has incomplete information on emissions generated by heterogeneous agents. Our contribution is to explicitly study a decentralized policy for adoption of monitoring equipment over time. We determine the second-best tax rates, the pattern of monitoring technology adoption, and identify conditions for the voluntary diffusion of monitoring technologies over time. Simulations show the welfare gains compared to alternative policies.

On modeling pollution-generating technologies

- Journal of Environmental Economics and Management---2012---Sushama Murty, R. Robert

Russell, Steven B. Levkoff

We argue analytically that many commonly used models of pollution-generating technologies, which treat pollution as a freely disposable input or as a weakly disposable and null-joint output, may generate unacceptable implications for the trade-offs among inputs, outputs, and pollution. We show that the correct trade-offs in production are best captured if a pollution-generating technology is modeled as an intersection of an intended-production technology of the firm and nature's residual-generation set. The former satisfies standard disposability properties, while the latter violates free (strong) disposability of pollution and pollution-causing inputs. As a result, the intersection—which we call a by-production technology—violates standard free disposability of pollution and pollution-causing inputs. Employing data envelopment analysis on an electric-power-plant database, we illustrate shortcomings, under by-production, of two popular efficiency indexes: the hyperbolic and directional-distance-function indexes. We propose and implement an alternative index with superior properties. Under by-production, most efficiency indexes decompose very naturally into intended-production and environmental efficiency indexes. This decomposition is difficult to find under alternative specifications of pollution-generating technologies.

Uncertain outcomes and climate change policy

- Journal of Environmental Economics and Management---2012---Robert Pindyck

I incorporate distributions for temperature change and its economic impact in an analysis of climate change policy. As a measure of willingness to pay (WTP), I estimate the fraction of consumption $w^*(\tau)$ that society would be willing to sacrifice to ensure that any increase in temperature at a future point is limited to τ . Using information on distributions for temperature change and economic impact from recent studies assembled by the IPCC and others, I fit displaced gamma distributions for these variables. These fitted distributions, which roughly reflect the “state of knowledge” regarding warming and its impact, generally yield values

of $w^*(\tau)$ below 2%, even for small values of τ , consistent with moderate abatement policies. I also calculate WTP for shifts in the mean and standard deviation of the temperature distribution, and show how WTP, and thus the demand for abatement, are driven more by outcome uncertainty than expected outcomes.

Pollution control with uncertain stock dynamics: When, and how, to be precautionous

- Journal of Environmental Economics and Management---2012---Stergios Athanasoglou, Anastasios Xepapadeas, Stergios Athanasoglou

The precautionary principle (PP) applied to environmental policy stipulates that, in the presence of uncertainty, society must take robust preventive action to guard against worst-case outcomes. It follows that the higher the degree of uncertainty, the more aggressive this preventive action should be. This normative maxim is explored in the case of a stylized dynamic model of pollution control with uncertain (in the Knightian sense) stock dynamics, using the robust control framework of Hansen and Sargent [12]. Optimal investment in damage control is found to be increasing in the degree of uncertainty, thus confirming the conventional PP wisdom. Optimal mitigation decisions, however, need not always comport with the PP. In particular, when damage-control investment is both sufficiently cheap and sensitive to changes in uncertainty, damage-control investment and mitigation may act as substitutes and a PP with respect to the latter can be unambiguously irrational. The theoretical results are applied to a calibrated linear-quadratic model of climate change. The analysis suggests that a reversal of the PP with respect to mitigation, while theoretically possible, is very unlikely.

Climate policy under sustainable discounted utilitarianism

- Journal of Environmental Economics and Management---2012---Simon Dietz, Geir Asheim

Empirical evaluation of policies to mitigate climate

change has been largely confined to the application of discounted utilitarianism (DU). DU is controversial, both due to the conditions through which it is justified and due to its consequences for climate policies, where the discounting of future utility gains from present abatement efforts makes it harder for such measures to justify their present costs. In this paper, we propose sustainable discounted utilitarianism (SDU) as an alternative principle for evaluation of climate policy. Unlike undiscounted utilitarianism, which always assigns zero relative weight to present utility, SDU is an axiomatically based criterion, which departs from DU by assigning zero weight to present utility if and only if the present is better off than the future. Using the DICE integrated assessment model to run risk analysis, we show that it is possible for the future to be worse off than the present along a ‘business as usual’ development path. Consequently SDU and DU differ, and willingness to pay for emissions reductions is (sometimes significantly) higher under SDU than under DU. Under SDU, stringent schedules of emissions reductions increase social welfare, even for a relatively high utility discount rate.

Kyoto and the carbon footprint of nations

- Journal of Environmental Economics and Management---2012---Rahel Aichele, Gabriel Felbermayr

The carbon footprint of a country refers to the flow of CO₂ emissions caused by domestic absorption (i.e., consumption and investment) activities. Trade in goods drives a wedge between the footprint and domestic emissions. We provide a new panel database on carbon footprints and carbon net trade. Using a first-differenced IV estimation strategy, we evaluate the effects of ratification of binding Kyoto commitments on the carbon footprint and emissions. Instrumenting countries’ Kyoto commitment by their participation in the International Criminal Court, we show that Kyoto commitment has reduced domestic emissions in committed countries by about 7%, has not lowered carbon footprints, but has increased the share of imported over domestic emissions by about 14 percentage points.

It follows that the Kyoto Protocol has had at best no effect on world-wide emissions. The results highlight the difficulties of unilateral climate policies.

The impact of weather anomalies on migration in sub-Saharan Africa

- Journal of Environmental Economics and Management---2012---Luca Marchiori, Jean-François Maystadt, Ingmar Schumacher

This paper analyzes the effects of weather anomalies on migration in sub-Saharan Africa. We present a theoretical model that demonstrates how weather anomalies induce rural–urban migration that subsequently triggers international migration. We distinguish two transmission channels, an amenity channel and an economic geography channel. Based on annual, cross-country panel data for sub-Saharan Africa, we present an empirical model that suggests that weather anomalies increased internal and international migration through both channels. We estimate that temperature and rainfall anomalies caused a total net displacement of 5 million people during the period 1960–2000, i.e. a minimum of 128,000 people every year. Based on medium UN population and IPCC climate change projections, we expect future weather anomalies to lead to an additional annual displacement of 11.8 million people by the end of the 21st century.

Emissions taxes versus intensity standards: Second-best environmental policies with incomplete regulation

- Journal of Environmental Economics and Management---2012---Stephen Holland

The best emissions tax or emissions cap may be an inferior instrument under incomplete regulation (leakage). Without leakage, an intensity standard (regulating emissions per unit of output) is inferior due to an implicit output subsidy. This inefficiency can be eliminated by an additional consumption tax. With leakage, an intensity standard can dominate the optimal emissions tax, since the implicit output subsidy prevents leakage. The addition of a consumption tax improves

an intensity standard's efficiency, may prevent leakage, and may be efficient. Comparing intensity standards to output-based updating shows that the latter dominates if updating is sufficiently flexible.

Fair agreements for sharing international rivers with multiple springs and externalities

- Journal of Environmental Economics and Management---2012---Rene van den Brink, Gerard van der Laan, Nigel Moes

We consider the problem of sharing water among agents located along a river. Each agent's benefit depends on the amount of water consumed. An allocation of water is efficient when it maximizes total benefits. To sustain an efficient water allocation the agents can compensate each other by monetary transfers. Every water allocation and transfer schedule yield a welfare distribution, where an agent's utility equals its benefit plus (possibly negative) monetary transfer. The problem of finding a fair welfare distribution can be modeled by a cooperative game. We consider river situations with satiable agents and multiple springs. We propose the class of weighted hierarchical solutions, including the downstream incremental solution of Ambec and Sprumont (2002, [3]), as a class of solutions satisfying the 'Territorial Integration of all Basin States' principle for sharing water of international rivers. When all agents have increasing benefit functions, every weighted hierarchical solution is core-stable. In case of satiation points, every weighted hierarchical solution is independent of the externalities.

A signaling theory of consumer boycotts

- Journal of Environmental Economics and Management---2012---Pim Heijnen, Allard van der Made

We present a theory that explains the prevalence of consumer boycotts. In our model, a firm does not know how concerned consumers are about the firm's misconduct. Because it is only optimal for the firm to alter its behavior if consumers are very concerned, consumers have an incentive to overstate their concern

by boycotting the firm. We show that free-riding problems do not preclude such boycotting. In fact, in each equilibrium boycotting occurs with positive probability and the firm always caters to the demands of those who boycott should boycotting ensue.

The triple bottom line: Meeting ecological, economic and social goals with individual transferable quotas

- Journal of Environmental Economics and Management---2012---Jean-Christophe Pereau,Luc Doyen,L.R. Little,O. Thébaud

This paper deals with the sustainable management of a renewable resource based on individual and transferable quotas (ITQs) when agents differ in terms of harvesting costs or catch capability. In a dynamic bio-economic model, we determine the feasibility conditions under which a fishery manager can achieve sustainability objectives which simultaneously account for stock conservation, economic efficiency and maintenance of fishing activity for the agents along time. We show how the viability of quota management strategies based on ITQ depends on the degree of heterogeneity of users in the fishery, the current status and the dynamics of the stock together with the selection of TAC schedules. In particular for a given stock, we compute the maximin effort for a given set of agents and we derive the maximal number of active agents for a given guaranteed effort. An application to the nephrops fishery in the Bay of Biscay illustrates the results.

The demand for ethanol as a gasoline substitute

- Journal of Environmental Economics and Management---2012---Soren Anderson

This paper estimates household preferences for ethanol (E85) as a gasoline (E10) substitute. I develop a theoretical model linking the shape of the ethanol demand curve to the underlying distribution among households of willingness to pay for ethanol. I estimate the model using instrumental variables techniques and data from many retail fueling stations. I find that a \$0.10-per-gallon increase in ethanol's price relative to gasoline

leads to a 12–16% decrease in the quantity of ethanol demanded. My findings imply that preferences for ethanol are heterogeneous and that a substantial fraction of households are willing to pay a premium for the fuel. This reduces substantially the simulated efficiency cost of an ethanol content standard, since some households choose ethanol without large subsidies, mitigating deadweight losses.

Improving air quality in California's San Joaquin Valley: The role of vehicle heterogeneity in optimal emissions abatement

- Journal of Environmental Economics and Management---2012---Pierre Mérel,Emily Wimberger

We exploit cross-sectional repair cost and emissions data to estimate an abatement cost schedule for vehicles participating in a program in California's San Joaquin Valley to reduce tailpipe emissions. We find that 1995 and older model year vehicles have a lower marginal abatement cost than newer vehicles across all emissions levels. Since older vehicles are also significantly more polluting, an optimal allocation of emissions-related repair funds should target these vehicles. Total emissions reductions could be improved by an estimated 20% if the program has to shift from the actual flat \$500 voucher to the first-best vehicle-specific voucher scheme. A two-tier voucher based on vehicle model year would yield a 15% decrease in emissions over the flat voucher, achieving three fourths of the remaining potential abatement. We also use our estimated abatement cost schedule to provide a measure of the foregone emissions reductions for this fleet due to the current structure of the California Smog Check program. Optimally redistributing the total expenditure required to bring each vehicle to California Smog Check standards could further reduce emissions by an estimated 19–31%.

Unintended consequences from nested state and federal regulations: The case of the Pavley greenhouse-gas-per-mile limits

- Journal of Environmental Economics and Management---2012---Lawrence H. Goulder, Mark R. Jacobsen, Arthur A. van Benthem

This paper reveals significant unintended consequences from recent 14-state efforts to reduce greenhouse gas emissions through limits on greenhouse gases per mile from new cars. We show that while such efforts significantly reduce emissions from new cars sold in the adopting states, they cause substantial emissions increases from new cars sold in other (non-adopting) states and from used cars. The costs per avoided ton of emissions are approximately twice as high once such offsets are recognized.

Anatomy of a paradox: Management practices, organizational structure and energy efficiency

- Journal of Environmental Economics and Management---2012---Ralf Martin, Mirabelle Muûls, Laure de Preux, Ulrich Wagner

This paper provides new evidence on the relationship between management practices and firm performance. We interviewed managers of 190 randomly selected manufacturing plants in the UK and matched their responses with official business microdata. We find that climate friendly management practices are associated with lower energy intensity and higher productivity. Firms that adopt more such practices also conduct more climate friendly R&D which will sustain future growth in energy efficiency. Our findings are akin to the “energy efficiency paradox” and highlight the linkages between particular management practices and firm-level energy efficiency. We also find a strong empirical link between climate friendly management practices and organizational structure. Firms are more likely to adopt such practices if climate change issues are managed by the environmental or energy manager, and if this manager is close to the CEO. Adoption is less likely when the CEO is in charge of climate change issues.

Second-best biofuel policies and the welfare effects of quantity mandates and subsidies

- Journal of Environmental Economics and Management---2012---Harvey Lapan, GianCarlo Moschini

The quest for biorenewable energy sources is held to justify a number of government interventions, including support policies for biofuels such as those responsible for the recent rapid growth of US ethanol production. This article provides an analytical assessment of such policies. We construct a general equilibrium, open economy model that captures the rationale typically invoked to justify government intervention in this setting: to alleviate the environmental impact of energy consumption and to decrease US energy dependence on foreign sources. The model is used to study both the positive and normative implications of alternative policy instruments, including the subsidies and mandates specified by the 2007 Energy Independence and Security Act. From a positive perspective, we find that biofuels mandates are equivalent to a combination of fuel taxes and biofuels subsidies that are revenue neutral. From a welfare perspective, we show that biofuels mandates dominate biofuels subsidies, and that combining fuel taxes with mandates would be welfare enhancing.

Ownership risk and the use of common-pool natural resources

- Journal of Environmental Economics and Management---2012---Jérémy Laurent-Lucchetti, Marc Santugini

It has long been recognized that the quality of property rights greatly impacts the economic development of a country and the use of its natural resources. Since Long [13], the conventional wisdom has been that ownership risk induces a firm to overuse the stock of a resource. However, the empirical evidence is mixed. In particular, Bohn and Deacon [1] find that weak property rights have an ambiguous effect on present extraction. We provide a theoretical model supporting these mixed observations in a common-pool resource

environment. We show that if ownership risk includes a risk of expropriation in which the identities of the excluded firms are unknown *ex ante*, then the present extraction of all firms may decrease along with a higher risk of expropriation. The elasticity of demand for the resource is key in explaining the effect of ownership risk on present extraction.

Optimal spatial control of biological invasions

- Journal of Environmental Economics and Management---2012---Rebecca S. Epanchin-Niell, James Wilen

This study examines the spatial nature of optimal bioinvasion control. We develop a spatially explicit two-dimensional model of species spread that allows for differential control across space and time, and we solve for optimal spatial–dynamic control strategies. The qualitative nature of optimal strategies depends in interesting ways on aspects of landscape and invasion geometry. For example, reducing the extent of exposed invasion edge, through spread, removal, or strategically employing landscape features, can be optimal because it reduces long-term containment costs. Optimal invasion control is spatially and temporally “forward-looking” in the sense that strategies should be targeted to slow or prevent the spread of an invasion in the direction of greatest potential long-term damages. These spatially explicit characterizations of optimal policies contribute insights and intuition to the largely nonspatial literature on controlling invasions and to understanding control of spatial–dynamic processes in general.

The natalist bias of pollution control

- Journal of Environmental Economics and Management---2012---David de la Croix, Axel Gossier

For a given technology, two ways are available to achieve low polluting emissions: reducing production per capita or reducing population size. This paper insists on the tension between the former and the latter. Controlling pollution either through Pigovian taxes or

through tradable quotas schemes encourages agents to shift away from production to tax free activities such as procreation and leisure. This natalist bias will deteriorate the environment further, entailing the need to impose ever more stringent pollution rights per person. However, this will in turn gradually impoverish the successive generations: population will tend to increase further and production per capita to decrease as the generations pass. One possible solution consists in capping population too.

Wildlife corridors as a connected subgraph problem

- Journal of Environmental Economics and Management---2012---Jon M. Conrad, Carla P. Gomes, Willem-Jan van Hoes, Ashish Sabharwal, Jordan Suter

Wildlife corridors connect areas of biological significance to mitigate the negative ecological impacts of habitat fragmentation. In this article we formalize the optimal corridor design as a connected subgraph problem, which maximizes the amount of suitable habitat in a fully connected parcel network linking core habitat areas, subject to a constraint on the funds available for land acquisition. To solve this challenging computational problem, we propose a hybrid approach that combines graph algorithms with Mixed Integer Programming-based optimization. We apply this technique to the design of corridors for grizzly bears in the U.S. Northern Rockies, illustrating the underlying computational complexities by varying the granularity of the parcels available for acquisition. The approach that is introduced is general and can be applied to other species or other similar problems, such as those occurring in social networks.

Climate change, humidity, and mortality in the United States

- Journal of Environmental Economics and Management---2012---Alan Barreca

This paper estimates the effects of humidity and temperature on mortality rates in the United States (c.

1973–2002) in order to provide an insight into the potential health impacts of climate change. I find that humidity, like temperature, is an important determinant of mortality. Coupled with Hadley CM3 climate-change predictions, I project that mortality rates are likely to change little on the aggregate for the United States. However, distributional impacts matter: mortality rates are likely to decline in cold and dry areas, but increase in hot and humid areas. Further, accounting for humidity has important implications for evaluating these distributional effects.

The influence of social relationships on pro-environment behaviors

- Journal of Environmental Economics and Management---2012---Julio Videras,Ann Owen,Emily Conover,Stephen Wu

We examine how social relationships are related to pro-environment behaviors. We use new data from a nationally representative US sample to estimate latent cluster models in which we describe individuals' profiles of social ties with family, neighbor, and coworkers along two dimensions: intensity of connections and pro-environment norms. While our results confirm the link between social ties and economic behaviors, we show that ties among relatives, neighbors, and coworkers are not perfect substitutes. In particular, we observe consistent relationships between green family profiles and altruistic and community-based behaviors. We also find that the effect of coworker ties is visible for cost-saving activities and altruistic behaviors, and that neighbors matter for working with others in the community to solve a local problem, volunteering, and recycling.

Cap-and-trade, taxes, and distributional conflict

- Journal of Environmental Economics and Management---2012---Ian MacKenzie,Markus Ohndorf

Enacting market-based environmental regulation, such as emissions taxes and cap-and-trade programs, often create rents that are contested by agents. In this paper,

we create a framework that compares social welfare from alternative market-based environmental policy instruments under the presence of rent seeking. We show that, contrary to the commonly held view, non-revenue-raising instruments (NRRIs) are in many cases preferable over revenue-raising instruments (RRIs). We find that the choice of instrument depends on the size of a potential revenue-recycling effect and the level of preassigned rents.

Are experienced people affected by a pre-set default option—Results from a field experiment

- Journal of Environmental Economics and Management---2012---Åsa Löfgren,Peter Martinsson,Magnus Hennlock,Thomas Sterner

The objective of the present paper is to investigate the robustness of the well-known result that pre-set default options determine people's choices. We do so by conducting a field experiment among environmental economists attending a large international conference on environmental economics. The participants were, at the time of registration, randomly allocated to different treatments related to carbon offsetting. What differs from earlier default studies is that our subjects have good knowledge about the good at hand. We investigate whether the choices of these experienced individuals are affected by a pre-set default option, and we also study the effect of a treatment with no pre-set default option. Our results, together with previous findings, indicate that the effect of a default option attenuates with experience.

Ordering effects and choice set awareness in repeat-response stated preference studies

- Journal of Environmental Economics and Management---2012---Brett Day,Ian Bate-man,Richard Carson,Diane Dupont,Jordan J. Louviere,Sanae Morimoto,Riccardo Scarpa,Paul Wang

We present an experiment designed to investigate the presence and nature of ordering effects within repeat-response stated preference (SP) studies. Our experi-

ment takes the form of a large sample, full-factorial, discrete choice SP exercise investigating preferences for tap water quality improvements. Our study simultaneously investigates a variety of different forms of position-dependent and precedent-dependent ordering effect in preferences for attributes and options and in response randomness. We also examine whether advanced disclosure of the choice tasks impacts on the probability of exhibiting ordering effects of those different types. We analyze our data both non-parametrically and parametrically and find robust evidence for ordering effects. We also find that the patterns of order effect in respondents' preferences are significantly changed but not eradicated by the advanced disclosure of choice tasks a finding that offers insights into the choice behaviors underpinning order effects.

Corruption and forest concessions

- Journal of Environmental Economics and Management---2012---Gregory S. Amacher,Markku Ollikainen,Erkki Koskela

We examine how corruption impacts a central government's application of concession policy instruments consisting of royalty rates, concession size, environmentally sensitive logging levels, and enforcement. Harvesters have incentives to illegally log by taking more volume than is allowed, high grading through removal of only the highest valued and best formed trees, and shirking environmentally sensitive logging requirements, all of which reduce public goods produced from native tropical forests. Corruption is introduced through logging inspectors who can be bribed by harvesters to avoid fines associated with illegal logging. Both the theory and a simulation are used to compare policy design under corruption and no corruption.

Environmental federalism and environmental liability

- Journal of Environmental Economics and Management---2012---Klaas van 't Veld,Jason Shogren

Environmental federalism considers what level of government should optimally regulate pollution. This paper addresses this question for accidental pollution, which government regulates through the ex post liability regimes of either negligence or strict liability. We find that decentralizing the choice between these regimes does not, in general, induce the socially optimal outcome. When firms can pay all damages, all regions may choose negligence and impose an overly strict standard of due care. When firms may be bankrupted by damages, all regions may choose strict liability, which induces too little care. In addition, asymmetric equilibria are possible in which some regions choose negligence, others strict liability. Combining negligence with a Pigovian tax, or strict liability with a bonding requirement can align regional authorities' incentives with those of a central government.

Unintended consequences of price controls: An application to allowance markets

- Journal of Environmental Economics and Management---2012---Andrew Stocking

Price controls established in a cap-and-trade allowance market are intended to reduce cost uncertainty by constraining allowance prices between a ceiling and floor; however, they could provide opportunities for strategic actions by firms that would lower government revenue and increase emissions. In particular, when the ceiling price is supported by introducing new allowances into the market, firms could choose to buy allowances at the ceiling price, regardless of the prevailing market price, in order to lower the equilibrium price of all allowances. Those purchases could either be transacted by firms intending to manipulate the market price or be induced through the introduction of inaccurate information about the cost of emissions abatement. Theory and simulations using allowance elasticity estimates for U.S. firms suggest that the manipulation could be profitable under the stylized setting and assumptions evaluated in the paper, although in practice many other conditions will determine its use.

Material interests, moral reputation, and crowding out species protection on private land

- Journal of Environmental Economics and Management---2012---Prasenjit Banerjee,Jason Shogren

We consider how the reputation of being socially responsible works as an effective source of motivation in protecting a public good, such as endangered species. This paper investigates the mechanism design for endangered species protection on private land under asymmetric information about reputation and land quality. We examine optimal monetary transfer by designing an efficient mechanism which takes into account the crowding out effect of monetary rewards on socially responsible behavior. We find landowners who have good reputation contribute more than the optimum level. Landowners with poor reputation sacrifice information rent; rather they buy reputation.

Green clubs

- Journal of Environmental Economics and Management---2011---Klaas van't Veld,,Matthew Kotchen,Klaas van 't Veld

This paper treats programs in which firms voluntarily agree to meet environmental standards as “green clubs” : clubs, because they provide non-rival but excludable reputation benefits to participating firms; green, because they also generate environmental public goods. The model illuminates a central tension between the congestion externality familiar from conventional club theory and the free-riding externality familiar from the theory on private provision of public goods. We compare three common program sponsors—governments, industry, and environmental groups. We find that if monitoring of the club standard is perfect, a government constrained from regulating club size may prefer to leave sponsorship to industry if public-good benefits are sufficiently low, or to environmentalists if public-good benefits are sufficiently high. If monitoring is imperfect, an important question is whether consumers can infer that a club is too large for its

standard to be credible. If they can then the government may deliberately choose an imperfect monitoring mechanism as a way of regulating club size indirectly. If they cannot then this reinforces the government's preference for delegating sponsorship.

Exurban development

- Journal of Environmental Economics and Management---2011---David Newburn,Peter Berck

Exurbia, the rural area beyond the built-up urban and contiguous suburban area, is being developed rapidly with attendant losses in habitat and ecosystem services. This paper analyzes a spatial dynamic model with two production technologies for residential development—municipal sewer service for suburban development and septic systems for exurban development. In outlying agricultural areas, the additional sewer extension costs can significantly reduce the value of agricultural land in suburban use. Exurban development, while at lower density, can occur immediately and requires only the onsite conversion costs of septic systems. Hence, the willingness to pay for exurban use from households with higher preferences for lot size may exceed the agricultural landowner's reservation price on future suburban use for a range of distances from the city boundary. This results in a “feasible zone” for exurban leapfrog development and another fundamental reason for scattered development in the urban–rural fringe.

Remanufacturing

- Journal of Environmental Economics and Management---2011---Sophie Bernard

This paper presents a theoretical model of remanufacturing where a duopoly of original manufacturers produces a component of a final good. The specific component that needs to be replaced during the lifetime of the final good creates a secondary market where independent remanufacturers enter the competition. An environmental regulation imposing a minimum level of remanufacturability is also introduced. The main results establish that, while collusion of the firms on

the level of remanufacturability increases both profit and consumer surplus, a social planner could use collusion as a substitute for an environmental regulation. However, if an environmental regulation is to be implemented, collusion should be repressed since competition supports the public intervention better. Under certain circumstances, the environmental regulation can increase both profit and consumer surplus. Part of this result supports the Porter Hypothesis, which stipulates that industries respecting environmental regulations can see their profits increase.

Emissions targets and the real business cycle: Intensity targets versus caps or taxes

- Journal of Environmental Economics and Management---2011---Carolyn Fischer, Michael Springborn

For reducing greenhouse gas emissions, intensity targets are attracting interest as a flexible mechanism that would better allow for economic growth than emissions caps. For the same expected emissions, however, the economic responses to unexpected productivity shocks differ. Using a real business cycle model, we find that a cap dampens the effects of productivity shocks in the economy on all variables except for the shadow value of the emissions constraint. An emissions tax leads to the same expected outcomes as a cap but with greater volatility. Certainty-equivalent intensity targets maintain higher levels of labor, capital, and output than other policies, with lower expected costs and no more volatility than with no policy.

No sympathy for the devil

- Journal of Environmental Economics and Management---2011---Richard Horan, Richard Melstrom

Pathogens are a significant driver of biodiversity loss. We examine two wildlife disease management strategies that have seen growing use, sometimes in combination: (i) trapping-and-culling infectious animals (disease control), and (ii) trapping-and-translocating healthy animals to a reserve, with possible future reintroduction.

A reserve can improve conservation when there is no disease. But, when infection exists, we show investing in the reserve may counteract disease control. We find jointly pursuing both strategies is sub-optimal when the reserve is costly to maintain. Numerically, we examine management of Devil Facial Tumor Disease, which has generated extinction risks for Tasmanian Devils. Disease control (though not eradication) is generally part of an optimal strategy, although a reserve is also optimal if it can be maintained costlessly. This implies preserving the original population by addressing in situ conservation risks, rather than translocating animals to a reserve and giving up on the original population, is generally the first-best.

Dissecting the tragedy: A spatial model of behavior in the commons

- Journal of Environmental Economics and Management---2011---Joshua K. Abbott, James Wilen

Much of the discussion of the tragedy of the commons focuses on aggregate impacts, often in data-poor developing country settings. Few non-experimental empirical studies shed light on contextual circumstances driving the extent of rent dissipation and overexploitation. We utilize a high-resolution data set to estimate a behavioral model of fishermen's spatial choices. A unique policy setting allows us to measure the degree to which individual fishermen's choices appear aimed at mitigating the tragedy of the commons in a small numbers setting. We find evidence of partial mitigation in excess of what we would expect under pure self-interest but short of what would occur under group-maximizing behavior. We also examine how contextual factors in the fishery shape the degree of cooperation within the fishing season and find evidence that competition for the common pool resource distorts fishermen's implicit cost of distance—creating a form of “common property inertia” .

Can incomplete information lead to under-exploitation in the commons?

- Journal of Environmental Economics and Management---2011---Ana Espinola-Arredondo,Felix Munoz-Garcia

This paper analyzes the protection of a common pool resource (CPR) through the management of information. Specifically, we examine an entry deterrence model between an incumbent perfectly informed about the initial stock of a CPR and an uninformed potential entrant. In our model, the appropriation of the CPR by the incumbent reduces both players' future profits from exploiting the resource. In the case of complete information, we show that the incumbent operating in a high-stock common pool overexploits the CPR during the first period since it does not internalize the negative external effect that its first-period exploitation imposes on the entrant's future profits. This inefficiency, however, is absent when the commons totally regenerate across periods. Under incomplete information, we identify an additional form of inefficiency. In particular, the incumbent operating in a low-stock CPR underexploits the resource in order to signal the low available stock to potential entrants, deterring entry.

An experimental analysis of compliance in dynamic emissions markets

- Journal of Environmental Economics and Management---2011---John Stranlund,James Murphy,John Spraggon

Two important design elements for emission trading programs are whether and to what extent firms are able to bank emissions permits, and how these programs are to be enforced. In this paper we present results from laboratory emissions markets designed to investigate enforcement and compliance when these markets allow permit banking. Banking is motivated by a decrease in the aggregate permit supply in the middle of multi-period trading sessions. Consistent with theoretical insights, our experiments suggest that high permit violation penalties have little deterrence value in dynamic emissions markets, and that the main

challenge of enforcing these programs is to motivate truthful self-reports of emissions.

Voluntary corporate environmental initiatives and shareholder wealth

- Journal of Environmental Economics and Management---2011---Karen Fisher-Vanden,Karin Thorburn

Researchers debate whether environmental investments reduce firm value or actually improve financial performance. We provide some compelling evidence on shareholder wealth effects of membership in voluntary environmental programs (VEPs). Companies announcing membership in EPA's Climate Leaders, a program targeting reductions in greenhouse gas emissions, experience significantly negative abnormal stock returns. The price decline is larger in firms with poor corporate governance structures, and for high market-to-book (i.e., high growth) firms. However, firms joining Ceres, a program involving more general environmental commitments, have insignificant announcement returns, as do portfolios of industry rivals. Overall, corporate commitments to reduce greenhouse gas emissions appear to conflict with firm value maximization. This has important implications for policies that rely on voluntary initiatives to address climate change. Further, we find that firms facing climate-related shareholder resolutions or firms with weak corporate governance standards – giving managers the discretion to make such voluntary environmentally responsible investment decisions – are more likely to join Climate Leaders; decisions that may result in lower firm value.

Skew and attribute non-attendance within the Bayesian mixed logit model

- Journal of Environmental Economics and Management---2011---Kelvin Balcombe,Michael Burton,Dan Rigby

We investigate non-attendance to choice set attributes and the accommodation of preference heterogeneity within the mixed logit model. We propose a generalisation of the mixed logit enabling the degree of skew

of marginal utility distributions to be estimated. The implementation is Bayesian with the marginal likelihood used as an arbiter of model performance. We find strong evidence of skew in the distributions of marginal utilities for most attributes. Models incorporating skew are preferred in all cases. The irrelevance of an attribute to significant numbers of respondents is a possible cause of such skew. We test alternative empirical accommodations of self-reported attribute non-attendance (ANA) and continue to find strong evidence of skew in the distributions of marginal utilities even having accounted for ANA. We find that, contrary to some recent findings, respondents who report having ignored an attribute typically do indeed have a zero marginal utility for that attribute.

Measurement of agricultural total factor productivity growth incorporating environmental factors: A nutrients balance approach

- Journal of Environmental Economics and Management---2011---Viet-Ngu Hoang, Timothy Coelli

This article proposes to use nutrient-orientated environmental efficiency (EE) measures to construct a nutrient total factor productivity index (NTFP). Since nutrient-orientated EE measures are consistent with the materials balance principle, NTFP index is superior to other existing TFP indexes. An empirical study on the environmental performance of an agricultural sector in 30 OECD countries from 1990 to 2003 yielded several important findings. First, these countries should be able to produce current outputs with at least 50% less aggregate eutrophying power, implying that they should have been able to substantially reduce the potential for eutrophication. Second, traditional TFP has grown by 1.6% per annum due to technical progress; however, there are lags in the responses of several countries to this technical progress. Third, environmental TFP has grown at a slower rate than traditional TFP growth due to reductions in nutrient-orientated allocative efficiency. Finally, changes in input combinations could have significantly improved environmental efficiency and productivity. These findings favor policy inter-

ventions and faster technological transfer to improve environmental performance.

The higher price of cleaner fuels: Market power in the rail transport of fuel ethanol

- Journal of Environmental Economics and Management---2011---Jonathan Hughes

This paper provides evidence of market power in the transportation of ethanol used in reformulated gasoline and alternative transportation fuels. I estimate a reduced form model for railroad route-level prices. My identification strategy instruments for railroad entry, controls for selection and explicitly models capacity constraints. A detailed understanding of this industry is important because U.S. environmental policies seek to substantially expand ethanol use. Evidence of market power may alter the types of policies pursued by lawmakers. I find that ethanol shipment prices are lower for more competitive routes. I also find evidence that railroads price discriminate based on environmental regulation at route destinations. Monopolist prices for shipments to carbon monoxide non-attainment areas are 3% higher than shipments to other destinations. This price premium falls sharply with increased competition. This suggests a perverse result where environmental regulation increases the price of a clean input.

Co-benefits and additionality of the clean development mechanism: An empirical analysis

- Journal of Environmental Economics and Management---2011---Junjie Zhang, Can Wang

The Clean Development Mechanism (CDM) allows industrialized countries to comply with the Kyoto Protocol by using carbon offsets from developing countries. There are two puzzles within this carbon market: additionality (the proposed activity would not have occurred in its absence) and co-benefits (the project has other environmental benefits besides climate mitigation). This paper proposes an econometric approach to evaluate the CDM effect on sulfur dioxide emission reductions and assess its additionality indirectly. Our

empirical model is applied to China's emissions at the prefecture level. We found that the CDM does not have a statistically significant effect in lowering sulfur dioxide emissions. This result casts doubt on additionality of these CDM activities, that is, they would have happened anyway.

Contract renegotiation and rent re-distribution: Who gets raked over the coals?

- Journal of Environmental Economics and Management---2011---Lea-Rachel Kosnik,Ian Lange

Policy shocks affect the rent distribution in long-term contracts, which can lead to such contracts being renegotiated. We seek an understanding of what aspects of contract design, in the face of a substantial policy shock, affect the propensity to renegotiate. We test our hypotheses using data on U.S. coal contracts after the policy shock of the 1990 Clean Air Act Amendments. Contracts are divided into two categories, those that were renegotiated following the shock and those that were not. Characteristics of the contract are used to explain whether or not the contract was ultimately renegotiated. Results provide guidance on rent re-distribution and contract renegotiation more generally and are applicable to contemporary policy issues such as climate change legislation.

On the economics of energy labels in the housing market

- Journal of Environmental Economics and Management---2011---Dirk Brounen,Nils Kok

Energy efficiency in the residential housing market can play an important role in the reduction of global carbon emissions. This paper reports the first evidence on the market adoption and economic implications of energy performance certificates implemented by the European Union. The results show that adoption rates are low and declining over time, coinciding with a negative sentiment regarding the label in the popular media. Labels are clustered among smaller, post-war

homes in neighborhoods with more difficult selling conditions. We also document that geographic variation in the adoption rate of energy labels is positively related to the fraction of "green" voters during the 2006 national elections. Within the sample of labeled homes, the energy label creates transparency in the energy efficiency of dwellings. Our analysis shows that consumers capitalize this information into the price of their prospective homes.

Fiscal spending and the environment: Theory and empirics

- Journal of Environmental Economics and Management---2011---Ramon Lopez,Gregmar Galinato,Asif Islam

During economic crises, governments often increase fiscal spending to stimulate the economy. While the fiscal spending surge may be temporary, spending composition is often altered in favor of expenditures on social programs and other public goods which may persist over time. We model and measure the impact of fiscal spending patterns on the environment. The model predicts that a reallocation of government spending composition towards social and public goods reduces pollution. However, increasing total government spending without altering its composition does not reduce pollution. We empirically test these predictions for air and water pollutants showing that they are fully supported.

Growth and pollution convergence: Theory and evidence

- Journal of Environmental Economics and Management---2011---Carlos Ordás Criado,Simone Valente,Thanasios Stengos

Stabilizing pollution levels in the long run is a prerequisite for sustainable growth. We develop a neoclassical growth model with endogenous emission reduction predicting that, along optimal sustainable paths, pollution growth rates are (i) positively related to output growth (scale effect) and (ii) negatively related to emission levels (defensive effect). This dynamic law reduces

to a convergence equation that is empirically tested for two major and regulated air pollutants - sulfur oxides and nitrogen oxides - with a panel of 25 European countries spanning the years 1980-2005. Traditional parametric models are rejected by the data. More flexible regression techniques confirm the existence of both the scale and the defensive effect, supporting the model predictions.

Sustainability, limited substitutability, and non-constant social discount rates

- Journal of Environmental Economics and Management---2011---Christian Traeger

The paper shows how limited substitutability in consumption between different classes of goods affects the magnitude and time development of social discount rates. It decomposes the discount rates into an absolute growth and a relative growth or substitutability effect. The paper relates between-good and intertemporal substitutability to the notions of weak and strong sustainability. It analyzes under which circumstances low as opposed to high between-good substitutability increases the weights given to long-run environmental services.

Optimal management with potential regime shifts

- Journal of Environmental Economics and Management---2011---Stephen Polasky,Aart de Zeeuw,Florian Wagener

We analyze how the threat of a potential future regime shift affects optimal management. We use a simple general growth model to analyze four cases that involve combinations of stock collapse versus changes in system dynamics, and exogenous versus endogenous probabilities of regime shift. Prior work in economics has focused on stock collapse with endogenous probabilities and reaches ambiguous conclusions on whether the potential for regime shift will increase or decrease intensity of resource use and level of resource stock. We show that all other cases yield unambiguous results. In particular, with endogenous probability of regime shift that affects system dynamics the potential for regime

shift causes optimal management to become precautionary in the sense of maintaining higher resource stock levels.

Are politicians office or policy motivated? The case of U.S. governors' environmental policies

- Journal of Environmental Economics and Management---2011---Per Fredriksson,Le Wang,Khawaja Saeed Mamun

Are elected politicians primarily motivated by holding office, thus choosing environmental policies accordingly? Or are they motivated by the chance to implement their preferred environmental policies? Do governors have character, in the sense that they promise and implement environmental policies consistent with their own preferences? To answer these questions, we study the differences in environmental spending across both re-electable and lame duck governors from the two main political parties. In our empirical analysis, we make use of parametric and non-parametric regression-discontinuity approaches. While re-electable governors do not set significantly different policies, lame duck governors do. We argue that in the area of environmental policy governors appear to be primarily office motivated and lack character.

Environmental Constituent Interest, Green Electricity Policies, and Legislative Voting

- Journal of Environmental Economics and Management---2011---Benjamin Chupp

Research in political economy has traditionally sought to disentangle the effects of legislative ideology and constituent interest in explaining policy decisions. Frequently, proxy variables are used to measure constituent interest. However, these measures do not adequately reflect true constituent interest, which is based upon the costs and benefits of the policies under consideration, incorporating the scope of the policies. Using Haiku, a detailed model of the US electricity sector, and TAF, an integrated assessment model of pollution pathways and valuation, I construct economic measures of constituent interest at the state level as

well as for federal policy. I then use these measures to analyze state adoption of more stringent green electricity policies and congressional roll-call voting on federal environmental policy. Previous studies that use proxy measures of constituent interest typically find that the legislator ideology matters more, while my study shows that both ideology and constituent interest are significant factors.

The switching effect of environmental taxation within Bertrand differentiated duopoly

- Journal of Environmental Economics and Management---2011---Oliwia Kurtyka,Philippe Mahenc

We investigate second-best optimal taxation of the polluting variety of a product in a Bertrand duopoly with differentiated varieties. The analysis provides novel insight on a useful social function of environmental regulation. Besides internalizing the environmental externality, the taxation of the polluting variety improves the matching of consumers and product varieties, and so creates a socially desirable business switching between the differentiated varieties.

Implications of simultaneity in a physical damage function

- Journal of Environmental Economics and Management---2011---Kelly M. Cobourn,Hannah J. Burrack,Rachael Goodhue,Jeffrey Williams,Frank G. Zalom

A modeler must often rely on highly simplified representations of complex physical systems when analyzing associated economic issues. Herein, we consider a management problem in which a bioeconomic system exhibits simultaneity in processes governing productivity and damage. In this case, it may benefit the producer to sacrifice productivity to reduce the costs associated with increased damage. We specify empirically a structural damage relationship that explains the biological process by which an invasive species damages a host and estimate the structural model and its reduced form with an exceptional dataset on infestation

of olives by the olive fruit fly. We contrast the results of these models with the approach typically taken in the economic literature, which expresses damage as a function of pest density. The population-based approach introduces significantly greater bias into the individual grower's choice of damage-control inputs than estimates based on the structural model.

Optimal environmental policy for waste disposal and recycling when firms are not compliant

- Journal of Environmental Economics and Management---2011---Hiroaki Ino

We investigate a model that considers disposal and recycling activities after the consumption of products. In the field, the deposit-refund (D-R) policy has been considered as an ideal policy for internalizing disposal costs, which can result in the realization of the first-best policy. However, the possibility of firms' illegal disposal has been neglected. We introduce a monitoring cost to prevent firms from disposing of collected residuals illegally and induce the second-best D-R policy. We find that the relation between the monitoring problem for firms and the price of the recycling market brings about a variation in the optimal level of the refunds (which is typically smaller than the first-best level). Further, we investigate an alternative policy that requires producers to take-back residuals and show how this policy works equivalently to the second-best D-R policy by applying the theory of the tradable rights market.

Editorial

- Journal of Environmental Economics and Management---2011---Daniel Phaneuf

2011

Time perspective and climate change policy

- Journal of Environmental Economics and Management---2011---Larry Karp,Yacov Tsur

The tendency to foreshorten time units as we peer further into the future provides an explanation for

hyperbolic discounting at an inter-generational time scale. We study implications of hyperbolic discounting for climate change policy, when the probability of a climate-induced catastrophe depends on the stock of greenhouse gasses. We characterize the set of Markov perfect equilibria (MPE) of the inter-generational game amongst a succession of policymakers. Each policymaker reflects her generation's preferences, including its hyperbolic discounting. For a binary action game, we compare the MPE set to a "restricted commitment" benchmark. We compare the associated "constant-equivalent discount rates" and the willingness to pay to control climate change with assumptions and recommendations in the Stern Review on Climate Change. "...My picture of the world is drawn in perspective.... I apply my perspective not merely to space but also to time"--Ramsey.

The burden of proof in trade disputes and the environment

- Journal of Environmental Economics and Management---2011---Henrik Horn

The WTO leaves discretion over environmental policies to its members, but requests that a fundamental non-discrimination principle is respected: National Treatment (NT). The provision seeks to prevent protectionist use of domestic policy instruments, requesting that when an imported product is sufficiently similar to a domestic product, they are treated identically. WTO adjudicators will often face severe informational problems in environmental disputes. Important for the practical implementation of NT is therefore the allocation of the burden of proof (BoP). This paper highlights basic implications of the BoP for the occurrence of judicial errors, for the environment and for welfare, using a setting where NT serves its intended role of supporting negotiated tariff liberalization. The paper suggests that NT may indeed constrain environmental policies, but that this may be desirable from an efficiency point of view. Also, BoP rules that benefit the environment may not benefit global welfare, and conversely.

Incentives to diffuse advanced abatement technology under environmental liability law

- Journal of Environmental Economics and Management---2011---Alfred Endres,Tim Friehe

Polluting firms with advanced abatement technology at their disposal have incentives or disincentives to share this technology with other polluting firms. The 'direction' and extent of those incentives depends on the liability rule applicable and the way technical change impacts marginal abatement costs. We establish that incentives for diffusion are socially optimal under strict liability and socially suboptimal under negligence if technical change lowers marginal abatement costs for all levels of abatement. Negligence may, however, induce better diffusion incentives than strict liability if technical change decreases (increases) marginal abatement costs for low (high) levels of abatement.

Negotiating a voluntary agreement when firms self-regulate

- Journal of Environmental Economics and Management---2011---Pierre Fleckinger,Matthieu Glachant

Does self-regulation improve social welfare? We develop a policy game featuring a regulator and a firm that can unilaterally commit to better environmental or social behavior in order to preempt future public policy efforts. We show that the answer depends on the set of policy instruments available to the regulator. Self-regulation improves welfare if the regulator can only use mandatory regulation, but it reduces welfare when the regulator opts for a voluntary agreement. This suggests that self-regulation and voluntary agreements are not good complements from a welfare point of view. We derive policy implications, and extend the basic model in several dimensions.

Do you not like Pigou, or do you not understand him? Tax aversion and revenue recycling in the lab

- Journal of Environmental Economics and Management---2011---Steffen Kallbekken,Stephan

Tax-aversion reduces the likelihood that price rationing can be a politically viable tool for environmental protection. We examine the case of the classic Pigouvian tax to control a negative externality, and consider how recycling the revenues, labeling of the tax and information about its purpose affects the support for taxation. We test the support for taxation within a single-price market experiment, in which purchases by some buyers impose external costs on others. Observing behavior consistent with tax-aversion, we also find that recycling the revenues to more narrowly targeted groups seems to increase support for taxation. In the absence of narrow revenue recycling, labeling a Pigouvian instrument as a 'tax' may significantly lower the likelihood of voter support.

Who counts in evaluating the effects of air pollution policies on households? Non-market valuation in the presence of dependencies

- Journal of Environmental Economics and Management---2011---Mary Evans,Christine Poulos,V. Smith

Individuals who are likely to realize the largest benefits from improvements in air quality often depend on other members of their households to make time or monetary contributions to their care. The presence of these dependency relationships among household members poses challenges for benefit estimation since it is unlikely that the conditions necessary for recovering the underlying individual preferences from household choices are satisfied in this setting. We propose a conceptual framework that highlights the role of these dependencies in the choice models used to estimate the willingness to pay for environmental quality improvements. We design a complementary stated preference survey that describes hypothetical dependency relationships for household members of different ages to test the implications of our conceptual model. Respondents' stated choices take into account the proposed caregiving responsibilities for young children and teenagers but not for older adults.

A calibrated auction-conjoint valuation method: Valuing pork and eggs produced under differing animal welfare conditions

- Journal of Environmental Economics and Management---2011---Bailey Norwood,Jayson Lusk

This paper develops a valuation method which generates consistent and systematic estimates of people's preferences for complex multi-attribute goods by inextricably linking auction bids with conjoint ratings. The advantage of the valuation approach is that it permits the estimation of people's values for many potential goods, allows one to decompose people's values for a good into its sub-components, and permits the study of preference heterogeneity without distributional assumptions. We apply the method to an important and increasingly controversial topic: animal welfare. The method is used to determine people's preferences for eggs and pork produced from different production systems. Data from experiments conducted in three diverse U.S. locations (Chicago, IL; Dallas, TX; and Wilmington, NC) indicates that people are, on average, willing to pay \$0.95 more for a dozen eggs raised in an aviary, pasture system vs. a cage system, and are willing to pay \$2.02 more for two-pounds of pork chops raised in a pasture system as opposed to a crate system.

Addressing onsite sampling in recreation site choice models

- Journal of Environmental Economics and Management---2011---Paul Hindsley,Craig Landry,Brad Gentner

Independent experts and politicians have criticized statistical analyses of recreation behavior, which rely upon onsite samples due to their potential for biased inference. The use of onsite sampling usually reflects data or budgetary constraints, but can lead to two primary forms of bias in site choice models. First, the strategy entails sampling site choices rather than sampling individuals--a form of bias called endogenous stratification. Under these conditions, sample choices

may not reflect the site choices of the true population. Second, exogenous attributes of the individuals sampled onsite may differ from the attributes of individuals in the population--the most common form in recreation demand is avidity bias. We propose addressing these biases by combining two the existing methods: Weighted Exogenous Stratification Maximum Likelihood estimation and propensity score estimation. We use the National Marine Fisheries Service's Marine Recreational Fishing Statistics Survey to illustrate methods of bias reduction, employing both simulated and empirical applications. We find that propensity score based weights can significantly reduce bias in estimation. Our results indicate that failure to account for these biases can overstate anglers' willingness to pay for improvements in fishing catch, but weighted models exhibit higher variance of parameter estimates and willingness to pay.

How wrong can you be? Implications of incorrect utility function specification for welfare measurement in choice experiments

- Journal of Environmental Economics and Management---2011---Catalina M. Torres Figuerola,Nick Hanley,Antoni Riera Font

Despite the vital role of the utility function in welfare measurement, the implications of working with incorrect utility specifications have been largely neglected in the choice experiments literature. This paper addresses the importance of specification with a special emphasis on the effects of mistaken assumptions about the marginal utility of income. Monte Carlo experiments were conducted using different functional forms of utility to generate simulated choices. Multi-Nomial Logit and Mixed Logit models were then estimated on these choices under correct and incorrect assumptions about the true, underlying utility function. Estimated willingness to pay measures from these choice modeling results are then compared with the equivalent measures directly calculated from the true utility specifications. Results show that for the parameter values and functional forms considered, a continuous-quadratic or a discrete-linear attribute specification is a good option regardless of the true effects the attribute has on utility.

We also find that mistaken assumptions about preferences over costs magnify attribute mis-specification effects.

A free lunch in the commons

- Journal of Environmental Economics and Management---2011---Matthew Kotchen,Stephen Salant

We derive conditions under which raising costs through a regulatory constraint or a fully expropriated tax can increase the profits arising from a common-pool resource. The basic model assumes a fixed number of identical agents with linear costs selling in a single period at an exogenous price. A necessary and sufficient condition for a cost increase to be profitable is that aggregate output from the resource be locally convex in aggregate effort. We also show that cost increases can be profitable even if price is endogenous, agents are heterogeneous, entry is costless, or agents are playing a Markov-perfect equilibrium of a dynamic game. We also discuss more general welfare implications of the result along with its relation to existing results for a Cournot oligopoly.

Robustness and vulnerability of community irrigation systems: The case of the Taos valley acequias

- Journal of Environmental Economics and Management---2011---Michael Cox,Justin Ross

Traditional economic and policy analysis theory has emphasized the implementation of private or public property rights regimes in order to sustainably manage natural resources. More recent work has challenged this approach by examining the strengths and weakness of common property governance of such resources. This paper contributes to this literature by analyzing the acequia irrigation communities in northern New Mexico. Through statistical analysis, we find that the acequias' ability to maintain collective-action as estimated by a critical performance function, crop production, is aided by water sharing agreements and

access to groundwater, and that it is hampered by property rights fragmentation and urbanization.

Optimal management of strategic reserves of nonrenewable natural resources

- Journal of Environmental Economics and Management---2011---Eric Bahel

This paper studies the stockpiling issue for an oil importing country that is likely to suffer embargoes, the occurrence and duration of which are uncertain. I show the existence of a decreasing reserves path that the country wants to attain in order to hedge against these disruptions. Allowing the importing country to invest in R&D in order to free itself from the embargo threat, I determine the optimal effort that should be engaged in research. The incentive to develop a backstop is shown to increase with the depletion of the reserves.

Would hotelling kill the electric car?

- Journal of Environmental Economics and Management---2011---Ujjayant Chakravorty, Andrew Leach, Michel Moreaux

In this paper, we show that the potential for endogenous technological change in alternative energy sources may alter the behaviour of resource-owning firms. When technological progress in an alternative energy source can occur through learning-by-doing, resource owners face competing incentives to extract rents from the resource and to prevent expansion of the new technology. We show that in such a context, it is not necessarily the case that scarcity-driven higher traditional energy prices over time will induce alternative energy supply as resources are exhausted. Rather, we show that as we increase the learning potential in the substitute technology, lower equilibrium energy prices prevail and there may be increased resource extraction and greenhouse gas emissions. We show that the effectiveness and the incidence of emissions reduction policies may be altered by increased potential for technological change. Our results suggest that treating finite resource rents as endogenous consequences of both technological progress and policy changes will

be important for the accurate assessment of climate change policy.

The value of disappearing beaches: A hedonic pricing model with endogenous beach width

- Journal of Environmental Economics and Management---2011---Sathya Gopalakrishnan, Martin D. Smith, Jordan M. Slott, A. Brad Murray

Beach nourishment is a policy used to rebuild eroding beaches with sand dredged from other locations. Previous studies indicate that beach width positively affects coastal property values, but these studies ignore the dynamic features of beaches and the feedback that nourishment has on shoreline retreat. We correct for the resulting attenuation and endogeneity bias in a hedonic property value model by instrumenting for beach width using spatially varying coastal geological features. We find that the beach width coefficient is nearly five times larger than the OLS estimate, suggesting that beach width is a much larger portion of property value than previously thought. We use the empirical results to parameterize a dynamic optimization model of beach nourishment decisions and show that the predicted interval between nourishment projects is closer to what we observe in the data when we use the estimate from the instrumental variables model rather than OLS. As coastal communities adapt to climate change, we find that the long-term net value of coastal residential property can fall by as much as 52% when erosion rate triples and cost of nourishment sand quadruples.

Strategic environmental disclosure: Evidence from the DOE's voluntary greenhouse gas registry

- Journal of Environmental Economics and Management---2011---Eun-Hee Kim, Thomas Lyon

Although mandatory disclosure programs have been studied extensively, strategic voluntary environmental disclosures by firms are not well understood. We

study the motivations for and impacts of firms' strategic disclosure of greenhouse gas reductions to the US government. We first model firms' joint abatement and disclosure decisions, incorporating both economic and political incentives. We then use data from the Department of Energy's Voluntary Greenhouse Gas Registry to compare reported reductions to actual emissions. We find that participants in the program engage in highly selective reporting: in the aggregate, they increase emissions over time but report reductions. In contrast, non-participants decrease emissions over time. Participants tend to be large firms facing strong regulatory pressure; pressure from environmental groups reduces the likelihood of participation, suggesting such groups viewed the program as a form of greenwash. Participating in the 1605(b) program had no significant effect on a firm's changes in carbon intensity over time.

Regulatory attitudes and environmental innovation in a model combining internal and external R&D

- Journal of Environmental Economics and Management---2011---Anthony Heyes, Sandeep Kapur

The extent to which environmental regulatory institutions are either 'green' or 'brown' impacts not just the intensity of regulation at any moment, but also the incentives for the development of new pollution-control technologies. We set up a strategic model of R&D in which a polluter can deploy technologies developed in-house, or license technologies developed by specialist outsiders (an 'eco-industry'). Polluters exert R&D effort and may even develop redundant technologies to improve the terms on which they procure technology from outside. We find that, while regulatory bias has an ambiguous impact on the best-available technology, strategic delegation to systematically biased regulators can improve social welfare.

Uncertainty and measurement error in welfare models for risk changes

- Journal of Environmental Economics and Management---2011---Mary Riddel

Most welfare models of environmental or mortality risk reductions assume that risks are exogenously determined and known with certainty. However, a growing body of research suggests that uncertainty about risks can affect choices over risky prospects. I present a decision-weighted random-utility model that decomposes welfare losses into those attributable to an increase in the deterministic component of risk and those attributable to uncertainty about risk. I apply the model to an illustrative dataset of subjects' perceived mortality risk and willingness to accept the risk of nuclear-waste transport. I estimate the model using Lewbel's (2000) strictly exogenous regressor approach to account for endogeneity bias and measurement error. Subjects display aversion to both risk and uncertainty about the risk of a transport accident, so that increases in either leads to social-welfare losses. Roughly 12% of the external cost of nuclear-waste transport is attributable to the public's uncertainty about transport risk.

At home and abroad: An empirical analysis of innovation and diffusion in energy technologies

- Journal of Environmental Economics and Management---2011---Elena Verdolini, Marzio Galeotti

This paper contributes to the induced innovation literature by extending the analysis of supply and demand determinants of innovation in energy technologies to account for international knowledge flows and spillovers. We select a sample of 38 innovating countries and study how knowledge related to energy-efficient and environmentally friendly technologies flows across geographical and technological space. We demonstrate that higher geographical and technological distances are associated with lower probabilities of knowledge flow. Next, we use previous estimates to construct internal and external knowledge stocks for a panel of 17 countries. We then present an econometric analysis of the supply and demand determinants of innovation accounting for international knowledge spillovers. Our results confirm the role of demand-pull effects, proxied by energy prices, and of technological opportunity,

proxied by the knowledge stocks. Our results show that spillovers between countries have a significant positive impact on further innovation in energy-efficient and environmentally friendly technologies.

Is there a double-dividend from anti-sprawl policies?

- Journal of Environmental Economics and Management---2011---Antonio Bento,Sofia Franco,Daniel Kaffine

This paper examines the welfare effects of anti-sprawl policies, such as development tax, in a simple spatial explicit urban model with two market failures - urban decline at the city core and underprovision of open space amenities at the urban fringe - and pre-existing distortionary property tax, used to fund public services and improvements to mitigate urban decline. Consistent with prior double-dividend literature, there is a tax interaction effect that occurs between the development tax and the pre-existing property tax. However, there are two fundamental differences between the tax interaction effect identified here and that of prior literature. Ours one has two components: First, there is a cost-side tax interaction effect that is 'spatially' concentrated at the urban fringe, as only agents at the urban fringe alter their behavior in response to the development tax. Second, there is also a benefit-side tax interaction effect, as increases in open space at the urban fringe are capitalized into housing prices throughout the city. In contrast to prior literature, we find that the empirical importance of the combined tax interaction effect is of substantially less importance and, as a consequence, the likelihood of a 'double-dividend' is higher than in prior studies. Further, we show that the development tax should be part of the local tax system, even in the absence of open space benefits.

Double-dipping in environmental markets

- Journal of Environmental Economics and Management---2011---Richard Woodward

There is an increasing tendency to use markets to induce the provision of environmental services. As such

markets increase in scope, potential market participants might sell multiple environmental services. The question we consider here is whether participants in such markets should be allowed to sell credits in more than one market simultaneously. Some have argued in favor of such "double-dipping", because it would make the provision of environmental services more profitable. In practice however, most programs do not allow double-dipping. We show that if the optimal level of pollution abatement is sought, then double-dipping maximizes societal net benefits. However, if pollution policies are set in a piecemeal fashion, then the caps for each market are unlikely to be optimal and, in this second-best setting, a policy prohibiting double-dipping can lead to greater social net benefits. We explore conditions under which a single-market policy is preferred, or equivalently, where piecemeal policies are likely to yield particularly inefficient outcomes.

Is ISO 14001 a gateway to more advanced voluntary action? The case of green supply chain management

- Journal of Environmental Economics and Management---2011---Toshi Arimura,Nicole Darnall,Hajime Katayama

Using Japanese facility-level data, we estimate the effects of ISO 14001 certification on the promotion of more advanced practices, namely green supply chain management (GSCM). Our results show that ISO 14001 promotes GSCM practices. Facilities with environmental management systems (EMS) certified to ISO 14001 are 40% more likely to assess their suppliers' environmental performance and 50% more likely to require that their suppliers undertake specific environmental practices. Further, government programs that encourage voluntary EMS adoption indirectly promote GSCM practices. These programs increase the probabilities that facilities will assess their suppliers' environmental performance and require suppliers to undertake specific environmental practices by 7% and 8%, respectively. Combined, these findings suggest that there may be significant but previously unnoticed spillover effects of ISO 14001 and government promotion of voluntary

action.

A characterization of sustainability with indicators

- Journal of Environmental Economics and Management---2011---Vincent Martinet

Economists favor the use of criteria to characterize sustainability. In practice, policy-makers use indicators, i.e., measurements based on the current economic state and decisions, representing given sustainability issues. In this paper, I introduce a criterion characterizing sustainability with indicators and thresholds acting as constraints. I interpret the thresholds as minimal rights to be guaranteed to all generations, and define sustainable trajectories as those satisfying all the constraints at all times. The new criterion is a "generalized" maximin criterion. The approach is applied to a simple production-consumption economy with non-renewable resources. To derive some policy recommendations on the use of indicators to deal with sustainability, I discuss the implications of such a criterion in terms of trade-off between sustainability thresholds, efficiency, and time-consistency. In particular, the resulting problem is time-inconsistent, and sustainability thresholds may be revised over time. Following the time-inconsistent policy based on indicators, with dynamic revision of the thresholds, may, however, result in a sustained utility path, and even in utility growth.

Does marginal price matter? A regression discontinuity approach to estimating water demand

- Journal of Environmental Economics and Management---2011---Shanthi Nataraj, Michael Hanemann

Although complex pricing schedules are increasingly common among water and electricity providers, it is difficult to determine whether consumers respond to changes in the pricing schedule because price changes are often confounded with simultaneous demand shocks or non-price policies. To overcome this challenge, we

exploit a natural experiment - the introduction of a third price block in an increasing block pricing schedule for water - in Santa Cruz, California. Using a regression discontinuity design, we find that consumers do respond to changes in marginal price. Doubling marginal price leads to a 12% decrease in water use (500 cubic feet per bill) among high-use households.

Valuation of cancer and microbial disease risk reductions in municipal drinking water: An analysis of risk context using multiple valuation methods

- Journal of Environmental Economics and Management---2011---Wiktor Adamowicz, Diane Dupont, Alan Krupnick, Jing Zhang

We examine the value of health risk reductions (microbial illnesses/deaths and bladder cancer illnesses/deaths) in the context of drinking water quality treatment by public systems. When we assume that combined mortality and morbidity risk reductions are equally spread in the future; our results suggest that microbial risk-reduction programs have higher value than cancer risk-reduction programs, but that mortality risk reduction values are not significantly different for cancer and microbials. However, when a 25-year cancer latency is accounted for and a 5% discount rate is used, the value of cancer mortality risk reductions exceeds the value for microbial risk reductions. We also address a number of methodological issues, including performance of alternative choice experiment estimation (CE) techniques, relationship of CE to contingent valuation results, and implications for incorporating morbidity and mortality endpoints in the same survey instrument.

Household incidence of pollution control policies: A robust welfare analysis using general equilibrium effects

- Journal of Environmental Economics and Management---2011---Abdelkrim Araar, Yazid Dissou, Jean-Yves Duclos

This study assesses the incidence of pollution control

policies on households. In contrast to previous studies, we employ an integrated framework combining a multisector general equilibrium model with a stochastic dominance analysis using household-level data. We consider three policy instruments in a domestic emission trading system: (i) an output-based allocation (OBA) of permits; (ii) the use of the proceeds of permit sales to reduce payroll taxes (RPT); (iii) and the use of these proceeds to reduce consumption taxes instead (UCS). The general equilibrium results suggest that the return to capital is more negatively affected than the wage rate in all simulations, since polluting industries are capital intensive. Abstracting from pollution externalities, the dominance analysis suggests that all three policies have a normatively robust negative (positive) impact on welfare (poverty). Formal dominance tests indicate that RPT first-order welfare dominates OBA over all values of household incomes. UCS also first-order poverty dominates RPT for any choice of poverty line below \$CAN 18,600, and poverty dominates for any poverty line (and thus welfare dominates) at the second order. Finally, while the three pollution control policies do not have a numerically large impact on inequality (in comparison to the base run), statistical tests indicate that inequality increases significantly more with OBA and RPT than with UCS.

Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology

- Journal of Environmental Economics and Management---2011---Kevin Gallagher, Erich Muehlegger

Federal, state, and local governments use a variety of incentives to induce consumer adoption of hybrid-electric vehicles. We study the relative efficacy of state sales tax waivers, income tax credits, and non-tax incentives and find that the type of tax incentive offered is as important as the generosity of the incentive. Conditional on value, sales tax waivers are associated with more than a ten-fold increase in hybrid sales relative to income tax credits. In addition, we examine how adoption varies with fuel prices. Rising gasoline prices are associated with greater hybrid vehicle sales, but

this effect operates almost entirely through high fuel-economy vehicles. By comparing consumer response to sales tax waivers and estimated future fuel savings, we estimate an implicit discount rate of 14.6% on future fuel savings.

Trade, technology, and the environment: Does access to technology promote environmental regulation?

- Journal of Environmental Economics and Management---2011---Mary Lovely, David Popp

Focusing specifically on regulation of coal-fired power plants, we examine how technological innovation by early adopters influences the timing of new environmental regulation in non-innovating countries. We build a general equilibrium model of an open economy to identify the political-economy determinants of regulation. With a newly created dataset of SO₂ and NO_x regulations for coal-fired power plants and a patent-based measure of the technology frontier, we estimate the determinants of environmental regulation diffusion. Our findings support the hypothesis that international economic integration eases access to environmentally friendly technologies and leads to earlier adoption, *ceteris paribus*, of regulation in non-innovating countries. However, we also find evidence that domestic trade protection promotes earlier adoption allowing shifts of regulatory costs to domestic consumers. Furthermore, international market power permits large countries to shift costs to foreign consumers. Other political economy factors, such as the quality of domestic coal, are also important determinants.

Plant vintages, grandfathering, and environmental policy

- Journal of Environmental Economics and Management---2011---Garth Heutel

Environmental regulations that grandfather existing plants, by not holding them to the same strict standards as new plants, may have the unintended consequence of retarding new investment. If new plants are cleaner, then this effect may increase pollution in

the short run. I develop a dynamic model of a facility's decisions over scrapping and abatement, which depend on capital depreciation, profitability shocks, and environmental policy. Using data from fossil fuel fired boilers at electric power plants, I estimate the structural parameters of the model and assess the impact of grandfathering in the Clean Air Act on sulfur dioxide emissions. Counterfactual policy simulations show that an increase in the stringency of performance standards would have led to a decrease in investment in new boilers. However, this does not lead to increased emissions, since there is less investment in dirtier coal boilers as compared to relatively cleaner oil or natural gas boilers.

Lose some, save some: Obesity, automobile demand, and gasoline consumption

- Journal of Environmental Economics and Management---2011---Shanjun Li,Yanyan Liu,Junjie Zhang

This paper examines the unexplored link between the prevalence of overweight and obesity and vehicle demand in the United States. Exploring annual sales data of new passenger vehicles at the model level in 48 U.S. counties from 1999 to 2005, we find that new vehicles demanded by consumers are less fuel-efficient on average as a larger share of people become overweight or obese. The OLS results show that a 10 percentage point increase in obesity and overweight reduces the average MPG of new vehicles demanded by 1.4 percent, an effect requiring a 12 cent increase in gasoline prices to counteract. The 2SLS results after controlling for possible endogeneity in overweight and obesity prevalence put those two numbers at 5 percent and 54 cent, respectively. These findings, robust to a variety of specifications, suggest that policies to reduce overweight and obesity can have additional benefits for energy security and the environment.

The Al Gore effect: An Inconvenient Truth and voluntary carbon offsets

- Journal of Environmental Economics and Management---2011---Grant Jacobsen

This paper examines the relationship between climate change awareness and household behavior by testing whether Al Gore's documentary *An Inconvenient Truth* caused an increase in the purchase of voluntary carbon offsets. I find that in the two months following the film's release, zip codes within a 10-mile radius of a zip code where the film was shown experienced a 50 percent relative increase in the purchase of voluntary carbon offsets. During other times, offset purchasing patterns for zip codes inside the 10-mile radius were similar to the patterns of zip codes outside the 10-mile radius. There is, however, little evidence that individuals who purchased an offset due to the film purchased them again a year later.

Pressure cookers or pressure valves: Do roads lead to deforestation in China?

- Journal of Environmental Economics and Management---2011---Xiangzheng Deng,Jikun Huang,Emi Uchida,Scott Rozelle,John Gibson

The effect of roads on forests is ambiguous. Many studies conclude that building and upgrading roads increases pressure on forests but some find that new and better roads may reduce the rate of deforestation. In this paper we use satellite remote sensing images of forest cover in Jiangxi Province, China, to test whether the existence and the size of roads (ranging from expressways to tertiary roads) in 1995 affected the level of forest cover in 2000 or the rate of change between 1995 and 2000. To account for road access for each of our 1 km² ("pixel") units of forest cover we measure whether or not and what type of roads penetrate the "watershed" in which the pixel lies. These watersheds allow more plausible measures of accessibility than do traditional "crowfly" distance measures that ignore topography. To account for possible confounding we also use 12 additional covariates: geographic and climatic variables (e.g., elevation, slope, rainfall, temperature, soil properties); demographic and economic variables (e.g., local population and GDP per square kilometer); and distance variables (e.g., distance to the nearest provincial capital). Although simple univariate OLS regressions show that forest levels are lower and de-

forestation rates higher either when there is a road, or when there is a higher quality road, these results are not robust. Controlling for all of the covariates and also using recently developed covariate matching techniques to estimate treatment effects, we find that roads in China's Jiangxi Province can most safely be described as having no impact on the level of forests and no impact on the rate of deforestation.

Shifting cultivation, forest fallow, and externalities in ecosystem services: Evidence from the Eastern Amazon

- Journal of Environmental Economics and Management---2011---Heather Klemick

This study examines the value of fallow ecosystem services in shifting cultivation, including hydrological externalities that may affect other farms. Using farm-level survey data from the Brazilian Amazon, I estimate a production function to assess the value of forest fallow and test whether it provides local externalities to agricultural production. Soil quality controls, instrumental variables, and spatial econometric approaches help address endogeneity issues. I use GIS data on external forest cover at the farm level and model the hydrological externality as an upstream-to-downstream process. The estimated parameters indicate that fallow contributes significantly to productivity both on farm and downstream. In addition, most farms allocate sufficient land to fallow, accounting for both the value of hydrological spillovers and the opportunity cost of land left out of cultivation. These results suggest that farming communities may have some self-interest in preserving forest cover locally--a finding that may bolster policy efforts aimed at conserving tropical forests for their global public goods.

Cap-and-trade properties under different hybrid scheme designs

- Journal of Environmental Economics and Management---2011---Georg Grull, Luca Taschini

This paper examines the key design mechanisms of existing and proposed cap-and-trade markets. First, it

is shown that the hybrid systems under investigation (price floor using a minimum price guarantee, price collar, allowance reserve, options offered by the regulator, and offset relaxation) can be decomposed into a combination of an ordinary cap-and-trade scheme with European- or American-style call and put options. Then, we quantify and discuss the advantages and disadvantages of the proposed hybrid schemes by investigating whether pre-set objectives (enforcement of permit price bounds and reduction of the compliance costs for relevant companies) can be accomplished while maintaining the original environmental targets. Plain vanilla options are proposed as an alternative that reconciles the otherwise conflicting policy objectives.

Which hedonic models can we trust to recover the marginal willingness to pay for environmental amenities?

- Journal of Environmental Economics and Management---2010---Nicolai Kuminoff, Christopher Parmeter, Jaren Pope

The hedonic property value model is among our foremost tools for evaluating the economic consequences of policies that target the supply of local public goods, environmental services, and urban amenities. We design a theoretically consistent and empirically realistic Monte Carlo study of whether omitted variables seriously undermine the method's ability to accurately identify economic values. Our results suggest that large gains in accuracy can be realized by moving from the standard linear specifications for the price function to a more flexible framework that uses a combination of spatial fixed effects, quasi-experimental identification, and temporal controls for housing market adjustment.

Impacts of alternative emissions allowance allocation methods under a federal cap-and-trade program

- Journal of Environmental Economics and Management---2010---Lawrence H. Goulder, Marc A.C. Hafstead, Michael Dworsky

This paper examines the implications of alternative allowance allocation designs for industry profits and GDP under a federal cap-and-trade program to reduce greenhouse gas emissions. We employ a general equilibrium model of the U.S. economy with a unique treatment of capital dynamics that permits close attention to profit impacts. Effects on profits depend critically on the relative reliance on auctioning or free allocation of allowances. Freely allocating fewer than 15% of the emissions allowances generally suffices to prevent profit losses in the most vulnerable U.S. industries. Freely allocating all of the allowances substantially overcompensates these industries. When emissions allowances are auctioned and the proceeds employed to finance cuts in income tax rates, GDP costs are about 33% lower than when all allowances are freely allocated. Our results are robust to policies differing in stringency, the availability of offsets, and the opportunities for intertemporal trading of allowances.

Voluntary environmental regulation in developing countries: Mexico's Clean Industry Program

- Journal of Environmental Economics and Management---2010---Allen Blackman,Bidisha Lahiri,William Pizer,Marisol Rivera Planter,Carlos Muñoz Piña

Because conventional command-and-control environmental regulation often performs poorly in developing countries, policymakers are increasingly experimenting with alternatives, including voluntary regulatory programs. Research in industrialized countries suggests that such programs are sometimes ineffective, because they mainly attract relatively clean participants free-riding on unrelated pollution control investments. We use plant-level data on more than 100,000 facilities to analyze the Clean Industry Program, Mexico's flagship voluntary regulatory initiative. We seek to identify the drivers of participation and to determine whether the program improves participants' environmental performance. Using data from the program's first decade, we find that plants recently fined by environmental regulators were more likely to participate, but that after graduating from the program, participants were not

fined at a substantially lower rate than nonparticipants. These results suggest that although the Clean Industry Program attracted dirty plants under pressure from regulators, it did not have a large, lasting impact on their environmental performance.

Risk aversion and CO2 regulatory uncertainty in power generation investment: Policy and modeling implications

- Journal of Environmental Economics and Management---2010---Lin Fan,Benjamin Hobbs,Catherine Norman

We consider a simulation of risk-averse producers when making investment decisions in a competitive energy market, who face uncertainty about future regulation of carbon dioxide emissions. Investments are made under regulatory uncertainty; then the regulatory state is revealed and producers realize returns. We consider anticipated taxes, grandfathered permits and auctioned permits and show that some anticipated policies increase investment in the relatively dirty technology. Beliefs about the policy instrument that will be used to price carbon may be as important as certainty that carbon will be priced. More generally, a failure to consider risk aversion may bias policy analysis for the power sector.

A latent segmentation approach to a Kuhn-Tucker model: An application to recreation demand

- Journal of Environmental Economics and Management---2010---Koichi Kuriyama,Michael Hanemann,James R. Hilger

In this paper, we extend the latent segmentation approach to the Kuhn-Tucker (KT) model. The proposed approach models heterogeneity in preferences for recreational behavior, using a utility theoretical framework to simultaneously model participation and site selection decisions. Estimation of the latent segmentation KT model with standard maximum likelihood techniques is numerically difficult because of the large number of parameters in the segment membership functions and the utility function for each latent segment. To address

this problem, we propose the expectation-maximization (EM) algorithm to estimate the model. In the empirical section, we implement the EM latent segmentation KT approach to analyze a Southern California beach recreation data set. Our empirical analysis suggests that three groups exist in the sample. Using the model to analyze two hypothetical beach management policy scenarios illustrates different welfare impacts across groups.

Environmental policy à la carte: Letting firms choose their regulation

- Journal of Environmental Economics and Management---2010---Frank Krysiak,Iris Oberauner

Under uncertainty, the optimal choice between price and quantity instruments depends on the technology of the regulated firms, which is often private information. We consider an environmental policy that delegates the prices-versus-quantities decision to the firms by offering them the choice between an emissions tax and permit trading. Such an approach is currently used in Swiss climate policy. We provide a detailed characterization of the optimal policy and show that this approach reduces expected social costs compared to a pure tax or permit-trading regime. We demonstrate that an optimal allocation of firms to instruments can be achieved despite substantial informational constraints, and that all firms gain from the introduction of the instrument choice compared to optimally designed single-instrument policies. Furthermore, we discuss the conditions under which this approach is likely to be preferable to a hybrid regulation.

Valuing open space in a residential sorting model of the Twin Cities

- Journal of Environmental Economics and Management---2010---Henry Klaiber,Daniel Phaneuf

We present an analysis of how open space amenities affect residential location choices using a horizontal sorting model to estimate household preferences for

open space. To parameterize the model, a new and rich dataset spanning 17 years of home sales in the seven-county Twin Cities area of Minnesota was assembled. Heterogeneity across types of open space and across households is shown to be a critical determinant of the welfare impacts of open space conservation. Our general equilibrium simulations allow housing prices to re-equilibrate in response to policy-induced demand shifts, demonstrating that as the scale of intervention becomes larger, general equilibrium and partial equilibrium welfare measures increasingly diverge. Finally, we find that the spatial structure of policy is an important component of policy design, suggesting open space policy should be place-specific in its design and implementation.

Green drivers or free riders? An analysis of tax rebates for hybrid vehicles

- Journal of Environmental Economics and Management---2010---Ambarish Chandra,Sumeet Gulati,Milind Kandlikar

We estimate the effect of tax rebates offered by Canadian Provinces on the sales of hybrid electric vehicles. We find that these rebates led to a large increase in the market share of hybrid vehicles. In particular, we estimate that 26% of the hybrid vehicles sold during the rebate programs can be attributed to the rebate, and that intermediate cars, intermediate SUVs and some high performance compact cars were crowded out as a result. However, this implies that the rebate programs also subsidized many consumers who would have bought either hybrid vehicles or other fuel-efficient vehicles in any case. Consequently, the average cost of reducing carbon emissions from these programs is estimated to be \$195 per tonne.

Conservation and development: Evidence from Thai protected areas

- Journal of Environmental Economics and Management---2010---Katharine R.E. Sims

Protected areas are a key tool for conservation policy but their economic impacts are not well understood.

This paper presents new evidence about the local effects of strictly protected areas in Thailand, combining data on socioeconomic outcomes from a poverty mapping study with satellite-based estimates of forest cover. The selective placement of protected areas is addressed by controlling for characteristics which drove both protection and development and by instrumenting for protection with priority watershed status. The estimates indicate that protected areas increased average consumption and lowered poverty rates, despite imposing binding constraints on agricultural land availability. Socioeconomic gains are likely explained by increased tourism in and around protected areas. However, net impacts are largest at intermediate distances from major cities, highlighting that the spatial patterns of both costs and benefits are important for efforts to minimize conservation-development tradeoffs.

Carbon markets and technological innovation

- Journal of Environmental Economics and Management---2010---Thomas Weber,Karsten Neuhoﬀ

This paper examines the effects of firm-level innovation in carbon-abatement technologies on optimal cap-and-trade schemes with and without price controls. We characterize optimal cap-and-trade regulation with a price cap and a price floor, and compare it to the special cases of pure taxation and a simple emissions cap. Innovation shifts the tradeoff between price- and quantity-based instruments towards quantity-based emissions trading schemes. More specifically, an increase in innovation effectiveness lowers the optimal emissions cap, and leads to relaxed price controls unless the slope of the marginal environmental damage curve is small. Because of the decrease in the emissions cap, innovation in abatement technologies can lead to a higher expected carbon price, so as to provide sufficient incentives for private R&D investments. The expected carbon price decreases once innovative technologies are widely used.

The optimal size of a permit market

- Journal of Environmental Economics and Management---2010---Frank Krysiak,Patrick Schweitzer

Regulating the emissions of non-uniformly mixed pollutants with a permit market carries the risk of hot spot formation, which can be reduced by dividing the regulation area into trading zones. The trading zone approach has been extensively discussed for the full-information case. We consider incomplete information concerning the emitters' abatement costs, their locations, and pollution dispersion. We derive the optimal number of trading zones and the optimal number of permits per zone and analyze under which conditions a system of independent trading zones is superior to other policy measures. Our results show that appropriately sized permit markets are well-suited to regulating non-uniformly mixed pollutants under informational constraints if firms are not too heterogeneous. Only for substantial heterogeneity and a highly non-linear damage function can it be optimal to use command-and-control strategies.

Risk-adjusted gamma discounting

- Journal of Environmental Economics and Management---2010---Martin Weitzman

It is widely recognized that the economics of distant-future events, like climate change, is critically dependent upon the choice of a discount rate. Unfortunately, it is unclear how to discount distant-future events when the future discount rate itself is unknown. In previous work, an analytically-tractable approach called "gamma discounting" was proposed, which gave a declining discount rate schedule as a simple closed-form function of time. This paper extends the previous gamma approach by using a Ramsey optimal growth model, combined with uncertainty about future productivity, in order to "risk adjust" all probabilities by marginal utility weights. Some basic numerical examples are given, which suggest that the overall effect of risk-adjusted gamma discounting on lowering distant-future discount rates may be significant. The driving

force is a "fear factor" from risk aversion to permanent productivity shocks representing catastrophic future states of the world.

On international equity weights and national decision making on climate change

- Journal of Environmental Economics and Management---2010---David Anthoff,Richard Tol

Estimates of the marginal damage costs of carbon dioxide emissions require the aggregation of monetised impacts of climate change over people with different incomes and in different jurisdictions. Implicitly or explicitly, such estimates assume a social welfare function and hence a particular attitude towards equity and justice. We show that previous approaches to equity weighting are inappropriate from a national decision maker's point of view, because domestic impacts are not valued at domestic values. We propose four alternatives (sovereignty, altruism, good neighbour, and compensation) with different views on concern for and liability towards foreigners. The four alternatives imply radically different estimates of the social cost of carbon and hence the optimal intensity of climate policy.

Dynamic sanitary and phytosanitary trade policy

- Journal of Environmental Economics and Management---2010---Lars Olson,Santanu Roy

This paper characterizes the optimal use of sanitary and phytosanitary standards to prevent the introduction of harmful pests and diseases through international trade. Because established pest and disease infestations grow and spread over time their introduction has intertemporal consequences. In a dynamic economic model, an efficient trade policy balances the costs of SPS measures against the discounted stream of the costs of control and social damages that are avoided by using SPS measures, where future growth of any established infestation is accounted for. We examine when phytosanitary trade policy makes good economic sense, when it is efficient to provide full protection against pests and diseases, and when restrictive, but not fully protective trade policy is efficient.

Green taxes: Refunding rules and lobbying

- Journal of Environmental Economics and Management---2010---Toke Aidt

Green taxes can internalize environmental externalities and raise revenues. We develop a positive theory that treats both of these aspects as endogenous outcomes of special-interest and electoral politics. We consider the choice among three (endogenous) refunding rules: income tax cuts, extra public spending and tax burden compensation to polluters. We show that a polluter lobby group may lobby for the ecotax revenue to be refunded to voters rather than to its members. The reason is that the "price" that the lobby group must pay for a reduction in the green tax can be reduced by supporting a refunding rule that pleases voters. Our analysis provides insights into recent green tax reforms in Europe.

The pungent smell of "red herrings": Subsoil assets, rents, volatility and the resource curse

- Journal of Environmental Economics and Management---2010---Frederick (Rick) van der Ploeg,Steven Poelhekke

Brunnschweiler and Bulte (2008) [1] and [2] provide cross-country evidence that resource curse is a "red herring" once one corrects for endogeneity of resource exports and allows resource abundance to affect growth. Their results show that resource exports are no longer significant while value of subsoil assets has a significant positive effect on growth. But the World Bank measure of subsoil assets is proportional to current rents, and thus is also endogenous. Furthermore, their results suffer from an unfortunate data mishap, omitted variables bias, weakness of instruments, violation of exclusion restrictions and misspecification error. Correcting for these issues and instrumenting resource exports with values of proven reserves at the beginning of the sample period, there is no evidence for resource curse either and subsoil assets are no longer significant. However, the same evidence suggests that resource exports or rents boost growth in stable countries, but also make especially already volatile countries more volatile and

thus indirectly worsen growth prospects. Ignoring the volatility channel may lead one to erroneously conclude that there is no effect of resources on growth.

Building out alternative fuel retail infrastructure: Government fleet spillovers in E85

- Journal of Environmental Economics and Management---2010---Kenneth Corts

One significant obstacle to meeting aggressive federal and state alternative fuel consumption targets is the relative scarcity of retail fueling stations that carry alternative fuels. Policies that encourage or mandate use of alternative fuel vehicles in government fleets, thereby increasing demand for such fuels, are one popular approach to stimulating further development of the alternative fuel retail infrastructure. I focus specifically on flex-fuel vehicles (FFVs) that burn E85, a combination of 85% ethanol and 15% gasoline, to study the impact of government fleet composition on retail alternative fuel infrastructure. Using data from six states in the Midwest that account for over 60% of US E85 stations, I show that government fleet adoption of FFVs leads to an increase in retail E85 stations. This finding persists when using instrumental variables techniques to address the endogeneity of government fleet FFV purchases.

Private citizen suits and public enforcement: Substitutes or complements?

- Journal of Environmental Economics and Management---2010---Christian Langpap, Jay Shimshack

Every major domestic environmental statute provides for citizen suits yet we know little about their implications. This paper's key contribution is systematic micro-level empirical evidence on the extent to which private environmental prosecutions crowd out, or crowd in, public monitoring and public enforcement. We use judicial instruments in an attempt to isolate the causal influence of private enforcement on public enforcement. We find that private citizen suits crowd in public monitoring but significantly crowd out public sanctions.

Second-best instruments for near-term climate policy: Intensity targets vs. the safety valve

- Journal of Environmental Economics and Management---2010---Mort Webster, Ian Sue Wing, Lisa Jakobovits

Current proposals for greenhouse gas emissions regulations in the United States mainly take the form of emissions caps with tradable permits. Since Weitzman's (1974) [3] study of prices vs. quantities, economic theory predicts that a price instrument is superior under uncertainty in the case of stock pollutants. Given the general belief in the political infeasibility of a carbon tax in the US, there has been recent interest in two other policy instrument designs: hybrid policies and intensity targets. We extend the Weitzman model to derive an analytical expression for the expected net benefits of a hybrid instrument under uncertainty. We compare this expression to one developed by Newell and Pizer (2006) [6] for an intensity target, and show the theoretical minimum correlation between GDP and emissions required for an intensity target to be preferred over a hybrid. In general, we show that unrealistically high correlations are required for the intensity target to be preferred to a hybrid, making a hybrid a more practical instrument in practice. We test the predictions by performing Monte Carlo simulation on a computable general equilibrium model of the US economy. The results are similar, and we show with the numerical model that when marginal abatement costs are non-linear, an even higher correlation is required for an intensity target to be preferred over a safety valve.

A quantile estimation approach to identify income and age variation in the value of a statistical life

- Journal of Environmental Economics and Management---2010---Mary Evans, Georg Schaur

In theory, heterogeneity in individual characteristics translates into variation in the marginal willingness to pay for a mortality risk reduction. Two dimensions of

heterogeneity, with respect to income and age, have recently received attention due to their policy relevance. We propose a quantile regression approach to simultaneously explore these two sources of heterogeneity and their interactions within the context of the hedonic wage model, the most common revealed preference approach for obtaining value of statistical life estimates. We illustrate the approach using data from the Health and Retirement Study (HRS). We find that the impact of age on the wage-risk tradeoff varies across the wage distribution. This result indicates important interactions between age and income heterogeneity. Thus, the conventional mean hedonic wage regression, even when the mean effect is allowed to vary with age, masks important heterogeneity.

Ordering anomalies in choice experiments

- Journal of Environmental Economics and Management---2010---Brett Day,Jose-Luis Pinto Prades,Jose-Luis Pinto-Prades

This paper investigates whether responses to choice experiments (CEs) are subject to ordering anomalies. While previous research has focussed on the possibility that such anomalies relate to position in the sequence of choice tasks, our research reveals that the particular order of tasks matters. Using a novel experimental design that allows us to test our hypotheses using simple nonparametric statistics, we observe ordering anomalies in CE data similar to those recorded in the dichotomous choice contingent valuation literature. Those ordering effects operate in both price and commodity dimensions and are observed to compound over a series of choice tasks. Our findings cast serious doubt on the current practice of asking each respondent to undertake several choice tasks in a CE while treating each response as an independent observation on that individual's preferences.

Scale factors and hypothetical referenda: A clarifying note

- Journal of Environmental Economics and Management---2010---Fredrik Carlsson,Olof Johansson-Stenman

In this note we explore in detail the importance of, and problems associated with, correcting for variance differences between data sets obtained from hypothetical and real referenda. We show that a previous discussion in the literature rests on a problematic estimation of the relative scale factor. The implications are illustrated with data from Cummings et al. (1997) [5], as well as with simulated data. Moreover, we propose a concrete methodology for how to analyze cases where it is difficult, or even impossible, to estimate the relative scale factor due to informational limitations, such as when there is no variation of the bid. We conclude that it is valuable to be able to separate behavioral differences into variance differences and parameter differences in the underlying objective function. Yet, we argue that when using the results to interpret the results of other hypothetical referenda, it is sometimes the net effect, i.e., without correction for scale differences, that matters.

The scope trials: Variation in sensitivity to scope and WTP with directionally bounded utility functions

- Journal of Environmental Economics and Management---2010---Edoh Y. Amiran,Daniel A. Hagen

Sensitivity to scope refers to the property that willingness to pay for an environmental amenity is an increasing function of the scope of the amenity. Measurements of the degree of sensitivity to scope are commonly proposed as a test for the reliability of contingent valuation studies. We evaluate the traditional scope test using neoclassical utility functions that are directionally bounded. We provide a formal definition of sensitivity to scope, and show that directionally bounded utility functions can produce arbitrarily small degrees of sensitivity to scope. We conclude that a failure to satisfy existing scope tests should not be used as a *prima facie* basis for rejecting contingent valuation studies. This does not imply that small degrees of sensitivity to scope should always be viewed as acceptable. Rather, the results of scope tests should be considered more carefully, with attention given to

the substitutability of market and non-market goods.

Market interactions between aquaculture and common-property fisheries: Recent evidence from the Bristol Bay sockeye salmon fishery in Alaska

- Journal of Environmental Economics and Management---2010---Diego Valderrama,James Anderson

The remarkable growth of the global salmon aquaculture industry has generated important implications for Alaskan salmon fisheries as increased supplies of farmed product have led to declines in prices of both farmed and wild species. In the particular case of Bristol Bay sockeye salmon, falling prices and declining profit margins have led to reduced participation in the limited-entry fishery. This study conducts a formal examination of market interactions between the aquaculture and commercial fishery sectors by adapting the Homans and Wilen (1997) model of regulated open access to the context of restricted access fisheries. The econometric model reveals that limited entry regulations were initially successful in extracting rents from the Bristol Bay fishery; however, these rents were gradually dissipated as a result of overcapacity and the effect of falling ex-vessel prices. The emergence of aquaculture provides a strong rationale in favor of right-based approaches to fisheries management in Alaska.

Managing partially protected resources under uncertainty

- Journal of Environmental Economics and Management---2010---Carolyn Fischer,Ramanan Laxminarayan

It is common wisdom that open-access leads to the inefficient use of resources and private ownership of resources improves efficiency. However, the impact of enclosure and efficient management of some resource pools on other open-access resource pools is poorly recognized. The problem is common to many congestion-prone facilities including roads, parks, fisheries, an-

tibiotics, grazing lands and wilderness areas. In this paper, we analyze the optimality of price and quantity instruments in regulating resource use when there is uncertainty about congestion costs. Price instruments are found to be preferable to quantity instruments, and strictly so when demand is less than perfectly elastic. We also explore the effect of market power by resource owners on the relative efficiency of the two instruments.

Expected net present value, expected net future value, and the Ramsey rule

- Journal of Environmental Economics and Management---2010---Christian Gollier

Weitzman [1] showed that when future interest rates are uncertain, using the expected net present value implies a term structure of discount rates that is decreasing to the smallest possible interest rate. On the contrary, using the expected net future value criteria implies an increasing term structure of discount rates up to the largest possible interest rate. We reconcile the two approaches by introducing risk aversion and utility maximization. We show that if the aggregate consumption path is optimized and made flexible to news about future interest rates, the two criteria are equivalent. Moreover, they are also equivalent to the Ramsey rule extended to uncertainty.

Pattern formation, spatial externalities and regulation in coupled economic-ecological systems

- Journal of Environmental Economics and Management---2010---William Brock,Anastasios Xepapadeas

We study the management of ecosystems in which interacting state variables that are affected by management decisions diffuse in space. We study pattern formation first in a setting where economic agents maximize myopic profits and ignore spillovers onto agents at other sites, and second in the context of a social planner who internalizes these spillovers. We compare patterns under these two institutions and study how the differences in the patterns generated by these two

institutions impact the design of regulatory schemes to internalize the externalities. At the same time we introduce new methods based on Fourier series type decompositions that enable us to turn an intractable infinite dimensional optimal control problem into a countable number of finite dimensional optimal control problems. As far as we know these methods are new to the economics literature. Our theory is applied to the management and regulation of a semi-arid system.

An expected profit model for monetizing fishing location choices

- Journal of Environmental Economics and Management---2010---Alan C. Haynie, David F. Layton

We develop and analyze the properties of a new type of discrete choice model which jointly estimates the expected value of catch and location choice. This model implicitly monetizes location choices and can be used to predict costs and effort redistribution of creating marine protected areas or of implementing other policy changes that either increase travel costs or alter expected revenue. We illustrate our approach by considering the closing of the Steller sea lion conservation area in the United States Bering Sea to pollock fishing.

Environmental policy in majoritarian systems

- Journal of Environmental Economics and Management---2010---Per Fredriksson, Xenia Matschke, Jenny Minier

This paper sheds new light on the determination of environmental tax policies in majoritarian federal electoral systems, such as the U.S., and derives implications for the environmental federalism debate on whether the national or local government should have authority over environmental taxes. In the absence of majority bias, the socially preferred policy would be federal district-level taxation which accounts both for cross-boundary pollution and differences in industry concentration across districts. In majoritarian systems, however, where the legislature consists of geographically distinct electoral districts, the majority party

(at the national or state level) favors home districts; depending on the location of polluting industries and the associated damages, the majority party may therefore impose sub-optimally high or low pollution taxes due to a majority bias. Majority bias can influence the social-welfare ranking of alternative environmental tax policies. In some cases, majority bias may make decentralized or federal uniform taxation the preferred solution.

How does the stock market respond to chemical disasters?

- Journal of Environmental Economics and Management---2010---Gunther Capelle-Blancard, Marie-Aude Laguna

In this paper, we examine the stock market reaction to industrial disasters. We consider an original sample of 64 explosions in chemical plants and refineries worldwide over the period 1990-2005. A quarter of the accidents resulted in a toxic release, and half of them caused at least one death or serious injury. On average, petrochemical firms in our sample experience a drop in their market value of 1.3% over the two days immediately following the disaster. Using multivariate analysis, we show that this loss is significantly related to the seriousness of the accident as measured by the number of casualties and by chemical pollution: each casualty corresponds to a loss of \$164 million and a toxic release to a loss of \$1 billion.

Strategic information acquisition and the mitigation of global warming

- Journal of Environmental Economics and Management---2010---Florian Morath

We consider the strategic role of uncertainty and information acquisition for the mitigation of global warming. Before the countries decide on their contribution to a mitigation of global warming, they may invest in information about the country-specific benefit of reductions of the emissions of greenhouse gases. We show that information acquisition has a substantial strategic value. Countries may prefer not to learn their benefit

of climate protection even if information acquisition does not involve a direct cost. This strategic information choice may further decrease the efficiency of the public good provision.

The effect of cap-and-trade programs on firms' profits: Evidence from the Nitrogen Oxides Budget Trading Program

- Journal of Environmental Economics and Management---2010---Joshua Linn

Cap-and-trade programs have become an increasingly common means of regulating emissions from electric power plants, but there is little empirical evidence about the programs' effects on regulated firms' profits. This paper uses stock prices to estimate the change in expected profits under the Nitrogen Oxides Budget Trading Program (NBP). Using regional variation in compliance costs, I find that the NBP reduced expected profits by as much as \$25 billion, primarily affecting the values of coal generators that operate in states with restructured electricity markets.

The value of a statistical life under ambiguity aversion

- Journal of Environmental Economics and Management---2010---Nicolas Treich

The paper shows that ambiguity aversion increases the value of a statistical life if the marginal utility of an increase in wealth is larger if one is alive rather than dead. Intuitively, ambiguity aversion has a similar effect as an increase in the perceived baseline mortality risk, and thus operates as the "dead anyway" effect. A numerical example suggests, however, that ambiguity aversion cannot justify the substantial "ambiguity premium" apparently embodied in environmental policy-making. The paper also shows that ambiguity aversion decreases the marginal cost of individual self-protection effort but may well decrease its marginal benefit, so that the total effect of ambiguity aversion on self-protection is unclear.

Environmental innovation and environmental performance

- Journal of Environmental Economics and Management---2010---Carmen Carrion-Flores, Robert Innes

By estimating a simultaneous panel data model of environmental innovation and toxic air pollution, this paper identifies bi-directional causal links between the two. We study a panel of 127 manufacturing industries over the period 1989-2004. Pollutant emissions are an implicit measure of policy stringency and environmental patent counts are used to measure environmental innovation. After accounting for the joint endogeneity, we find that environmental innovation is an important driver of reductions in US toxic emissions. Conversely, we find that tightened pollution targets induce environmental innovation. However, our estimates indicate that the "environmental policy multiplier" - the proportionate contribution of induced innovation to long-run emission reduction - is small.

Allowance price drivers in the first phase of the EU ETS

- Journal of Environmental Economics and Management---2010---Beat Hintermann

In the first phase of the EU Emissions Trading Scheme (EU ETS), the price per ton of CO₂ initially rose to over [euro]30; the price then collapsed to essentially zero by mid 2007. By deriving a structural model of the allowance price under the assumption of efficient markets I examine the extent to which this variation in price can be explained by marginal abatement costs. I then gradually relax the model by allowing for delayed adjustment of price to fundamentals, as well as by introducing lagged LHS variables. The pattern of results suggests that while prices were not initially driven by marginal abatement costs, this inefficiency was largely corrected after the accounting of 2005 emissions in April 2006.

The organization of extended producer responsibility in waste policy with product differentiation

- Journal of Environmental Economics and Management---2010---Pierre Fleckinger,Matthieu Glachant

The paper analyzes the efficiency of extended producer responsibility (EPR) for waste management. We consider a vertically differentiated duopoly where endogenous market quality affects waste disposal costs. Each producer has to meet a take-back requirement that forces it to collect and treat the waste associated with its products. In line with reality, we assume that the producers either organize themselves individually or cooperate by setting up a producer responsibility organization (PRO). We study the various implementations of EPR. Central to the analysis is the trade-off between collusion through the PRO and market power in the waste industry.

What are the consequences of consequentiality?

- Journal of Environmental Economics and Management---2010---Joseph Herriges,Catherine Kling,Chih-Chen Liu,Justin Tobias

We investigate the extent to which dichotomous choice referenda responses are shaped by whether the individual believes the survey itself will ultimately impact policy. Using survey data from the Iowa Lakes Project, we test this supposition. Specifically, we employ a Bayesian treatment effect model in which the degree of perceived consequentiality, measured as an ordinal response, is permitted to have a structural impact on willingness to pay (WTP) for a hypothetical environmental improvement. We test whether the estimated WTP distributions are the same for each value of the ordinal response. In our survey data, a subsample of individuals were randomly assigned supporting information suggesting that their responses to the questionnaires were important and will have an impact on policy decisions. In conjunction with a Bayesian posterior simulator, we use this source of exogenous variation to

identify the structural impacts of consequentiality perceptions on willingness to pay, while controlling for the potential of confounding on unobservables. We find evidence consistent with a "knife-edge" result, namely that the willingness to pay distributions are equal among those believing the survey to be at least minimally consequential, and different for those believing that the survey is irrelevant for policy purposes.

Environmental tax design with endogenous earning abilities (with applications to France)

- Journal of Environmental Economics and Management---2010---Helmuth Cremer,Firouz Gahvari,Norbert Ladoux

This paper studies environmental taxation in a Mirrlees setting with two novel features. First, energy, a polluting good, is used both as a factor of production and a final consumption good; second, the wage is determined endogenously while labor of different individual types remain homogeneous. The model is calibrated for the French economy. We show that: (i) The optimal tax is less than the marginal social damage of emissions and turns into an outright subsidy when the inequality aversion index is high; (ii) the optimal tax on energy as an input is always equal to its marginal social damage; (iii) the social welfare gain due to lowering the current energy taxes to their optimal levels, with the general income tax being set optimally in both cases, is between 17 and 32 euro per household. This hurts the rich and benefits the poor.

Technology, development, and the environment

- Journal of Environmental Economics and Management---2010---Karen Fisher-Vanden,Mun Ho

In an attempt to achieve the positive externalities from a more knowledge-intensive economy, many developing countries have emphasized improvements in their science and technology (S&T) capabilities. China, in particular, has been experiencing an acceleration in its R&D intensity, causing many to wonder whether China is undergoing an S&T takeoff. In this paper, we

simulate the effects of an S&T takeoff using a model of China that incorporates econometric estimates from 1500 industrial enterprises in China. We find that an S&T takeoff will lead to lower goods prices overall, but a larger drop in energy prices due to the energy-saving bias of R&D. The outcome is higher capital investment and economic growth; a substitution of energy for other factors of production; and greater energy consumption by households. Our findings underscore the importance of considering the economy-wide implications of a technology policy, recognizing that better technology does not necessarily imply a cleaner environment.

When additional resource stocks reduce welfare

- Journal of Environmental Economics and Management---2010---Hassan Bencheekroun,Alex Halsema,Cees Withagen

In the dominant firm model, we show that an increase of the fringe's reserves of a nonrenewable resource may lead to a decrease in aggregate discounted social welfare. This happens when the difference between the fringe's extraction cost and the dominant firm's is positive and large enough. We also show that welfare might decrease if the fringe's marginal extraction cost decreases.