

Zhen Zhu
C.H. Guernsey and Company
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EDUCATION:

Ph.D., Economics, University of Michigan, 1994
M.A., Economics, Bowling Green State University, 1987
B.A., Business Administration, People's University of China, 1985

EXPERIENCE RECORD:

2000-Present C. H. Guernsey & Company, Oklahoma City, Okla.

Dr. Zhu is an Economist specializing in the areas of cost of capital and cost of service analysis for electric and gas utilities. He has provided analyses and support in many public utility (both electric and gas) cost-of-capital cases and cost of service cases. He has been providing consulting services on behalf of the State Water Project of California (an Intervenor) in the Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric Transmission Formula rate cases. More recently, he has been involved with providing consulting services to the Duke Energy Progress rate case intervention for the US Army, among others. He has also presented cost of capital direct testimony and rebuttal testimony in the rate case of Dominion Energy South Carolina on behalf of the US Army, and cost of capital direct testimony in the Vermont Gas Systems rate case in 2021 on half of Vermont Department of Public Service.

Dr. Zhu also specialized in areas such as load forecasting, natural gas market analysis and modeling, gas price and underground storage forecasting, risk management and hedging strategy, financial analysis of merger potential, and other economic and statistical analyses. He has performed various studies regarding natural gas market risk management, price and volatility determination, market efficiency, and the analysis of gas pipelines. He has also performed numerous power price analyses, load analyses, weather normalization, and demand and energy forecasts for electric IOUs and cooperatives, evaluation of solar energy projects, corporate merger activities, stock market and foreign exchange market volatility, and financial market deregulation. Dr. Zhu has been instrumental in successfully modeling the storage injections and withdrawals from the U.S. natural gas reservoirs and the impact of these net supply changes on natural gas prices. Dr. Zhu and other Guernsey economists have received national recognition for successfully modeling the prices of natural gas in the physical market and at many trading hubs used in pricing natural gas in today's markets.

Dr. Zhu has testified in cases before several public service commissions regarding cost of capital, long-term demand and load forecasts, fuel price projections, and other issues.

Dr. Zhu is also Dr. Michael Metzger Endowed Chair and Professor of Economics at the University of Central Oklahoma.

Dr. Zhu teaches Master's level Energy Finance courses (Energy Valuation and Investment, Trading, and Risk Management) for the Mewbourne School of Petroleum and Geological Engineering and International Finance, Trade, and other courses for Advanced Programs at the University of Oklahoma.

SPECIFIC EXPERIENCE:**Natural Gas**

Dr. Zhu has developed and maintains natural gas futures contract pricing models and natural gas storage models. He has also developed and maintained natural gas pricing models for multiple delivery points for a large Texas-based electric distribution cooperative and several other cooperatives. Dr. Zhu devised hedging strategies for several utilities and has done extensive study of natural gas price and natural gas markets.

Cost of Capital

Dr. Zhu has provided testimony and support in many gas and electric utility cost of capital cases.

Dr. Zhu provided cost of capital testimony in the rate case of Vermont Gas Systems on behalf of Vermont Department of Public Service in 2021.

Dr. Zhu was a ROE expert on a rate case of Columbia Gas Transmission LLC on behalf of Ohio Consumers Counsel before FERC in 2021

Dr. Zhu also serves as a cost of capital consultant for Ohio Consumers Counsel on the Columbia Gas of Ohio rate case in 2022.

Dr. Zhu also serves as a cost of capital consultant for Ohio Consumers Counsel on the Eastern Gas Transmission and Storage rate case before FERC in 2022.

Dr. Zhu serves as a ROE expert in the rate case of Dominion Energy South Carolina, and submitted direct and rebuttal testimonies before the South Carolina Public Service Commission on behalf of the US Army and other Executive Agencies.

Dr. Zhu has assisted Department of Defense on Duke Energy Progress rate case in North Carolina on cost of capital and capital structure issues, DOCKET NO. E-2, SUB 1219, 2019-2020.

Dr. Zhu has assisted clients in Illinois on cases pending at FERC on ROE issues based on the new FERC ROE methodology.

Dr. Zhu has been providing consulting services, specifically related to capital structure and return on equity, to and on behalf of the State Water Project of California (an Intervenor) in the Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric Transmission Formula rate cases. Teaming with legal counsel, Dr. Zhu represents and negotiates on behalf of client at settlement conferences conducted at FERC in Washington DC.

Dr. Zhu testified on cost of capital on behalf of Michigan Attorney General's Office before Michigan Public Service Commission in the Matter of the Application of Indiana Michigan Power Company for authority to increase its rates in the sale of electricity energy and for approval of depreciation accrual rates and other related matters, Case No. U-18370, 2017.

In addition, Dr. Zhu has studied the connection of the U.S. economy and U.S. gas and electric utility return on equities, and the determination of the ROE. The studies have been published in trade, industrial, and academic journals.

Load Forecasting & Statistical Analysis, and other Financial and Economic Analysis

Dr. Zhu examined factors determining future fuel prices and loads, and then provided expert testimony services related to fuel prices and load forecasts for the following projects:

Dr. Zhu testified on energy and demand forecasts, and fuel price forecast issues before the Georgia Public Service Commission in Georgia Power Company's application for Approval of its 2007 Integrated Resource Plan, Docket No. 24505-U, 2007.

Dr. Zhu presented expert testimony before the Oklahoma Corporation Commission on fuel cost/pricing issues, providing rebuttal testimony before the Corporation Commission of the State of Oklahoma, in the Application of Blue Canyon Windpower II, LLC for establishment of purchased power rates and a purchase power contract with DUKE – Public Service Company of Oklahoma, pursuant to PURPA, Cause No. PUD 20030063, 2004.

Dr. Zhu presented expert testimony before the South Carolina Public Service Commission Docket No. 2008-196-E: "Combined Application of SCE&G for the Construction and Operation of a Nuclear Facility in Jenkinsville, S. Car." regarding load forecast and fuel forecast issues.

Dr. Zhu has performed numerous studies of financial markets and published extensively in financial economics, energy economics and other economics/finance fields.

Dr. Zhu studied the impact of government regulation on stock price volatilities using the event study methodology and the study was published in Journal of Financial Services Review and many other journals.

Dr. Zhu has used many time series models to study the financial prices including exchange rates, stock prices, and natural gas futures prices and so on. The studies have been published in many leading academic journals.

Other Consulting Experience

Dr. Zhu developed and maintained GUERNSEY's LDC, DisCo, and GenCo stock price indices, developed fuel cost and hedging strategies for utilities, and developed and maintains load forecast models.

Dr. Zhu has been involved in the inventory forecast system development, merger intervention projects for gas and electric utilities, integrated resource planning projects, survey design and statistical analysis, weather normalization studies and many others.

Previous Professional Experience:

Dr. Zhu has served as an Assistant Professor of Economics at The University of Oklahoma, a Research Fellow of Financial Research Institute at the University of Missouri, and as an Instructor and Teaching Assistant in the Department of Economics at the University of Michigan.

SELECTED RECENT PUBLICATIONS AND PROFESSIONAL PAPERS

Zhu, Zhen, with Scott Linn, 2022 (forthcoming), "The Hamada Beta Adjustment and the Cost of Capital for the Regulated Utilities," *Energy Forum*, International Association for Energy Economists.

Zhu, Zhen, with Sheng-Hung Chen and Song-Zan Chiou-Wei, 2021, "Stochastic Seasonality in Commodity Prices: The Case of U.S. Natural Gas", *Empirical Economics*.

Zhu, Zhen, with William Sutton. 2021, "Cost Savings in Areas with Unproven Reserves: Risk = Reward in Big Oil", *Energy Forum*, International Association for Energy Economists 2021 (1).

Zhu, Zhen, with Sheng-Hung Chen, Song-Zan Chiou-Wei, 2020. "Natural Gas Price, Market Fundamentals and Hedging Effectiveness", *Quarterly Review of Economics and Finance*.

Zhu, Zhen, with Sheng-Hung Chen, Song-Zan Chiou-Wei, 2019. "Energy and Agricultural Commodity Markets Interaction: An Analysis of Crude Oil, Natural Gas, Corn, Soybean, and Ethanol Prices." *The Energy Journal*, Volume 40, Number 2, pages 265-296.

Zhu, Zhen 2018. "Chinese Natural Gas Market: Huge but Beset with Difficulties." *Natural Gas and Electricity*, July 2018, Volume 34, Number 12, pp. 1-7.

- Zhu, Zhen, with Yue Wang. 2018. "Cost of Natural Gas in Eastern Chinese Markets: Implications for LNG Imports," *Energy Forum*, International Association for Energy Economists, 2018:3, pp. 13-20.
- Zhu, Zhen, with Kuang-Chung Hsu, Michael Wright. 2017. "What motivates merger and acquisition activities in the upstream oil & gas sectors in the U.S.?" *Energy Economics*, pp. 240-250.
- Zhu, Zhen, with Song Zan Chiou-Wei. 2016. "Controlling for Relevant Variables: Energy Consumption and Economic Growth," *Energy*, Vol. 109, 391-399, 2016.
- Zhu, Zhen, with Song Zan Chiou-Wei. 2015. "A Meta-Analysis of the Energy Consumption-Economic Growth Nexus," *International Journal of Economics and Social Sciences*, 2015.
- Zhu, Zhen, with Song Zan Chiou-Wei, and Fanbei Zhou. 2014. "Forecasting Natural Gas Consumption: China and Japan," *Asia-Pacific Economic and Management Review*, Vol. 18, No. 1, 65-84, 2014.
- Zhu, Zhen, with Mariya Berdina, Michael Wright. 2014. "Is the Stock Market Sticker Shocked? A Study of Market Response to Recent CAFE Regulations in the U.S.," *Applied Economics*, 2014.
- Zhu, Zhen, with Chiou Wei Song Zan and Scott Linn. 2014. "The response of U.S. natural gas futures and spot prices to storage change surprises: Fundamental information and the effect of escalating physical gas production," *Journal of International Money and Finance*, 2014, Vol. 42, 156-173.
- Zhu, Zhen, with Glenn Hsu and Michael Wright. 2014. "Merger and Acquisition Activities in the U.S. Oil and Gas Industry," *Energy Forum*, International Association for Energy Economists, 2014:1.
- Zhu, Zhen, with Donald A. Murry. 2013. "For Gas and Electric Utilities the Recent Recession/Recovery is Different from Previous Ones," *United States Association for Energy Economics Forum* (May 2013).
- Zhu, Zhen, with Joe Johnson and Cody Woods. 2013. "An Economic Analysis of Wind Generation Capacity," *International Journal of Economics and Social Sciences*.
- Zhu, Zhen, with Don Murry, and Mike Knapp. 2011. "The Equivalent Risk Standard and Allowed ROEs in the Gas and Electric Utility Industries," *Journal of Applied Economics and Policy*, Volume 30, Number 1, 47-60.
- Zhu, Zhen and M Ji, and H Lin. 2011, "The Roles of Speculation and Fundamentals in Commodity Markets: The Case of U.S. Natural Gas Market," *Review of Futures Markets*, Volume 19, Issue 3, 217-246.
- Zhu, Zhen, with Don Murry, and Mike Knapp. 2010. "Economic Recovery and Industrial Natural Gas Demand," *USAEE Dialogue* 18 (November).
- Zhu, Zhen, with J.D. Ju, and Scott Linn. 2010. "Price Dispersion in a Model with Middlemen and Oligopolistic Market Journal Makers: A Theory and an Application to the North American Natural Gas Market," *Journal of Economics and Management Strategy* 19 (Spring): 1–23.
- Zhu, Zhen, and Don Maxwell. 2011. "An Empirical Examination of the Impacts of Natural Gas Prices and LNG Transport Costs on the Dynamics of LNG Import Demand," *Energy Economics*, Vol. 33, 2011, 217-226.
- Zhu, Zhen, and Shinhua Liu. 2009. "Stock Market Volatility and Commission Deregulation: Further Evidence from Japanese Stock Markets," *Journal of Financial Services Review* 36 (August): 65-83.
- Zhu, Zhen, with Chiou Wei Song Zan and Yung-Hsing Kuo. 2010. "Government Size and Economic Growth: An Application of the Smooth Transition Regression Model," *Applied Economics Letters* 17: 1405–1415.
- Zhu, Zhen, with Veljko Fotak and Scott Linn. 2008. "Natural Gas Price Volatility," *Natural Gas and Electricity* 24 (June): 8-13.
- Zhu, Zhen, with Don Murry and Mike Knapp. 2008. "Linking Risk and ROE," *Public Utility Fortnightly* (January): 30-33.

- Zhu, Zhen. "Hedging Strategies and Cost/Price of Natural Gas." 2009.
- Zhu, Zhen, and Song Zan Chiou Wei. 2007. "Volatility Impact of Political and Economic Events on Stock Prices: Empirical Evidence from Taiwan." *India Economics Journal* 55 (October-December): 24-39.
- Zhu, Zhen, with Song Zan Chiou Wei and Ching-Fu Chen. 2008. "GDP Growth and Energy Consumption Revisited: Evidence from Linear and Nonlinear Granger Causality." *Energy Economics* 30 (November): 3063-3076.
- Zhu, Zhen, and Chiou Wei Song Zan. 2010. "Financial Development and Economic Growth in South Korea: An Application of Smooth Transition Error Correction Analysis." *Applied Economics*. June-July 2010, v. 42, iss. 16-18, pp. 2041-52
- Zhu, Zhen, and Don Murry. 2008. "Asymmetric Price Responses, Market Integration and Market Power: A Study of the U.S. Natural Gas Market." *Energy Economics* 30: 748-765.
- Zhu, Zhen and Song Zan Chiou Wei. 2006. "Commodity Convenience Yield and Risk Premium Determination: The Case of the U.S. Natural Gas Market." *Energy Economics*, 28 (July): 523-534.
- Zhu, Zhen, and Don Murry. 2004. "An Empirical Analysis of U.S. Natural Gas Market Power." *Proceedings of 24th International Association of Energy Economists Meetings* (July).
- Zhu, Zhen, and Scott Linn. 2004. "Storage Announcement and Natural Gas Futures Market Volatility." *Journal of Futures Market* 24 (March): 283-313.
- Zhu, Zhen, and Don Murry. 2004. "Enron Online and Informational Efficiency in the U.S. Natural Gas Market." *The Energy Journal* 25.
- Zhu, Zhen and Chiou Wei Song Zan. "Equality of Interest Rates Revisited: The Multi-Country Evidence." *International Economic Journal*.
- Zhu, Zhen and Donald A. Murry, Ph.D. 2002. "Economic Modeling Refutes Some Common Gas Market Assumptions." *UE Perspectives* 1 (February). Published by The Williams Company.
- Zhu, Zhen, and Scott Linn. 2002. "Forecastability of Natural Gas and Its Implications for Hedging." *Financial Research Institute* (November). University of Missouri, Columbia, Missouri.
- Zhu, Zhen and Scott Linn. 2002. "Public News and Energy Market Response: The Case of Natural Gas Market." *Financial Management Association Meetings* (October). San Antonio, Texas.
- Zhu, Zhen. 2002. "Time-Varying Forward Bias and the Expected Excess Returns." *Journal of International Financial Markets, Institutions and Money*.
- Zhu, Zhen, and Chiou Wei Song Zhang. 2002. "Sources of Export Fluctuations: Empirical Evidence from Taiwan and South Korea, 1981-2000." *Journal of Asian Economies*.
- Zhu, Zhen. 2001. "Are Long-Term Bond Yields Excessively Volatile?" *Journal of Economic Studies* 28: 433-445.
- Zhu, Zhen. 2001. "The Effect of Exchange-Rate Risk on Exports: Some Additional Empirical Evidence." *Journal of Economic Studies* 28: 106-121.
- Zhu, Zhen, and Donald A. Murry, Ph.D. 2001. "Recession Should Have Little Effect on Gas Prices" *The Competitive Edge* 3. Published by C. H. Guernsey & Company.
- Zhu, Zhen, and Donald A. Murry, Ph.D. 2001. "Gas Market Trends Create Opportunities for Low-Cost, Risk-Averse Strategy." *The Competitive Edge* 3. Published by C. H. Guernsey & Company.
- Zhu, Zhen. 2000. "Generation Companies Exhibit Growth and Volatility." *The Competitive Edge* 2. Published by C. H. Guernsey & Company.

PROFESSIONAL ACTIVITIES / HONORS:

Barnabas Fellow, UCO, 2011-2012

Distinguished Paper Award, Association of Public and Business Administration, 2008

Faculty Research Merit Award, UCO, 2007, 2009, 2011

OSEHE-EPSCor Summer grant Writing Institute, UCO, 2008

Faulty Incentive Awards, Graduate College, UCO, 2007, 2008, 2009

McGraw-Hill Irwin Distinguished Paper Award, Southwestern Society of Economists, 2006.

Marquis' Who's Who in American Education, 2003.

Research Fellow, Financial Research Institute, University of Missouri, 2001, 2002.

Hauptman Fellow, University of Central Oklahoma, 2001.

Distinguished Researcher Award, College of Business, University of Central Oklahoma, 2002.

Marquis Who's Who in America: Finance and Industry, 1999

ODE Professor of the Year, 1997-1998, University of Oklahoma

Member, American Finance Association, International Association for Energy Economists