A Method for Comparison of the Efficiency of Countries with Distinct Technologies

Carlos Arnade and Keithly G. Jones

The authors are economists with the Animal Products Branch, Markets and Trade Economics Division, Economic Research Service, USDA. Contact authors at 1800 M Street NW, Washington DC. Phone 202-694-5187 (CA), 202-694-5172 (KJ) Email: Carnade@ers.usda.gov, and **kjones@ers.usda.gov**

Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Denver, Colorado, August 1-4, 2004

A Method for Comparison of the Efficiency of Countries with Distinct Technologies

Carlos Arnade and Keithly Jones

Abstract

We divide countries into two technology categories: developed and developing. Agricultural efficiency within each technology category was calculated. Cross-category efficiency measures were developed and combined with own-category measures to develop a technical difference index. Results indicate convergence of efficiency within both categories but divergence of efficiency between the two categories.

We wish to appreciate the comments James Stout and other reviewers at the Economic Research Service.

A Method for Comparison of the Efficiency of Countries with Distinct Technologies

Carlos Arnade and Keithly Jones

The concept of convergence, which postulates that less developed countries (regions-farm units), grow at a faster rate than the more developed countries (regions) has dominated the international development and trade literature. Eventually, even growth rates themselves are believed to converge (Nahar and Inder, 2002). These studies have been grounded in the theory of convergence in economic growth pioneered by Solow (1956). However, after years of empirical work in this area, economists have come to believe that there may co-exist two sets of countries whose economies converge to two distinct steady state levels of economic development. This is referred to as "twin peaks" (Chen, 2003). Developed countries and some developing countries are believed to converge to one common steady state level of development while the developing countries are believed to converge to a different steady state level of development. These differences may hold particularly true for agricultural sectors where natural resource endowments play a vital role in production, and where agriculture may plays a distinct role relative to the overall economy.

We accept the “twin peaks” concept by assuming that there are two sets of countries with different agricultural technologies, climate endowments, and other natural endowments. Accepting this, we introduce a mixed set distance function, which can provide some insights into the relative agricultural performance of these two sets of countries.

The objective of this paper is to compare technical (or production) efficiency of countries with distinct agricultural technologies. First, we break countries into two categories: developed and developing. Second, we calculate country level agricultural efficiency using distinct frontier measures for countries that are classified as different. Third, we pursue the issue further and develop country efficiency measures relative to the frontier of countries belonging to the *other* technology category. Finally, we evaluate trends in efficiency of countries with these distinct technologies.

Background

In 1957, Farrell pointed out that the existing firms may not be operating on the frontier of their production function and made acceptable the concept of production-based inefficiency. This concept has been refined over the years and has led to the use of the term "technical inefficiency." In order to distinguish the Farrell concept of inefficiency from behavioral-based concepts of inefficiency (i.e. allocative inefficiency, market inefficiencies), firms which are technically inefficient can be viewed as either using too many inputs to produce a particular level of output or as producing too little output given the amount of inputs they use.

This former view of technical inefficiency can be related to Debreu's (1951) input distance function (the latter can be related to the output distance function). The input distance function represents the maximum amount by which input usage can be jointly reduced to produce the same level of output. In input space, that distance function represents the maximum radial reduction in inputs that is possible to reach the isoquant. As such, it is the distance between an observed point in input space and the isoquant.

Relating this to Farrell's concept of efficiency, firms operating on an isoquant are viewed as efficient. Firms with input use that is interior to the isoquant are wasting inputs and are inefficient. Charnes, Cooper and Rhodes (1978) developed a programming problem to measure technical inefficiency. However, it was when Färe (1992) pointed that empirical based measures of technical inefficiency represent the reciprocal of the distance function that these programming based measures took on a greater significance, particularly in the area of measuring total factor productivity (TFP). Caves et al., (1982) had earlier introduced the Malmquist TFP index which had been composed of various distance functions. By relating these programming based measures of efficiency to the distance function, Färe was able to derive a method for calculating TFP from a series of programming problems (1993) which used input and output data. Subsequent papers demonstrated that it was possible to break the Malmquist index into two components--TFP arising from improvement in efficiency, and TFP arising from technical change.

A number of studies have used programming methods to calculate technical inefficiency for various components of the agricultural sector. Numerous studies have also used Färe's method to calculate the mixed efficiency measures in the Malmquist TFP index. While the bulk of these studies have applied this method at the firm level, a number of authors have also used international data to calculate country specific measures of agricultural TFP, inefficiency, and technical change (Arnade, 1994, Fulginiti and Perrin, 1997, Thirtle 1997, Trueblood 1996, Nin et al. 2001). The programming program that underlies these empirical studies rest on the assumption that observed data represents producers who have access to a common technology.

While Arnade (1994) divided countries in 4 technological groups, subsequent papers by most authors have assumed all countries operated under a single technology. In doing so, all county observations were compared to a common frontier in order to measure inefficiency.[1]

Recent development of the "twin peaks" literature has raised the familiar issue that co-existing technologies may exist. If countries can belong to distinct technology categories, then it may be useful when calculating TFP measures for a broad range of observations (countries, or other units), to calculate distinct frontiers for each technology category. That is, *even when there is technical change* it maybe useful to classify observations into distinct technological categories.

Methodology

Our goal is to create a technical difference index consisting of measurable agricultural efficiency scores. To do this, we divided twenty-six countries into two technology categories--developed and developing, each consisting of thirteen countries. We then calculated technical efficiency scores within each group and then calculated "mixed" efficiency scores that measure how each country performs relative to the other category frontier. With these scores, it is possible to construct a technical difference index similar to the technical change component of a Malmquist index (Caves, 1982). Malmquist indexes are written in terms of distance functions, which is the inverse of the efficiency scores (Färe et al. 1994). To construct a technical difference index, consider the following bilateral measure comparing country i that belongs to the technology of group B, and country j that belongs to the technology of group A.

[1] While flexible ways of measuring efficiency (Bogetoft and Hougaard, 2004) are constantly being developed, the traditional DEA methods for measuring efficiency are used in this study.

1) $Td^{i,j} = [(D^a(y_i^b, x_i^b) / D^b(y_i^b, x_i^b)) * (D^a(y_j^a, x_j^a) / D^b(y_j^a, x_j^a))]^{1/2}$

$= [(ND^a(y_i^b, x_i^b) /* ND^b(y_j^a, x_j^a))]^{1/2}$

where

$(ND^a(y_j^b, x_j^b) / D^b(y_j^b, x_j^b)$

The geometric means of the two mixed indices relative to efficiency measures define this specific technical difference index. The index can also be viewed as the ratio of two mixed scores normalized on their own measure of technical efficiency. Mixed scores (mixed distance functions) will be less (greater) than one if one country's observation appears inefficient relative to the isoquant of the other country group.

There are several important distinctions between the index in Equation 1 and a standard technical change index. Unlike a technical change index, there is no suggested base or direction of movement. A technical difference index can compare either technical category in any direction. Second, a technical change index measures an observation's performance across two time-periods. Each time-period has its own technology so that introduction of a 3rd time period produces a 3rd frontier and a second index.

In contrast, when comparing across technologies at particular point in time there is a range of countries that belong to the technology category "A" and a range of countries that belong to the technology category "B". Introduction of a third country does not mean that a new technology category is introduced. In fact, there is a range of possible bilateral comparisons, each which could give different measures of technical differences. Because of this, we suggest the following broader based index to measure the differences in the two technologies:

$$2)\quad Td^g = \sum_{i=1}^{k}\sum_{j=1}^{n} \quad [(D^a(y_i^b, x_i^b)/D^b(y_i^b, x_i^b))*(D^a(y_j^a, x_j^a)/D^b(y_j^a, x_j^a))]^{1/2} /(k*n)$$

where k represents the number of countries belonging to technology of group B and n represents the number of countries belonging to the group A.

Bilateral Indices

It is not clear how one should interpret a bilateral-based technical difference index, as presented in Equation 1. The individual mixed efficiency scores can be used to determine how much one country would have to reduce (increase) its inputs and yet produce the same output if that country could use the technology of another country in the other category. Mixed scores will be greater than 1 if a country's observation lies beneath the isoquant of the other group. An index greater than one represents a country, which would have to increase its input use if it tried to produce the same level of output, with another country's technology. The index in Equation 1, which consists of 4 scores provides *one* measure of technical differences, a measure based on the own and mixed efficiency scores of two countries. One could view Td^{ij} as a measure of technical differences between country *i* and *j,* or view it as a measure of the appropriateness of applying each country's technology to another country.[2] In the later view, bilateral scores may provide insights about the possibility for transfer of technology among countries.

[2] Unlike a time index-there is no suggested base. That is the index can be viewed as based on countries in either category "A" or "B."

Data

Using FAO data from 1961 to 1999 representing 26 countries for 1962 and 1999, we divided countries into 2 technological categories of 13 each. Group 1 consisted primarily of developed countries and group 2 consisted primarily of developing countries. No formal criteria was used to categorize countries and the results should be viewed in light our country groupings. In general we put OECD countries in the developed category.[3] It should be emphasized that a different categorization could lead to a different set of results. Table 1 reports efficiency scores and also breaks countries down by country groupings. Our input data consists of measurements of land, fertilizer, labor, tractors, and livestock while our output consists of a price weighted index of crops and livestock. Price weights represent the 3-year average (1984-1986) of commodity prices from the United States.

Empirical Application and Results

Our country observations were divided into two technology categories--developed and developing, each with thirteen countries. We then proceeded to calculate own technology measures of efficiency for every country, for each time period. We did this for each group. Descriptions of the Data Envelopement Analysis (DEA) programming problem used to calculate efficiency scores are provided in Färe et al. (1988).

The scores represent the level of efficiency of each country relative to a frontier calculated from observations of all countries within its category. Two of these scores, one from each category, are used to calculate a bilateral index represented in equation 2. Then, we set up a mixed

[3] However, countries such as South Africa were put in the developed category because South Africa has capital intensive agriculture and produces a greater proportion of its output that its labor-intensive agriculture.

programming problem, comparing the agricultural efficiency of a country belonging to one technology category with the frontier of the other technology category.[4] That is, we measured the efficiency of each developing country relative to the developed country frontier. Then, we reversed the process and measured the efficiency of each developed country, relative to the developing country frontier. Two of these mixed scores, one from each category, *also* must be used create the bilateral index in equation 2.

All own-efficiency and cross-technology measures were calculated at a similar point in time providing own measures and cross-measures of efficiency for each of the 38 years in our database. Tables 1 lists the country efficiency scores averaged over four time periods 1961-69, 1970-79, 1980-89, and 1990-99. Scores relative to the own frontier must be equal or less than one. An index of less than one represent inefficiency. Brazil's average score for the 1960's is 0.98. As measured, if Brazil were efficient it could reduce its input use by 2 percent, yet produce the same level of output.

Mixed scores

There is no boundary on mixed scores. As such, some mixed scores may be greater than one. As with their time-based counterparts, these mixed scores have much more meaning as a component of an index than as stand alone indices. Therefore, we present technical difference indices based on several bilateral country comparisons.

[4] Since we calculate input distance functions, our solution for the particular observation *j* represents how much inputs can be reduced in order to produce the observe level of output *if it were efficient in terms of technology of group A.*

Surprisingly, some developing country's agriculture appears efficient relative to developed countries. At first this result appears counterintuitive, but in reality developing countries with fewer resources could be more inclined to conserve resources and avoid overuse. This finding is consistent with work done by Arnade, Fuliginti and Perrin, and Trueblood (see Nin et. al).

Specifically, the distinct bilateral technical difference indices yield some interesting results. These mixed measures are based on the index in equation 1 and are comprised of 4 distinct efficiency scores. If both countries were efficient they can be interpreted as the amount by which one country will have to increase or reduce its inputs to get to the same output of another country should it switch to the technology of that country's group. Figure 1 shows the technical differences indices based on cross and own efficiency scores of Argentina and Australia. Argentina is in the developing country grouping while Australia is in the developed country grouping. Both Argentina and Australia are indexed on their respective country frontier. A relative decline in Argentina's technical efficiency relative to Australia's is observed. Up until the middle 1980's Argentina would have had to increase its input use to get the same level of output, if it were to adopt Australia's technology. But, since then, because of the decline in Argentina's relative efficiency, Argentia could reduce its inputs to obtain the same level of output, if it were to use Australia's. Since we were not able to quality adjust our input data, differences in land quality will be reflected in our efficiency measures, which may explain Argentina's relatively superior performance in the early years of analysis.

Figure 2 shows the bilateral mixed indices for Australia, France, Japan, and the United States with Mexico. These measures represent the index in equation 1 where countries in the developing country grouping are indexed on the developing country frontier and countries in the developed country grouping are indexed on the developed country frontier.

Clearly, it matters which country is chosen for the bilateral comparison-indicating that these specific measures represent a restricted measure of technical differences.[5] While there are differences the direction movement is the same. For example, a decline in Mexico's technology relative to that of developed countries can be seen in each of the four country-based indices. Yet, a comparison of bilateral indices provides some interesting insights. Viewing the difference in these indices it is clear, that with time, some convergence can be seen in the "measures" of relative technical difference *among* the developed countries, while at the same time they are diverging from Mexico. If Mexico could use the technology of each comparison country it could reduce its input use to obtain the same output, by a greater amount over time. Similarly, figure 3 graphs mixed indices for 6 developing countries with that of the United States. A similar pattern of convergence and divergence was seen among developing countries. The bilateral indices measure technical differences among developing countries are converging at the very same time they are diverging with the United States.

Comparisons of Standard efficiency measures

Having used the mixed scores to provide some indication of technical differences within (between) regions along with convergence (divergence), we turn to more formal parametric and nonparametric testing on the standard efficiency scores of the two categories of countries. This permits further probe into the technical difference between developed and developing countries. The Wilcoxon test revealed that the developed country group was significantly more technically efficient than the developing country group. The validity of this test rests on the assumption that the two groups of countries are independent. Tests for the two samples consisting of 507 observations in each group yield a *z*-value of –5.41, suggesting that we are 99 percent confident that we can reject the null hypothesis of equality in the means of the two groups.

Interestingly, a Kruskal-Wallis test for comparing the technical difference over time among the 13 countries in each group, separately, also yielded some informative results. The Kruskal-Wallis test tests the hypothesis the 13 developed countries were drawn from similar distributions. A similar test was carried out for the 13 developing countries. The Kruskal-Wallis test revealed significant differences in technical efficiency difference among developing countries, as well as, among developed countries. Among developing countries a chi-square value of 411.97 (df=12, n=39) was calculated while among the developed countries a chi-square value of 390.52 (df=12, n=39) was calculated. In both cases, we are 99 percent confident that we can reject the null hypothesis of equality of mean technical efficiency among countries in each of the group.

These nonparametric tests lend some support to the idea that there exist two distinct categories of technology. Yet these tests often compare measures of central tendencies and could mask efficiency movements over time. Comparing the pattern of efficiency variability over time using an efficiency variability index which is

4.) $$EV_{it} = (\sum (E_{itj} - \overline{E}_{itj})^2 / n_{it})^{1/2}$$

Where Ev_{ict} is the efficiency variability of country i of year t, E_{itj} is the efficiency of country i in the group j in year t, and n_{it} is the number of countries in each group in year t. The index in

[5] These differences may highlight the useful index of the more general index in equation 3.

equation 4 is thus, an index of the cross-sectional variability of efficiency at a particular point in time. To account for the annual variation in efficiency we divided the index by the average annual efficiency for each group. This serves to normalize the efficiency giving a new variable similar to the coefficient of variation, CEV_{it}.

5.) $$CEV_{it} = \frac{EC_{it}}{\overline{E}_{itj}}$$

Based on earlier results, there is some evidence of convergence in efficiency variability across countries. The relationship between efficiency and efficiency variability can be accounted for by the parametric analysis of variability. Here, we examine variability and efficiency levels. We regressed the logs of efficiency variability ($lnCEV_{it}$) against the log of efficiency (lnE_t), and a trend variable (tr) to account for the trend in efficiency variability between 1961-1999. For each group of countries, this was expressed as:

6.) $$\ln CEV_t = \beta_0 + \beta_1 \ln E_t + \beta_2 tr + \varepsilon_t$$

The hypothesis that efficiency variability is different for the two groups of countries was tested with the used of a dummy variable, D_j where D=1 for developing countries and D=0 for developed countries. The was expressed as;

6.) $$\ln CEV_t = \beta_0 + \beta_1 \ln E_t + \beta_2 tr + \beta_3 D_j + \varepsilon_t$$

The results of efficiency variability presented in table 2 provide some interesting points of discussion. First, it is apparent that the efficiency variability is significant and inversely related to the level of efficiency. Among the developing country grouping, a 1-percent increase in efficiency results in a 1.27 percent reduction in efficiency variability while for the developed country grouping, a 1-percent increase in efficiency results in a 3.12-percent reduction in efficiency variability.[6] The nonparametric results on efficiency differences support these results. Because of the wide range of efficiency levels in developing countries, increases in efficiency may not be as dramatic on variability as if they were within a narrower efficiency range as is the case with the developed country grouping.

Second, the trend in efficiency variability is negative in all of the country groupings. However, only the developing country grouping registered statistically significantly less variability with time. This confirms prior results, which show that developing countries show a convergence in technical efficiency.

Finally, the dummy variable that signifies differences in country groupings is statistically significant suggesting that efficiency for the developed country is significantly greater than the developing country grouping. This confirms the results from the earlier nonparametric test that the efficiency measures may represent different technologies, which are converging to distinct points.

In general, these formal tests of within group efficiency scores tend to support the results we obtained on the mixed-scores. Both mixed scores and formal tests of within group scores indicate that there are both differences among countries within each of the two technology categories and significant differences between categories. Mixed scores and formal tests of within group scores provide evidence these differences within each group are declining over

[6] Some of this is to be expected for any variable with an upper bound. Simply raising E reduces potential variability

time. In other words there is convergence of efficiency scores within each group. Mixed scores also provide evidence that the 2 groups of countries are diverging.

Conclusions

In this paper, we develop an index, which provide measures of technical differences across two sets of countries. To do so we take the technology change component of the Malmquist index and adapt it to measuring technology differences among two categories of countries. We adopt Färe's mixed programming method (DEA) which calculates the performance of a particular observation in time 0 against a frontier calculated using data in time 1 to our cross-technology problem. That is, we divide data into two categories, developing and developed, and measure the efficiency of developing (developed) countries relative to a developed (developing) country frontier. We apply several statistical tests to own-frontier efficiency measures and find these test results tend to be consistent with cross-frontier measures.

Looking at the relative agricultural performance of two sets of countries with distinct technologies provide some insight into the trends in efficiencies of developed and developing countries. In general there tends to be significant differences between the two sets of countries. On average, developed countries appear more technically efficient than developing countries. The evidence from this paper also suggests that there is convergence in efficiency variability within each category of countries. Variability in efficiency among developing countries appears to lessen over time and appears to be converging relative to developed countries.

The results presented also suggested that although developed countries on average were significantly more efficient than developing countries, there were significant differences in technical efficiency difference among developing countries, as well as, among developed countries. This would suggest that our ad-hoc criteria for selecting country groupings were not optimal. Given the finding, it may be beneficial to develop formal criteria for selecting countries with similar technologies. In fact, it may be possible to apply some of the methods used in this paper to such a task.

Our finding of convergence towards two distinct technologies may be useful in determining whether to pursue a measure of comparative advantage. This would help to distinguish between those advantages that are based on resource quality and those that are technology based. It also may be useful in distinguishing between resource-based models of trade (Hecksher-Olin) and productivity based models of trade (Ricardo). If measures of distinct technology differences such as these were available (which currently show up in productivity) they could be classified into either category or used as a distinct explanatory variable in a model to predict a country's relative trade mix. In any case, combining the analysis in this paper with analysis of indices of country product-mix (i.e. livestock versus crops), or with product specific efficiency measures may provide a first step towards such analysis.

References

Arnade, C. "Using Data Envelopment Analysis to Measure International Agricultural Productivity. Tech Bull No. 1831 ERS, USDA, 1994.

Bogetoft, P. and J. Hougaard. "Super Efficiency Evaluations Based on Potential Slack" *European Journal of Operational Research*. Vol. 152, 2004, 14-21.

Caves, D., L. Christensen, and E. Diewert "The Economic Theory of Index Numbers and Measurement of Input, Output, and Productivity, " *Econometrica,* Vol. 50, 1982, 73-86.

Charnes, A., W. Cooper, and E. Rhodes "Measuring the Efficiency of Decision Making Units" *European Journal of Operational Research* Vol. 2, 1978, 429-444.

Chen, C. "An Intra-Distribution Dynamics Approach to Convergence in the Asia Pacific Basin: The Influence of Inward FDI and Neighborhood Spillover", Manchester School Vol. 71, 2003, 78-88.

Debreu, G., "The Coefficient of Resource Utilization" *Econometrica* Vol. 19, 1951, 272-292.

Färe, R., S. "Fundamentals of Production Theory". Berlin Springer-Verlag, 1988.

Färe, R., S. Grosskopf, M. Norris, and Z. Zhang, 1994. "Productivity Growth, Technical Progress and Efficiency Change in Industrial Countries". *American Economic Review*. Vol. 84, 1994, 66-83.

Färe R, Grosskopf, S. Lindgren, B. and Roos, P. "Productivity Developments in Swedish Hospitals" in Charnes, A. Cooper, W., Lewin A. and Seiford(ed) *Data Envelopment Analysis, Theory, Methodology, and Applications.* Kluwer Academic Publishers, Boston Mass.,1992.

Fulginiti, L. and Perrin, R. "LDC Agriculture: Nonparametric Malmquist Productivity Indices. *Journal of Development Economics* Vol. 53, 1997, 373-390.

Nahar, S and B. Inder. "Testing Convergence in Economic Growth for OECD Countries," *Applied Economics*. Vol. 34, 2002, 2011-2022.

Nin, Alejadro, Arndt C., Preckel, Paul V. "Is Agricultural Productivity in Developing Countries Really Shrinking? New Evidence Using A modified Nonparametric Approach," *Journal of Development Economics*, Vol. 71, 2003, 395-415.

Solow, R.M "A Contribution to the Theory of Economic Growth," *The Quarterly Journal of Economics.* Vol. 70, 1956, 65-94.

Thirtle C, Hadely D. and Townsend R. Policy Induced Innovation in Sub-Saharan Agriculture a Multilateral Malmquist Productivity Index Approach, 1997. Working Paper, the University of Reading.

Trueblood M. "An Intercountry Comparison of Agricultural Efficiency and Productivity," Phd. Dissertation," University of Minnesota, 1996.

Figure 1. Comparative Technology Measure: Argentina versus Australia

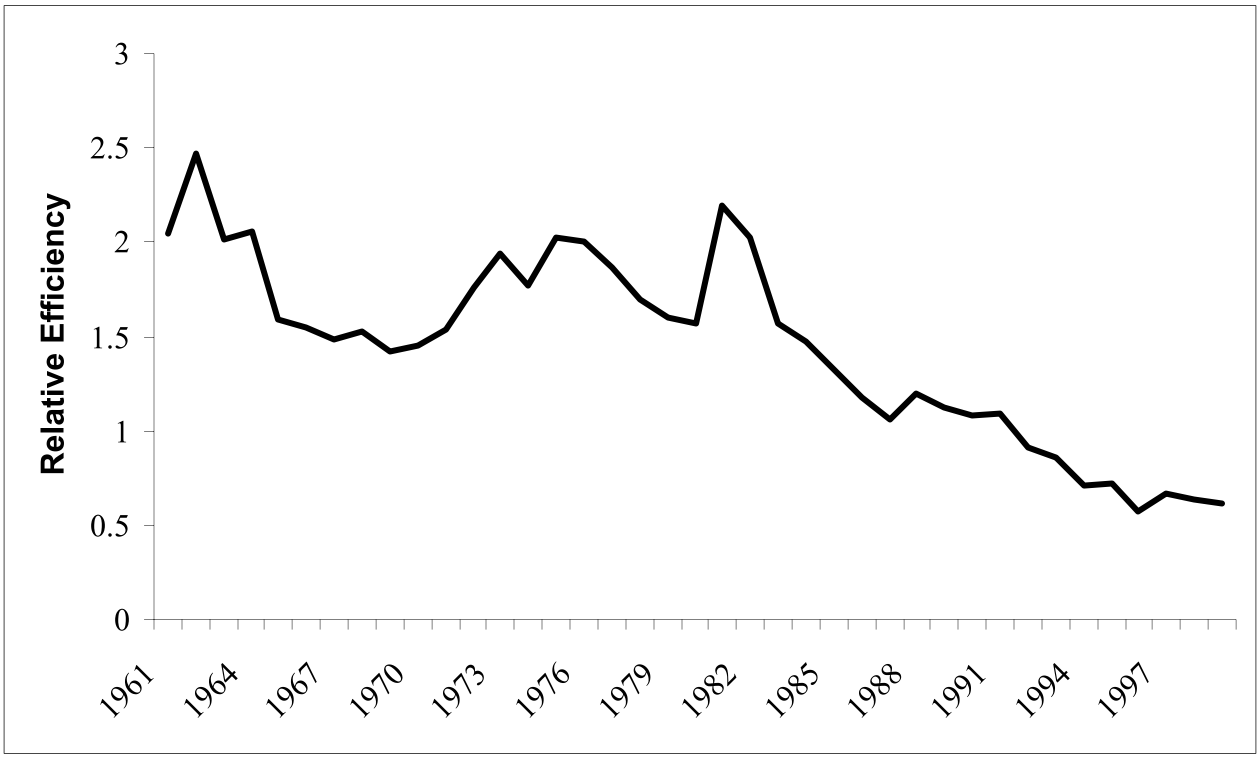

Figure 2. Comparative Technology Measure Developing (Mexico) versus Group of Developed Countries

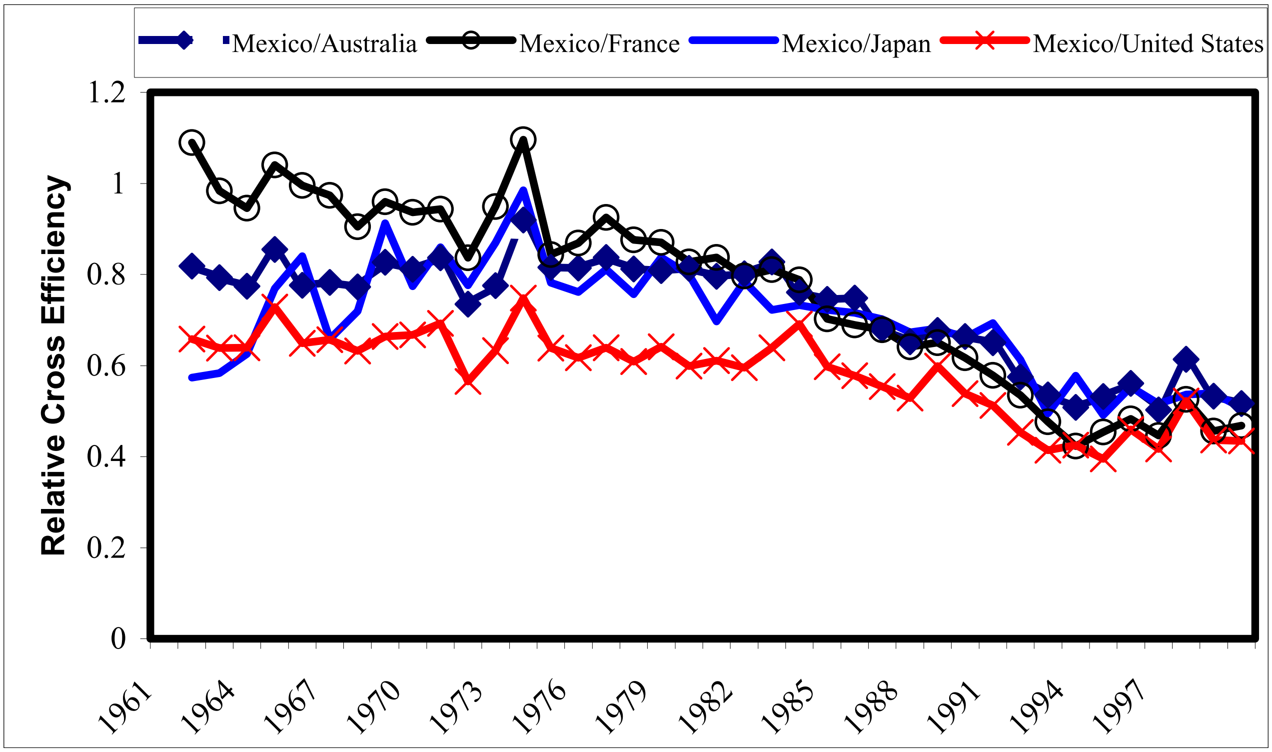

Figure 3. Comparative Technology Measure: Developed (United States) versus Group of Developing Countries

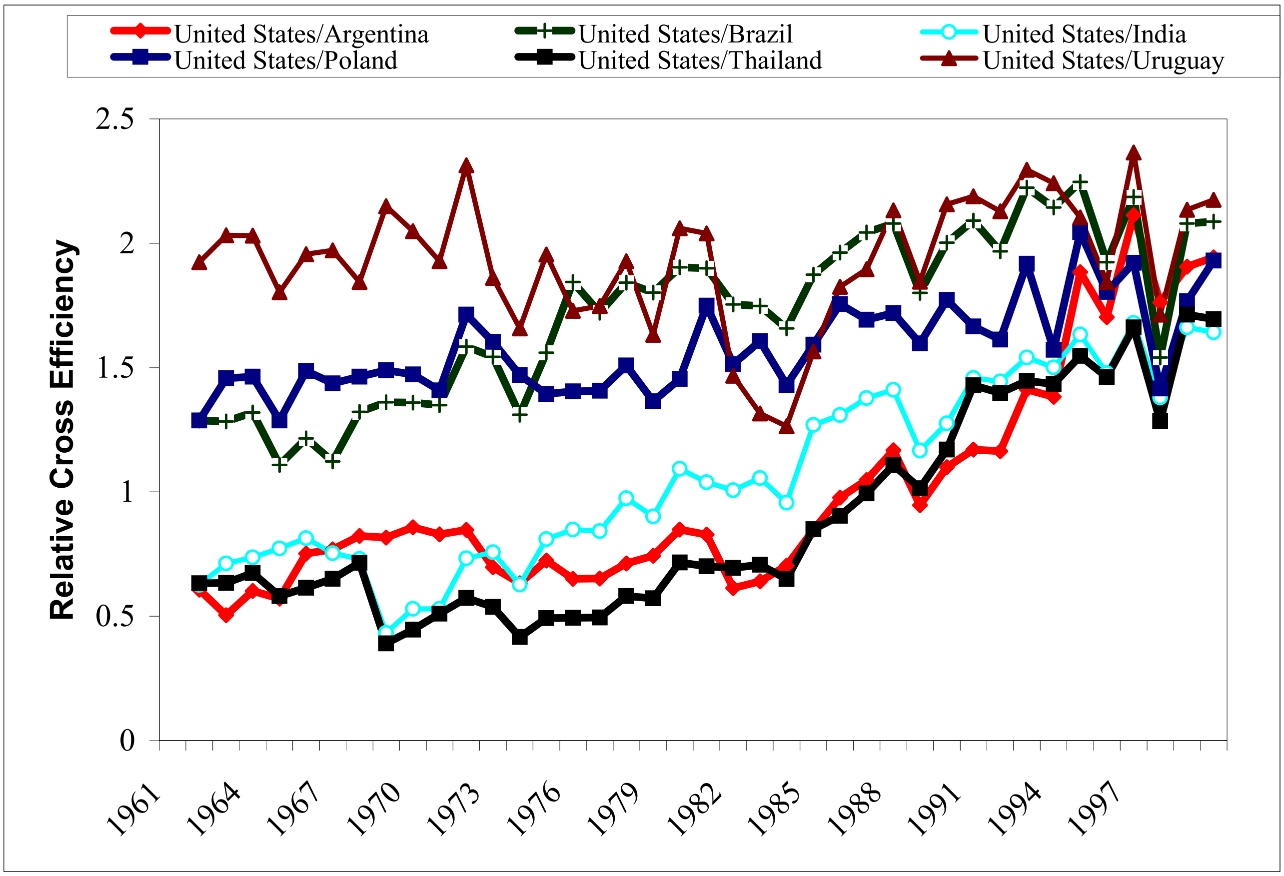

Table 1. Average Estimates of Country Efficiency –Developing and Developed Countries

Country Grouping	1961-69	1970-79	1980-89	1990-99
Developing[1]				
Argentina	1	1	1	0.99
Brazil	0.98	0.82	0.64	0.6
Costa Rica	0.22	0.33	0.41	0.79
Hungary	0.9	1	1	1
India	0.83	0.68	0.67	0.91
Kenya	0.49	0.58	0.56	0.96
Mexico	0.66	0.76	0.68	0.9
Paraguay	1	1	1	1
Poland	1	1	1	1
Romania	0.92	0.94	1	0.94
Thailand	1	1	1	1
Uruguay	0.62	0.56	0.55	0.51
Zimbabwe	0.22	0.3	0.25	0.35
Developed[2]				
Australia	0.87	0.9	0.94	0.98
Canada	1	1	0.99	1
Denmark	0.98	1	1	1
France	0.91	0.85	0.81	0.83
Germany	1	1	0.99	0.86
Ireland	0.78	0.55	0.45	0.38
Italy	1	1	1	1
Japan	1	1	1	1
New Zealand	0.83	0.76	0.75	0.81
Spain	0.37	0.46	0.47	0.42
South Africa	1	1	1	1
United Kingdom	1	1	1	0.89
United States	1	1	1	1

[1]/ Indices measured relative to frontier calculated with data on countries classified as developing
[2]/ Indices measured relative to frontier calculated with data on countries classified as developed

Table 2-Efficiency Variability Across Countries

Country	Developing Countries		Developed Countries		Combined	
	Estimated Coefficient	*t-ratio*	*Estimated Coefficient*	*t-ratio*	*Estimated Coefficient*	*t-ratio*
Log (efficiency)	-1.274*	(-8.35)	-3.122*	(-15.03)	-1.869	(-15.12)
Trend	-0.0007*	(-3.16)	0.00034	(1.67)	-0.00009	(-0.56)
Dummy (country grouping)					0.700*	(7.4)
Constant	-0.668	(-1.03)	-6.199*	(6.60)	-0.853	(-1.54)

*Significant at the 1 percent level