ECON 425 Energy Economics

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Tyler Hall 337

Course meetings: Tyler Hall Rm 121, MWF 12:00 PM – 12:50 PM
Office hours: MW 11:00 AM – 11:50 AM, Friday 10:00 AM – 12:50 AM

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
20	Homework assignments
30	Midterm
50	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. Exams

We will have one midterm exam. The exam will ask you to perform calculations and will emphasize interpreting results.

2.4. 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

Week	Date	Topic	Reading
Week 1	Wednesday, January 16, 2019	Course Overview	
	Friday, January 18, 2019	Energy basics, terminology and introduction to the energy system, energy balances and accounting	
Week 2	Monday, January 21, 2019	MLK Holiday (No Class)	
	Wednesday, January 23, 2019	Energy Demand Analysis - Consumer Theory	Mathematical Programming, Optimization and GAMS
	Friday, January 25, 2019	Energy Demand Analysis - Introduction to Econometrics	Bhattacharya data
Week 3	Monday, January 28, 2019	Energy Demand Analysis - Habits and Persistence	✓ Alfredo M. Pereira & José M. Belbute, 2014. "Final Energy Demand in Portugal: How Persistent it is and Why it Matters for Environmental Policy," International Economic Journal, Taylor & Francis Journals, vol. 28(4), pages 661-677, December.
	Wednesday, January 30, 2019	Energy efficiency and the rebound effect	✓ Orea, Luis & Llorca, Manuel & Filippini, Massimo, 2015. "A new approach to measuring the rebound effect associated to energy efficiency improvements: An application to the US residential energy demand," Energy Economics, Elsevier, vol. 49(C), pages 599-609.
	Friday, February 1, 2019	Factor Analysis - Decomposition Analysis - Energy intensity	
Week 4	Monday, February 4, 2019	Profit Maximization - estimating production functions	Hill data and Greene data
	Wednesday, February 6, 2019	Cost Minimization - estimating cost functions	✓ Bjung-Joo Lee, "Separability Test for the Electricity Supply Industry", Journal of Applied Econometrics, Vol. 10, No. 1, 1995, pp. 49-60.
	Friday, February 8, 2019	Electricity Markets - Monopoly Pricing and Regulation	Welfare effects of tiered prices
Week 5	Monday, February 11, 2019	Electricity Markets - Generation and Scenarios	TIMES model and results
	Wednesday, February 13, 2019	Electricity Markets - Regional Markets	✓ Lee, Kangil & T. Melstrom, Richard. (2018). Evidence of increased electricity influx following the regional greenhouse gas initiative. Energy Economics. 76. 10.1016/j.eneco.2018.10.003.
	Friday, February 15, 2019	Oil and Gas Prices - Unit Roots	✓ Miljkovic, Dragan & Dalbec, Nathan & Zhang, Lei, 2016. "Estimating dynamics of US demand for major fossil fuels," Energy Economics, Elsevier, vol. 55(C), pages 284-291.
Week 6	Monday, February 18, 2019	Structural breaks in oil and gas markets	Greene data
	Wednesday, February 20, 2019	Oil Prices - What is a oil price shock and what are its consequences?	✓ Hamilton, James D., 2003. "What is an oil shock?," Journal of Econometrics, Elsevier, vol. 113(2), pages 363-398, April.
	Friday, February 22, 2019	Oil and Gas Prices - Unit Roots with a structural break	✓ Zivot, Eric & Andrews, Donald W K, 1992. "Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis," Journal of Business & Economic Statistics, American Statistical Association, vol. 10(3), pages 251-270, July.
Week 7	Monday, February 25, 2019	Asymmetric and Heterogeneous Price transmission in oil and gas markets	✓ Bumpass, Donald & Ginn, Vance & Tuttle, M.H., 2015. "Retail and wholesale gasoline price adjustments in response to oil price changes," Energy Economics, Elsevier, vol. 52(PA), pages 49-54.
	Wednesday, February 27, 2019	Kuznet's curve - cointegration and granger causality	✓ Martin Wagner, "The Environmental Kuznets Curve, Cointegration and Nonlinearity", Journal of Applied Econometrics, Vol. 30, No. 6, 2015, pp. 948-967.
	Friday, March 1, 2019	**Take home test 1 due**	
Week 8	Monday, March 4, 2019	Spring Break	
	Wednesday, March 6, 2019	Spring Break	
	Friday, March 8, 2019	Spring Break	

Week 9	Monday, March 11, 2019	Vector autoregression - estimation	
	Wednesday, March 13, 2019	Vector autoregression - identification and the choleski decomposition	
	Friday, March 15, 2019	Impulse response functions	✓ Lutz Kilian, 1998. "Small-Sample Confidence Intervals For Impulse Response Functions," The Review of Economics and Statistics, MIT Press, vol. 80(2), pages 218-230, May.
Week 10	Monday, March 18, 2019	Impulse response functions - elasticities and marginal products	
	Wednesday, March 20, 2019	Economic effects of energy consumption in Portugal	✓ Marvão Pereira, Alfredo & Marvão Pereira, Rui Manuel, 2010. "Is fuel-switching a no-regrets environmental policy? VAR evidence on carbon dioxide emissions, energy consumption and economic performance in Portugal," Energy Economics, Elsevier, vol. 32(1), pages 227-242, January.
	Friday, March 22, 2019	Panel Data Analysis - energy efficiency	✓ Baltagi, B.H. and J.M. Griffin (1983), Gasoline Demand in the OECD:An Application of Pooling and Testing Procedures,European Economic Review, 22, 117-137.
Week 11	Monday, March 25, 2019	Panel Data Analysis - panel unit roots	✓ Im, Kyung So, Pesaran, M and Shin, Yongcheol, (2003), Testing for unit roots in heterogeneous panels, Journal of Econometrics, 115, issue 1, p. 53-74.
	Wednesday, March 27, 2019	Panel Data Analysis - panel vars	✓ Ouyang, Yaofu & Li, Peng, 2018. "On the nexus of financial development, economic growth, and energy consumption in China: New perspective from a GMM panel VAR approach," Energy Economics, Elsevier, vol. 71(C), pages 238-252.
	Friday, March 29, 2019	VAR applications **Take Home Test 2 Due**	✓ Cesar Calderon, Enrique Moral-Benito, and Luis Serven, "Is Infrastructure Capital Productive? A Dynamic Heterogeneous Approach", Journal of Applied Econometrics, Vol. 30, No. 2, 2015, pp. 177-198.
Week 12	Monday, April 1, 2019	Energy Demand Analysis - Benefit Cost Analysis	
	Wednesday, April 3, 2019	Benefit-cost analysis - fuel economy standards	Fuel Economy vs Fuel Tax excel file
	Friday, April 5, 2019	Benefit-cost analysis - large scale projects	Clean Development Mechanism
Week 13	Monday, April 8, 2019	VAR applications	✓ Susana Silva & Isabel Soares & Carlos Pinho, 2012. "The Impact of Renewable Energy Sources on Economic Growth and CO2 Emissions - a SVAR approach," European Research Studies Journal, European Research Studies Journal, vol. 0(4), pages 133-144.
	Wednesday, April 10, 2019	VAR applications	✓ Salisu, Afees A. & Oloko, Tirimisiyu F., 2015. "Modeling oil price–US stock nexus: A VARMA–BEKK–AGARCH approach," Energy Economics, Elsevier, vol. 50(C), pages 1-12.
	Friday, April 12, 2019	VAR applications	✓ Lutz Kilian & Robert J. Vigfusson, 2011. "Are the responses of the U.S. economy asymmetric in energy price increases and decreases?," Quantitative Economics, Econometric Society, vol. 2(3), pages 419-453, November.
Week 14	Monday, April 15, 2019	VAR applications	✓ Alfredo Marvão Pereira & Rui Manuel Pereira, 2017. "On the Effects of Infrastructure Investments on Industrial CO2 Emissions in Portugal," GEE Papers 0081, Gabinete de Estratégia e Estudos, Ministério da Economia, revised Oct 2017.
	Wednesday, April 17, 2019	VAR applications	✓ Mohammadi, Hassan & Amin, Modhurima Dey, 2015. "Long-run relation and short-run dynamics in energy consumption–output relationship: International evidence from country panels with different growth rates," Energy Economics, Elsevier, vol. 52(PA), pages 118-126.
	Friday, April 19, 2019	Panel unit roots and structural breaks	✓ Apergis, Nicholas & Lau, Marco Chi Keung, 2015. "Structural breaks and electricity prices: Further evidence on the role of climate policy uncertainties in the Australian electricity market," Energy Economics, Elsevier, vol. 52(PA), pages 176-182.
Week 15	Monday, April 22, 2019		
	Wednesday, April 24, 2019		
	Friday, April 26, 2019		