EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 9 | Issue: 9 | September 2022

# PRODUCTIVITY GROWTH, TECHNICAL PROGRESS AND EFFICIENCY CHANGE

**Kanika Aggarwal, Puneet Singh**


**Article DOI: https://doi.org/10.36713/epra11207**
**DOI No: 10.36713/epra11207**

*This paper analyzes productivity growth of GDP in 5 countries over the period 1990- 2015. The proposed approach relies on using a stochastic production function to provide estimates of technical efficiency, technical change and Total factor productivity.*

## INTRODUCTION

Productivity is the most important determinant of the standard of living of a group of people, a nation or a planet. Productivity in its simplest form is output per hour worked, andits recent slower growth rate is distressing. The great gains in standard of living have come from higher output per hour. That was true of the United States and Europe during the industrial revolution, and it's true of Asia in recent years. Gain could, theoretically, have come from a change in distribution: more income going to workers, and less to owners of capital. Despite recent talk about inequality, changes in income distribution have not drivenrising living standards over long periods of time. Rising incomes result from rising productivity.

Note that when "productivity" is used alone, it usually refers to labor productivity, but theconcept can be applied to other factors of production. We sometimes refer to energy productivity (output per unit of energy used), and factory managers look at the ratio of output produced to raw materials used. In this article we focus on GDP productivity usinglabor, capital and energy as inputs.

In this paper we use the Stochastic frontier approach to to categorize our five selected countries which are India, United States, France, United Kingdom and South Africa according to their economic growth by analysing productivity growth of GDP. The technique we use allows us to calculate two mutually exclusive and exhaustive components:changes in technical efficiency over time and shifts in technology over time. These components lend themselves in a natural way to the identification of catching up and the identification of innovation, respectively. Assuming a translog production function, the product of these two is productivity change.

Economic growth can be defined as a positive change in the level of goods and services produced by a country over a certain period of me. Economic growth can be achieved when the rate of increase in total output is greater than the rate of increase in population of a country. The important determinants of growth are Human Resource, Natural Resources, Capital Formation, Technological Development, Social and PoliticalFactors.

The recent growth rates of India, United States, France, United Kingdom and South Africahave been 7.2%, 1.6%, 1.2%, 1.8% and 0.3% respectively. According to UNDP, out of these, India and South Africa are developing countries and rests of them are developed countries. We will see how GDP has changed over years and how much of the growth in productivity has been due to technical change and how much is due to efficiency change.

## LITERATURE REVIEW

The concept of a stochastic production frontier was developed and extended by Aigner, Lovell, and Schmidt (1977), Meeusen and van den Broeck (1977), Battese and Corra (1977), Battese and Coelli (1988), Lee and Tyler (1978), Pitt and Lee (1981), londrow et al. (1982), Kalirajan and Flinn (1983), Bagi and Huang (1983), Schmidt and Sickles (1984), and Waldman (1984). The basic idea behind the stochastic frontier model as stated by Forsund, Lovell, and Schmidt (1980) is that the error term is composed of two parts: (1) the systematic component (i.e., a traditional random error) that captures the effect of measurement error, other statistical noise, and random shocks; and (2) the one-sided component that captures the effects of inefficiency.

In the paper "Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries" by Rolf Fare, Shawna Grosskopf, Mary Norris, And Zhongyang Zhang, they analyze productivity growth in 17 OECD countries over the period 1979-1988. A nonparametric programming method (ac vity analysis) is used to compute Malmquist productivity indexes. These are decomposed into two component measures, namely, technical change and effciency change. They find that U.S. productivity growth is slightly higher than average, all of which is due to technical change. Japan's productivity growth is the highest in the sample, with almost half due to efficiency change.

The convergence view has been ar culated by many, including Moses Abramovitz (1986, 1990), William J. Baumol (1986), and Baumol et al. (1989). Using data collected by Angus Maddison (1982,1989), these authors provide evidence that incomes have been converging over a fairly long period. For example, Baumol (1986) finds a high inverse correlation between a country's productivity level (as proxied by GDP per work-hour) in 1870 and its productivity growth in terms of GDP per work-hour over the next 110 years. While these results have been shown to be very sensitive to the sample of countries selected (see J. Bradford De Long, 1988), there remains evidence that convergence has occurred among an ex ante chosen subset of OECD countries (Baumol and Edwin J. Wolff, 1988; Baumol et al.,1989). We note that the measure of productivity used in these studies, namely, labor productivity, may also have influenced their results. The goal here is to measure explicitly total factor productivity.

Jin et al. (2010) document that the magnitude of TFP is determined by changes both in efficiency and technical change. Technical ineffciency leads to increased production costs and decrease TFP. Technical change is the main component pulling TFP upward (Ruan 2002; O'Donnell 2012). However, factors for technical change and effciency measures for both crops and livestock, at the aggregate level, have not been examined. Tian and Wan (2000) note that analyzing efficiency determinants is more important than presenting effciency indices. That is, decomposition of TFP into its components is a first and necessarystep but not suffcient. As Stewart, Veeman and Unterschultz (2009) note, decomposition ofTFP into components permits evaluation of how TFP growth occurs which is distinct from the causal assessments of why TFP growth happens. Whereas previous studies have examined why overall TFP growth occurs, this study differs by focusing on why growth of TFP components occurs.

Vahid Shahabinejad, Mohammad Reza Zare Mehrjerdi, Morteza Yaghoubi's aim of the paper is to analyze total factor productivity (TFP) growth and its components in Asian countries applying Stochastic Frontier Analysis (SFA) to the time series data of 44 Asian countries from 2000 to 2010. Using Battese and Coelli approach, TFP is divided into technical efficiency change and technical change. TFP decomposition using SFA method forthe years 1998 to 2007 indicates that in 75 % of these economies, the role of technical change in productivity growth is negative. Only in 11 countries technical change had a positive role in productivity growth. The growth of TFP shows that Japan has the highest productivity growth (2.55 %) and Saudi Arabia, Korea and Hong Kong are located in subsequent positions. Furthermore, due to the lowest technical progress, newly independent countries, such as Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan have the slowest TFP growth.

In their papers, Caves et al. (1982a,b) (hereafter, CCD) show that under certain circumstances, the Tornqvist index (which is the discrete counterpart of the Divisia index) is equivalent to the geometric mean of two Malmquist output productivity indexes.2 Moreover, they show that the Tornqvist index is "exact" for technology that is translog (i.e., one can compute a nonparametric [in the sense that one need not es mate the parameters of technology] productivity index that is "exactly" consistent with the translog form).

Furthermore, since the translog is flexible, the Tornqvist index is "superlative" in the terminology coined by W. Erwin Diewert (see e.g., Diewert, 1976).

## DATA

Our study is based on a Panel Data drawn from World Bank Data Bank. At the World Bank, the Development Data Group coordinates statistical and data work and maintains a number of macro, financial and sector databases. Working closely with the Bank's regions and Global Practices, the group is guided by professional standards in the collection, compilation and dissemination of data to ensure that all data users can have confidence in the quality and integrity of the data produced. Much of the data comes from the statistical systems of member countries, and the quality of global data depends on how well these national systems perform. The World Bank works to help developing countries improve thecapacity, efficiency and effectiveness of national statistical systems.

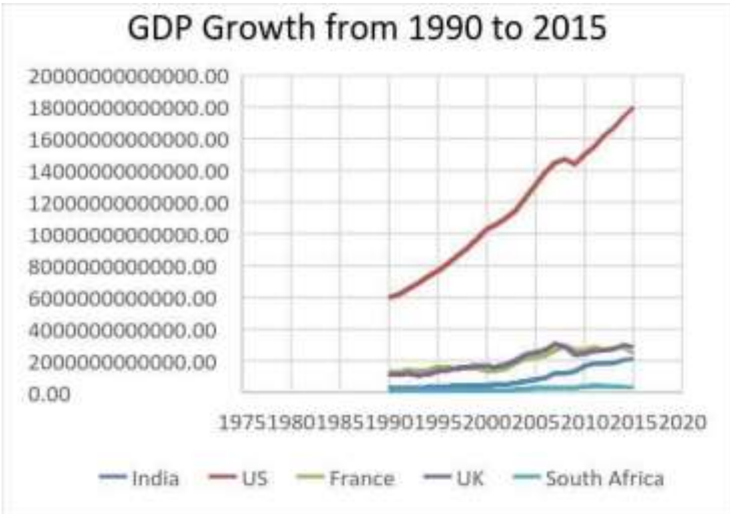
EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 9 | Issue: 9 | September 2022

The following are some of the main features of the data series used. The column number inthe parenthesis relates to the excel file attached.

**Country coverage (Column 1):**
The study includes 5 countries. These have been picked up to cover maximumpossible continents.

**Time Period (Column 2):**
The present paper is based on results for the period 1990 to 2015.Our analysis has beenrestricted to this shorter period since input force data were not readily available for the years other than 1990-2015.

**OutputSeries(Column 3):**
Our output is Gross Domestic Product in current US dollars. The trends in growth of GDPhave been shown in adjacentfigure.




**Input Series (Column 4,5,6):**
Given the constraints on the availability of data, we could get input data only for Laborforce (Total), Energy use (kg of oil equivalent per capita) and Gross fixed capital formation (current US$).

## METHODOLOGY

The general stochastic production frontier model is described by the equations below, where y is the vector for the quantities produced by the various countries, x is the vector forproduction factors used, and β is the vector for the parameters defining the production technology:

$$y = f(t, x, \beta) \cdot \exp(v) \cdot \exp(-u), \quad u \geq 0.$$

The v and u terms (vectors) represent different error components. The first one refers to therandom part of the error, while the second is a downward deviation from the production frontier i.e. Technical inefficiency. The level of technical efficiency (TE), that is, the ratio of observed output to potential output (given by the frontier) is captured by the component exp(-u).

**Production Function Used**
We analyzed different types of production functions so as to boil down to a production function which was most suited for our analysis. The most common production function used in empirical estimations of frontier models is the logarithmic transformation of theCobb Douglas, mostly due to its simplicity.

The various production functions which were taken into consideration were:
1) Cobb Douglas production function
2) Full trans-log production function

The problem with cobb douglas production function is that we were getting wrong coefficient signs and the AES for cobb douglas is unitary which implies it is not a flexibleproduction function. When we used full translog production function, the log likelihood ratio increased from 125 to 206.40 which show a much better fit.

EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 9 | Issue: 9 | September 2022

Functional form of translog production model in SFA:

$$\ln(Y_{it}) = \beta_0 + \sum_{i=1}^{n} \beta_i \ln X_{it} + \frac{1}{2}\sum_{i=1}^{n} \beta_{ii} \ln X_{it}^2 + \sum_{i=1}^{n} \sum_{j \neq i=1}^{n} \beta_{ij} \ln X_i \ln X_j + v_{it} - u_{it}$$

Where,

$Y_{it}$=Output in the i-th country in the t-th period $X_{it}$=input variables in the i-th country in the t-th period$\beta_0$, $\beta_i$, $\beta_{ii}$=the unknown parameter to be estimated.

v = independently and identically distributed random error having normal distribution withmean 0 and variance $\sigma^2$

u = downward deviation from the production frontier i.e. Technical Inefficiency. It is measured as ratio of observed output to the corresponding SFA output. It takes a valuebetween 0 and 1.

$$TE_{it} = \frac{Y_{it}}{\exp(X'_{it}\beta + v_{it})} = \frac{\exp(X'_{it}\beta + v_{it} - u_{it})}{\exp(X'_{it}\beta + v_{it})} = \exp(-u_{it})$$

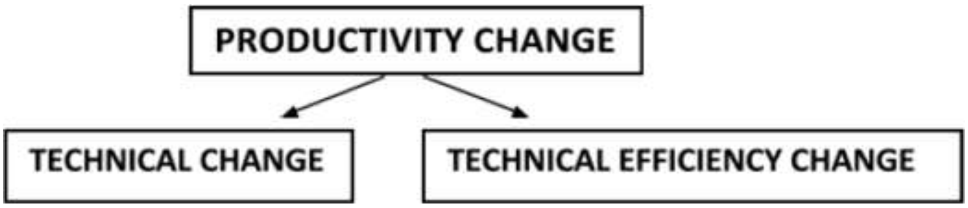
**Our Specification**

Full translog production function (Time varying fixed effects model)

$$Ln(GDP) = \beta_0 + \beta_1 Ln(L) + \beta_2 Ln(k) + \beta_3 Ln(E) + \beta_4 t + \beta_5 (Ln(L))^2 + \beta_6 (Ln(K)^2 + \beta_7 (Ln(E))^2 + \beta_8 t^2 + \beta_9 Ln(L)Ln(K) + \beta_{10} Ln(L)Ln(E) + \beta_{11} Ln(E)Ln(K) + \beta_{12} tLn(L) + \beta_{13} tLn(K) + \beta_{14} tLn(E) + \beta_{15} Country2 + \beta_{16} Country3 + \beta_{17} Country4 + \beta_{18} Country5 + v - u$$

*Where,*

*GDP = Gross Domestic Product*
*L =Labour*
*K =Capital*
*E =Energy*
*T = Time*
*Country2 = 1 if US*
*= 0 o/w*
*Country3 = 1 if France*
*= 0 o/w*
*Country4 = 1 if UK*
*= 0 o/w*
*Country5 = 1 if South Africa*
*= 0 o/w*



Total factor productivity growth can be decomposed into Technical Change (TC) and Technical Efficiency Change (TEC). Technically, we calculate TC and TEC, the productof which is TFP growth. Once estimates of the parameters are obtained, we can calculateTEC and TC using the following formulae.

**Technical Change**

The technical change index for a country between period t and period t+1 is computed as the geometric mean of exponentials of two partial derivations of the production function with respect to time, that is

$TC(t,t+1) = \text{Geometric Mean} \{ TC(t), TC(t+1) \}$

Where $TC(t) = Exp \{\partial \ln Y / \partial t \}$

- TC > 1 means an upward shift in the production frontier and technological progress
- TC < 1 represents a downward shift in the production frontier and technologicalregress and
- TC = 1 means that the frontier remain unchanged

**Technical Efficiency Change**

The efficiency change index for a country is the ratio of the observed technical efficiency intime period t+1 to that in time t, that is

$TEC(t,t+1) = TE(t+1) / TE(t)$

- TEC > 1 means that the producer moved towards the production frontier, i.e.,became more efficient,
- TEC < 1 represents a movement away of the frontier and
- TEC = 1 means that the position of the producer in relation to the production frontier remained unchanged

**Total Factor Productivity Change**

$TFPC(t,t+1) = TC(t,t+1) * TEC(t,t+1)$

$= \{TC(t) * TC(t+1)\}^{0.5} * \{TE(t+1)/TE(t)\}$

## RESULTS AND DISCUSSION

The idea of an inefficiency stochastic frontier production function discussed above was then applied to a macroeconomic scenario in which the 5 countries' GDP using a set ofinputs was used.

A time varying fixed effect stochastic frontier approach has been used to estimate the production function. We have 5 countries so, 4 dummies were created for each country to capture the specific traits of each country with the country India as the basecountry. The following table shows the results obtained:

EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 9 | Issue: 9 | September 2022

```
Stoc. frontier normal/half-normal model          Number of obs      =        128
                                                 Wald chi2(18)      =  170754.81
Log likelihood =  206.40483                      Prob > chi2        =     0.0000
```

| logGDP | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| logK | 5.744386 | 1.96535 | 2.92 | 0.003 | 1.89237 | 9.596401 |
| logL | -3.162327 | 4.808352 | -0.66 | 0.511 | -12.58652 | 6.26187 |
| logE | -7.83641 | 4.061741 | -1.93 | 0.054 | -15.79728 | .1244567 |
| T | -.3360413 | .1059203 | -3.17 | 0.002 | -.5436412 | -.1284413 |
| TT | -.0013434 | .0003365 | -3.99 | 0.000 | -.0020029 | -.000684 |
| logKlogK | -.1851783 | .0752301 | -2.46 | 0.014 | -.3326266 | -.03773 |
| logLlogL | -.0897508 | .132372 | -0.68 | 0.498 | -.3491952 | .1696936 |
| logElogE | -.132549 | .165102 | -0.80 | 0.422 | -.456143 | .191045 |
| logKlogL | .1180292 | .0811927 | 1.45 | 0.146 | -.0411057 | .277164 |
| logKlogE | .3177921 | .1485586 | 2.14 | 0.032 | .0266227 | .6089616 |
| logElogL | .0668117 | .1586395 | 0.42 | 0.674 | -.2441161 | .3777395 |

Continued results

| | | | | | | |
|---|---|---|---|---|---|---|
| TlogK | .0187017 | .0102512 | 1.82 | 0.068 | -.0013903 | .0387938 |
| TlogL | .0062739 | .0079538 | 0.79 | 0.430 | -.0093153 | .0218632 |
| TlogE | -.0257603 | .0112855 | -2.28 | 0.022 | -.0478795 | -.0036411 |
| _ICountry_2 | 6.059362 | .7785277 | 7.78 | 0.000 | 4.533475 | 7.585248 |
| _ICountry_3 | -3.41446 | .1034618 | -33.00 | 0.000 | -3.617242 | -3.211679 |
| _ICountry_4 | .2430911 | .0332713 | 7.31 | 0.000 | .1778805 | .3083017 |
| _ICountry_5 | 5.056717 | .5470641 | 9.24 | 0.000 | 3.984492 | 6.128943 |
| _cons | 27.27899 | 34.2029 | 0.80 | 0.425 | -39.75748 | 94.31545 |
| /lnsig2v | -8.938654 | .7130253 | -12.54 | 0.000 | -10.33616 | -7.541151 |
| /lnsig2u | -4.861942 | .1544562 | -31.48 | 0.000 | -5.164671 | -4.559213 |
| sigma_v | .011455 | .0040839 | | | .0056955 | .0230388 |
| sigma_u | .0879514 | .0067923 | | | .0755973 | .1023244 |
| sigma2 | .0078667 | .0011592 | | | .0055947 | .0101386 |
| lambda | 7.677978 | .0092616 | | | 7.659825 | 7.69613 |

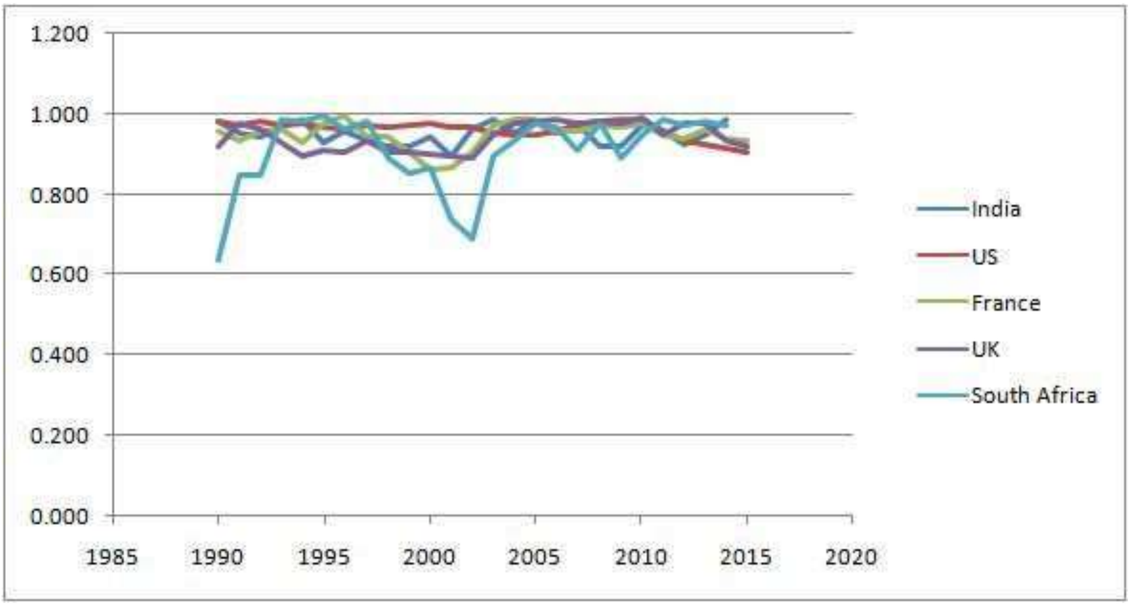
```
Likelihood-ratio test of sigma_u=0: chibar2(01) = 30.47  Prob>=chibar2 = 0.000
. predict TE, te
(2 missing values generated)

. sum TE
```

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| TE | 128 | .9423383 | .053155 | .6359022 | .9959911 |

Estimated production function

$$Ln(GDP) = 27.27 - 3.16Ln(L) + 5.74Ln(k) - 7.83Ln(E) - 0.33t - 0.08(Ln(L))^2 - 0.18(Ln(K))^2 - 0.13(Ln(E))^2 + 0.00t2 + 0.11Ln(L)Ln(K) + 0.06Ln(L)Ln(E) + 0.31Ln(E)Ln(K) + 0.00tLn(L) + 0.01tLn(K) - 0.02tLn(E) + 6.05Country2 - 3.41Country3 + 0.24Country4 + 5.05Country5 + v - u$$

- At the first glance, the parameter of mu (u) is 0.0879514 and is significant.
- The value of u is close to zero which means that there is not much scope for improvement in technical efficiency. Thus the efficiency estimate for most of the observations will be close to 1 which is validated by the fact that mean efficiency is0.9423 with standard deviation of 0.05.
- The country dummies are all highly significant (p values are 0) which means there arecountry specific fixed effects that affect GDP of a country.
- Some of the estimates for explanatory variables used are significant and some are not.Some signs are positive and some are negative but nothing can be said about the correctness because these are not individual effects of say labor or capital. There are square and interaction terms also that affect GDP.

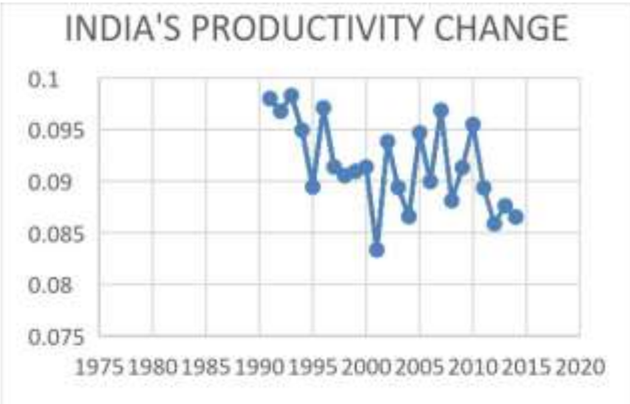


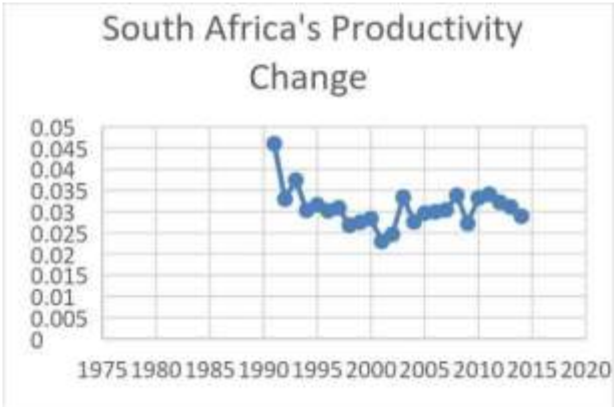

Technical efficiency graph is almost horizontal for most of the countries except SouthAfrica that shows a small degree of variation ranging from 0.0636 to 0.996.

| COUNTRY | MIN | MAX |
|---|---|---|
| India | 0.896 | 0.988 |
| US | 0.907 | 0.987 |
| France | 0.862 | 0.994 |
| UK | 0.888 | 0.992 |
| South Africa | 0.636 | 0.996 |

Using the above coeffcients we computed the trends in Productivity change, Technical effciency change, Technical change for each country for the overall me period. The results are given in the Appendix.

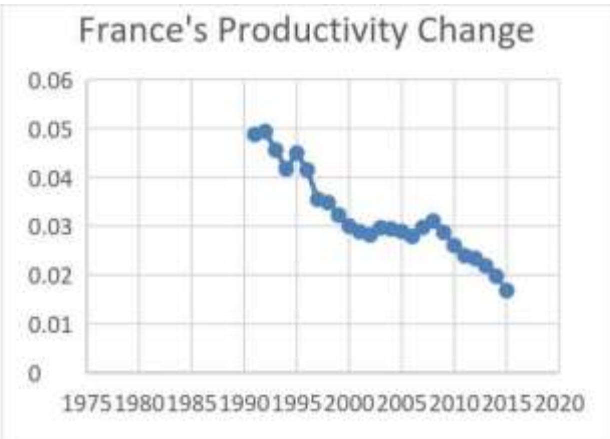
## DEVELOPING COUNTRIES: INDIA AND SOUTH AFRICA



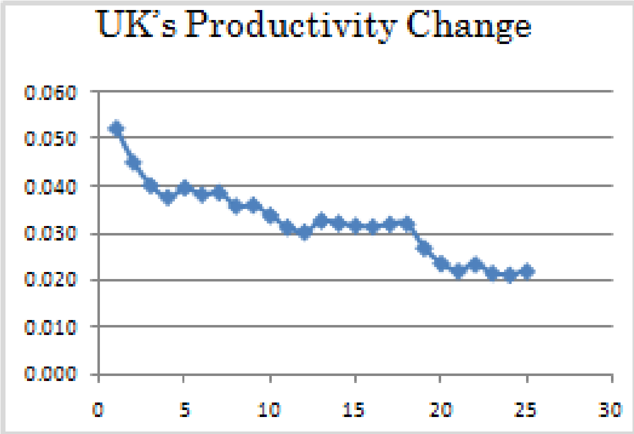




Developing countries are exhibiting a "pro-cyclical" pattern of productivity change which means governments of these countries are adopting pro-cyclical fiscal policy thatcan be summarized simply as governments choosing to increase public spending and reduce taxes during an economic boom, but reduce spending and increase taxes during arecession. However, the productivity growth is more uncertain in India as compared to South Africa.

## DEVELOPED COUNTRIES: US, UK AND FRANCE




EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 9 | Issue: 9 | September 2022




As countries develop, we see that the pattern of productivity change is less pro-cyclicaland more towards declining pattern.

**Possible explanations**

1. One explanation has been that the technological advances and management strategies that worked to propel productivity in the past have been fully implemented and are nolonger contributing to productivity.
2. New technologies are getting hard to find, so workers are no longer getting newtechnologies to make doing their jobs more efficient.
3. Falling working hours and increase in unemployment benefits can be another reasonwhy productivity is falling.

## CONCLUSION

This paper presented some important findings.

- When countries are on a developing path and have not yet realised their full potentialgrowth, they still have the ability to increase their productivity and grow at a higher rate.
- On the other hand, when countries are developed and have realised their full potential then a declining trend in productivity is exhibited as there is not muchscope left for increasing ability.
- Hence, a *converging trend* between countries can be inferred from the above analysis i.e. developing countries grow at higher rate than developed countries.

## LIMITATIONS

- No way to counter check that results obtained under SFA are correct or not.
- Conclusion based on the above data can be wrong since only five countries weretaken into consideration. To improve the fit of the model, we need to take intoconsideration even more countries with wider period of time.
- SFA requires an explicit imposition of a particular parametric functional formrepresenting the underlying technology and also an explicit distributional assumption for the inefficiency terms.

EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 9 | Issue: 9 | September 2022

## APPENDIX

**Reason for including energy as input:** *Energy is a key source of economic growthbecause many production and consumption activities involve energy as a basic input. Energy is one of the most important inputs for economic development. Some analysts argue that growth in energy use directly causes growth in GDP.*

**Table showing TC, TEC and TFP Change.**

| Country | Year | TE | TEC | dlogy/dT | exp(dlogy/dt) | TC | PC |
|---|---|---|---|---|---|---|---|
| India | 0 | 0.985 | . | 0.105 | 1.110 | . | . |
| India | 1991 | 0.953 | 0.968 | 0.098 | 1.103 | 1.103 | 1.068 |
| India | 1992 | 0.946 | 0.992 | 0.097 | 1.102 | 1.103 | 1.094 |
| India | 1993 | 0.976 | 1.032 | 0.093 | 1.098 | 1.100 | 1.135 |
| India | 1994 | 0.987 | 1.012 | 0.094 | 1.099 | 1.100 | 1.112 |
| India | 1995 | 0.931 | 0.944 | 0.095 | 1.100 | 1.100 | 1.038 |
| India | 1996 | 0.957 | 1.027 | 0.094 | 1.098 | 1.099 | 1.129 |
| India | 1997 | 0.935 | 0.978 | 0.093 | 1.098 | 1.098 | 1.074 |
| India | 1998 | 0.919 | 0.982 | 0.091 | 1.096 | 1.097 | 1.078 |
| India | 1999 | 0.921 | 1.002 | 0.090 | 1.094 | 1.096 | 1.098 |
| India | 2000 | 0.946 | 1.028 | 0.088 | 1.092 | 1.094 | 1.124 |
| India | 2001 | 0.896 | 0.947 | 0.088 | 1.092 | 1.093 | 1.035 |
| India | 2002 | 0.963 | 1.075 | 0.086 | 1.090 | 1.092 | 1.173 |
| India | 2003 | 0.988 | 1.025 | 0.088 | 1.092 | 1.092 | 1.119 |
| India | 2004 | 0.954 | 0.966 | 0.091 | 1.096 | 1.094 | 1.056 |
| India | 2005 | 0.982 | 1.030 | 0.093 | 1.097 | 1.095 | 1.128 |
| India | 2006 | 0.954 | 0.971 | 0.093 | 1.097 | 1.096 | 1.064 |
| India | 2007 | 0.980 | 1.028 | 0.096 | 1.100 | 1.098 | 1.129 |
| India | 2008 | 0.919 | 0.937 | 0.092 | 1.097 | 1.098 | 1.029 |
| India | 2009 | 0.921 | 1.002 | 0.090 | 1.094 | 1.096 | 1.098 |
| India | 2010 | 0.973 | 1.056 | 0.091 | 1.095 | 1.095 | 1.157 |
| India | 2011 | 0.958 | 0.985 | 0.091 | 1.095 | 1.095 | 1.079 |
| India | 2012 | 0.926 | 0.967 | 0.087 | 1.091 | 1.093 | 1.057 |
| India | 2013 | 0.948 | 1.023 | 0.084 | 1.088 | 1.090 | 1.116 |
| India | 2014 | 0.988 | 1.042 | 0.082 | 1.086 | 1.088 | 1.134 |
| India | 2015 | | 0.000 | 0.248 | 1.281 | 1.181 | 0.000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| US | 1990 | 0.980 | #DIV/0! | 0.071 | 1.074 | 1.126 | . |
| US | 1991 | 0.972 | 0.992 | 0.069 | 1.071 | 1.098 | 1.089 |
| US | 1992 | 0.984 | 1.012 | 0.067 | 1.070 | 1.084 | 1.097 |
| US | 1993 | 0.971 | 0.987 | 0.067 | 1.069 | 1.076 | 1.062 |
| US | 1994 | 0.978 | 1.007 | 0.066 | 1.068 | 1.072 | 1.080 |
| US | 1995 | 0.968 | 0.990 | 0.065 | 1.068 | 1.070 | 1.059 |
| US | 1996 | 0.965 | 0.997 | 0.065 | 1.067 | 1.068 | 1.065 |
| US | 1997 | 0.975 | 1.010 | 0.064 | 1.066 | 1.067 | 1.078 |
| US | 1998 | 0.968 | 0.993 | 0.064 | 1.066 | 1.067 | 1.060 |
| US | 1999 | 0.971 | 1.003 | 0.063 | 1.065 | 1.066 | 1.069 |
| US | 2000 | 0.977 | 1.007 | 0.062 | 1.064 | 1.065 | 1.072 |
| US | 2001 | 0.966 | 0.989 | 0.061 | 1.063 | 1.064 | 1.052 |
| US | 2002 | 0.969 | 1.003 | 0.059 | 1.061 | 1.062 | 1.066 |
| US | 2003 | 0.953 | 0.983 | 0.058 | 1.060 | 1.061 | 1.043 |
| US | 2004 | 0.948 | 0.994 | 0.058 | 1.059 | 1.060 | 1.054 |
| US | 2005 | 0.948 | 1.001 | 0.058 | 1.059 | 1.060 | 1.060 |
| US | 2006 | 0.957 | 1.009 | 0.057 | 1.059 | 1.059 | 1.069 |
| US | 2007 | 0.975 | 1.019 | 0.055 | 1.057 | 1.058 | 1.078 |
| US | 2008 | 0.984 | 1.009 | 0.054 | 1.055 | 1.057 | 1.067 |
| US | 2009 | 0.986 | 1.002 | 0.051 | 1.052 | 1.054 | 1.056 |
| US | 2010 | 0.987 | 1.001 | 0.048 | 1.049 | 1.052 | 1.053 |
| US | 2011 | 0.960 | 0.973 | 0.048 | 1.049 | 1.050 | 1.022 |
| US | 2012 | 0.937 | 0.977 | 0.048 | 1.049 | 1.050 | 1.025 |
| US | 2013 | 0.924 | 0.986 | 0.047 | 1.048 | 1.049 | 1.034 |
| US | 2014 | 0.915 | 0.990 | 0.046 | 1.047 | 1.048 | 1.037 |
| US | 2015 | 0.907 | 0.991 | 0.045 | 1.046 | 1.047 | 1.038 |
| France | 1990 | 0.958 | 1.057 | 0.052 | 1.053 | 1.050 | . |
| France | 1991 | 0.933 | 0.974 | 0.048 | 1.049 | 1.050 | 1.022 |
| France | 1992 | 0.958 | 1.027 | 0.048 | 1.049 | 1.049 | 1.078 |
| France | 1993 | 0.960 | 1.002 | 0.043 | 1.044 | 1.047 | 1.049 |
| France | 1994 | 0.928 | 0.966 | 0.043 | 1.044 | 1.045 | 1.010 |
| France | 1995 | 0.975 | 1.051 | 0.042 | 1.043 | 1.044 | 1.098 |
| France | 1996 | 0.994 | 1.019 | 0.039 | 1.040 | 1.042 | 1.062 |
| France | 1997 | 0.944 | 0.950 | 0.036 | 1.036 | 1.039 | 0.987 |
| France | 1998 | 0.942 | 0.997 | 0.034 | 1.035 | 1.037 | 1.034 |
| France | 1999 | 0.904 | 0.961 | 0.033 | 1.034 | 1.035 | 0.994 |
| France | 2000 | 0.862 | 0.954 | 0.030 | 1.030 | 1.033 | 0.985 |
| France | 2001 | 0.868 | 1.007 | 0.027 | 1.028 | 1.030 | 1.037 |
| France | 2002 | 0.904 | 1.041 | 0.027 | 1.027 | 1.029 | 1.071 |
| France | 2003 | 0.971 | 1.074 | 0.029 | 1.029 | 1.029 | 1.105 |
| France | 2004 | 0.986 | 1.015 | 0.029 | 1.030 | 1.029 | 1.045 |
| France | 2005 | 0.984 | 0.998 | 0.029 | 1.029 | 1.029 | 1.027 |
| France | 2006 | 0.956 | 0.972 | 0.029 | 1.029 | 1.029 | 1.000 |
| France | 2007 | 0.958 | 1.002 | 0.031 | 1.031 | 1.030 | 1.032 |
| France | 2008 | 0.971 | 1.013 | 0.031 | 1.031 | 1.031 | 1.044 |
| France | 2009 | 0.964 | 0.993 | 0.027 | 1.028 | 1.029 | 1.022 |
| France | 2010 | 0.976 | 1.013 | 0.024 | 1.025 | 1.027 | 1.040 |
| France | 2011 | 0.946 | 0.969 | 0.025 | 1.025 | 1.026 | 0.994 |
| France | 2012 | 0.938 | 0.992 | 0.022 | 1.022 | 1.024 | 1.016 |
| France | 2013 | 0.959 | 1.023 | 0.021 | 1.021 | 1.023 | 1.046 |
| France | 2014 | 0.936 | 0.976 | 0.020 | 1.020 | 1.021 | 0.997 |
| France | 2015 | 0.932 | 0.995 | 0.014 | 1.014 | 1.018 | 1.013 |
| UK | 1990 | 0.920 | 0.987 | 0.051 | 1.053 | 1.035 | . |
| UK | 1991 | 0.978 | 1.063 | 0.047 | 1.048 | 1.042 | 1.108 |
| UK | 1992 | 0.965 | 0.987 | 0.044 | 1.045 | 1.044 | 1.030 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| UK | 1993 | 0.929 | 0.963 | 0.039 | 1.040 | 1.042 | 1.003 |
| UK | 1994 | 0.895 | 0.963 | 0.039 | 1.040 | 1.041 | 1.003 |
| UK | 1995 | 0.909 | 1.015 | 0.039 | 1.040 | 1.040 | 1.056 |
| UK | 1996 | 0.903 | 0.994 | 0.038 | 1.039 | 1.039 | 1.033 |
| UK | 1997 | 0.931 | 1.031 | 0.037 | 1.038 | 1.039 | 1.071 |
| UK | 1998 | 0.902 | 0.968 | 0.037 | 1.037 | 1.038 | 1.005 |
| UK | 1999 | 0.904 | 1.003 | 0.035 | 1.036 | 1.037 | 1.040 |
| UK | 2000 | 0.900 | 0.995 | 0.033 | 1.033 | 1.035 | 1.030 |
| UK | 2001 | 0.893 | 0.992 | 0.030 | 1.031 | 1.033 | 1.025 |
| UK | 2002 | 0.888 | 0.995 | 0.031 | 1.031 | 1.032 | 1.026 |
| UK | 2003 | 0.949 | 1.068 | 0.031 | 1.031 | 1.032 | 1.102 |
| UK | 2004 | 0.978 | 1.031 | 0.032 | 1.032 | 1.032 | 1.064 |
| UK | 2005 | 0.983 | 1.005 | 0.031 | 1.032 | 1.032 | 1.037 |
| UK | 2006 | 0.989 | 1.006 | 0.031 | 1.032 | 1.032 | 1.038 |
| UK | 2007 | 0.976 | 0.987 | 0.034 | 1.034 | 1.033 | 1.019 |
| UK | 2008 | 0.982 | 1.006 | 0.030 | 1.031 | 1.032 | 1.038 |
| UK | 2009 | 0.976 | 0.994 | 0.024 | 1.025 | 1.028 | 1.022 |
| UK | 2010 | 0.992 | 1.017 | 0.022 | 1.022 | 1.025 | 1.043 |
| UK | 2011 | 0.950 | 0.957 | 0.024 | 1.024 | 1.025 | 0.981 |
| UK | 2012 | 0.977 | 1.028 | 0.022 | 1.022 | 1.023 | 1.052 |
| UK | 2013 | 0.979 | 1.003 | 0.021 | 1.021 | 1.022 | 1.025 |
| UK | 2014 | 0.932 | 0.952 | 0.024 | 1.024 | 1.023 | 0.974 |
| UK | 2015 | 0.917 | 0.984 | 0.021 | 1.021 | 1.022 | 1.006 |
| South Africa | 1990 | 0.636 | 0.694 | 0.037 | 1.038 | 1.030 | . |
| South Africa | 1991 | 0.848 | 1.333 | 0.032 | 1.032 | 1.031 | 1.375 |
| South Africa | 1992 | 0.846 | 0.998 | 0.034 | 1.035 | 1.033 | 1.031 |
| South Africa | 1993 | 0.987 | 1.166 | 0.030 | 1.031 | 1.032 | 1.204 |
| South Africa | 1994 | 0.982 | 0.994 | 0.031 | 1.031 | 1.032 | 1.026 |
| South Africa | 1995 | 0.996 | 1.015 | 0.032 | 1.032 | 1.032 | 1.047 |
| South Africa | 1996 | 0.964 | 0.968 | 0.031 | 1.031 | 1.032 | 0.999 |
| South Africa | 1997 | 0.980 | 1.016 | 0.030 | 1.030 | 1.031 | 1.048 |
| South Africa | 1998 | 0.892 | 0.910 | 0.029 | 1.029 | 1.030 | 0.938 |
| South Africa | 1999 | 0.853 | 0.957 | 0.029 | 1.029 | 1.030 | 0.985 |
| South Africa | 2000 | 0.865 | 1.014 | 0.027 | 1.028 | 1.029 | 1.043 |
| South Africa | 2001 | 0.735 | 0.849 | 0.027 | 1.027 | 1.028 | 0.873 |
| South Africa | 2002 | 0.690 | 0.939 | 0.026 | 1.026 | 1.027 | 0.964 |
| South Africa | 2003 | 0.895 | 1.297 | 0.026 | 1.026 | 1.027 | 1.331 |
| South Africa | 2004 | 0.933 | 1.043 | 0.027 | 1.027 | 1.027 | 1.071 |
| South Africa | 2005 | 0.978 | 1.048 | 0.029 | 1.030 | 1.028 | 1.078 |
| South Africa | 2006 | 0.966 | 0.987 | 0.031 | 1.032 | 1.030 | 1.017 |
| South Africa | 2007 | 0.911 | 0.943 | 0.033 | 1.034 | 1.032 | 0.973 |
| South Africa | 2008 | 0.979 | 1.074 | 0.030 | 1.030 | 1.031 | 1.108 |
| South Africa | 2009 | 0.890 | 0.909 | 0.030 | 1.031 | 1.031 | 0.937 |
| South Africa | 2010 | 0.948 | 1.066 | 0.032 | 1.033 | 1.032 | 1.100 |
| South Africa | 2011 | 0.987 | 1.040 | 0.033 | 1.034 | 1.033 | 1.074 |
| South Africa | 2012 | 0.974 | 0.987 | 0.032 | 1.033 | 1.033 | 1.020 |
| South Africa | 2013 | 0.979 | 1.005 | 0.030 | 1.030 | 1.032 | 1.037 |
| South Africa | 2014 | 0.971 | 0.992 | 0.028 | 1.029 | 1.030 | 1.021 |
| South Africa | 2015 | | 0.000 | 0.232 | 1.262 | 1.140 | 0.000 |