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An Annotated Bibliography of Selected Productivity Literature

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AN ANNOTATED BIBLIOGRAPHY OF SELECTED PRODUCTIVITY LITERATURE

By

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AN ANNOTATED BIBLIOGRAPHY OF SELECTED PRODUCTIVITY LITERATURE

This paper annotates and cites literature that is relevant to my interest in agricultural productivity analysis. I have attempted to locate agricultural productivity studies for all countries dating back to World War II, whether the articles were in well-known journals or obscure monographs.

First, I have annotated those articles that I consider to be particularly significant in the development of agricultural productivity analysis. These articles were selected for one of the following reasons: the article was a pioneering empirical effort; the article had a major impact on subsequent efforts by offering new theory or improving existing productivity estimation procedures; or, the article was the first multifactor productivity analysis for some country in a geographic region of the world. These articles include comparative productivity analysis (for example, Hayami and Ruttan, 1970) and country-specific multifactor productivity analysis (for example, the United States in Ball, 1983).

In the second section ("Other Productivity Studies"), I have cited references of articles in which the authors have undertaken formal empirical productivity analysis. Many of these excellent studies could have been written up in the annotated bibliography section. Most of the studies are either comparative productivity studies or country-specific multifactor productivity studies; however, there are some studies cited that are early partial-factor productivity studies (for example, land or labor productivity) for countries in which complete data were not available.

In the third section, I have listed references that incorporate negative externalities into productivity or environmental accounting analysis. These citations are listed separately since I have an interest in incorporating negative externalities into future productivity research. While there appears to have been much research on environmental accounting (see, for example, U.S. Commerce Department, 1994; Repetto, 1989), it seems that there have been only two articles attempting to incorporate negative externalities into

productivity analysis. At the micro level, Archibald (1988) has provided an analysis of farm-level productivity in California's Imperial Valley; at the macro level, Oskam (1991) has provided an analysis of The Netherlands agricultural sector's MFP growth rate (see "Chronological Annotated Bibliography" section).

In the last section ("Related References: Method and Data"), I have listed other references that are related to the previously cited articles. An important category of articles here includes the theoretical articles that underlay the empirical studies. Other categories include country-specific economic performance articles (without formal productivity analysis) and productivity critique articles.

Empirical productivity studies have proliferated rapidly in recent years, especially for developing countries. To summarize some of my findings, I have put together in Table 1 a listing of country-specific multifactor productivity studies. According to my count, this table shows that there has been a total of 72 studies for 29 countries. This is not to mention the numerous studies in which comparative productivity theory has been evolving and in which developed countries' researchers are beginning to collaborate and "harmonize" government accounts (see Narayan and King, 1992). Thus, I find this evolving field to be exciting and I trust that this bibliography will be useful to other researchers.

Chronological Annotated Bibliography

Barton, Glen T. and M.R. Cooper. "Relation of Agricultural Production to Inputs." *Review of Economics and Statistics* 30(1948):117-126.

This study is one of the very earliest published reports on agricultural productivity. This report laid the foundation for the report by Ralph Loomis and Glen Barton in 1961, which provided a more thorough analysis of the productivity of the U.S. agricultural sector (Loomis and Barton, 1961). The Loomis and Barton report established U.S.D.A.'s Economic Research Service as the first governmental agency to publish annual multifactor productivity (MFP) statistics (it was not until 1983 that the Department of Labor's Bureau of Labor Statistics began publishing MFP statistics for other sectors). Barton and Cooper did not publish productivity indices per se, but instead provided numerous charts that explicitly and implicitly showed partial and multifactor productivity results for the 1910-1944 period. Barton and Cooper discussed in detail the problems of input and output definition, measurement, aggregation, and weighting procedures.

Ruttan, Vernon W. "The Contribution of Technological Progress to Farm Output: 1950-75." *Review of Economics and Statistics* 38(1956): 61-69.

Total factor input (land, labor, capital and operating expenses) measures were employed, using a Cobb-Douglas production function with coefficients based on factor shares, to estimate total and partial productivity growth rates for 1910-1950. Scenarios involving alternative land and labor productivity projections were constructed to estimate the implications for capital and operating input and total factor productivity requirements to meet projected 1960 and 1980 agricultural output levels. This was the first attempt to construct consistent projections for the agricultural sector based on consistent factor input and partial and total factor productivity growth rates.

Hsieh, S.C. and T.H. Lee. *An Analytical Review of Agricultural Development in Taiwan -- An Input-Output Approach*. Taipei, Taiwan, China: Chinese-American Joint Commission on Rural Reconstruction, Economic Digest Series No. 12, 1958.

To our knowledge, this study was the first agricultural multifactor productivity study for a developing country. This report is interesting for a few reasons: the authors do not cite the study by Barton and Cooper (1948), but do cite the work of Schultz (1953) and Ruttan (1956); this study came out at nearly the same time as Solow's influential growth accounting article (1957); the authors distinguishes between "production efficiency" (input per unit of output) and the reciprocal "resource productivity" (output per unit of input); and labor input is adjusted for "man-year equivalents." Except for the war years, Hsieh and Lee showed that aggregate production efficiency decreased about 16 percent over the 1935-1956 period (less input required to produce the same level of output) and (conversely) that resource productivity increased by about the same amount for the same period. Hsieh and Lee weighted output and inputs using 1935-1937 base year (Laspeyres) average prices. Detailed tables are provided in the appendices. This analysis was later updated by the same authors in 1966 (Hsieh and Lee, 1966).

Hayami, Yujiro and Vernon W. Ruttan. "Agricultural Productivity Differences Among Countries." *American Economic Review* 60(1970): 895-911.

This article is important for several reasons. First, this study used aggregate country observations as the unit of analysis, which although not original, substantially improved the results given first by Bhattacharjee (1955). Secondly, the study helped establish human capital variables as important variables that allow countries to adopt the latest technology. Thirdly, the coefficients obtained in the aggregate intercountry production function estimates were used in the growth accounting exercise, which helped explain why some countries were relatively more efficient than other countries. These productivity findings were important in the larger context of the theory of induced innovaton, that is, that countries pursue technologies that are biased towards the direction of factors of production that are relatively scarce. Lastly, this article stimulated a new literature on identifying the sources of agricultural productivity growth (for a review, see Trueblood, 1991). The authors themselves frequently updated this study, most recently in Kawagoe, Hayami, and Ruttan (1985). This analysis has also been incorporated into the authors' book, *Agricultural Development: An International Perspective* (first and second editions).

Brown, Randall. "Productivity Returns and the Structure of Production in U.S. Agriculture, 1947-74." Ph.D. Thesis, University of Wisconsin, 1978.

This study, supervised by Laurits Christensen, represented the first challenge to official ERS multifactor productivity statistics. The study appears to have been influential, judging by later references to it by subsequent studies; also the timing of the thesis slightly preceded a joint ERS-AAEA Task Force study (U.S.D.A., 1980), which called for substantial changes in the way ERS measured outputs and inputs and then calculated official multifactor productivity growth rates. Brown used Tornqvist indices and made substantial quality adjustments in the measurements of labor and capital. Brown calculated MFP growth at 1.15 percent per year over the 1948-1974 period, which for that time period compared to ERS' 1.57 percent per year. Since this thesis, there have been at least 10 other studies that have similarly tried to improve upon official ERS statistics (see Trueblood and Ruttan, 1992, for a comparative analysis).

Tang, Anthony M. and Bruce Stone. *Food Production in the People's Republic of China*. Washington, DC: International Food Policy Research Institute, Research Report 15, May 1980.

This lengthy report updates and analyzes more completely the earlier reports by Tang on China's agricultural performance. Subsequent studies on China's agricultural sector have used this study as a starting reference point. Tang and Stone show that while output grew substantially over the 1952-1977 period, input use grew even faster, leading to a MFP growth rate of -0.6 percent per year. This is one of a few studies that shows a country with negative productivity growth.

Antle, John M. "Infrastructure and Aggregate Agricultural Productivity: International Evidence." *Economic Development and Cultural Change* 31(1983): 609-618.

In this study, Antle attempted to improve the previous intercountry production function studies by Hayami-Ruttan and others. Antle argued that while all countries may have access to agricultural technology, a country's adoption and diffusion rate of new technology is affected by its level of infrastructure, particularly for developing countries. Using a cross-section of countries for 1965, Antle found that the partial output elasticity for infrastructure, measured as a country's portion of GDP spent on transportation and communications, was positive and statistically significant for all countries and for a LDC subsample. Econometrically, Antle attempted to address problems of multicollinearity by comparing OLS results with the Principal Components Regression (PCR) estimator, an approach that was later emulated by others.

Ball, V. Eldon. "Output, Input, and Measurement in U.S. Agriculture, 1948-79." *American Journal*

of Agricultural Economics 67(1985): 475-486.

This article essentially replicates Ball's 1984 staff report (see Other Productivity Studies). The article is highlighted since it represented an alternative methodology to the official ERS productivity statistics. Since publishing this article, Ball (an ERS employee) has helped lead ERS in revising its productivity calculations. Ball found that MFP had grown at 1.75 percent per year over the 1948-1979 period. The most important revision of the official ERS methodology by Ball was the use of the Tornqvist index, as opposed to the Laspeyres index. Other revisions included the use of quality-adjusted labor input and improved capital input measurements.

Wong, Lung-Fai. *Agricultural Productivity in the Socialist Countries.* Boulder, CO: Westview Press, 1986.

This study represents a significant breakthrough in terms of trying to understand the agricultural performance of the former Centrally Planned Economies (Eastern Europe, former U.S.S.R., and People's Republic of China). Until this study, economists had attempted to measure agricultural productivity with very limited success (see for example, Falcon and Nelson, 1978; and Barker, 1980). Wong calculated both arithmetic and geometric productivity indices; the factor shares used as weights were obtained from pooled regression results. All nine countries experienced negative MFP growth rates over the 1950-1980 period (some countries, such as China and Romania, showed average annual growth rates at over negative 8 percent!). Most countries' MFP growth rates stabilized after the 1950's, with much slower negative growth rates for the 1960-1980 period. The data in the study are similar to the Hayami-Ruttan stock variables, using a variety of sources. The output variable is based upon the author's construction of wheat unit equivalents for the 1976 period, then interpolated for other years based upon ERS estimates of output growth rates.

Lau, Lawrence J. and Pan A. Yotopolous. "Do Countries Idiosyncrasies Matter in Estimating a Production Function for World Agriculture?" *Journal of Economic Development* 13(1988): 7-19.

This study attempted to address implausible regression results obtained by Kawagoe-Hayami-Ruttan (1985) and other intercountry production function studies. For instance, Lau and Yotopolous argued that it was not likely that in the developed countries that general education (a human capital variable) could have a negative partial elasticity of output; nor was it plausible that with pooled data that the developing countries as a group regressed 22 and 43 percent from 1960-1970 and 1960-1980, respectively (inward shifts of the production function). Lau and Yotopolous argued that these peculiarities could be traced to a sample in which the observations were closely clustered together, thereby lacking sufficient variation for a reliable linear fit. To overcome this problem, the authors used first differences for the pooled Hayami-Ruttan database observations. Subsequently, the authors rejected the Cobb-Douglas functional form, favoring the translog form instead. They found that the returns to scale vary in each country according to a country's ability to exploit mechanization (that is, only the second order machinery variable was found to be statistically significant along with the first order terms).

Oskam, Arie. "Productivity Measurement, Incorporating Environmental Effects of Agricultural Production." *Agricultural Economics and Policy: International Challenges for the Nineties (Essays in Honour of Prof. Jan De Veer),* ed. K. Burger, M. De Groot, J. Post, and V. Zachariasse, pp. 186-204. Amsterdam: Elsevier, 1991.

This study appears to be the first one that attempts to incorporate (negative) externalities into productivity analysis at the aggregate level (Netherlands). Oskam cites possible sources of externality effects in agriculture: air pollution, surface water pollution, groundwater pollution, soil

pollution, landscape attractiveness, and nature conservation. Theoretically, indices used in productivity analysis with externalities can be modified by acknowledging that besides producing the desired output good, there is also produced an accompanying side effect (whether positive or negative externalities) (see Pittman, 1983). That is, the new output is defined as $(\mathbf{p}'\mathbf{y} + \mathbf{v}'\mathbf{z})$, where $\mathbf{p}'$ is an output price vector, $\mathbf{y}$ the output quantity vector, and $\mathbf{v}'$ a shadow price vector for the associated externality quantity output vector $\mathbf{z}$. The quantitative negative externalities were estimated for pollution of air, surface water, ground water, and soils using technical procedures. Since shadow prices were not readily observable, alternative prices scenarios were tested (low, medium, and high prices). The final results show that MFP was lowered by 2 to 10 percent compared to results without negative externalities included.

Arnade, Carlos A. *Productivity of Brazilian Agriculture: Measurement and Uses*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Staff Report No. AGES 9219, July 1992.

This report study appears to be the first published multifactor productivity (MFP) study for the agricultural sector of a Latin American country. Under the assumption of constant returns to scale, MFP grew at an annual rate of 2.57 percent per year over the 1968-1987 period; allowing non-contant returns to scale, MFP grew at an annual rate of 1.17 percent per year. The study uses an Tornqvist index approach. Thorough documentation is provided of the data sources. Output indices are constructed for 62 crop and livestock products, while 49 inputs are aggregated into 8 categories. The data were combined from a variety of sources, including United Nations Food and Agriculture Organization, World Bank, Inter-American Institute for Cooperation in Agriculture, Brazilian Government yearbooks, and U.S. Department of Agriculture. Importantly, most of the price data for constructing the indices come from the Getulio Vargas Foundation and are incomplete for a few commodities, requiring the author to make some educated guesses on prices.

Luh, Yir-Hueih and Spiro E. Stefanou. "Learning-By-Doing and the Sources of Productivity Growth: A Dynamic Model with Application to U.S. Agriculture." *The Journal of Productivity Analysis* 4(1993): 353-370.

Luh and Stefanou argue in this article that shifts in the U.S. agricultural production function have been largely attributable to learning-by-doing. Using a dynamic optimization framework, Luh and Stefanou decompose production function shifts into four components: technical change, scale economies, disequilibrium effects, and learning-by-doing. The data used in the study are from Capalbo, Vo, and Wade (1985), with the learning-by-doing variable proxied by accumulated current gross investment in durable equipment and labor. Estimates with a modified generalized Leontief production function show that MFP grew at a slower rate (1.31 percent per year) than other studies report, with learning-by-doing and technical change representing almost 90 percent of the growth.

Thirtle, C. et al. "Agricultural Productivity in Zimbabwe, 1970-90." *The Economic Journal* 103(1993): 474-480.

This study represents the first multifactor productivity study for a country in Sub-Saharan Africa. Since this study, there have been two other working papers on MFP growth rates for Sub-Saharan African countries: one on Kenya (Njue and Fox, 1993) and one on South Africa (Thirtle, von Bach, and van Zyl, 1993). Lack of analysis on Sub-Saharan Africa countries is the motivating force behind the study by Block, 1993. The authors argue that Zimbabwe's national accounts are similar to the United Kingdom, allowing the authors to use a methodology developed by Thirtle and Bottomley for that country. These authors estimate MFP growth rates with Tornqvist indices for the

separate (dualistic) commercial and communal agricultural sub-sectors. They find that MFP growth rates are impressive for both sub-sectors: the commercial sub-sector grew at 3.43 percent per year for the 1970-89 period and the communcal sub-sector grew at 4.64 percent per year for the 1975-90 period.

Arnade, Carlos A. *Using Data Envelopment Analysis to Measure International Agricultural Efficiency and Productivity*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Technical Bulletin No. 1831, February 1994.

This recent report uses "data envelopment analysis" (DEA) to measure technical efficiency and multifactor productivity for 77 countries. The technical efficiency concept relates observed production points to best-practice observation points for production units at any time period (the "distance function"). The multifactor productivity component relates overall changes of outputs to inputs over time for a given production unit. These two concepts are captured in the Malmquist index initially developed theoretically by Caves, Christensen, and Diewert and later refined by Färe and others. Countries were divided into four categories by the author: advanced technology, middle technology, low technology, and Asian rice technology. Within these categories, the countries' technical efficiency is measured relative to the "best-practice" countries for each 3 year average increment. Overall MFP indices for each country are also given relative to the 1961-1963 base period, as well as the technical change component of MFP. The data are taken from ERS'*World Agriculture: Trends and Indicators*, which uses stock data only.

Pardey, Philip G., Barbara J. Craig, and Klaus Deininger. "A New Look at State-Level Productivity Growth in U.S. Agriculture." *Evaluating Agricultural Research and Productivity in an Era of Resource Scarcity*, ed. W. Burt Sundquist. Department of Agricultural and Applied Economics Staff Report P94-2, University of Minnesota, 1994.

This recent article revises the MFP growth rate calculations in the Deininger Ph.D. dissertation, which was given an honorable mention award by the AAEA for best dissertation in 1993. The dissertation examines multifactor productivity using disaggregated state level data, a significant improvement from official ERS aggregate data. Furthermore, the dissertation examines the diffusion of nationally available technology and whether there has been a convergence of productivity growth rates. Another topic addressed is the role of (lagged) R&D as an explanatory variable for technical change. Pardey et al. find that MFP grew at 1.59 percent per year over the 1949-1985 period. A very similar study by Huffman and Evenson (see Other Productivity Studies) came out at about the same time as the Deininger dissertation; Huffman and Evenson found that MFP grew at 1.84 percent per year over the 1950-1952 period. ERS is in the process of revising of its productivity methodology again, this time to use dissaggregated data like the Pardey et al. and the Huffman and Evenson studies (preliminary results are available in Ball et al., 1994).

U.S. Department of Commerce. "Integrated Economic and Environmental Satellite Accounts," *Survey of Current Business*, April 1994, pp. 33-49.

This article explains the Commerce Department's commitment to develop new auxillary GDP statistics; that is, GDP statistics that allow for environmental and resource use accounting. These new auxillary statistics will not substitute for the existing GDP statistics, but rather will complement them. This new commitment reflects the Clinton's Administration's interest in producing so-called "green GDP" statistics, which partly was a result of the Earth Day summit in Brazil. Two proposed supplementary GDP tables are given in the text, with a detailed explanation of those statistics that are currently available and those that are not. There will be some experimentation for statistics that are not currently available and are subject to much valuation debate (for example, renewable

resources such as fish stocks). A companion article on minerals highlights some of the valuation issues and how these issues affect the supplementary GDP figures. This article also provides an excellent history of proposals to revise GDP statistics.

Table 1 - An overview of MFP growth rate esimates for different countries' agricultural sectors

COUNTRY	Author(s)	Period	Growth Rate
AUSTRALIA	Young (1971)	1948-1967	1.9
BRAZIL	Arnade (1992)	1968-1987	2.57
BULGARIA	Wong (1986)	1960-1980	-0.90
CANADA	Furniss (1970)	1949-1969	1.90
	Danielson (1975)	1946-1970	1.97
	McInnis (1980)	1871-1921	0.77 to 0.87
	Tung and Strain (1985)	1961-1980	1.66
	Agriculture Canada (1992)	1961-1990	2.14
	Veeman and Fantino (19920	1962-1990	1.25
CHINA,	Tang and Stone (1980)	1952-1977	-.60
PEOPLE'S REP.	Wiens (1980)	1952-1977	-1.55 to 0.53
	Tang and Huang (1980)	1952-1979	-0.35
	Wong (1986)	1960-1980	-3.14
	Fan (1990)	1965-1986	1.14
CZECHO-			
SLOVAKIA	Wong (1986)	1960-1980	0.17
GERMANY,			
FED. REP.	Weber (1973)	1950-1968	2.0
GERMAN			
DEM. REP.	Wong (1986)	1960-1980	0.83
HUNGARY	Wong (1986)	1960-1980	-0.19
INDIA	Galgalikar and Alshi (1987)	1951-1981	1.1
	Rosegrant and Evenson (1993)	1956-1985	1.01
INDONESIA	Ahmad (1982)	1950-1978	0.60
	Reksasudharma (1987)	1951-1980	0.5
ITALY	De Meo (1966)	1951-1963	4.40
	Barbero (1974)	1951-1970	2.09
JAPAN	Yamada and Hayami (1979)	1880-1965	0.9
	Yamada (1982)	1880-1975	1.0
	Yamada (1987)	1945-1980	1.7
KENYA	Njue and Fox (1993)	1964-1989	-0.58
KOREA,	Ban (1979)	1920-1969	0.52
REP. OF	Ban (1982)	1946-1977	2.00
	Ban (1987)	1946-1980	2.52
NETHERLANDS	Oskam (1991)	1949-1988	2.06
PAKISTAN	Ahmed (1987)	1950-1983	1.10
	Rosegrant and Evenson (1987)	1956-1985	1.07
PHILIPPINES	Lawas (1965)	NA	NA
	Hooley (1968)	1902-1961	Unclear
	Paris (1971)	1948-1967	0.4
	Crisostomo (1972)	NA	NA
	David and Barker (1979)	1950-1969	0.7
	David et al. (1987)	1955-1980	0.9
POLAND	Wong (1986)	1960-1980	-3.25
	Gemma (1989)	1950-1986	1.25,5.56
ROMANIA	Wong (1986)	1960-1980	-1.67
SOUTH AFRICA	Thirtle, von Bach, and van Zyl (1993)	1947-1991	1.3
SPAIN	Evenson et al. (1993)	1962-1989	2.57
TAIWAN	Hsieh and Lee (1958)	1945-1956	5.80
	Hseih and Lee (1966)	1950-1960	2.19
	Lee and Chen (1979)	1913-1970	0.7
	Chen and Wang (1982)	1913-1977	1.0
	Shih (1982)	1901-1942	1.0
	Chen (1987)	1951-1981	1.6
THAILAND	Wannitikul (1972)	1950-1969	2.00
	Tananasanta et al (1978)	1950-1976	Unclear
	Thanomvongtai (1984)	NA	NA
	Budhaka (1987)	1951-1981	2.6
UNITED KINGDOM	Thirtle and Bottomley (1992)	1967-1990	1.88
UNITED STATES	Barton and Loomis (1961)	1870-1956	0.80
	Brown (1978)	1947-1974	1.42
	Kendrick (1983)	1948-1979	3.50
	Ball (1984)	1948-1979	1.75
	Capalbo-Vo (1988)	1950-1983	1.22
	Capalbo (1988)	1950-1983	1.4 to 1.6
	Cox-Chavas (1990)	1950-1983	1.89
	Jorgenson (1990)	1948-1979	1.61
	USDA/ERS (1991)	1948-1989	1.58
	USDA/BLS	1948-1990	3.06
	Luh and Stefanou (1993)	1950-1982	1.31
	Huffman and Evenson (1993)	1950-1982	1.84
	Pardey et al. (1994)	1949-1985	1.59
U.S.S.R.	Wong (1986)	1960-1980	-1.69
ZIMBABWE	Thirtle et al. (1993)	1970-1989	3.43, 4.64

Other Productivity Studies

Ahmad, Ismet. "Indonesian Agricultural Productivity And Its Relation to Development Strategy: A Value-Added Approach." Ph.D. Thesis, University of Florida, 1982.

Ahmad, Syed and Atif Abdallah Kurbursi. "Induced Adjustment and the Role of Agriculture in Economic Development: A Case Study of Egypt and Syria." Department of Economics Staff Paper 77-20, McMaster University, December 1977.

Ahmed, S. Ismal. "Pakistan," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 381-408. Tokyo: Asian Productivity Organization, 1987.

Ball, V. Eldon, James Matson, and Agapi Somwaru. "Agricultural Productivity Revisited." Washington, DC: U.S. Department of Agriculture, Economic Research Service, Unpublished monograph, 1994.

Ball, V. Eldon. *Measuring Agricultural Productivity: A New Look*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Staff Report No. AGES 840330, 1984.

Ban, Sung Hwan. "Agricultural Growth in Korea, 1918-1971." *Agricultural Growth in Japan, Taiwan, Korea, and the Philippines*, ed. Y. Hayami, V. Ruttan, and H. Southworth, pp. 90-116. Honolulu: The University Press of Hawaii, 1979.

Ban, Sung-Hwan. "The Growth of Agricultural Output and Productivity in Korea, 1918-1978." *Agricultural Development in China, Japan, and Korea*, ed. Chi-Ming Hou and Tzong-shian Yu, pp. 171-194. Taipei, Taiwan, Republic of China: Academia Sinica, 1982.

Ban, Sung Hwan. "Korea," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 339-380. Tokyo: Asian Productivity Organization, 1987.

Barbero, Giuseppe. "Produttivita e Progresso Technio Nell'agricoltura Italiano 1951-1970." *Rivista di Economia Agraria* 29(1971): 55-95.

Behrens, R. and H. DeHaen. "Aggregate Factor Input and Productivity in Agriculture: A Comparison for the EC-Member Countries, 1963-76." *European Review of Agricultural Economics* 8(1980): 109-146.

Bhattacharjee, Jyoti. "Resource Use and Productivity in World Agriculture." *Journal of Farm Economics* 37(1955): 57-71.

Block, Steven Abraham. "Agricultural Productivity in Sub-Saharan Africa." Ph.D. Thesis, Harvard University, 1993.

Boyd, M.L. "The Performance of Private and Co-operative Socialist Organization: Postwar Yugoslav Agriculture." *Review of Economics and Statistics* 69(1987): 205-214.

Budhaka, Boonkerd. "Thailand," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 439-484. Tokyo: Asian Productivity Organization, 1987.

Bureau, J-C., R. Färe, and S. Grosskopf. *Non-parametric Measures of Productivity Growth in*

European and United States Agriculture. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Working Paper, 1993.

Bureau, J-C. and J-P. Butault. "Productivity Gaps, Price Advantages, and Competitiveness in E.C. Agriculture." *European Review of Agricultural Economics* 19(1992): 25-48.

Bureau, J.C., J.P. Butault, and A. Barkaoui. "Productivity Gaps Between European and United States Agriculture." *Measuring Agricultural Productivity and Related Data for Regional, National, and International Comparisons*, ed. Shankar Narayanan and Joseph King, pp. 68-87. Ottawa: Agriculture Canada, Farm Development Policy Directorate, October, 1992.

Capalbo, Susan and Trang T. Vo. "A Review of the Evidence on Agricultural Productivity and Aggregate Technology," *Agricultural Productivity: Measurement and Explanation*, ed. Susan Capalbo and John Antle, pp. 96-137. Washington, DC: Resources for the Future, 1988.

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

Capalbo, Susan. "A Comparison of Econometric Models of U.S. Agricultural Productivity and Aggregate Technology." *Agricultural Productivity: Measurement and Explanation*, ed. Susan Capalbo and John Antle, pp. 157-188. Washington, DC: Resources for the Future, 1988.

Chen, Yueh-eh and You-tsao Wang. "Secular Trends of Output, Inputs, and Productivity: A Quantitative Analysis of Agricultural Development in Taiwan." *Agricultural Development in China, Japan, and Korea*, ed. Chi-Ming Hou and Tzong-shian Yu, pp. 519-580. Taipei, Taiwan, Republic of China: Academia Sinica, 1982.

Chen, Yueh-eh. "China, Rep. of," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 133-193. Tokyo: Asian Productivity Organization, 1987.

Cox, Thomas L. and J.P. Chavas. "A Non-parametric Analysis of Productivity: The Case of U.S. Agriculture." *European Review of Agricultural Economics* 17(1990): 449-464.

Craig, Barbara J., Philip G. Pardey, and Johannes Roseboom. "International Agricultural Productivity Patterns." Center for International Food and Agricultural Policy Working Paper WP94-1, University of Minnesota, February 1994.

Craviolatti, P. et al. "Policy Induced Innovation: Accounting for Agricultural Productivity Growth in Sub-Saharan Africa." *Conference Paper, Development Studies Association*, University of Nottingham, Sept. 1992.

Crisostomo, C. "Sources of Output Growth in Philippine Agriculture, 1948-1968." M.S. Thesis, University of the Philippines, 1972.

Danielson, Robert S. *Productivity Growth in Canadian Agriculture*. Canada: Department of Manpower and Immigration, Strategic Projects Group, March 1975.

David, Cristina Crisostomo and Randolph Barker, "Agricultural Growth in the Philippines, 1948-

1971," *Agricultural Growth in Japan, Taiwan, Korea, and the Philippines*, ed. Y. Hayami, V. Ruttan, and H. Southworth, pp. 117-142. Honolulu: The University Press of Hawaii, 1979.

David, C.C., R. Barker, and A. Palacpac. "Philippines," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 409-438. Tokyo: Asian Productivity Organization, 1987.

De Meo, Giuseppe. "Productivity and the Distribution of Income to Factors in Italy (1951-63)." *Banca Nazionale del Lavoro Quarterly Review* 76(1966): 1-32.

Deininger, Klaus. "Technical Change, Human Capital, and Spillovers in U.S. Agriculture, 1949-85: An Empirical Analysis." Ph.D. Thesis, University of Minnesota, 1994.

Evenson, Robert and Yoav Kislev. *Agricultural Research and Productivity*. New Haven: Yale University Press, 1975.

Evenson, Robert, M. Carmen Fernandez, and A. Casimiro Herruzo. "Measurement of the Total Factor Productivity of Spanish Agriculture: 1962-1989." Economic Growth Center Discussion Paper No. 708, Yale University, December 1993.

Evenson, R.R. and C.E. Pray, ed. *Research and Productivity in Asian Agriculture*. Ithaca: Cornell University Press, 1991.

Fan, Shenggen. *Regional Productivity Growth in China's Agriculture*. Boulder, CO: Westview Press, Inc., 1990.

Färe, R., R. Grabowski, and S. Grosskopf. "Technical Efficiency of Philippine Agriculture." *Applied Economics* 17(1985): 205-214.

Färe, Rolf. "Returns to Scale and Size in Agricultural Economics: Comment." *Western Journal of Agricultural Economics* 13(1988): 149-150.

Furniss, I.F. "Agricultural Productivity in Canada: Two Decades of Gains." *Canadian Farm Economics* 5(1970): 16-27.

Galgalikar, V.D. and M.R. Alshi. "India," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 195-224. Tokyo: Asian Productivity Organization, 1987.

Gemma, Masahiko. "Reforming Polish Agriculture: Productivity Growth and Market Behavior of Socialized and Private Farms." Ph.D. Thesis, University of Minnesota, 19889.

Gollop, Frank M. "U.S. Productivity Growth by Industry, 1947-1973." Ph.D. Thesis, Harvard University, 1974.

Griliches, Zvi. "Estimates of the Agricultural Production Function from Cross-Sectional Data." *Journal of Farm Economics* 45(1963): 419-428.

Griliches, Zvi. "Research Expenditures, Education, and the Aggregate Production Function." *American Economic Review* 54(1964): 962-974.

Haley, Stephen L. and Philip C. Abbott. "Estimation of Agricultural Production Functions on a

World-Wide Basis." *Canadian Journal of Agricultural Economics* 34(1986): 433-454.

Hayami, Yujiro and Vernon W. Ruttan. "Factor Prices and Technical Change in Agricultural Development: The United States and Japan, 1880-1960." *Journal of Political Economy* 78(1970): 1115-1141.

Hayami, Yujiro and Vernon W. Ruttan. *Agricultural Development: An International Perspective* (2nd ed.). Baltimore: The Johns Hopkins University, 1985.

Hayami, Y., V. Ruttan, and H. Southworth, ed. *Agricultural Growth in Japan, Taiwan, Korea, and the Philippines*. Honolulu: East West Center, 1979.

Hofler, R.A. and J.E. Payne. "Efficiency in Socialist Versus Private Agricultural Production: The Case of Yugoslavia." *Review of Economics and Statistics* 73(1993): 153-157.

Hooley, R. "Long-Term Economic Growth of the Philippine Economy, 1902-1961." *The Philippine Economic Journal* 7(1968): 1-24.

Hsieh, S.C. and T.H. Lee. *Agricultural Development and Its Contributions to Economic Growth in Taiwan*. Taipei, Taiwan, China: Chinese-American Joint Commission on Rural Reconstruction, Economic Digest Series No. 17, 1966.

Huffman, Wallace E. and Robert Evenson. *Science for Agriculture: A Long-Term Perspective.* Ames, IO: Iowa State University Press, 1993.

Jorgenson, Dale W., Frank M. Gollop, and Barbara M. Fraumeni. *Productivity and U.S. Economic Growth*. Boston: Harvard University Press, 1987.

Jorgenson, Dale W. and Frank M. Gollop. "Productivity Growth in U.S. Agriculture: A Postwar Perspective." *American Journal of Agricultural Economics* 74(1992): 745-750.

Kawagoe, Toshiko, Yujiro Hayami, and Vernon W. Ruttan. "The Intercountry Agricultural Production Function and Productivity Differences Among Countries." *Journal of Development Economics* 17(1985): 113-132.

Kendrick, John W. and Elliot S. Grossman. *Productivity in the United States: Trends and Cycles*. Baltimore: Johns Hopkins University Press, 1980.

Kendrick, John W. *Interindustry Differences in Productivity Growth*. Washington, DC: American Enterprise Institute, 1983.

Kostrowicka, Irena. "Changes in Agricultural Productivity in the Kingdom of Poland in the XIXth and Early XXth Centuries." *Journal of Economic History* 44(1984): 75-97.

Lau, Lawrence J. and Pan A. Yotopolous. "The Meta-Production Function Approach to Technological Change in World Agriculture." *Journal of Development Economics* 31(1989): 241-269.

Lawas, J. "Output Growth, Technical Change, and Employment of Resources in Philippine Agriculture: 1948-1975." Ph.D. Thesis, Purdue University, 1965.

Lee, Teng-hui and Yueh-eh Chen. "Agricultural Growth in Taiwan, 1911-1972." *Agricultural Growth*

in Japan, Taiwan, Korea, and the Philippines, ed. Y. Hayami, V. Ruttan, and H. Southworth, pp. 59-89. Honolulu: The University Press of Hawaii, 1979.

Lok, Siepko H. "An Inquiry Into the Relationships Between Changes in Overall Productivity and Real Net Return Per Farm, and Between Change in Total Output and Real Gross Return, Canadian Agriculture, 1926-1957." Ph.D. Thesis, Michigan State University, 1961.

Loomis, R.A. and G.T. Barton. *Productivity of Agriculture*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Technical Bulletin No. 1238, 1961.

Mark, Jerome A. and William H. Waldorf. "Multifactor Productivity: A New BLS Measure,"*Monthly Labor Review*. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, 1983: 3-15.

McInnis, R.M. "Output and Productivity in Canadian Agriculture, 1870-71 to 1926-27." *Long-Term Factors in American Economic Growth*, ed. Stanley L. Engerman and Robert E. Gallman, pp. 737-770. Chicago: The University of Chicago Press, 1986.

Mundlak, Yair and Rene Hellinghausen. "The Intercountry Agricultural Production Function: Another View." *American Journal of Agricultural Economics* 64(1982): 664-672.

Narain, Dharm. "Growth of Productivity in Indian Agriculture." *Studies on Indian Agriculture: Dharm Narain*, ed. K.N. Raj, Amartya Sen, and C.H. Hanumantha Rao, pp. 129-181. Delhi: Oxford University Press, 1988.

Narayanan. Shankar and Joseph King. ed. *Measuring Agricultural Productivity and Related Data for Regional, National, and International Comparisons*. Ottawa: Agriculture Canada, Farm Development Policy Directorate, October, 1992.

Nguyen, Dung. "On Agricultural Productivity Differences Among Countries." *American Journal of Agricultural Economics* 61(1979): 565-570.

Njue, Evelyn and Glenn Fox. "Productivity in Kenyan Agriculture: 1964-1989." Department of Agricultural Economics and Business Working Paper WP93/02, University of Guelph, January 1993.

Paris, T.B. Jr. "Output, Inputs, and Productivity of Philippine Agriculture, 1948-1967." M.S. Thesis, University of the Philippines, 1971.

Piesse, J., C. Thirtle, and J. Turk. "The Productivity and Efficiency of Private and Social Farms: A Non-Parametric Analysis of Slovene Dairying Enterprises." *Unpublished Monograph*, 1994.

Rao, D.S. Prasada. *Intercountry Comparisons of Agricultural Output and Productivity*. Rome, Italy: United Nations Food and Agriculture Organization, 1992.

Reca, Lucio Graciano. "The Price and Production Duality Within Argentine Agriculture, 1923-1965." Ph.D. Thesis, The University of Chicago, 1967.

Reksasudharma, Chris. "Indonesia," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 225-262. Tokyo: Asian Productivity Organization, 1987.

Resnick, S. "The Decline of Rural Industry Under Export Expansion: A Comparison Among Burma,

Philippines, and Thailand, 1870-1938." *Journal of Economic History* 30(1970): 51-73.

Rosegrant, Mark W. and Robert E. Evenson. "Agricultural Productivity Growth in Pakistan and India: A Comparative Analysis." *The Pakistan Development Review* 32(1993): 433-451.

Ruttan, Vernon W. "Agricultural and Non-Agricultural Growth in Output Per Unit of Input." *Journal of Farm Economics* 39(1957): 1566-1576.

Ruttan, Vernon W. *Technological Progress in the Meatpacking Industry, 1919-47*. Washington, DC: U.S. Department of Agriculture, Marketing Research Report No. 59, 1954.

Scandizzo, Pasquale L. *Agricultural Growth and Factor Productivity in Developing Countries*. Rome: United Nations Food and Agriculture Organization, Economic and Social Development Paper #42, Rome, 1984.

Schultz, Theodore W. *Economic Organization of Agriculture*. New York: McGraw Hill, 1953.

Shih, Jhi-tzeng. "Technical Bias, Relative Prices, and Factor Shares in Prewar Taiwan Agriculture." *Agricultural Development in China, Japan, and Korea*, ed. Chi-Ming Hou and Tzong-shian Yu, pp. 465-517. Taipei, Taiwan, Republic of China: Academia Sinica, 1982.

Shoemaker, Robbin A. "Productivity and Technological Change in U.S. Agriculture: A Decomposition Analysis, 1950-1980." M.S. Thesis, University of Maryland, 1984.

Stout, Thomas T. and Vernon W. Ruttan. "Regional Patterns of Technological Change in American Agriculture." *Journal of Farm Economics* 40(1958): 196-207.

Tang, Anthony M. and Cliff J. Huang. "Changes in Input-output Relations in the Agriculture of the Chinese Mainland, 1952-1979." *Agricultural Development in China, Japan, and Korea*, ed. Chi-Ming Hou and Tzong-shian Yu, pp. 319-348. Taipei, Taiwan, Republic of China: Academia Sinica, 1982.

Tang, Anthony M. "Trend, Policy Cycle, and Weather Disturbance in Chinese Agriculture, 1952-1978." *American Journal of Agricultural Economics* 62(1980): 339-348.

Tasanasanta, Damrongsak P. "Sources of Agricultural Output and Productivity Growth in Thailand." Ph.D. Thesis, Washington State University, 1978.

Terluin, Ida J. *Comparison of Real Output, Productivity, and Price Levels in Agriculture in the EC - A Reconnaissance*. The Hague, The Netherlands: Agricultural Economics Research Institute LEI, 1990.

Thanomvongtai, Prapaporn. "Productivity Growth of Agriculture in Thailand, 1951-1981." M.S. Thesis, Kasetsart University, 1984.

Thirtle, C., D. Hadley, and J-C. Bureau. "Productivity Comparisons and the Returns to R&D in EC Agriculture." *Conference Paper, "Strengthening Endogenous Development Patterns in European Agriculture,"* Chania, Crete, Oct. 1992.

Thirtle, Colin and Paul Bottomley. "Total Factor Productivity in UK Agriculture, 1967-1990."

Journal of Agricultural Economics 43(1992): 381-400.

Thirtle, Colin et al. "Endogenous Agricultural Growth in Sub-Saharan Africa: A Multilateral Malmquist Productivity Index Approach." *Unpublished Monograph*, 1994.

Thirtle, C., H. Sartorious von Bach and J. van Zyl. "Explaining Total Factor Productivity in South African Agriculture, 1947-1991." Department of Economics and Department of Agricultural Economics Discussion Paper No. 7 (Series G, Volume I), University of Reading, 1993.

Toutain, J.C. *Le Produit de'Agriculture Française, 1700 à 1958: Estimation de produit au XVII Siècle*. Paris: L'Institute de Science Economique Appliquée, 1961.

Trueblood, Michael A. *Agricultural Production Functions Estimated From Aggregate Intercountry Observations: A Selected Survey*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Staff Report No. AGES 9132, 1991.

Trueblood, Michael A. and Vernon W. Ruttan. "A Comparison of Multifactor Productivity Calculations of the U.S. Agricultural Sector." Department of Agricultural and Applied Economics Staff Paper P92-29, University of Minnesota, 1992.

Tung, Fu-Lai and G. Strain. "Research, Technology and Productivity Change in Canadian Agriculture." *Canadian Farm Economics*, 21(1987): 37-43.

U.S. Department of Labor, Bureau of Labor Statistics. *Unpublished computer run on U.S. Agricultural Multifactor Productivity, 1948-1990*, 1992.

U.S. Department of Agriculture. *Economic Indicators of the Farm Sector: Production and Efficiency Statistics, 1989*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, ECIFS 9-4, 1991.

U.S. Department of Labor. "Trends in Multifactor Productivity, 1948-1981." *Bureau of Labor Statistics, Bulletin 2178*, 1983.

van Oostroom, H. and Angus Maddison. "An International Comparison of Levels of Real Output and Productivity in Agriculture in 1975." Institute of Economic Research, Research Memorandum No. 192, University of the Groningen, The Netherlands, 1984.

Veeman, Terrence and A. Fantino. "Empirical Measurement of Multifactor Productivity in Canadian Agriculture." *Measuring Agricultural Productivity and Related Data for Regional, National, and International Comparisons*, ed. Shankar Narayanan and Joseph King, pp. 108-117. Ottawa: Agriculture Canada, Farm Development Policy Directorate, October, 1992.

Wade, William W. *Institutional Determinants of Technical Change and Agricultural Productivity Growth: Denmark, France, and Great Britain, 1870-1965*. Ph.D. Thesis, University of Minnesota, 1973.

Wannitikul, Wilaiwan. "Productivity Growth in Thailand: 1950-1968." M.S. Thesis, Thamasat University, 1972.

Weber, Adolf and Marquard Gregersen. "The Changing Productivity Structure of the World's Cattle

Industry in the Course of Economic Development." *Zeitschrift für ausländische Landwirtschaft* 16(1977): 285-314.

Weber, Adolf. "Productivity Growth in German Agriculture: 1850 to 1970." Department of Agricultural and Applied Economics Staff Paper P73-1, University of Minnesota, August 1973.

Wiens, Thomas B. "Declining Total Factor Productivity? A Counterview." *Unpublished monograph*, 1980.

Yamada, Saburo. "Japan," *Productivity Measurement and Analysis: Asian Agriculture*, pp. 263-338. Tokyo: Asian Productivity Organization, 1987.

Yamada, Saburo and Yujiro Hayami. "Agricultural Growth in Japan, 1880-1970." *Agricultural Growth in Japan, Taiwan, Korea, and the Philippines*, ed. Y. Hayami, V. Ruttan, and H. Southworth, pp. 33-58. Honolulu: The University Press of Hawaii, 1979.

Yamada, Saburo and Vernon W. Ruttan. "International Comparisons of Productivity in Agriculture." *New Developments in Productivity Measurements*, ed. J. Kendrick and Beatrice Vaccara, pp. 509-585. Chicago: University of Chicago Press, 1980.

Yamada, Saburo. "The Secular Trends in Input-output Relations of Agricultural Production in Japan, 1878-1978." *Agricultural Development in China, Japan, and Korea*, ed. Chi-Ming Hou and Tzong-shian Yu, pp. 23-96. Taipei, Taiwan, Republic of China: Academia Sinica, 1982.

Young, R. "Productivity Growth in Australian Rural Industries." *Quarterly Review of Agricultural Economics* 24(1971): 185-205.

Studies Involving Externalities and Productivity or Environmental Accounting

Archibald, Sandra. "Incorporating Externalities Into Productivity Analysis." *Agricultural Productivity: Measurement and Explanation*, ed. S. Capalbo and J. Antle, pp. 366-393. Washington, DC: Resources for the Future, 1988.

Antle, John M and T. McGuckin. "Technological Innovation, Agricultural Productivity, and Environmental Quality." *Agricultural and Environmental Resource Economics*, ed. G.A. Carlson, D. Zilberman, and J.A. Miranowski, pp. 175-220. New York: Oxford University Press, 1993.

Antle, John M. and Prabhu L. Pingali. *Pesticides, Productivity, and Farmer Health: A Philippine Case Study.* Washington, DC: Resources for the Future, Discussion Paper QE 93-10, 1993.

Crosson, Pierre. "An Income and Product Account Perspective on the Sustainability of U.S. Agriculture." Working paper presented at University of Minnesota, 1993.

Ehui, Simeon K. and Dunstan S.C. Spencer. "Measuring the Sustainability and Economic Viability of Tropical Farming Systems: A Model from Sub-Saharan Africa." *Agricultural Economics*, 9(1992): 279-296.

Färe, Rolf et al. "Multilateral Productivity Comparisons When Some Outputs are Undesirable: A Nonparametric Approach." *Review of Economics and Statistics* 71(1989): 90-98.

Färe, Rolf et al. "Derivation of Shadow Prices for Undesirable Outputs: A Distance Function Approach." *Review of Economics and Statistics* 75(1993): 374-380.

Gray, Wayne B. and Ronald J. Shadbegian. *Environmental Regulation and Manufacturing Productivity at the Plant Level.* NBER Working Paper No. 4321, 1991.

Hrubovcak, J., M. LeBlanc, and K. Eakin. "Environmental Accounting and Agriculture." *Conference Paper, "Global Environmental Change and Agriculture: Assessing the Impacts,"* Washington, DC, 1994.

Kim, Jeong-In. "Environmental Accounting in a SAM Framework: The Case of Mexico." Ph.D. Thesis, University of Minnesota, 1993.

McEvily, Sue. "The Need for Environmental Accounting: Critical Review of Proposed Methods for Modifying National Income and Product Accounts." Unpublished monograph, University of Minnesota, 1992.

Pittman, Russel W. "Multilateral Productivity Comparisons With Undesirable Outputs." *The Economic Journal* 93(1983): 883-891.

Repetto, Robert. "Balance Sheet: Incorporating Natural Resources in National Income Accounts." E*nvironment*, September 1992, pp. 13-20.

Repetto, Robert et al. *Wasting Assets: Natural Resources in the National Income Assets*. Washington, DC: World Resources Institute, 1989.

World Resources Institute. *Accounts Overdue: Natural Resource Depreciation in Costa Rica.*

Washington, DC, 1991.

Related References: Method and Data

Ahn, Byung-Joon. "The Political Economy of the People's Commune in China: Changes and Continuities." *Journal of Asian Studies*, 34(1975): 631-658.

Alston, J., J. Anderson, and P. Pardey. "Perceived Productivity, Foregone Future Farm Fruitfulness, and Rural Research Resource Rationalization." *Conference Paper, Internatonal Conference of Agricultural Economists*, Harare, Zimbabwe, August, 1994.

Aly, H. and R. Grabowski. "Measuring the Rate and Bias of Technical Innovation in Japanese Agriculture: An Alternative Approach." *European Review of Agricultural Economics*. 16(1989): 65-81.

Antle, John M. and Susan M. Capalbo. "An Introduction to Recent Developments in Production Theory and Productivity Measurement." *Agricultural Productivity: Measurement and Explanation*, ed. Susan Capalbo and John Antle, pp. 17-95. Washington, DC: Resources for the Future, 1988.

Ball, V. Eldon. "Sources of Agricultural Economic Growth and Productivity: Discussion." *American Economic Review* 74(1992): 764-765.

Barker, Randolph. "Technology and Incentives in Chinese Agriculture." *Unpublished monograph*, 1980.

Barker, Randolph et al.. "National and Regional Trends in Grain Production in China." *Unpublished monograph*, 1980.

Brookings Institution. *The Measurement of Productivity: An Exchange of Views Between Dale W. Jorgenson and Zvi Griliches, and Edward F. Denison.* Washington, DC: Brookings Institute, Reprint 224, 1972.

Butlin, J.A. "The Effect of Canadian Business Cycles on the Adoption of Technological Innovations in Canadian Agriculture 1926/67." *Canadian Journal of Agricultural Economics* 19(1971): 61-71.

Capalbo, S., M. Denny, A. Hoque, and C.E. Overton. *Methodologies for Comparisons of Agricultural Output, Input, and Productivity: A Review and Synthesis.* Washington, DC: U.S. Department of Agriculture, Economic Research Service, Staff Report No. AGES 9122, 1991.

Caves, D., L. Christensen, and E. Diewert. "The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity." *Econometrica* 50(1982): 1393-1414.

Chambers, R.G. *Applied Production Analysis: A Dual Approach.* Cambridge: Cambridge University Press, 1988.

Charnes, A., W. Cooper, and E. Rhodes. "Measuring Efficiency of Decision Making Units." *European Journal of Operations Research* 3(1978): 363-384.

Christensen, Laurits R. "Concepts and Measurement of Agricultural Productivity" *American Journal of Agricultural Economics* 57(1975): 910-915.

Danielson, Robert S. *Output and Input Data for Canadian Agricultural 1926-1970*. Canada: Department of Manpower and Immigration, Research Projects Group, March 1975.

Danielson, Robert S. *A Canadian Agricultural Transformation Function 1946-1970: A Dual Approach*. Canada: Department of Manpower and Immigration, Research Projects Group, March 1975.

Denny, M., M. Fuss, and L. Wavermann. "The Measurement and Interpretation of Total Factor Productivity in Regulated Industries With Application to Canadian Telecommunications." *Productivity Measurement in Regulated Industries*, ed. T. Cowing and R. Stevenson, pp. 179-218. New York: Academic Press, 1981.

Diewert, Erwin. "Exact and Superlative Index Numbers." *Journal of Econometrics*, 21(1976): 115-146.

Elias, Victor J. "The Role of Total Productivity on Economic Growth." *Estudios de Economia* 20(1993): 19-47.

Falcon, Walter P. and Gerald C. Nelson. "Prospects for China's Agriculture." *Unpublished monograph*, 1978.

Färe, Rolf. *Fundamentals of Production Theory*. Berlin: Springer-Verlag, 1988.

Färe, Rolf. "The Malmquist Productivity Index and the Circular Test." CORE Discussion Paper No. 9142, Universite Catholique de Louvain, 1991.

Färe, R., S. Grosskopf, and C.A.K. Lovell, ed. *The Measurement of Efficiency of Production*. Boston, Kluwer-Nijhoff, 1985.

Färe, R. and S. Grosskopf. "Malmquist Indexes and Fisher Ideal Indexes." *Economic Journal* 102(1990): 158-160.

Färe, Rolf et al. "Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries." *American Economic Review* 84(1994): 66-83.

Färe, R., S. Grosskopf, and C.A.K. Lovell. *Production Frontier*s. Cambridge: Cambridge
University Press, 1993.

Farrell, M.J. "The Measurement of Productive Efficiency." *Journal of the Royal Statistical Society*, A 120, Part 3, (1957): 253-281.

Gerardi, Dino. "Selected Problems of Inter-Country Comparisons on the Basis of the Experience of the EEC." *The Review of Income and Wealth* 28(1982): 381-405.

Griliches, Zvi. "Measuring Inputs in Agriculture: A Critical Survey." *Journal of Farm Economics* 42(1960): 1398-1427.

Griliches, Zvi. "The Sources of Measured Productivity Growth: United States Agriculture, 1940-1960." *Journal of Political Economy* 71(1963): 331-346.

Hallam, Arne. "A Brief Overview of Nonparametric Methods in Economics." *Northeastern Journal*

of Agricultural and Resource Economics 21(1992): 98-112.

Hulten, Charles R. "Divisia Index Numbers." *Econometrica* 41(1973): 1017-1025.

Hulten, Charles R. and F.C. Wycoff. "Economic Depreciation and the Taxation of Structures in United States Manufacturing Industries: An Empirical Analysis." *The Measurement of Capital,* ed. D. Usher, pp. 83-120. Chicago: The University of Chicago Press, 1981.

Johnson, D. Gale. "The Nature of the Supply Functions for Agricultural Products." *American Economic Review* 32(1950): 539-564.

Jorgenson, Dale W. "Productivity and Economic Growth," *Fifty Years of Economic Measurement: The Jubilee Conference on Research in Income and Wealth*, ed. E. Berndt and J. Triplett, pp. 19-118. Chicago: The University of Chicago Press, 1990.

Jorgenson, D.W. and M. Nishimizu. "U.S. and Japanese Economic Growth, 1952-1974: An International Comparison." *Economic Journal* 88(1978): 707-726.

Kravis, I., R. Summers, and A. Heston. "Comments on: 'Selected Problems of the Intercountry Comparisons on the Basis of the Experience of the EEC.'" *Review of Income and Wealth* 28(1982): 407-410.

Kravis, Irving B. "A Survey of International Comparisons of Productivity." *Economic Journal* 86(1976): 1-44.

Lewis, Frank and Marvin McInnis. "The Efficiency of the French-Canadian Farmer in the Nineteenth Century." *The Journal of Economic History* 40(1980): 497-514.

Malmquist, S. "Index Numbers and Indifference Surfaces." *Trabajos de Estadistica* 4(1953): 209-242.

Mittlehammer, Ron C. et al. "Mitigating the Effects of Multicollinearity Using Exact and Stochastic Restrictions: The Case of an Aggregate Agricultural Production Function in Thailand." *American Journal of Agricultural Economics* 62(1980): 199-210.

Myers, Ramon H. "Wheat in China--Past, Present, and Future." *The China Quarterly* (1978): 297-333.

Nadiri, M. Ishaq. "Some Approaches to the Theory and Measurement of Total Factor Productivity: A
Survey." *Journal of Economic Literature* 8(1970): 1137-1178.

National Academy of Sciences. *Agricultural Production Efficiency.* Washington, DC: National Academy of Sciences, 1975.

Penson, J.B., Robert F.J. Hughes, and D.W. Romain. "Net Investment in Farm Tractors: An Econometric Analysis." *American Journal of Agricultural Economics* 63(1981): 629-635.

Rainelli, P. "Le Capital, Le Produit et Les Autres Facteurs de Production Dans L'Agriculture Francaise de 1789 a Nos Jours." *Annales d'Économie et Sociologie Rurales* 2(1973): 1-14.

Richter, Marcel K. "Invariance Axioms and Economic Indexes." *Econometrica* 34(1966): 739-755.

Schultz, Theodore W. *The Economic Organization of Agriculture*. New York: McGraw-Hill, 1983.

Shumway, C. Richard. "The Statistical Base for Agricultural Productivity Research: A Review and Critique." *Agricultural Productivity: Measurement and Explanation,* ed. Susan Capalbo and John Antle, pp. 138-156. Washington, DC: Resources for the Future, 1988.

Simula, Markku. "Productivity Differentials in the Finnish Forest Industries." *Acta Forestalia Fennica 180*. Helsinki, Finland: University of Helsinki, Faculty of Agriculture and Forestry, 1983.

Sinai, Allen and Houston H. Stokes. "Real Money Balances: An Omitted Variable From the Production Function?" *The Review of Economics and Statistics* 54(1972): 290-296.

Solow, Robert. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics* 70(1956): 65-94.

Solow, Robert. "Technical Change and the Aggregate Production Function." *Review of Economics and Statistics* 39(1957): 312-320.

Stout, Thomas T. and Vernon W. Ruttan. "Regional Patterns of Technical Change in American Agriculture." *Journal of Farm Economics* 40(1958): 196-207.

Teigen, Lloyd D., Allen G. Smith, Charles Cobb, V. Eldon Ball, and Richard Simunek. *The U.S.D.A. Productivity Indicators and Recommended Improvements.* Washington, DC: U.S. Department of Agriculture, Economic Research Service, Unpublished Report, 1982.

U.S. Department of Agriculture. *Measurement of U.S. Agricultural Productivity: A Review of Current Statistics and Proposals for Change*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Technical Bulletin No. 1614, 1980.

U.S. Congress, Joint Economic Committee. *China: A Reassessment of the Economy*. Washington, DC: U.S. Government Printing Office, July 10, 1975.

U.S. Department of Agriculture. *Economic Indicators of the Farm Sector: Production and Efficiency Statistics, 1985*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, ECIFS 5-5, 1987.

U.S. Department of Agriculture. *Major Statistical Series of the U.S. Department of Agriculture, Volume No. 2: Agricultural Production and Efficiency*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, Agricultural Handbook No. 671, 1989.

Varian, Hal R. "The Nonparametric Approach to Production Analysis." *Econometrica* 52(1984): 579-597.

Wong, John. "China's Wheat Import Programme." *Food Policy* 5(1980): 117-131.

Yorgason, Vern W. and Donald E. Spears. "The Canadian Agricultural Production Function." *Canadian Journal of Agricultural Economics* 19(1971): 66-76.

Zentner, Robert P. "An Economic Evaluation of Public Wheat Research Activities in Canada." Ph.D.

Thesis, University of Minnesota, 1982.