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PROFESSIONAL APPOINTMENTS

Assistant Professor of Economics and Public Policy, Heinz College
Carnegie Mellon University (Aug 2013 – present)
(On leave – Spring 2015)

Visiting Assistant Professor of Economics, University of Chicago (Spring 2015)

Research Affiliate, Institute for the Study of Labor (IZA) (Mar 2013 – present)

EDUCATION

Ph.D., Economics, University of California at Berkeley (UC Berkeley) (2013).
Dissertation: *Essays in Applied Microeconomics*
Committee: David Card, Enrico Moretti, Patrick Kline, Steven Raphael

M.Sc., Economics, Pontifical Catholic University of Rio de Janeiro (PUC-Rio) (2007).
B.A., Economics (*summa cum laude*), University of São Paulo (USP) (2004).

RESEARCH FIELDS

Primary Fields: Urban, Energy, and Environmental Economics, and Economic History
Secondary Fields: Applied Econometrics, Labor Economics

WORKING PAPERS

“The Power of Hydroelectric Dams: Agglomeration Spillovers” (*Job Market Paper*)

How much of the geographic clustering of economic activity is attributable to agglomeration spillovers as opposed to natural advantages? I present evidence on this question using data on the long-run effects of large scale hydroelectric dams built in the U.S. over the 20th century, obtained through a unique comparison between counties with or without dams but with similar hydropower potential. Until mid-century, the availability of cheap local power from hydroelectric dams conveyed an important advantage that attracted industry and population. By the 1950s, however, these advantages were attenuated by improvements in the efficiency of thermal power generation and the advent of high tension transmission lines. Using a novel combination of synthetic control methods and event-study techniques, I show that, on average, dams built before 1950 had substantial short run effects on local population and employment growth, whereas those built after 1950 had no such effects. Moreover, the impact of pre-1950 dams persisted and continued to grow after the advantages of cheap local hydroelectricity were attenuated, suggesting the presence of important agglomeration spillovers. Over a 50 year horizon, I estimate that at least one half of the long run effect of pre-1950 dams is due to spillovers. The estimated short and long run effects are highly robust to alternative procedures for selecting synthetic controls, to controls for confounding factors such as proximity to transportation networks, and to alternative sample restrictions, such as dropping dams built by the Tennessee Valley Authority or removing control counties with environmental regulations. I also find small local agglomeration effects from smaller dam projects, and small spillovers to nearby locations from large dams. Lastly, I find relatively small costs of environmental regulations associated with hydroelectric licensing rules.

“Coal-Fired Power Generation, Air Pollution, and Infant Health Outcomes Induced by the Shutdown of Nuclear Power Plants: The Case of the Tennessee Valley Authority (TVA) in the 1980s”

When environmental regulations focus on a subset of power plants, the ultimate goal of human health protection may not be reached. Because power plants are interconnected through the electrical grid, excessive scrutiny of a group of facilities may generate more pollution out of another group, with potential deleterious effects to public health. I study the impact of the shutdown of nuclear power plants in the Tennessee Valley Authority (TVA) in the 1980s, on health outcomes at birth. After the Three Mile Island accident in 1979, the Nuclear Regulatory Commission (NRC) intensifies inspections in nuclear facilities leading to the shutdown of many of them, including Browns Ferry and Sequoyah in the TVA area. I first show that, in response to the shutdown, electricity generation shifts one-for-one to coal-fired power plants within TVA, increasing air pollution in counties where they are located. Second, I find that babies born after the shutdown have both lower birth weight and lower gestational age in the counties most affected by the shutdown. Third, I highlight the presence of substantial heterogeneity in those effects depending on how much more electricity those coal-powered facilities are

generating in response to the shutdown. Lastly, I use the heterogeneity in response to the shutdown to provide suggestive evidence on the "safe" threshold of exposure to total suspended particles (TSP), which may help the Environmental Protection Agency (EPA) to set the National Ambient Air Quality Standards (NAAQS) for particulate matters (PM). It may also help regulators to incentivize power companies to respond optimally to unexpected energy shortages.

“Canary in a Coal Mine: Impact of Mid-20th Century Air Pollution Induced by Coal-Fired Power Generation on Infant Mortality and Property Values”, joint with Karen Clay (CMU) and Joshua Lewis (University of Montreal)

This paper studies the local impact of air pollution on infant mortality and housing prices. The empirical analysis relies on the historical expansion in fossil fuel electricity generation from 1938 to 1962, the leading source of domestic coal consumption by the mid-20th century. Combining newly digitized information on plant-level coal consumption with county-level air quality measures and infant mortality rates, we find that increases in coal consumption are associated with higher concentrations of total suspended particulates (TSPs) and increases in infant mortality. Our estimates suggest that the rise in power plant emissions was responsible for an additional 9,486 infant deaths over the sample period. We examine whether these health costs were capitalized into housing values. Although estimates of the average marginal willingness to pay for clean air are close to zero, there appears to be significant heterogeneity in the housing market response. At low levels of baseline electricity access, thermal power plants are considered an amenity by local residents. As access to electricity expands, the pollution costs overwhelm the benefits of energy production, and the relationship between thermal emissions and housing prices reverses. These results highlight a challenge for current energy policy in the developing world: Given the longevity of electricity generation infrastructure, policymakers must take into account both current and future preferences for thermal power when making investment decisions.

“The Value of Rural Electricity: Evidence from the Rollout of the U.S. Power Grid”, joint with Joshua Lewis (University of Montreal)

This paper exploits the historical rollout of the U.S. power grid between 1930 and 1960 to study the impact of rural electrification on local economies. We find that rural electrification led to large gains in agricultural employment and farm population. These gains were offset by contractions in urban industries, as increased demand for rural land drove up local housing costs and crowded-out non-agricultural sectors. The growth in the rural sector was due both to advances in agricultural productivity and improvements in housing quality. Applying a standard Rosen-Roback style model to our reduced form estimates, we derive estimates of the implied value of electricity for agricultural productivity, and the amenity value of residential electricity access. We find that farm access to electricity raised productivity by over 40%, and that families were willing to

forgo 28% of annual income to live in an electrified home. The results suggest that the benefits of rural electrification far exceeded the historical costs of extending the grid, and imply that there is large scope to expand rural access in the developing world today.

“Pollution, Infectious Disease, and Infant Mortality: Evidence from the 1918-1919 Spanish Influenza Pandemic”, joint with Karen Clay (CMU) and Joshua Lewis (University of Montreal)

Urban outdoor air pollution is responsible for 1.3 million premature deaths annually (WHO, 2009). In addition to these direct effects, poor air quality may also be harmful to the immune system, lowering underlying health, and leaving individuals more susceptible to the consequences of a negative health shock. In this study, we use newly digitized data from 559 U.S. cities over the period 1915-1925 to examine the effects of pollution, influenza, and pollution interacted with influenza on infant mortality. In time series regressions, the coefficient on the interaction of pollution and influenza on infant mortality is positive and statistically significant. We evaluate the impact of the pandemic on infant mortality in two counterfactual scenarios. First, consider a decline in average capacity within 30 miles of 100mw. This scenario would result in 600 infant lives saved, which is a 5.5 percent decline in pandemic related mortality. Second, consider a decline in all above median cities to median levels of capacity. This scenario would result in 1332 infant lives saved, which is a 12.2 percent decline in pandemic related mortality.

“Who to Marry and Where to Live: Estimating a Collective Marriage Market Model”

I study the joint choice of spouse and location made by individuals at the start of their adult lives in the U.S. I assume that potential spouses meet in a marriage market and decide who to marry and where they will live, taking account of varying economic opportunities in different locations and inherent preferences for living near the families of both spouses. I develop a theoretical framework that incorporates a collective model of household allocation, conditional on the choice of spouse and location, with a forward-looking model of the marriage market that allows for the potential inability of spouses to commit to a particular intra-household sharing rule. Estimation results for young dual-career households in the 2000 Census point to three main findings. First, I find excess sensitivity of the sharing rule that governs the allocation of resources among couples to the conditions in the location they actually choose, implying that spouses cannot fully commit to a sharing rule. Second, I show that the lack of commitment has a relatively larger effect on the share of family resources received by women. Third, I find that the failure of full commitment can explain nearly all of the gap in the intra-state migration rates of single and married people in the U.S.

RESEARCH IN PROGRESS

“The Effects of the Clean Air Act on Productivity in the Electricity Industry: Evidence from the U.S. 1938-1993”, joint with Karen Clay (CMU) and Joshua Lewis (University of Montreal)

The costs of environmental regulations have been widely debated in the U.S. since the passage of the Clean Air and Water Acts beginning in the 1960s. Using data from 1972-1993, a recent paper by Greenstone, List and Syverson (2012) showed large productivity losses in manufacturing from air quality regulations. The authors’ paper also highlighted the need for data spanning longer time periods, since it was impossible to follow plants during a significant portion of the period of regulatory change. This study provides new evidence on the effects of regulation by digitizing and analyzing data on steam power electricity plants covering the period 1938-1993. Federal Power Commission data begins in 1938. Data in the Federal Power Commission Reports is very detailed and so will allow analysis of the effects of regulation on steam power plants that burn coal, natural gas, and oil. By following specific plants over time, one can observe fuel switching by existing plants, fuel choices by new plants, and changes in output resulting from regulation-induced technological modifications. These are relevant for understanding productivity losses in electricity generation in developing countries that are beginning to implement or strengthen enforcement of air quality regulations.

“Climate Penalty on Ozone”, joint with Antonio Bento (Cornell University)

It is well documented in the literature that most of the remarkable reductions in criteria pollutants in the U.S. since the 1970s is primarily attributed to the Clean Air Act (CAA). Recently, there is an increasing concern that most of this achievement can be undone, as climate change – whether measured by increased mean temperature, precipitation, or extreme events – can bring some areas that have experienced major improvements out of attainment with CAA federal standards. For example, atmospheric scientists have shown that ozone is formed by a sunlight-aided reaction of volatile organic compounds with nitrogen oxides, and is created more quickly at higher temperatures. In this study, we investigate the causal effect of temperature and precipitation on ozone concentration at the county level, as well as the interaction between those climate variables and CAA attainment/non-attainment status (A/NAS). The A/NAS might be a sufficient statistic for changes in stationary and non-stationary sources of pollution over time. Our longitudinal analysis approach uses data since the 1980s. Our goal is to use that causal effect to (i) predict the impact of climate change on ozone concentration in the next decades, and assess the concern that climate change might revert the improvement in air quality associated with the CAA, and (ii) recover the cost of additional regulation that may be needed to offset the effect of climate change.

“Linking Housing and Automobile Purchase Decisions: Do Housing Supply Regulations Promote Green Cities?”, joint with Antonio Bento (Cornell University) and Joel Landry (Pennsylvania State University)

In the United States, households devote nearly a quarter of after-tax income on just two durable goods: housing and automobiles. In turn, consumption of these goods accounts for 45% of the greenhouse gas emissions, and several other unpriced externalities, such as congestion and local air pollution. In principle, policies aimed at regulating each of these markets will have feedback effects. For example, regulation of housing markets should impact households’ disposable income, which would alter the automobiles households select and how much they decide to use them. In this study, we examine the effects of housing supply regulations on the resulting vehicle composition, fuel economy, and vehicle miles traveled. We use a comprehensive dataset spanning 1990 to 2010. The core of this dataset is the Nationwide Personal Transportation Survey (NPTS) for 1990 and the National Household Transportation Surveys (NHTS) for 2001 and 2009 that has been carefully merged with automobile attribute data from the Ward’s Automotive Yearbooks and Automobile-Catalog.com.

“Energy Mix and Political Affiliation: Evidence from U.S. States Since 1960”, joint with Karam Kang (CMU)

The two major political parties in the U.S. appear to take opposite views on energy and environmental policies, such as whether CO₂ emissions should be regulated under the Clean Air Act. We intend to investigate the historical relationship between the energy mix and the political environment related to party affiliation of state government in continental U.S. If we find that a specific political environment affects the role of fossil fuel in the energy mix, measured in terms of share of fossil-fuel installed capacity and electricity generation, we question how this impacts the distribution of emissions across the nation. Further, we study how political environment affects the decisions of firms regarding where to open a new plant or expand existing ones.

“A Note on the Trade-off between Ecosystem Preservation and Air Quality: Evidence from Hydroelectric Licensing Rules”

Do environmental regulations aimed at preserving natural ecosystems really protect the environment? The answer seems to be not really. I present suggestive evidence that, while hydroelectric licensing rules conserve the wilderness and wildlife by restricting the development of hydro projects, they lead to more greenhouse gas emissions. Basically, land conservation regulations give rise to a replacement of hydropower, which is a renewable, non-emitting source of energy, with conventional fossil-fuel power, which is highly polluting. I find that, on average, each megawatt of hydropower that is not developed because of these regulations induces the same amount of carbon dioxide that a U.S. coal-fired plant would emit in producing a megawatt of electricity. Environmental

regulations focusing only on the preservation of ecosystems appear to encourage electric utilities to substitute dirtier fuels for electricity generation.

FELLOWSHIPS, GRANTS, AND AWARDS

2014	Berkman Faculty Development Fund (\$5,180)
2014	Carnegie Mellon Electricity Industry Center (with Karen Clay, \$10K)
2011, 2012	Graduate Division Summer Grant, UC Berkeley
2010-2011	Dean's Normative Time Fellowship, UC Berkeley
2009	Outstanding Graduate Student Instructor Award, UC Berkeley
2007-2008	Departmental Fellowship, UC Berkeley
2005-2007	CAPES Graduate Fellowship, PUC-Rio

TEACHING

Instructor, Heinz College, Carnegie Mellon University

Cost-Benefit Analysis (Fall 2013, Spring 2014, Fall 2014)
Urban Economics (Spring 2014, Fall 2014)

Teaching Assistant, Ewing Marion Kauffman Foundation

Longitudinal and Survival Analysis of Business Data: A Two-Day Training Using the Kauffman Firm Survey
San Francisco (May 2011), San Antonio (Aug. 2011), Washington DC (Nov. 2011), Chicago (Jan. 2012), Boston (Aug. 2012)

Teaching Assistant, Department of Economics, UC Berkeley

Graduate Econometrics (Fall 2009, Spring 2010, Fall 2012, Spring 2013)
Introduction to Econometrics (Summer/Fall 2008, Spring/Summer 2009, Spring 2012)

Teaching Assistant, Department of Economics, PUC-Rio

Graduate Econometrics (Spring/Fall 2006)

SELECTED PRESENTATIONS

2015 ASSA Meetings in Boston, University of Chicago - EPIC, UCLA, University of Illinois at Urbana-Champaign, Annual Meeting of the Population Association of America

2014 ASSA Meetings in Philadelphia, University of California at Berkeley - Labor Lunch, Carnegie Mellon University, Cornell University, University of Montreal, University of

Pittsburgh, 61st Annual North American Meetings of the Regional Science Association International, 36th Annual Meeting of the Brazilian Econometric Society, 2nd Economics of Low-Carbon Markets Workshop at the University of São Paulo (Ribeirão Preto)

2013 Carnegie Mellon University, London School of Economics, NBER Summer Institute - Development of the American Economy (DAE), Toulouse School of Economics, George Washington University, Case Western Reserve University, University of Calgary, 8th Meeting of the Urban Economics Association, World Bank, Inter-American Development Bank, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Getulio Vargas Foundation (EPGE), 35th Annual Meeting of the Brazilian Econometric Society, Cornerstone Research

2012 University of California at Berkeley

OTHER PROFESSIONAL ACTIVITIES

Referee for Journal of Economic History, Journal of Public Economics, and Economic Inquiry

OTHER INFORMATION

Affiliations: American Economic Association, Association of Environmental and Resources Economists, Economic History Association, Population Association of America

Languages: English (fluent), Portuguese (native), Spanish (intermediate)

Citizenship: Brazil (H-1B visa)