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Examining Cross-Country Agricultural Productivity Differences

Ebenezer O. Ogunyinka
PhD Candidate
Department of Agricultural Economics
Kansas State University, 332D Waters Hall, Manhattan 66506, Kansas
email: eogun@agecon.ksu.edu

Michael R. Langemeier
Professor
Department of Agricultural Economics
Kansas State University, 346 Waters Hall, Manhattan 66506, Kansas
email: mlange@agecon.ksu.edu

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Abstract

This paper computes Malmquist agricultural productivity indexes for 125 countries over the period 1961-2001. These are decomposed into efficiency change (i.e., pure technical efficiency and scale efficiency changes) and technical change (i.e., input bias and magnitude components). Results show that developing and developed countries derive their growth from efficiency change and technical change, respectively. Input bias technical change is evident for both developing and developed countries.

1.0 Introduction

Empirical analysis of international productivity is important for a couple of reasons. First, these studies are useful in determining which countries have a competitive advantage. Second, these studies are helpful in determining whether countries that had a competitive disadvantage in the past are catching up to countries on the world production frontier. If a country is catching up it will have a positive efficiency change over time. The degree of catching up or the efficiency change can be related to institutional factors, and domestic and trade policies of specific countries.

The objective of this paper was to measure and compare agricultural productivity growth across countries. Also, the relative importance of technical and efficiency changes in explaining productivity growth will be examined.

The paper is organized as follows. Section 2 presents a review of relevant past studies, and methodologies used. The empirical model and the sources of data used are discussed in section 3. In section 4, the research findings are presented and discussed. Finally, section 5 summarizes the paper and discusses the implications of the findings.

2.0 Literature Review

Solow (1956; 1957) was one of the first economists to quantify productivity changes. Using a production function and Euler's theorem, Solow disentangled variations in output per labor due to technical change from those variations due to changes in the availability of capital. Although it was evident that technical progress occurred in the U.S. between 1909 and 1949, the results were inconsistent because he assumed an exogenous and neutral technical change and did not account for depreciation in the output proxy used (i.e., Gross National Product). In addition, he used the stock of inputs of labor and capital as proxies and focused on partial measures of growth.

Recent models permit the use of an expanded number of inputs such as research and development (R&D), human capital, and input quality variables as intermediate inputs in the analysis of technical change (Schultz, 1963; Hayami and Ruttan, 1970, 1985; Lucas, 1988; Romer, 1990, 1994; Grossman and Helpman, 1991, 1994; Mankiw *et al.*, (1992); Barro, 1999; and Zepeda, 2001). The discussion below focuses on several papers that are relevant to this study.

Christensen and Jorgenson (1969; 1970; and 1973), and Jorgenson and Nishimizu (1978) compared aggregate economic growth in the United States and Japan from 1952 to 1974. They indicated that the productivity gap between the two countries was narrowing and attributed much of Japanese's gain in productivity to technical change and an increase in capital intensity (i.e., capital input per unit of labor input).

Nishimizu and Page (1982) discussed the decomposition of total factor productivity (TFP) change into technical change and the change in technical efficiency. Using panel data for the 1965-1978 period and eight regions of the former Yugoslavia (comprising six republics: Bosnia, Croatia, Macedonia, Montenegro, Serbia, Slovenia; and two autonomous provinces: Kosovo and Vojvodina), the authors showed that deteriorating technical efficiency rather than the reduction in the rate of technical change explained the slowdown in TFP.

Following studies by Diewert (1976) and Caves *et al.* (1982a; 1982b), a wildfire revival of interest in growth theory led to the development of alternative approaches to estimating technical change and productivity growth. Resurgence of interest in growth measurement with less parametric restrictions on growth models attests to the current wave of research that uses nonparametric techniques.

Färe *et al.* (1994a) analyzed productivity growth among 17 member countries of the Organization for Economic Co-operation and Development (OECD) over the period 1979-1988 using nonparametric output-based Malmquist productivity indexes. Decomposing these indexes into technical change and efficency change components, the authors found that U.S. productivity change was higher than average and was due to technical change, while Japan's productivity growth, the highest among the countries examined, was due to efficiency change.

Arnade (1998) calculated disaggregated multifactor agricultural productivity for seventy countries using an output-based nonparametric Malmquist index approach. He showed that agriculture in many developing countries (e.g., China, Iran, Ireland, South Africa, Zambia and Zimbabwe) is technically inefficient, that technical change has had a large impact on productivity growth in developed countries like the United States and Japan, and that TFP is declining in many developing countries.

A recent study of 41 countries of Africa between 1961 and 1999 revealed a similar deterioration in productivity due largely to regressive technical change (Yu *et al.*, 2003). This deterioration was particularly evident in the first half of the study period.

Serrao (2003) examined agricultural productivity growth and differences among eighteen countries and five regions in the European Union over the 1980-1998 period. Using the stochastic frontier approach (SFA) and Data Envelopment Analysis (DEA), France was found to record the highest performance followed by Germany and Belgium-Luxembourg. Technical change appeared to be the major factor contributing to TFP growth and differences among countries. Specifically, they found that the mean TFP scores are higher under DEA than under SFA because DEA fits a tighter (i.e., more flexible) frontier. Hence, they warned against the subjective choice of a particular approach and suggested the use and comparisons of more than one approach.

3.0 Data and Methodology

3.1 Types and Source of Data

The data used for this study are comprised of a balanced panel dataset for the agricultural sector that contains aggregate annual observations on outputs and inputs from 1961 to 2001 for 125 countries. Aggregate agricultural output is expressed as the quantity of agricultural production in millions of 1989-1991 "international dollars". Agricultural inputs consist of land (measured as the sum of arable land and permanent crops in 1,000 hectares); labor (i.e., the economically active population engaged in production agriculture); capital which is measured in two forms: farm machinery (i.e., number of tractors used on farms) and number of livestock units (computed as a weighted average of the number of animals on farms in 1,000's using Hayami and Ruttan (1971;

1985)); and the quantity of fertilizer consumed (i.e., sum of *N*, P_2O_5, and K_2O in metric tons).

The data were retrieved from the official website of the United Nations' Food and Agriculture Organization (i.e., FAOSTAT). The countries were classified into two major income groups (i.e., 99 developing and 26 developed countries) using the World Bank's (2001) income classification. Developing countries were further classified into 40 low income, 37 lower middle income, and 22 upper middle income groups while the developed countries were classified into 22 high income OECD countries and 4 high income non-OECD countries (Table 1).

3.2 Summary Statistics of Data

Horizontal averages of the output and inputs over the 1961-2001 period for each country were calculated first. Then vertical averages across country classifications were computed. Standard deviations of the observations were based on the computed averages for each income group.

The mean of the output and input data across income groups are presented in Table 2. This table shows that the quantity of output and quantities of inputs are higher for the high income countries. The relatively high employment of capital inputs (in relation to the other inputs) is a major characteristic of developed countries. In contrast, the developing countries had a higher relative use of labor and livestock. Table 3 presents the standard deviation of the sample data.

3.3 Analytical Method

A non-parametric, non-stochastic, input-based Malmquist index approach was used to analyze inter-country total factor productivity growth. In this context, productivity measures how well a country improves (i.e., doing it better) efficiency (i.e., doing it correctly) and effectiveness (i.e., doing the right things) of resource use (Bodek, 1985; and Powell, 1990). Thus, productivity is defined as the ratio of aggregate output and aggregate input. The Malmquist productivity index is defined using distance functions that are estimated using Data Envelopment Analysis (Caves *et al*., 1982b; Färe *et al*., 1994a; and Ramanathan, 2003).

Following Färe *et al*. (1985; 1994a; 1994b), the Malmquist productivity change index was decomposed into efficiency change and technical change components. Following Färe and Grosskopf (1996) we also decomposed both of these components further. Efficiency change was decomposed into pure technical efficiency change (which shows if a country was using the best available technology) and scale efficiency change (which shows if a country was on its optimal production size). The technical change component (which is typically associated with innovation or shifts in the technology frontier) is also decomposed into output bias (which indicates whether technical change shifts all of the output vector by different amounts), input bias (which shows whether technical change is input-using or input-saving), and magnitude components (which equals technical change in the absence of input and output biases), respectively. These components are estimated under constant returns to scale and are equal to 1 if there is no output or input biases. Output bias technical change equals unity in this study because we are using one output.

Efficiency, technical change and TFP estimates that are greater than 1 indicate that countries are making progress, while those under 1 are not. Decomposing efficiency change and technical change reveals the sources of progress (i.e., any component that is greater than or equal to 1) or regress (i.e., any component that is less than 1).

4.0 Results and Discussion

The average results for the entire sample (i.e., all countries combined for the 41 year period) are shown in table 4. This table shows that technical change and its input bias component are above 1 for the world. All efficiency change components are less than 1 for all classes of countries except for the pure technical efficiency change (PTEC) for upper middle income and high income non-OECD countries.

Technical change (TECH) is greater than 1 for the upper middle income and for both high income classes. However, total factor productivity (TFP) estimates are greater than 1 only for the two high income classes. Because the developed country classification includes the two high income classes, TFP was also greater than 1 for the developed country classification. The TFP indexes of 1.0215 for the high OECD countries and 1.0037 for the high non-OECD countries indicate that productivity growth increased 2.15% per year for high OECD countries and 0.37% for the non-OECD countries.

Technical change was the major factor behind the strong productivity growth of the developed countries. Efficiency change for the entire period was actually negative for the developed countries. Efficiency change for the developing countries was similar to that of the developed countries. However, technical change was negative for the developing countries. This indicates that the production frontier for these countries actually shifted inward over the period.

In order to delineate the information contained in table 4, estimates of TFP and its components were computed for each 5-year consecutive period. These results are reported in tables 5 to 12.

World productivity growth was above 1 in the 1981/82 to 1985/86, 1986/87 to 1990/91, and 1991/92 to 1995/96 periods. The lack of productivity of the developing countries was the major reason for the low world productivity over most of the period. The only periods in which productivity growth was greater than 1 for the developing countries were the 1981/82 to 1985/86, the 1986/87 to 1990/91, and the 1991/92 to 1995/96 periods. In contrast, productivity growth was greater than 1 for the developed countries for all of the 5-year periods except the 1961/62 to 1965/66 period.

When considering the individual countries in the entire sample, results show that 37, 39, and 49 countries have pure technical efficiency change (PTEC) that is greater than, equal to, and less than 1, respectively. Scale efficiency change (SCC) is greater than, equal to, and less than 1 for 36, 14, and 75 countries, respectively. Total efficiency change (EFFC) is above, equal to, and below 1 for 43, 14 and 68 countries, respectively. For the technical change (TECH) component of productivity change, 60 countries have an index above 1 and 65 countries have an index below 1. Finally, TFP change is greater than 1 for 57 countries but less than 1 for 68 countries.

5.0 Implications of Findings, Summary and Conclusion

The focus of this study was to compare agricultural productivity growth or total factor productivity (TFP) among developing and developed countries of the world. To do this, complete data on aggregate agricultural output and inputs (land, labor, tractor, fertilizers and livestock unit) for 125 countries over the 1961-2001 period were collected from FAO online database.

To avoid interpretation difficulties, the countries in the sample were classified into groups using the World Bank's (2001) classification. The developing countries group was comprised of three low income groups (i.e., low, lower middle, and upper middle income groups) and contained 99 countries. The developed countries group was comprised of two high income groups (i.e., high income OECD and high income non-OECD) and contained 26 countries.

Data Envelopment Analysis was used to estimate the world frontiers and the results were in turn used to calculate TFP, efficiency change, and technical change. Efficiency change was decomposed into pure technical efficiency change and scale change. Technical change was decomposed into input bias and magnitude.

World agricultural productivity growth averaged a -0.36% per year over the 41 year period. For the 26 developed countries, productivity growth averaged 1.87% per year. In contrast, for the 99 developing countries, productivity growth averaged -0.94% per year. For the developed countries, productivity growth was greater than 1 for every 5-year period except 1961/62 to 1965/66. The only 5-year periods for which productivity growth was greater than 1 for the developing countries were the 1981/82 to 1985/86, the 1986/87 to 1990/91, and the 1991/92 to 1995/96 periods. On average, the developing countries derived improvements in TFP primarily from efficiency change while the developed countries derived improvements primarily from technical change.

The next step in the analysis is to investigate efficiency convergence and to identify the factors that help explain this convergence. Also, it would be interesting to examine the inputs responsible for the input bias.

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Table 1: Countries by Classes			
Developing			Developed
Low Income:	Lower Middle Income:	Upper Middle Income:	High Income OECD:
Angola	Algeria	Botswana	Austria
Benin	Egypt	Libyan Arab Jamahiriya	Belgium-Luxembourg
Burkina Faso	Morocco	Mauritius	Denmark
Cameroon	Swaziland	South Africa	Finland
Central African Republic	Tunisia	Hungary	France
Chad	Albania	Malta	Germany
Congo, Dem Republic of	Bulgaria	Poland	Greece
Congo, Republic of	Romania	Korea, Republic of	Iceland
Cote d'Ivoire	China	Lebanon	Ireland
Ghana	Iran, Islamic Rep of	Malaysia	Italy
Guinea	Iraq	Saudi Arabia	Netherlands
Kenya	Jordan	Barbados	Norway
Lesotho	Philippines	Mexico	Portugal
Madagascar	Sri Lanka	Panama	Spain
Malawi	Syrian Arab Republic	Saint Kitts and Nevis	Sweden
Mali	Thailand	Saint Lucia	Switzerland
Mozambique	Turkey	Trinidad and Tobago	United Kingdom
Nigeria	Belize	Argentina	Japan
Reunion	Costa Rica	Brazil	Canada
Senegal	Cuba	Chile	United States
Sierra Leone	Dominican Republic	Uruguay	Australia
Somalia	El Salvador	Venezuela, Boliv Rep of	New Zealand
Sudan	Guadeloupe		
Tanzania, United Rep of	Guatemala		
Uganda	Honduras		NonOECD:
Zambia	Jamaica		Cyprus
Zimbabwe	Martinique		Israel
Afghanistan	Saint Vincent/Grenadines		Singapore
Bangladesh	Bolivia		US Virgin Islands
Cambodia	Colombia		
India	Ecuador		
Indonesia	Guyana		
Korea, Dem People's Rep	Paraguay		
Laos	Peru		
Myanmar	Suriname		
Nepal	Fiji Islands		
Pakistan	Papua New Guinea		
Viet Nam			
Haiti			
Nicaragua			

Table 2: Mean of Sample Data (1961 – 2001)							
		Output	Land	Labor	Tractor	Fertilizer	Live-stock
Income Classes:	# C	(1000 I$)	(1000 ha)	(Econ. active)	(# in use)	(Metric ton)	(In 1000)
Low Income	40	4,317,036	9,423	11,278	24,264	312,792	11,589
Lower Middle	37	6,561,731	7,132	13,475	47,098	639,418	6,722
Upper Middle	22	5,482,865	7,061	2,004	88,149	475,641	11,106
High OECD	22	15,492,499	17,065	1,277	618,201	1,866,833	11,049
High nonOECD	4	423,018	152	47	8,150	25,955	105
Developing	99	5,415,036	8,042	10,038	46,995	471,053	9,663
Developed	26	13,174,117	14,463	1,088	524,347	1,583,621	9,366

C = Number of countries.

Table 3: Standard Deviation of Sample Data (1961 – 2001)							
		Output	Land	Labor	Tractor	Fertilizer	Live-stock
Income Classes:	# C	(1000 I$)	(1000 ha)	(Econ. active)	(# in use)	(Metric ton)	(In 1000)
Low Income	40	12,892,577	26,495	32,992	97,196	1,186,610	37,686
Lower Middle	37	24,234,723	19,275	67,790	112,799	2,686,314	18,381
Upper Middle	22	9,314,818	11,962	3,677	176,158	783,830	23,970
High OECD	22	28,012,650	39,698	1,756	1,052,661	3,627,223	19,974
High nonOECD	4	588,774	195	38	10,229	36,101	140
Developing	99	17,363,217	21,161	46,301	125,197	1,834,069	28,595
Developed	26	26,266,731	36,912	1,672	990,555	3,392,730	18,744

C = Number of countries.

Table 4: Components of Productivity (1961/62 – 2000/01 Average)								
Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	0.9979	0.9989	0.9968	1.0351	0.9590	0.9927	0.9841
Lower Middle	37	0.9982	0.9956	0.9938	1.0064	0.9927	0.9990	0.9928
Upper Middle	22	1.0009	0.9916	0.9924	1.0112	0.9953	1.0064	0.9988
High OECD	22	0.9966	0.9983	0.9949	1.0054	1.0211	1.0267	1.0215
High non-OECD	4	1.0022	0.9901	0.9923	1.0470	0.9660	1.0115	1.0037
Developing	99	0.9987	0.9960	0.9947	1.0190	0.9795	0.9981	0.9906
Developed	26	0.9975	0.9971	0.9945	1.0117	1.0125	1.0243	1.0187
World	125	0.9984	0.9963	0.9947	1.0175	0.9863	1.0035	0.9964

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 5: Components of Productivity (1961/62 – 1965/66 Average)								
Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	0.9913	0.9834	0.9749	1.0231	0.9580	0.9802	0.9555
Lower Middle	37	0.9949	0.9748	0.9698	1.0115	0.9941	1.0056	0.9752
Upper Middle	22	0.9993	0.9881	0.9873	1.0165	0.9861	1.0023	0.9896
High OECD	22	1.0011	0.9953	0.9964	1.0110	1.0081	1.0191	1.0154
High non-OECD	4	0.9981	0.9299	0.9281	1.0987	0.8950	0.9834	0.9126
Developing	99	0.9944	0.9812	0.9757	1.0173	0.9776	0.9945	0.9704
Developed	26	1.0007	0.9849	0.9856	1.0240	0.9898	1.0135	0.9989
World	125	0.9957	0.9820	0.9778	1.0187	0.9801	0.9984	0.9762

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 6: Components of Productivity (1966/67 – 1970/71 Average)								
Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	0.9886	0.9606	0.9496	1.0174	0.9857	1.0028	0.9523
Lower Middle	37	0.9810	0.9485	0.9305	1.0066	1.0326	1.0395	0.9672
Upper Middle	22	0.9918	0.9451	0.9373	1.0196	1.0369	1.0572	0.9909
High OECD	22	0.9877	0.9741	0.9621	1.0070	1.0577	1.0651	1.0247
High non-OECD	4	0.9977	1.0034	1.0012	1.0395	1.0309	1.0716	1.0729
Developing	99	0.9864	0.9526	0.9397	1.0138	1.0143	1.0284	0.9664
Developed	26	0.9893	0.9786	0.9680	1.0119	1.0535	1.0661	1.0320
World	125	0.9870	0.9579	0.9455	1.0134	1.0224	1.0361	0.9797

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 7: Components of Productivity (1971/72 – 1975/76 Average)								
Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	0.9981	0.9642	0.9624	1.0231	1.0062	1.0295	0.9908
Lower Middle	37	0.9828	0.9425	0.9263	1.0062	1.0534	1.0600	0.9818
Upper Middle	22	0.9849	0.9675	0.9529	1.0110	1.0410	1.0524	1.0029
High OECD	22	0.9974	0.9918	0.9892	1.0071	1.0201	1.0273	1.0162
High non-OECD	4	0.9712	0.9647	0.9369	1.0449	1.0297	1.0759	1.0081
Developing	99	0.9894	0.9568	0.9467	1.0141	1.0314	1.0459	0.9901
Developed	26	0.9933	0.9876	0.9810	1.0128	1.0215	1.0346	1.0149
World	125	0.9902	0.9631	0.9537	1.0138	1.0293	1.0435	0.9952

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 8: Components of Productivity (1976/77 – 1980/81 Average)								
Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	0.9911	1.0235	1.0144	1.0595	0.9001	0.9536	0.9673
Lower Middle	37	1.0036	1.0368	1.0405	1.0022	0.9475	0.9495	0.9880
Upper Middle	22	1.0047	0.9980	1.0027	1.0125	0.9808	0.9930	0.9957
High OECD	22	0.9913	1.0035	0.9947	1.0037	1.0291	1.0329	1.0275
High non-OECD	4	1.0267	1.0042	1.0310	1.0284	0.9554	0.9825	1.0130
Developing	99	0.9987	1.0227	1.0214	1.0273	0.9352	0.9607	0.9813
Developed	26	0.9967	1.0036	1.0002	1.0075	1.0174	1.0250	1.0253
World	125	0.9983	1.0187	1.0170	1.0231	0.9517	0.9737	0.9903

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 9: Components of Productivity (1981/82 – 1985/86 Average)								
Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	1.0053	1.0161	1.0215	1.0328	0.9593	0.9908	1.0120
Lower Middle	37	0.9940	1.0162	1.0101	1.0048	0.9791	0.9837	0.9937
Upper Middle	22	1.0107	0.9906	1.0012	1.0081	0.9806	0.9885	0.9897
High OECD	22	1.0038	0.9961	0.9999	1.0038	1.0240	1.0279	1.0279
High non-OECD	4	0.9975	0.9987	0.9962	1.0356	0.9801	1.0150	1.0112
Developing	99	1.0023	1.0104	1.0127	1.0167	0.9714	0.9876	1.0002
Developed	26	1.0028	0.9965	0.9994	1.0086	1.0172	1.0259	1.0253
World	125	1.0024	1.0075	1.0099	1.0151	0.9807	0.9955	1.0053

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 10: Components of Productivity (1986/87 – 1990/91 Average)								
Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	1.0023	1.0261	1.0285	1.0445	0.9327	0.9742	1.0020
Lower Middle	37	1.0090	1.0541	1.0636	1.0061	0.9543	0.9601	1.0212
Upper Middle	22	1.0088	1.0428	1.0520	1.0073	0.9599	0.9669	1.0172
High OECD	22	0.9885	1.0209	1.0092	1.0053	1.0044	1.0097	1.0190
High non-OECD	4	1.0042	1.0099	1.0141	1.0534	0.9360	0.9860	0.9999
Developing	99	1.0062	1.0402	1.0467	1.0217	0.9467	0.9673	1.0125
Developed	26	0.9909	1.0192	1.0099	1.0125	0.9936	1.0060	1.0160
World	125	1.0030	1.0358	1.0390	1.0198	0.9563	0.9752	1.0132

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 11: Components of Productivity (1991/92 – 1995/96 Average)

Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	1.0025	1.0204	1.0230	1.0370	0.9566	0.9920	1.0148
Lower Middle	37	1.0230	1.0128	1.0361	1.0025	0.9872	0.9897	1.0255
Upper Middle	22	1.0001	1.0119	1.0121	1.0080	0.9728	0.9806	0.9924
High OECD	22	1.0013	1.0100	1.0112	1.0028	1.0079	1.0107	1.0220
High non-OECD	4	1.0183	1.0092	1.0277	1.0223	0.9441	0.9652	0.9919
Developing	99	1.0096	1.0157	1.0254	1.0176	0.9715	0.9886	1.0137
Developed	26	1.0039	1.0098	1.0137	1.0058	0.9978	1.0035	1.0173
World	125	1.0084	1.0145	1.0230	1.0151	0.9769	0.9917	1.0145

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.

Table 12: Components of Productivity (1996/97 – 2000/01 Average)

Income Classes:	# C	PTEC	SCC	EFFC	IBTE	MATE	TECH	TFP
Low Income	40	1.0040	0.9996	1.0036	1.0440	0.9776	1.0207	0.9800
Lower Middle	37	0.9978	0.9847	0.9825	1.0109	0.9983	1.0092	0.9915
Upper Middle	22	1.0071	0.9913	0.9983	1.0067	1.0075	1.0143	1.0125
High OECD	22	1.0017	0.9958	0.9975	1.0030	1.0187	1.0218	1.0193
High non-OECD	4	1.0051	1.0038	1.0089	1.0551	0.9648	1.0180	1.0271
Developing	99	1.0024	0.9922	0.9945	1.0232	0.9919	1.0149	0.9915
Developed	26	1.0023	0.9970	0.9993	1.0109	1.0102	1.0212	1.0205
World	125	1.0023	0.9932	0.9955	1.0206	0.9957	1.0162	0.9974

C = Number of countries, PTEC = Pure Technical Efficiency Change, SCC = Scale Efficiency Change, EFFC = Efficiency Change, IBTE = Input Bias Technical Change, MATE = Magnitude Component of Technical Change, TECH = Technical Change, and TFP = Total Factor Productivity.