ECON 425 Energy Economics

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Course meetings: Tyler Hall Rm 121, MWF 1200 – 1250
Office hours: Friday 1300 – 1350, 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
Week 1	Wednesday, January 22, 2020	Introduction, Course Overview, Tour of the Blackboard Site		First Day of Class
	Friday, January 24, 2020	Energy basics, terminology and introduction to the energy system, energy balances and accounting		
	Monday, January 27, 2020	Energy Demand Analysis - Review of Consumer Theory		
Week 2	Wednesday, January 29, 2020	Energy Demand Analysis - Introduction to Econometrics: Estimation		
	Friday, January 31, 2020	Short run vs. long run elasticities of demand		
	Monday, February 3, 2020	**Fuel economy standards** and the rebound effect	A1 - Estimating Demand Functions	
Week 3	Wednesday, February 5, 2020	**Gasoline** taxation, prices and consumer welfare		
	Friday, February 7, 2020	**Carbon dioxide emissions** from fossil fuel combustion activities		
	Monday, February 10, 2020	Factor Analysis - Decomposition Analysis - Energy Intensity		
Week 4	Wednesday, February 12, 2020	Producer behavior - energy in the firms production technology		
	Friday, February 14, 2020	Estimating production functions: Hypothesis testing - the F-test		
	Monday, February 17, 2020	**Energy infrastructures: Oil and gas pipelines**	A2 - Estimating Production Functions	
Week 5	Wednesday, February 19, 2020	Introduction to time series models		
	Friday, February 21, 2020	The AR(1) model		
	Monday, February 24, 2020	Unit roots theory and testing		
Week 6	Wednesday, February 26, 2020	Granger Causality		
	Friday, February 28, 2020	Cointegration and the error correction model		
	Monday, March 2, 2020	Producer behavior - cost minimization - energy intensive industries	A3 - Time Series Analysis	
Week 7	Wednesday, March 4, 2020	Cost curves and natural monopolies		
	Friday, March 6, 2020	The structure of the **Electric Power Industry**		
	Monday, March 9, 2020			Spring Break
Week 8	Wednesday, March 11, 2020			Spring Break
	Friday, March 13, 2020			Spring Break
	Monday, March 16, 2020	**Electric Power** in Virginia		
Week 9	Wednesday, March 18, 2020	**Oil and gas markets**		
	Friday, March 20, 2020	The Organization of Petroleum Exporting Countries (OPEC)		
	Monday, March 23, 2020	Structural Breaks: deterministic breaks - t-test and chow tests		
Week 10	Wednesday, March 25, 2020	Structural Breaks: unknown break date		
	Friday, March 27, 2020	Threshold models and asymmetric policy responses - **wholesale and retail gasoline prices**		
	Monday, March 30, 2020	**Oil prices** and inflation	A4 - Structural Breaks	
Week 11	Wednesday, April 1, 2020	Vector autoregression - the model		
	Friday, April 3, 2020	Vector autoregression - estimation		
	Monday, April 6, 2020	Vector autoregression - identification and the choleski decomposition		
Week 12	Wednesday, April 8, 2020	Impulse response functions - elasticities and marginal products		
	Friday, April 10, 2020			Passover
	Monday, April 13, 2020	Economic effects of energy consumption in Portugal		
Week 13	Wednesday, April 15, 2020			Passover
	Friday, April 17, 2020	Vector autoregression - modeling process		
	Monday, April 20, 2020	Energy and economic performance	A5 - Vector Autoregression	
Week 14	Wednesday, April 22, 2020	Forecasting energy prices and energy demand		
	Friday, April 24, 2020	Forecasting with a VAR model		
	Monday, April 27, 2020	Benefit Cost Analysis - Hybrid cars	Data for Paper Due	
Week 15	Wednesday, April 29, 2020	Benefit Cost Analysis - Solar power		
	Friday, May 1, 2020			LDOC
	Thursday, May 7, 2020	Exam Block	Final Paper Due at noon	