

Curriculum Vitae

V. Eldon Ball

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Education:

University of Maryland, College Park, MD. Ph.D. in Agricultural and Resource Economics, 1987
North Carolina State University, Raleigh, NC. M.A. in Economics, 1972
Berea College, Berea, KY. B.A. in Mathematics, 1970

Honors:

Fellow, Agricultural and Applied Economics Association (formerly American Agricultural Economics Association); Distinguished Alumnus, Department of Agricultural and Resource Economics, University of Maryland; Distinguished Alumnus, Berea College; Honorary Kentucky Colonel

Awards: Administrator's Special Merit Award(s) for Outstanding Research

Research Professor, Department of Agricultural and Resource Economics, University of Maryland, 2017 and currently. Led an international effort to construct comparably defined production accounts for agriculture for OECD countries. The accounts underpin efforts to measure growth as well as relative levels of technology across countries, with a focus on capital accumulation as a source of (conditional) convergence.

Senior Economist, United States Department of Agriculture, Economic Research Service, Resource and Rural Economy Division, Agricultural Structure and Productivity Branch, 1987 – 2017.

Ongoing Responsibilities: Responsible for the design and implementation of the program of research on agricultural productivity.

Other Research Topics: The Office of Management and Budget (OMB) mandates specific standards for data quality and prescribes procedural and analytical guidelines for the management of Federal information resources. Under these guidelines, ERS implemented a program review for the agency's data products, including the production accounts and estimate of productivity growth. I assembled an external panel charged with reviewing the program of work and incorporated recommendations regarding methods and data. I penned the manuscript *Productivity and Economic Growth: A New Look* that detailed changes.

Construct production accounts and measures of productivity for the agricultural sector. The trans-log transformation frontier provides the theoretical underpinnings for the estimates of productivity. It relates the growth rates of multiple outputs to the cost-share weighted growth rates of labor, capital and intermediate inputs. The applied model is quite detailed. The changing demographic character of the agricultural workforce is used to build a quality-adjusted index of labor input. Similarly, much asset-specific detail underlies the measure of capital input. The measure of capital input is formed by aggregating over the various capital assets, using cost-share weights based on asset-specific rental prices. The contributions of feed and seed, energy, agricultural chemicals, and purchased services are captured in the index of intermediate inputs. An important innovation is the use of hedonic price indexes in constructing measures of fertilizers and pesticides consumption. The result is a series of productivity indexes for each state and the aggregate farm sector defined over states.

Used time series techniques to test for a slowdown in U.S. agricultural productivity growth. The time series tests allow for multiple structural breaks in the series at unknown points in time. We identify a break in trend beginning in 1974. Prior to 1974, productivity grew at an annual rate of 1.71%, but this rate of growth slowed to 1.56% beginning in 1974. The identified break in trend coincides with the widely publicized productivity slowdown in the non-farm sector. We attribute the slowdown to the rapid and

unexpected rise in energy prices, arguing that sharply higher energy prices rendered obsolete a significant portion of the capital stock.

Investigated the role of energy productivity in U.S. agriculture using panel data at the state level for the period 1960-2004. We first provide a historical account of energy use in U.S. agriculture. To do this we rely on the Bennet cost indicator to study how the price and volume components of energy costs have developed over time. We then analyze the contribution of energy to productivity employing the Bennet productivity indicator. An important feature of the Bennet indicator is its direct association with the change in (normalized) profits. Thus, our study is also able to analyze the link between profitability and productivity. Panel regression estimates indicate that energy prices have a negative effect on profitability in the agricultural sector. We also find that energy productivity has generally remained below total factor productivity following the 1973-1974 global energy crisis.

Study focused on the relation between the business cycle and convergence in levels of total factor productivity (TFP) across states. First, we found evidence of convergence in TFP levels across the different phases of the business cycle, but the speed of convergence was much greater during periods of contraction in aggregate economic activity than during periods of expansion. Second, we found that technology embodied in capital was an important source of productivity growth in agriculture. As with the rate of catch-up, the embodiment effect was much stronger during low economic activity phases of the business cycle.

Examined international competitiveness of agriculture in the European Union and the United States. The most intuitive concept of competitiveness is that of price competitiveness. We calculate relative prices for eleven Member States of the European Union and the United States for the period 1973-2002. We assume that markets are perfectly competitive and in long-run equilibrium, so that the observed price always equals average total cost, as measured by the cost dual to the production function. This assumption is used in our calculation of relative competitiveness and productivity gaps between the European Union and the United States and in our decomposition of relative price movements between changes in relative input prices and changes in relative productivity levels.

Organized USDA/AIEA2 International Congress on Competitiveness in Agriculture and the Food Sector: US and EU Perspectives, Bologna, Italy, June 2006. Edited proceedings volume with the same title.

Used multilateral index number techniques to decompose nominal cost differences among states into components. This is an extension of the approach applied to a single time series for United States agriculture, but uses an adaptation to the Törnqvist index to insure that the comparisons are transitive.

Provided an exact decomposition of growth in revenue and cost using superlative indexes. We provide an analytical basis for the empirical observation that the Fisher ideal and Törnqvist indexes closely approximate each other. Beyond this confirmation, our decomposition procedure has clear policy implications. Since revenue or cost measures income, the proposed decomposition determines the contributions of growth in output prices and input quantities and growth in total factor productivity to growth in income. An application using data from agriculture shows that productivity growth is the dominant source of growth in income. This result suggests that measures such as public investment in research and development may be more effective in increasing income than are price policies.

Organized USDA/Farm Foundation Conference on Agricultural Productivity: Measurement and Sources of Growth, Washington, DC, March 2000. Edited proceedings volume with the same title.

Incorporated environmental impacts into a measure of productivity growth. We merge data on environmental impacts with input and output data to form a state-by-year panel of relative levels of outputs and inputs including environmental impacts. We do not have price information for these undesirable outputs, since they are not marketed. Consequently, we construct a series of Malmquist productivity indexes, which do not require price information. Our benchmark index is a conventional Malmquist index based on marketed outputs and purchased inputs only. Our comparison indexes consist of environmentally sensitive Malmquist productivity indexes that include indicators of environmental degradation. Two types of information emerge. One is an environmentally sensitive index of productivity change, which differs from the conventional index through time and across states. Another is a set of virtual prices of the undesirable outputs that can be used to construct environmentally sensitive Fisher or Törnqvist indexes. Finally, we construct a set of abatement elasticities for the undesirable outputs. These elasticities provide a foundation for marginal benefit calculations in the design of environmental policies.

Developed an index of environmental performance for agriculture. Our motivation was to assess improvements in the ability of the sector to produce desirable outputs while minimizing the environmental damage. The index is based on distance functions. These distance functions explicitly allow us to model joint production of desirable and undesirable outputs without requiring information on shadow prices of the undesirable outputs. Our approach allows us to aggregate across multiple undesirable outputs, again without requiring information on shadow prices. An index of environmental performance is then constructed as the ratio of the quantity index of desirable outputs to the quantity index of undesirable outputs.

Estimated system of flexible input demand equations for the states that allow for technical inefficiency. Bayesian methods are used to ensure that the estimated functions have properties consistent with economic theory. Our estimates of relative technical efficiency suggest that the Mountain states are the most technically efficient, while the states in the Southeast are least efficient.

Compared growth rates and relative levels of agricultural productivity among the U.S. states using transitive multilateral indexes. We find that every state exhibits positive and generally substantial average annual rates of productivity growth. However, there is considerable variance. The disparity in growth rates resulted in substantial changes in the rank order of the states. Remarkably, the range of levels of productivity among states narrowed over the study period. Using regression analysis, we find that the rate of productivity growth is inversely related to the initial level of productivity, consistent with the catch-up hypothesis. The rate of productivity growth is positively related to growth of the capital-labor ratio, suggesting embodiment.

Developed international comparisons of levels of farm sector productivity. We find that the dispersion in relative levels of productivity declined steadily. This result is consistent with Gerschenkron's notion of the advantages of relative backwardness; those countries that were particularly far behind the technology leaders had the most to gain from diffusion of technical information and proceeded to grow most rapidly. Moreover, the rate of convergence is positively related to the rate of growth of the capital-labor ratio. This relation implies that technological innovation is embodied in capital.

Measured agricultural productivity growth at both sector and state levels. This is done in a way that preserves the economic integrity of national and state production accounts. A model accounting for interstate transactions in farm goods links sector wide and state-specific measures of total factor productivity growth. An interesting conclusion is that the smooth, persistently positive trend typically observed for farm sector productivity growth masks considerable variation across states and regions. The results also indicate that farm sector productivity growth is wholly a function of productivity trends in the individual states. Interstate shifts in production activity and resource reallocations have had little impact.

Integrated land set-aside provision of Common Agriculture Policy reforms into model of supply response of European Union agriculture. Inequality constrained maximum likelihood estimation is used to ensure theoretical consistency of the estimated model. Long run output supplies and input demands are obtained by evaluating short run response functions at profit maximizing land allocations. Supply response was found to be price inelastic even when evaluated at the profit maximizing land allocations.

Visiting Scholar, Institut für Agrarpolitik, Universität Bonn, Bonn, Germany, December 1989 - February 1990. Compiled capital accounts for SPEL/EU.

Agricultural Economist, National Economics Division, Food Marketing and Consumption Economics

Branch, 1984 - 1987. Studied investment behavior in U.S. agriculture. Agricultural firms are assumed to maximize discounted stream of profits subject to technology that implies that capital and labor stocks are costly to adjust. We compute adjustment matrix for quasi-fixed stocks. We estimate the supply elasticities at observed and steady-state levels of capital stocks.

Modeled multiproduct supply response in agriculture. Convexity of the underlying profit function in prices takes the form of nonlinear inequality constraints involving both the data and the unknown parameters. Developed an algorithm for inequality constrained maximum likelihood estimation that employs the Cholesky decomposition of a positive definite matrix. *Administrator's Special Merit Award for Outstanding Research.*

Visiting Lecturer, Department of Agricultural and Resource Economics, University of Maryland, College Park, Maryland, 1984. Taught introductory course in agricultural economics.

Agricultural Economist, National Economics Division, Farm Sector Economics Branch, 1981 - 84. Reviewed methods and data used by Department of Agriculture to measure sectoral productivity growth. Constructed product accounts for aggregate farm sector. Output is defined as gross production leaving farm sector, as opposed to real value added. Inputs are not limited to capital and labor, but include intermediate inputs as well. The revised estimates suggest that the official series understates productivity growth in agriculture. *Administrator's Special Merit Award for Outstanding Research.*

Studied meat packing industry in response to proposed legislation to restructure industry. We found the industry to be characterized by decreasing costs over observed range of output. Empirical evidence of increasing returns to scale suggests that concerns about possible exercise of monopoly power were justified.

Agricultural Economist, Commodity Economics Division, Livestock Branch, 1975 - 1981. Analyzed economic conditions in livestock industry. Published bimonthly *Livestock and Meat Outlook and Situation Report*. Contributed to monthly *Agricultural Outlook*. Conducted staff analysis on issues relating to livestock industry. Participated in national and regional outlook conferences.

Credit Officer, Farm Credit Administration, Washington, DC, 1974 - 1975. Held staff responsibility for supervision of lending operations of Federal Farm Credit Banks.

Economist, Spindletop Research, Lexington, KY, 1973 - 74. Compiled economic indicators for Kentucky State Government. Designed *Development Information System* as companion document for use by State planning authority.

Research Associate, Department of Economics, North Carolina A&T University, Greensboro, NC, 1972 - 73.

Books:

Fuglie, Keith, Sun Ling Wang, and V. Eldon Ball, eds. *Productivity Growth in Agriculture: An International Perspective*, Oxfordshire, United Kingdom: CAB International. 2012.

Ball, V. Eldon, Roberto Fanfani, and Luciano Gutierrez, eds. *Economic Implications of Public Support for Agriculture: An International Perspective*, New York: Springer US, 2010.

Fanfani, Roberto, V. Eldon Ball, Luciano Gutierrez, and Elisa Ricci-Maccarini, eds. *Competitiveness in Agriculture and the Food Sector: US and EU Perspectives*, Bologna: Bologna University Press, 2008.

Ball, V. Eldon and George Norton, eds. *Agricultural Productivity: Measurement and Sources of Growth*, Boston: Kluwer Academic Publishers, 2002.

Refereed Journals:

Ball, V. Eldon, Richard Nehring, and Sun Ling Wang. "Productivity Growth in Postwar Agriculture: 1948-2013,"

International Productivity Monitor. Number 30, (Spring 2016):64-76

Ball, V. Eldon, Sean Cahill, Carlos San Juan Mesonada, Richard Nehring, and Yu Sheng. "Comparisons of Real Values of Capital Input in OECD Agriculture: 1973-2011," *Review of Economics and Finance*, Vol. 6. No 3. (2016):25-48

Ball, V. Eldon, Sun Ling Wang, Richard Nehring, and Roberto Mosheim. "Productivity and Economic Growth in U.S. Agriculture: A New Look," *Applied Economic Perspectives and Policy* 38(2016):30-49.

Sheng, Yu, V. Eldon Ball, and Katerina Nossal. "Comparing Agricultural Total Factor Productivity Among Australia, Canada, and the United States, 1961-2006," *International Productivity Monitor* 29(2015):38-59.

Ball, V. Eldon, Rolf Fare, Shawna Grosskopf, and Dimitri Margaritis. "The Role of Energy Productivity in U.S. Agriculture," *Energy Economics* 49(2015):460-471.

Ball, V. Eldon, Carlos San Juan, and Camilo Ulloa. "Agricultural Productivity in the United States: Catching-Up and the Business Cycle," *Journal of Productivity Analysis*, 42(2014):327-338.

Ball, V. Eldon, David Schimmelpfennig, and Sun Ling Wang "Is Agricultural Productivity Growth Slowing?" *Applied Economic Perspectives and Policy*, 35(2013):435-450.

Liu, Yucan, C. Richard Shumway, Robert Rosenman, and V. Eldon Ball. "Productivity Growth and Convergence in U.S. Agriculture: New Cointegration Panel Data Results," *Applied Economics* 43(2011):91-102.

Ball, V. Eldon, Jean-Pierre Butault, Carlos San Juan, and Ricardo Mora. "Productivity and International Competitiveness of European Union and United States Agriculture," *Agricultural Economics*. 41(2010):611-627.

Dumagan, Jesus and V. Eldon Ball. "Decomposing Growth in Revenue and Cost into Price, Quantity, and Multifactor Productivity Contributions," *Applied Economics* 41(2009):2943-2953.

Ball, V. Eldon, William Lindamood, Richard Nehring and Carlos San Juan. "Capital as a Factor of Production in OECD Agriculture: Measurement and Data," *Applied Economics* 40(2008):1253-1277.

Ball, V. Eldon, Rolf Färe, Shawna Grosskopf, and Osman Zaim. "Accounting for Externalities in the Measurement of Productivity Growth: The Malmquist Cost Productivity Measure," *Structural Change and Economic Dynamics* 16(2005):374-394.

Ball, V. Eldon, Jean-Pierre Butault, and Carlos San Juan. "Measuring Real Capital Input in OECD Agriculture," *Canadian Journal of Agricultural Economics* 52(2004):351-370.

Ball, V. Eldon, Charles Hallahan, and Richard Nehring. "Convergence of Productivity: An Analysis of the Catch-up Hypothesis within a Panel of States," *American Journal of Agricultural Economics* 86(2004):1315-1321.

Ball, V. Eldon, C.A. Knox Lovell, H. Luu, and Richard. Nehring. "Incorporating Environmental Impacts in the Measurement of Agricultural Productivity Growth," *Journal of Agricultural and Resource Economics* 29(2004):436-460.

Morrison-Paul, Catherine J., V. Eldon Ball, Ronald G. Felthoven, and Richard Nehring. "Effective Costs and Chemical Use in U.S. Agricultural Production: Benefits and Costs of Using the Environment as a Free Input," *American Journal of Agricultural Economics*. 84(2002): 902-915.

Ball, V. Eldon, Jean-Christophe Bureau, Jean-Pierre Butault, and Richard Nehring. "Levels of Farm Sector Productivity: An International Comparison," *Journal of Productivity Analysis* 15(2001):5-29.

Morrison-Paul, Catherine, V. Eldon Ball, Ronald Felthoven, and Richard Nehring. "Public Infrastructure Impacts on U.S. Agricultural Production: A State-Level Panel Analysis," *Public Finance and Management* 2(2001), http://PFM_PUB/index.html

O'Donnell, Christopher, Richard Shumway, and V. Eldon Ball. "Inefficiency in U.S. Agriculture: A Bayesian Approach," *American Journal of Agricultural Economics*, 81(1999):865-880.

Ball, V. Eldon, Frank Gollop, Alison Kelly-Hawke, and Gregory Swinand. "Patterns of Productivity Growth in the U.S. Farm Sector: Linking State and Aggregate Models," *American Journal of Agricultural Economics*, 81(1999):164-179.

Ball, V. Eldon, Jean-Christophe Bureau, Richard Nehring, and Agapi Somwaru. "Agricultural Productivity Revisited." *American Journal of Agricultural Economics*, 79(1997):1045-1063.

Ball, V. Eldon, Jean-Christophe Bureau, Kelly Eakin, and Agapi Somwaru. "CAP Reform: Modelling Supply Response Subject to the Set-Aside." *Agricultural Economics*, 17(1997):277-288.

Ball, V. Eldon, Ahmed Barkaoui, Jean-Christophe Bureau, and Jean-Pierre Butault. "Aggregation Methods for Intercountry Comparisons of Prices and Real Values in Agriculture: A Review and Synthesis," *European Review of Agricultural Economics*, 24(1997):183-207.

Ball, V. Eldon, C.A. Knox Lovell, Richard Nehring, and Agapi Somwaru. "Incorporating Undesirable Outputs into Models of Production." *Cahiers d'economie et Sociologie* 31(1994):60-74.

Ball, V. Eldon, Jean-Christophe Bureau, Jean-Pierre Butault, and Heinz-Peter Witzke. "The Stock of Capital in European Community Agriculture." *European Review of Agricultural Economics*, 20(1993):437-450.

Yee, Jet, James Hauver, and V. Eldon Ball. "Fixed Factor Models of Productivity Growth," *Applied Economics* 25(1993):1187-1196.

Ball, V. Eldon. "Sources of Agricultural Economic Growth: Discussion." *American Journal of Agricultural Economics* 74(1992):764-65.

Capalbo, Susan, V. Eldon Ball, and Michael Denny. "International Comparisons of Agricultural Productivity: Development and Usefulness." *American Journal of Agricultural Economics* 72(1990):1292-1297.

Vasavada, Utpal and V. Eldon Ball. "A Dynamic Investment Model Within a Multi-Commodity Framework," *Agricultural Economics*, 2(1988):123-37.

Ball, V. Eldon. "Modelling Supply Response in a Multiproduct Framework," *American Journal of Agricultural Economics*, 70(1988):813-25.

Ball, V. Eldon. "Output, Input, and Productivity Measurement in U.S. Agriculture, 1948-79," *American Journal of Agricultural Economics* 67(1985):425-36.

Ball, V. Eldon and Robert G. Chambers. "An Economic Analysis of Technology in the Meat Products Industry," *American Journal of Agricultural Economics*, 64(1982):699-709.

Book Chapters, Technical Bulletins, and Staff Reports:

Ball, V. Eldon, Rolf Färe, Shawna Grosskopf, and Dimitri Margaritis. *The Role of Energy Productivity in U.S. Agriculture*. Working Paper, Economic Series 14-24, Departamento de Economía, Universidad Carlos III de Madrid, November 2014.

Ball, V. Eldon, David Schimmelpfennig, and Sun Ling Wang. "Is Agricultural Productivity Growth Slowing?" Working Paper, Economic Series 12-25, Departamento de Economía, Universidad Carlos III de Madrid, September 2012.

Wang, Sun Ling, Eldon Ball, Lilyan Fulginiti, and Alejandro Plastina. 2012. "Accounting for the

Impacts of Public Research, R&D Spill-ins, Extension, and Roads in U.S. Regional Agricultural Productivity Growth, 1980-2004". in *Productivity Growth in Agriculture: An International Perspective*. Fuglie, Wang and Ball, editors, Oxfordshire, UK: CAB International. Sep. 2012.

Ball, V. Eldon, Carlos San Juan, and Camilo Ulloa. *Agricultural Productivity in the United States: Catching-Up and the Business Cycle*. Working Paper, Economic Series 11-16, Departamento de Economía, Universidad Carlos III de Madrid, June 2011. .

Ball, V. Eldon, Rolf Färe, Shawna Grosskopf, and Dimitri Margaritis. "R&D and U.S. Agricultural Productivity," in *Economic Implications of Public Support for Agriculture: An International Perspective*, eds. V. Eldon Ball, Roberto Fanfani, and Luciano Gutierrez, pp. 125-139. New York: Springer, 2010.

Ball, V. Eldon, Jean-Pierre Butault, Carlos San Juan, and Ricardo Mora. "Agricultural Competitiveness," in *Economic Implications of Public Support for Agriculture: An International Perspective*, eds. V. Eldon Ball, Roberto Fanfani, and Luciano Gutierrez, pp. 243-271. New York: Springer, 2010.

Ball, V. Eldon, Ricardo Cevazos, Jeff LaFrance, Rulon Pope, and Jesse Tack. "Aggregation and Asset Management in Joint Production," in *Economic Implications of Public Support for Agriculture: An International Perspective*, eds. V. Eldon Ball, Roberto Fanfani, and Luciano Gutierrez, pp. 309-328. New York: Springer, 2010.

Ball, V. Eldon, W.A. Lindamood, Richard Nehring, and Carlos San Juan. "Capital Input in OECD Agriculture: A Multilateral Comparison," in *Competitiveness in Agriculture and the Food Sector: US and EU Perspectives*, eds. Roberto Fanfani, V. Eldon Ball, Luciano Gutierrez, and Elisa Ricci-Maccarini, pp.443-465. Bologna: Bologna University Press, 2008.

Ball, V. Eldon, Jean-Pierre Butault, and Richard Nehring. "United States Agriculture, 1960-1996: A Multilateral Comparison of Total Factor Productivity," in *Agricultural Productivity: Measurement and Sources of growth*, eds. V. Eldon Ball and George Norton, pp. 11-36. Boston: Kluwer Academic Publisher, 2002.

Ball, V. Eldon, Rolf Färe, Shawna Grosskopf, and F. Hernandez-Sancho. "The Environmental Performance of the U.S. Agricultural Sector," in *Agricultural Productivity: Measurement and Sources of Growth*, eds. V. Eldon Ball and George Norton, pp. 257-276. Boston: Kluwer Academic Publisher, 2002.

Ball, V. Eldon, Ronald Felthoven, Richard Nehring, and Catherine Morrison-Paul. "Cost of Production and Environmental Risk: Resource-Factor Substitution in U.S. Agricultural Sector," in *Agricultural Productivity: Measurement and Sources of growth*, eds. V. Eldon Ball and George Norton, pp.293-310. Boston: Kluwer Academic Publishers, 2002.

Huffman, Wallace, V. Eldon Ball, Munisamy Gopinath, and Agapi Somwaru. "Public R&D and Infrastructure: Effects on Cost of Production," in *Agricultural Productivity: Measurement and Sources of Growth*, eds. V. Eldon Ball and George Norton, pp. 167-185. Boston: Kluwer Academic Publishers, 2002.

O'Donnell, Chris, Prasada Rao, and V. Eldon Ball. "Transitive Multilateral Comparisons of Agricultural Output, Input, and productivity: A Nonparametric Approach," in *Agricultural Productivity: Measurement and Sources of Growth*, eds. V. Eldon Ball and George Norton, pp. 85-116. Boston: Kluwer Academic Publishers, 2002.

Ball, V. Eldon Ball, Rolf Färe, Shawna Grosskopf, and Richard Nehring. "Productivity of the United States Agricultural Sector: The Case of Undesirable Outputs," in *New Developments in Productivity Analysis*, eds. Charles Hulten, Edward Dean, and Michael Harper, Chicago: University of Chicago Press, 2001.

Ball, V. Eldon, Jean-Pierre Butault, and Richard Nehring. *United States Agriculture, 1960-1996: A Multilateral Comparison of Total Factor Productivity*. ERS Staff Paper No. AGES 00-03, USDA, October 2000.

Ball, V. Eldon and Richard Nehring. *Patterns of State Productivity Growth in the U.S. Farm Sector*. ERS Staff Paper No. 9804, USDA, July 1998.

Bureau, Jean-Christophe, V. Eldon Ball, Jean-Pierre Butault, and Ahmed Barkaoui. "Productivity Gaps Between European and United States Agriculture." *Issues in Agricultural Competitiveness*, I.A.A.E. Occasional Paper No.

7, eds. Roger Rose, Carolyn Tanner, and Margot Bellamy, pp. 39-46. Dartmouth Publishing Company Limited, Hants, England, 1997.

Ball, V. Eldon and Richard Nehring. "Productivity: Agriculture's Engine of Growth," *Agricultural Outlook* AO-229 May 1996.

Ball, V. Eldon, Jean-Christophe Bureau, Colin Thirtle, and Robert Townsend. "Accounting for Productivity Differences in European Community Agriculture." *Agricultural Competitiveness: Market Forces and Policy Choice*, Proceedings of the Twenty-Second International Conference of Agricultural Economists, Harare, Zimbabwe. August 1994.

Ball, V. Eldon and Richard Nehring. "Building a Better Agricultural Productivity Index," *Agricultural Outlook* AO-205 March 1994.

Ball, V. Eldon and Jean-Christophe Bureau. *Productivity Growth in Agriculture: Multilateral Comparisons Between OECD Member Countries*. Organization for Economic Cooperation and Development, Agricultural Trade Analysis Division, Paris, France, 1994.

Ball, V. Eldon, Agapi Somwaru, and Utpal Vasavada. "Modelling Dynamic Adjustment Subject to Integrability Constraints." in *Agricultural Sector Modelling*, eds. W. Henrichsmeyer and S. Baher, pp. 279-287. Wissenschaftsverlag Vauk, Kiel, 1989, pp.279-87.

Hertel, Thomas, V. Eldon Ball, Kuo Huang, and Marinos Tsigas. *Computing Farm Level General Equilibrium Demand Elasticities for Agricultural Commodities*, Department of Agricultural Economics, Research Bulletin 988, Purdue University, West Lafayette, IN., July 1989.

Ball, V. Eldon. *Estimating Supply Response of Multiproduct Farms*. ERS Technical Bulletin No. 1750, December 1988.

Vasavada, Utpal, V. Eldon Ball, and Agapi Somwaru. *Modelling Quasi-Fixed Input Adjustment: Methodology and an Application to Agriculture*. Organization for Economic Cooperation and Development Agricultural Trade Analysis Division, Paris, France, November 1988.

Vasavada, Utpal and V. Eldon Ball. *Modelling Dynamic Adjustment in a Multi-Output Framework*. ERS Staff Report, No. AGES880205, USDA, June 1988.

Vasavada, Utpal and V. Eldon Ball. *Distribution Lags in Agricultural Production: A Multiple-Input Multiple-Output Approach*. Department of Agricultural Economics, Faculty Series No. FS88-24, University of Georgia, Athens, Georgia, March 1988.

Miranowski, John, Robbin Shoemaker, and V. Eldon Ball. "Productivity and Resource Use Impacts of Environmental Regulations on the Agricultural Economy," in *The Role of Exactions in Controlling Pollution*, ed. Fredrick Stocker, Lincoln Institute of Land Policy, Property Tax Papers Series No. TPR-15, Cambridge, MA., 1987.

Ball, V. Eldon. *Measuring Agricultural Productivity: A New Look*. ERS Staff Report, No. AGES840330, USDA, May 1984.

Ball, V. Eldon and Robert G. Chambers. *Characterization of Technology in Food Processing: The Meat Product Industry*. ERS Staff Report, No. AGES810710, USDA, July 1981.

Invited Papers:

"Accounting for Growth", OECD /University of Maryland Workshop on Productivity Measurement. College Park, Maryland, October 2019.

"Measuring China's Agricultural Total Factor Productivity and Its International Comparison, Second CCAP's Workshop, Peking University, Beijing, China, June 2019.

“Comparing Real Values of Capital Input in OECD Agriculture”, Public Lecture, Department of Economics, Peking University, Beijing, China, May 2018.

“Productivity Gains: The Engine of Economic Growth in U.S. Agriculture” Measuring China’s Agricultural Total Factor Productivity CCAP’s Workshop, Peking University, Beijing, China, May 2018.

“Productivity Growth in the U.S. Agricultural Sector” OECD Workshop on Productivity Measurement, Paris, France, November 2012.

“Productivity and Growth in U.S. Agriculture: 1948-2008,” The First World KLEMS Conference at Harvard University, Cambridge, MA, August 2010.

“Agricultural Competitiveness,” USDA/Farm Foundation Conference on Causes and Consequences of Global Agricultural Productivity Growth, Washington, DC, May 2010.

“Productivity and Profitability of U.S. Agriculture: Evidence from a Panel of States,” Jean Monnet Economics of European Integration Seminar, Universidad Carlos III of Madrid, Madrid, Spain, January 20

“Output, Input, and Productivity Measurement,” Centre for Efficiency and Productivity Analysis Workshop on Measuring Agricultural Productivity, University of Queensland, Brisbane, Australia, October 2009.

“R&D and U.S. Agricultural Productivity: A State Panel Approach,” Second USDA/AIEA2 International Congress on Economic Implications of Public Support for Agriculture, Bologna, Italy, June 2008.

“Aggregation and Arbitrage in Joint Production,” Second USDA/AIEA2 International Congress on Economic Implications of Public Support for Agriculture, Bologna, Italy, June 2008.

“Productivity and International Competitiveness of European Union and United States Agriculture,” USDA /AIEA2 International Congress on Competitiveness in Agriculture and the Food Sector: US and EU Perspectives, Bologna, Italy, June, 2006.

“Convergence of Productivity: An Analysis of the Catch-up Hypothesis Within a Panel of States,” American Agricultural Economics Association, Denver, Colorado, August 2004.

“Accounting for Bads in the Measurement of Productivity Growth: The Malmquist Cost Productivity Measure and its Application to U.S. Agriculture,” Jean Monnet Economics of European Integration Seminar, Universidad Carlos III of Madrid, Madrid, Spain, November 2002.

“Levels of Farm Sector Productivity: An International Comparison,” Joint UNECE/OECD/Eurostat/FAO Meeting on Food and Agricultural Statistics in Europe, Geneva, Switzerland, October 2001.

“United States Agriculture, 1960-1996: A Multilateral Comparison of Total Factor Productivity,” USDA/Farm Foundation Conference on Agricultural Productivity: Data, Methods, and Measurement, Washington, DC, March 2000.

“The Environmental Performance of the U.S. Agricultural Sector,” USDA/Farm Foundation Conference on Agricultural Productivity: Data, Methods, and Measures, Washington, DC, March 2000.

“Cost of Production and Environmental Risk: Resource-Factor Substitution in U.S. Agriculture,” USDA/Farm Foundation Conference on Agricultural Productivity: Data, Methods, and Measures, Washington, DC, March 2000.

“Public R&D and Infrastructure: Effects on Cost of Production in Agriculture,” USDA/Farm Foundation Conference on Agricultural Productivity: Data, Methods, and Measures, Washington, DC, March 2000.

“Transitive, Multilateral Comparisons of Agricultural Output, Input, and Productivity: A Nonparametric Approach,”

USDA/Farm Foundation Conference on Agricultural Productivity: Data, Methods, and Measurement, Washington, DC, March 2000.

"Agricultural Productivity in Developed Countries: A Comparison Between the United States and the European Community," Conference on Global Agricultural Science Policy for the Twenty-first Century, Melbourne, Australia, August 1996.

"Accounting for Productivity Differences in European Community Agriculture," International Association of Agricultural Economists, Harare, Zimbabwe, August 1994.

"CAP Reform: Modelling Supply Response Subject to the Land Set-aside," Institut National de la Recherche Agronomique Conference on Modelling Agricultural Supply Response for Policy Analysis: The State of the Art, Rennes, France, July 1993.

"International Comparisons of Agricultural Productivity: Development and Usefulness," American Agricultural Economics Association, Vancouver, British Columbia, Canada, August 1990.

Contributed Papers:

"Education, Labor Quality and the Contribution to Growth," Agricultural and Applied Economics Association, San Francisco, California, July 2015.

"Measurement of U.S. Agricultural Productivity: What Follows the External Review?," Agricultural and Applied Economics Association, San Francisco, California, July 2015.

"Measuring Land and Other Capital Inputs," Soil and Water Conservation Service, Greensboro, North Carolina, July 2015.

"Long-Lived Farm Animals as Capital Assets," Agricultural and Applied Economics Association, San Francisco, California, July 2015.

"State Productivity Growth: Catching Up and the Business Cycle," Agricultural and Applied Economics Association, Seattle, Washington, August 2012.

"Agricultural Productivity in the United States: Catching-Up and the Business Cycle," European Workshop on Efficiency and Productivity Analysis, Verona, Italy, June 2011.

"Productivity and International Competitiveness of Agriculture in the European Union and the United States," Agricultural and Applied Economics Association, Milwaukee, Wisconsin, July 2009.

"Impact of Local Public Goods on Agricultural Productivity growth," Agricultural and Applied Economics Association, Milwaukee, Wisconsin, July 2009.

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"The Stock of Capital In European Community Agriculture," Congress of the European Association of Agricultural Economists, Stresa, Italy, September 1993.

"Modelling Dynamic Resources Adjustment: Empirical Restrictions and an Application to U.S. Agriculture," Agricultural Economics Society, Aberystwyth, Wales, United Kingdom, April 1989.

"A Convex Value Function for Analyzing Agricultural Investment Decisions," Joint International Conference on Operations Research/Management Sciences, Paris, France, July 1988.

"Distributed Lags in Agricultural Production: A Multiple-Input Multiple-Output Approach," Society of Economic Dynamics and Control, Tempe, Arizona, March 1988.

"Modelling Supply Response of Multiproduct Farms," Southern Alliance of Agricultural Scientists, New Orleans, Louisiana, February 1988.

"Dynamic Resource Allocation in a Multioutput Framework," Congress of the European Association of Agricultural Economists, Budapest, Hungary, September 1987.

"Price Expectations and Dynamic Adjustment," American Agricultural Economics Association, Reno, Nevada, July 1986.

"A Characterization of Technology in the Meat Products Industry," Southern Alliance of Agricultural Scientists, Orlando, Florida, February 1982.

Seminars and Workshops:

"Comparing Real values of Capital Input in OECD Agriculture: 1973-2011," OECD Workshop on Measuring Environmentally Adjusted Agricultural Productivity, Paris, France, December 2015.

"Productivity and Economic Growth in Postwar Agriculture," Bureau of Labor Statistics, U.S. Department of Labor, Washington, DC, September 2015.

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