ECON 425 Energy Economics

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Course meetings: Tyler Hall Rm 121, MW 1400 – 1520
Office hours: Friday 1000 – 1100, and MW by appointment

1. Course overview

Energy is critically important to the modern global economy. This course examines energy markets including markets for oil, refined petroleum products, natural gas, electricity and renewable energies. We study supply, demand, and efficiency in energy markets as how energy markets interact with the rest of the economy. We will also examine why energy markets have historically been subject to extensive government intervention.

This course is designed for economics major interested in a quantitative and theoretical approach to energy economics and policy. As such, **econometrics** and **intermediate microeconomic theory** are prerequisites for the course. The course will derive demand functions and specify production technologies based on microeconomic foundations, and estimate these based on time series data. We will study some of the econometric issues that arise in the specification and estimation of a production function to understand the relationship between energy consumption and economic growth and learn how to address these issues using time series methods. We will also examine the organization of energy industries and how market structure may raise important regulatory issues.

The purpose of this course is to use computational and applied mathematics and statistical methods to develop research in energy economics. The course will help students develop econometric and time series methods as well as computational optimization and simulation based methods applied to the study of energy markets and policy.

This class serves three important purposes. First, it provides an introduction to the study of economic behavior in energy markets and policy and will help you to develop your ability to apply the tools of economic analysis to energy issues. Second, it provides an introduction to **applied statistical methods** in econometrics and time series analysis. Third, it provides an introduction to **optimization and simulation methods** in microeconomics for the analysis of energy markets and issues. Finally, it emphasizes writing about and communicating quantitative results to readers who may lack quantitative training. To serve those ends, in this class you will develop quantitative skills by actually practicing them.

2. Assignments and grading

2.1. Grading

I will calculate course grades based on the following items. You need to complete all items to receive course credit. Students not completing all items will receive an Incomplete.

Percent	Item
40	Homework assignments
60	Final paper

In general, I will base grades on the following percentage scale with partial-percents typically rounded to the nearest full percent: A=93-100; A-=90-92; B+=88-89; B=83-87; B-=80-82; C+=78-79; C=73-77; C-=70-72; D+=68-69; D=63-67; D-=60-62; F<60.

In a class such as this, any grade below a "B" on any assignment, exam, or paper suggests that a student is having trouble grasping basic course ideas, which are essential building blocks for future courses and the work world. Please talk with me if you find yourself having difficulty.

Finally, because errors sometimes creep into grade calculations (and on rare occasions assignments are misplaced after they have been handed in) please keep a copy of all work submitted for this course until final grades have been processed.

2.2. Homework assignments

These assignments will focus on real life policy questions. It is crucial that you complete these assignments on time. Grading will stress two things: (1) the degree to which you have made a strong effort to complete all parts of each assignment; and (2) the extent to which your work, especially the statistical computing component and the writing component, is polished and professionally done.

The homework assignments will provide you with a way to critically evaluate and test predictions made by economic theory by looking to bridge applied econometrics and microeconomic theory.

2.3. Final Paper

The course's capstone paper will provide you an opportunity to use your quantitative skills in an area that you choose. I will make some data sets available but you may also use data from another source. More details about the paper will be forthcoming.

3. COLL 400

This course is designed as a COLL 400 course. The COLL 400 capstone experience will require students to take initiative in synthesis and critical analysis, to solve problems in an applied and/or academic setting, to create original material or original scholarship, and to communicate effectively with a diversity of audiences.

Assignments in the course specifically encourage synthesis and critical analysis

The applied methods used in this course in the 5 homework assignments and in the independent, capstone project developed by the student encourage a critical analysis of economic theory by requiring the student to examine the behavioral implications of economic theory and test the predictions of these theory using real data.

Assignments involve solving problems in an applied and academic setting, and creating original material or original scholarship

The applied econometric methods used in this course to study energy markets have very natural extensions in a number of different ways. In academic journals, the methods and approaches to economic analysis that we will cover in this class and that have seen their foundations in econometrics have lead to a wealth of research that has examined the relationship between energy and economic performance in different cities and states in the United States and in different countries and regions around the world. In addition, these studies can and have focused on understanding the relationship between energy and economic performance in specific industries and looking at specific forms of energy, on looking to spillovers between regions and between different industries, and on finding new ways to identify economic relationships in the data.

These methods are introduced and studied in the context of 5 homework assignments and culminate in the development of independent student research based on publicly available data from the Department of Energy, the International Energy Agency, the Bureau of Labor Statistics, the Census Bureau, the Bureau of Economic Analysis, the World Bank, and the OECD among other sources.

Communicating effectively to disparate audiences

Students will have to learn to communicate technical information to a non-technical audience. This will require effectively communicating information in a way that is technically complete but accessible to the general public.

The capstone project for the course will require the students to develop an academic research paper that is suitable for submission to a peer-reviewed journal, an op-ed piece that summarizes their work and a blog with five entries highlighting progress on the research. Students will also present their methods and analysis and provide constructive feedback in the class room setting to other students on the independent research projects they develop.

4. Course Topics

We will adjust this schedule as needed. Any changes to assignment or exam due dates will provide you with more time, not less time, to complete the work. You'll notice that the reading assignments repeat for some days. That is intentional because re-reading certain pages in a new context will help to deepen your understanding of prior concepts while establishing new ones.

The first five weeks of the course is designed to help you to develop the skills needed to develop independent research in energy economics. The next five weeks is designed to introduce subject specific detail and help you in synthesizing and applying economic analysis to an energy market issue of your choosing. The final portion of the course is designed to provide you with support in the development and completion of your independent work.

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1. **Introduction and Course Overview**
2. **Consumer Theory**
    - 2.1. Energy Demand Analysis
3. **Producer Theory**
    - 3.1. Energy Production Technologies - Estimating Production Functions
    - 3.2. Profit Maximization
    - 3.3. Cost Minimization
    - 3.4. Electricity Markets and Regulation
4. **Energy Markets**
    - 4.1. Time Series Analysis
    - 4.2. Oil and Gas Prices
    - 4.3. Structural Breaks
5. **Energy and Economic Growth**
    - 5.1. The Kuznet's Curve
    - 5.2. Advanced Time Series Analysis
    - 5.3. VAR Models
6. **Project Evaluation**
    - 6.1. Benefit-Cost Analysis

Date	Topics	Assignments	Note
Wednesday, August 28, 2019	Introduction, course overview and tour of the blackboard course page		First Day of Class
Monday, September 2, 2019	Energy Demand Analysis - Consumer Theory		
Wednesday, September 4, 2019	Energy Demand Analysis - Introduction to Econometrics		
Monday, September 9, 2019	Behavior - Energy Demand Analysis - Habits and Persistence	A1	
Wednesday, September 11, 2019	Consumer Theory - Equivalent and Compensating Variation		
Monday, September 16, 2019	Consumer Theory - Constant Elasticity of Substitution		
Wednesday, September 18, 2019	Factor Analysis - Decomposition Analysis - Energy intensity		
Monday, September 23, 2019	Profit Maximization - estimating production functions	A2	
Wednesday, September 25, 2019	Cost Minimization		
Monday, September 30, 2019			The Jewish New Year
Wednesday, October 2, 2019	Electricity Markets - Monopoly Pricing and Regulation		
Monday, October 7, 2019	Electricity Markets - Regional Markets	A3	
Wednesday, October 9, 2019			Day of Atonement
Monday, October 14, 2019			Fall Break
Wednesday, October 16, 2019	Structural breaks in oil and gas markets		Classes resume from Fall Break
Monday, October 21, 2019			Shmini Atzeret
Wednesday, October 23, 2019	Asymmetric and Heterogeneous Price transmission in oil and gas markets		
Monday, October 28, 2019	Vector autoregression - estimation	A4	
Wednesday, October 30, 2019	Vector autoregression - identification and the choleski decomposition		
Monday, November 4, 2019	Impulse response functions - elasticities and marginal products		
Wednesday, November 6, 2019	Economic effects of energy consumption in Portugal		
Monday, November 11, 2019	Panel Data Analysis - panel unit roots	A5	
Wednesday, November 13, 2019	Panel Data Analysis - panel vars		
Monday, November 18, 2019	Energy Demand Analysis - Benefit Cost Analysis		
Wednesday, November 20, 2019	Benefit-cost analysis - Applications: fuel economy standards, solar panels		
Monday, November 25, 2019	VAR applications	A6	
Wednesday, November 27, 2019			Thanksgiving Break
Monday, December 2, 2019	VAR applications		Classes resume from Thanksgiving Break
Wednesday, December 4, 2019	VAR applications		