V. Eldon BALL and George W. NORTON (eds), **Agricultural Productivity: Measurement and Sources of Growth.**

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This book is a collection of papers that were presented at the USDA/ERS/NC 208 conference on *Agricultural Productivity Analysis: Data, Methods, and Measures,* held in Washington DC in March of 2000. The book is of great interest, even for non-specialists in productivity analysis. The amazingly high productivity level of US agriculture is not exactly a new result, but it remains a puzzling phenomenon. To put « amazingly high » in perspective, Dale W. Jorgenson states in his foreword that 21 % of growth in US productivity between 1958 and 1999 can be attributed to agriculture even though this sector makes up only 1.3 % of US GDP! The book is divided in three sections: the first two document the variability of growth in agricultural productivity across states and identify and measure the influence of factors conditioning productivity. The third section is about the controversial relation between productivity growth and the environment. The last chapter, mislabelled « *The Usefulness of Productivity Measurement* », is actually a discussion about the difficulties encountered in constructing quality data, especially series for labour and capital inputs. This insightful assessment of the limitations of the data was written by a most impressive panel made up of R. Evenson, B.L. Gardner, D.W. Jorgenson and R. Shumway.

Agricultural Productivity: Measurement and Sources of Growth is above all a testimony to the personal and institutional commitments of Eldon Ball and the USDA/ERS to push the frontiers of productivity analysis and to assemble remarkable data sets. Nine of the thirteen chapters involve at least one agricultural economist from USDA/ERS. As such, the book vividly demonstrates that academia and government can create a strong symbiosis.

The editors of the book provide a concise overview of the papers in chapter one. Chapter 2, penned by Ball, Butault and Nehring, kicks off the first part of the book on production accounts and productivity of US agriculture. The methodology and data definitions used in the computation of total factor productivity (TFP) estimates for 48 states are clearly exposed, which facilitates the reading of subsequent chapters, especially for the non-initiated readers. The authors find wide variations in TFP across states. The convergence hypothesis is tested and validated through regression analysis. Acquaye, Alston and Pardey in chapter 3 also find much variability in productivity across states. Their state estimates differ from the ones reported by Ball, Butault and Nehring due to differences in the composition of aggregates which better internalize quality changes in inputs and outputs. The main lesson here is that time devoted to improve the quality of the data is time well spent. Having to present a large number of statistics is always a challenge and the authors succeed, except for the two panels of figure 3.3 which are too messy to be informative. In chapter 4, Rao, O'Donnell and Ball rely on a non-parametric approach to perform multilateral comparisons of agricultural productivity across US states. Their chapter begins with a discussion of index number theory. There is an emphasis on the popular Eltetö-Köves-Szulc (EKS) method to multilateral comparisons and its variants and alternatives. The EKS method assumes that all binary comparisons are equally reliable, a truly heroic assumption considering the heterogeneity of agricultural sectors across the 48 states. The authors show that an easy-to-implement generalization of the EKS method and the minimum spanning tree approach are viable alternatives to

the standard EKS approach. The last chapter in Part 1 decomposes farm land values into productivity and urban growth effects through a three-equations econometric model. Starting from the premise that land prices are affected by differences in land quality, the paper innovates in giving quality a physical dimension and a spatial one. The idea is that land located near urban centers offers a competitive advantage in the production of products costly to transport. The results obtained by Moss, Livanis, Breneman and Nehring provide empirical support for this so-called « accessibility effect ». They also find that house values have a significant effect on farm land values.

Part II combines three chapters. C.J. O'Donnell provides estimates of technical and allocative efficiency for US agriculture from a system of shadow cost and cost-share equations estimated within a Bayesian framework. Such a framework makes it easy to force the monotonicity and concavity properties through inequality constraints. This ambitious econometric exercise generates a wide range of normalized technical efficiency estimates (0.26 for West Virginia and 1 for Florida and a relatively low mean of 0.64) which contrasts with allocative efficiency estimates which vary between 0.65 (for Arizona) and 0.94 (for South Dakota) with a mean of 0.88. In terms of cost efficiency estimates, which combine technical and allocative efficiency estimates, the top two states are Florida and Iowa while the bottom two are West Virginia and Wyoming. Huffman, Ball, Gopinath and Somwaru assess the effect of public R & D and infrastructure investment on the cost of production and input demands in Minnesota, Iowa, Illinois, Missouri and Indiana. They estimate a Translog cost function and the associated input share equations. They use non-linear optimization procedures to impose concavity during the estimation of the system of equations. For any given state, research spillovers from neighbouring states are found to be significant, thus prompting the authors to conclude that state-level R & D planning may be socially inefficient. This conclusion is also drawn from the results of Yee, Huffman, Ahearn and Newton presented in chapter 8 as they too found large spillover effects in their investigation of the effects of R & D and extension activities on TFP.

Part III on productivity growth and the environment begins with an analysis of the evolution of potential risks to human health and the environment from pesticide use. Kellogg, Nehring, Grube, Goss and Plotkin compute indices called Threshold Exceedence Units (TEU) to compare risk from multiple pesticides over space and time. Thresholds are defined for four target groups : humans, fish, crustaceans and algae. Potential risk for all groups increased in the 1960s to high levels in the 1970s and then either decreased or remained constant through the 1980s and 1990s. As for TFP studies, the national scores hide wide state variations. In the chapter entitled « *The environmental performance of the US agricultural sector* », Ball, Färe, Grosskopf, Hernandez-Sancho and Nehring compute an index of environmental performance as the ratio of a quantity index of agricultural outputs and an index of undesirable outputs *(i.e.*, the risks to human health and fish). Because the « green » index is the ratio of two distance functions, data envelopment analysis, DEA, is used for estimation purposes. As in the chapter preceding it, it is found that environmental productivity is slightly rising when all states are considered. However, different states exhibit very different patterns. The effect of ground water regulation on productivity growth in the farm sector is the topic of chapter 11. Chaston and Gollop replace the TFP concept by the more inclusive Total Resource Productivity (TRP) to account for

environmental quality in productivity analysis. Through the estimation of a Translog cost function and its input shares that incorporate the production of a « bad » output and government regulation, they show that annual TFP growth rates fell by 0.5 % annually between 1960-77 and 1977-96 while TRP actually increased by 0.45 %. This performance improvement is attributed to regulation-induced improvements in risk management. In chapter 12, Ball, Felthoven, Nehring and Morrison Paul estimate a generalized Leontief cost function with factor demand and marginal cost equations for a technology with two good outputs (crops and animal products), two bad outputs (risks for human health from runoff and leaching) and six variable inputs (land, labour, capital, fertilisers, pesticides and other materials). The pesticide data is quality-adjusted to account for innovations through time. The multitude of second derivatives of the cost function provides many useful results like the effect of a risk reduction/decrease of a bad output on pesticide use or on the marginal cost of production of a good output.

This book is a wonderful collection of articles about agricultural (and environmental) productivity analysis. Beyond the wealth of interesting results, it will make anybody cognizant of the fact that there is no substitute for quality data as it re-impresses upon us the old say « garbage in – garbage out » (no matter how complex the estimation techniques). As such, Ball and Norton did our profession a big favour !

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