Syllabus
Spring 2020

Department of Urban Studies and Planning
Massachusetts Institute of Technology

11.113/11.413
The Economic Approach to Cities and Environmental Sustainability

Level: Undergraduate (11.113)/ Graduate (11.413)
Units: 12 (3-0-9)
Class meeting time and place: 9 am -12 noon, Friday; Classroom 9-354
     Recitation: 2-3:30 pm, Friday, 09-554
Instructor: Prof. Siqi Zheng
             9-323, sqzheng@mit.edu, http://siqizheng.mit.edu
Teaching Assistant: Juan Palacios (jpalacio@mit.edu), 9-333
Pre-requisite: Basic statistics
               11.113 Prerequisite: 14.30 or 1.010 or 18.650[J] or permission of instructor
               11.413 Prerequisite: 11.220 or 14.300 or permission of instructor

Course Description and Objectives

Understanding the relationship between urban development and environmental quality is no mere academic exercise. Today, 55% of the world’s population lives in urban areas, a proportion that is expected to increase to 68% by 2050 (United Nations, 2018). Urban development is a dynamic process. Millions of individual firms and households, as well as local governments, make their daily choices in cities. The future of urban environmental quality depends on how policy, decision making and planning evolves in conjunction with protecting and enhancing our natural environment.

The course is designed for students who wish to gain deeper insights into the tension and synergy between urban development and the environment from a global perspective; and at the same time, to enhance their analytical reasoning and quantitative skills to assist evidence-based study and policy design evaluation in this field. It aims to guide and explore the causes and consequences of urban environmental quality dynamics, and provide econometric tools to quantify such relationships: (1) How does urban development, along multiple dimensions, impact environment sustainability; (2) How does environmental quality influence individuals’ quality of life, their choices, and cities’ growth potential.

The course will provide students with a systematic framework of the interplay (both tension and synergy) between urbanization and environmental sustainability, and introduce them to the most pressing environmental challenges accompanied with urban development worldwide. The
course will familiarize students with the state-of-the-art research in this field, by introducing empirical studies from both developing and developed countries (with fast urbanization highlighted). This international perspective will help to cultivate a context-specific analytical mindset and facilitate comparative studies between countries, cities and urbanization stages.

In this learning process, students will improve their skills in several aspects: (1) Critical and economic thinking: framing right questions, weighing the tradeoffs, linking incentives and behaviors; (2) Econometric approaches: data analytics, statistical programming, and basic and modern econometric methods for identification and causal inference; (3) A quantitative economic approach for urban and environmental policy evaluation in gauging the intended and unintended consequences, which will expand students’ policy evaluation toolkits and complement other approaches.

Finally, the course will benefit from the talks of experts in the area of sustainability and climate change. The talks will provide students with the latest insights in the field from research, policy and practice. This year, the guest speakers are:

- Eriz Yoeli (director of the Applied Cooperation Team, MIT’s Sloan School of Management). Eriz collaborates with governments, nonprofits, and companies to apply the lessons of this research towards addressing real-world challenges like increasing energy conservation, improving antibiotic adherence, reducing smoking in public places, and promoting philanthropy. Eriz will provide a fantastic lecture on nudging in the area of sustainability.

- Nils Kok (Maastricht University and Geophy), a leading researcher in the area of green buildings and sustainable finance. Nils Kok is Chief Economist at GeoPhy, the leading provider of automated valuations for the real estate sector, combining advanced research and reporting tools with a database that currently covers over 100 million buildings across 50 countries. Previously, Nils was the founder and CEO of Global Real Estate Sustainability Benchmark (GRESB), a global ESG rating company for real estate and infrastructure investments. Nils will give an exciting lecture about green building and CO2 emissions in the real estate sector.

- Chris Pyke (Georgetown University, and USGBC). Chris has a great experience in the industry, including his past job as a lead author for the United Nations Intergovernmental Panel on Climate Change (Working Group III), chair of the US EPA Chesapeake Bay Program Scientific and Technical Advisory Committee, and co-chair of the U.S. Climate Change Science Program Interagency Working Group on Human Contributions and Responses to Climate Change. Chris will give an inspiring talk about climate resilience in modern cities and real estate markets.
Course structure and schedule

Course structure design

This course has eight sections:

(1) Overview (1 weeks)

(2) Environmental Quality in the Urban Context (1 week)

(3) Urban Households and the Environment (2 weeks)
   1. Energy consumption, energy gap, and green nudge
   2. Green buildings, CO2 emissions, and real estate markets

(4) Urban Transportation and the Environment (2 weeks)
   1. Command-and-control policies (driving restriction, least emission zone)
   2. Market-based policies (road pricing, subsidy and tax)
   3. Subway and air pollution

(5) Urban Form and the Environment (2 weeks)
   1. Urban spatial structure and environmental impacts
   2. Suburbanization: causes and consequences

(6) Urban Production and the Environment (2 weeks)
   1. Energy prices, externalities and pollution heaven
   2. Environmental justice, regulation and monitoring

(7) Economics of Climate Change (1 week)
   1. Social cost of carbon emission
   2. Urban economic approach to climate change
   3. Discounting climate damages

(8) Political Economy of Cities and the Environment (1 week)
Each section comprises two basic parts:

(1) A comprehensive overview of the theoretical framework and research trajectory of the key environmental issues on that specific subtopic. These will be presented with peer-reviewed studies worldwide as references.

(2) An empirical economic approach including Ordinary Least Squares (OLS) Randomized Controlled Trail (RCT), Propensity Score Matching (PSM), Regression Discontinuity Design (RDD), Difference-in-Differences (DID), Instrumental Variable (IV), etc. Application-oriented illustration of how to use such tools in real-world urban and environmental context will be provided through an in-depth analysis of one or two empirical papers.

Instead of focusing on the mathematical and technical details of these empirical economic approaches, the course will introduce the experimental and quasi-experimental methods through an application-oriented means. Through learning empirical methods with exemplary literature and by practicing the use of statistical software (i.e. R/STATA), students will be ready to embark on their own independent research with the applicability, limitation, and estimation methods of those empirical tools.
Course schedule

Section I. Overview

Week #1

- Course overview
  - Introduction: tension and synergy between urbanization and the environment
  - Course structure and features
  - Story-telling approach: “driving restriction in Mexico City”

- Empirical cases and econometric skills
  - Causality and correlation: empirical economics toolkit
    - Fundamental problem of causal inference
    - Method overview: OLS, RCT, PSM, IV, RD, DID
  - In-depth analysis of empirical studies

Section II. Environmental Quality in the Urban Context

Week #2

- Overall framework and key mechanisms
  - Tension between urbanization, economic development and environmental degradation
    - Environmental Kuznets Curve (EKC)
    - Linking three dimensions of urban development with EKC: population growth, income growth and spatial growth
  - Environmental Valuation Approaches
    - Basic rationale of cost benefit analysis
    - Environmental valuation I: stated preference
    - Environmental valuation II: revealed preference (Hedonic property valuation)

- Empirical cases and econometric skills
  - Regression model, OLS estimator and Fixed Effects
  - In-depth analysis of empirical studies
Section II. Urban Households and the Environment

Week #3

- Overall framework and key mechanisms
  - Determinants of household energy consumption
  - Energy efficiency gap
  - Information based intervention: label and certificate, social norm, risk alert
- Empirical cases and econometric skills
  - Econometric skill: Randomized Controlled Trail (RCT)
  - In-depth analysis of empirical studies


- Guest Lecture: “The Green Nudge” by Erez Yoeli (Sloan, MIT)

Week #4

- Overall framework and key mechanisms
  - Technology: energy efficiency in the real estate sector
  - Label and certificate (continued)
- Empirical cases and econometric skills
  - Econometric skill: Propensity Score Matching (PSM)
  - In-depth analysis of empirical studies


- Guest lecture: “Green buildings, CO2 emissions, and real estate markets” by Nils Kok (Maastricht University, and Geophy)

Section III. Urban Transportation and the Environment

Week #5

- Overall framework and key mechanisms
  - Overview: Common environmental policy instruments in transportation sector
  - Command and Control (CAC) policies
    - Driving restriction and others
o Economic Incentive Policy (EI)
   ▪ Road pricing

• Empirical cases and econometric skills
  o Regression Discontinuity Design (RDD)
  o In-depth analysis of empirical studies

Week #6

• Overall framework and key mechanisms
  o Command and Control (CAC) policies
    ▪ Least emission zone (LEZ)
  o Economic Incentive Policy (EI)
    ▪ Vehicle based tax; Road pricing; Gasoline/ fuel tax (emission-based taxes); Green vehicle subsidy/ rebate
  o Public transit: subway and pollution

• Empirical cases and econometric skills
  o Difference-in-Difference (DID) estimator
  o In-depth analysis of empirical studies

**Section IV. Urban Form and the Environment**

Week #7

• Overall framework and key mechanisms
  o Urban spatial structure: urban form measures and urban sprawl
  o Monocentric city model (AMM)
  o Impacts of urban form on travel behaviors
• Empirical cases and econometric skills
  o Discrete choice model (DCM)
  o In-depth analysis of empirical studies


Week #8
• Overall framework and key mechanisms
  o Causes of suburbanization
  o Consequences of suburbanization
• Empirical cases and econometric skills
  o Instrumental Variables (IV)
  o In-depth analysis of empirical studies


Section V. Urban Production and the Environment

Week #9
• Overall framework and key mechanisms
  o Energy prices and economic damage of energy production
  o Pollution externalities
    ▪ Pollution, morbidity and mortality
    ▪ Pollution and labor markets
    ▪ Labor migration (brain drain), supply and productivity
  o Pollution Haven Hypothesis and environmental regulation
  o Environmental policy and innovation
• Empirical cases and econometric skills
  o Review econometric skills
  o In-depth analysis of empirical studies


Week #10

- Overall framework and key mechanisms
  - Environmental justice
    - The economic approach to environmental justice
    - Measures and models
    - Urban economic approach to air pollution: Tibout sorting model
  - Regulation of air pollutants
    - Trading versus taxes
    - Differentiation vs uniform regulation
  - Enforcement of air pollution regulation
    - Inspection strategies: Random vs. differentiated inspections. The value of inside information
    - Air pollution monitoring and weak institutions
- Empirical cases and econometric skills
  - In-depth analysis of empirical studies: IV using meteorological instruments


Section VII. Economics of Climate Change

Week #11

- Overall framework and key mechanisms
  - Impacts of Climate change
  - Urban economics model of climate adaptation
    - Static location and investment problem
    - Lucas Critique for reduced form cost forecast
    - Modification: dynamic and endogenous change
  - Discounting future damages of climate change
Empirical evidence of climate adaptation: air conditioning, migration, insurance and alert

- Empirical cases and econometric skills
  - In-depth analysis of empirical studies

- Guest lecture “Climate Resilient Urban Development” by Chris Pyke (Georgetown, ArcSkoru)

**Section VIII. Political Economy of Cities and the Environment**

Week #12

- Overall framework and key mechanisms
  - Promotion/election incentive and environmental regulation effort
  - Political competition and strategic behaviors (race to the bottom)
  - Environmentalist and environmental NGOs

- Empirical cases and econometric skills
  - Building valid proxy for unobserved characteristics
  - In-depth analysis of empirical studies

Week #13

Last class: Individual research project presentation
Grading

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<th>Proportion</th>
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<tbody>
<tr>
<td>Class active participation</td>
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<tr>
<td>#1 Class participation</td>
<td>15%</td>
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<tr>
<td>#2 In class student presentation</td>
<td>15%</td>
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<tr>
<td>Assignments</td>
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<tr>
<td>#1 Research replication practice (both graduate students and undergraduate students)</td>
<td>40%</td>
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<td>#2 Referee report for working paper/ Research proposal (graduate students)</td>
<td>30%</td>
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<tr>
<td>Two problem sets (undergraduate students)</td>
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<td>Sum</td>
<td>100%</td>
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Assignment

Our assignment consists of two parts:

1) Both graduates and undergrads: research replication practice (40%),
2) Graduates: referee report for unpublished working papers or research proposal (30%);
   Undergrads: two problem sets (30%).

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<thead>
<tr>
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<th>Empirical methods</th>
<th>Due date</th>
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<tbody>
<tr>
<td>#1 Two research replication exercises</td>
<td>Required: OLS (cross-sectional) or panel FE/RE</td>
<td>One of the other covered methods (IV, PSM, DID, RDD, Logit)</td>
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<td>#2 Referee report/Research proposal (graduate students)</td>
<td>Complete a referee report for a working paper OR research proposal on one of the covered topics (graduate students)</td>
<td>Complete two problem sets (undergraduate students)</td>
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<td>Two problem sets (undergraduate students)</td>
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#1 Two research replication exercises

Students need to replicate TWO existing empirical scholarly articles with R codes and data provided while applying some estimation methods covered in this course. The replication of a paper that uses OLS or panel FE/RE analysis is required. For the second replication exercise, students may choose a paper that employs one of the methods covered in this course, including IV, PSM, DID, RDD, and Logit. They need to go through the whole procedure of selected...
research, lay out the rationale of using specific methods to solve that particular problem, reproduce Tables and Figures of that paper, and make a brief analysis of the validity of methods and results. This practice intends to train students to go through the complete research process, and learn using statistical software in practice.

#2 Graduate Students - Research Proposal/Referee report for unpublished working papers

As an individual research project, students have two options:

(1) Research proposal
A clear, concise research proposal with the background, potential data source, selected empirical economic method, expected results, etc. Students need to identify the key components of a research proposal. The proposal will be evaluated on student’s demonstrated scientific originality, logical consistency, methods, and writing skills.

(2) Referee report for unpublished working papers
Students should select one unpublished working paper to complete 1 referee report with 2-line spacing, 12 pt. fonts, based on APA Style. The reports should summarize and assess the contribution of the article, and provide critical and/or constructive comments to improve the paper and analysis. They should make a recommendation as to whether a revised version of the article would be suitable for publication in a top journal (such as the American Economic Review), or alternatively a good field journal (such as the Journal of Environmental Economics and Management); or whether it should be rejected, just like what a referee would do. Students’ referee reports will be evaluated based on how helpful their comments/feedback are. Some useful resources regarding preparing a referee report:

- A template of a referee report provided by NBER: https://users.nber.org/~nikolovp/studentresources/refreport.pdf

This practice will train students to have a deeper understanding of a specific research sub-field in urban and environmental economics, review the application and limitation of each empirical method, and enhance their ability of critical analysis.

Suggestions regarding how to find an article: check out websites of researchers working in the relevant area; NBER working papers; or recent conferences in the field, such as the AERE conferences, NBER Summer Institute, etc.; or Social Science Research Network (https://www.ssrn.com/en/).
#3 Undergraduate Students – Two problem sets

*(will be uploaded to the Stellar website)*