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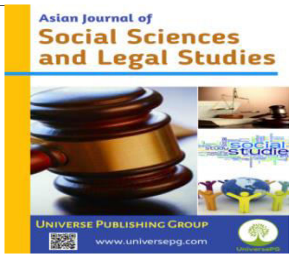

A Study of the Economic Productivity of Several Countries Using a Modified Cobb-Douglas Function

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ABSTRACT

The study analyzes the dynamics of economic productivity in 44 countries using a modified Cobb-Douglas production function. Aside from continuous variables such as labor, capital and energy, this model also accommodates non-continuous variables in order to provide a more accurate representation of the economic relationships. The findings reveal some rather intriguing results regarding the returns to scale and the influence of government and natural disasters on economic output. Negative returns to scale in certain countries can be attributed to factors such as declining working hours and unemployment. The 'Government' variable, despite revealing positive coefficients for most of the countries analyzed, is still nuanced in nature and requires more contextual understanding. The 'Natural Disaster' variable, meanwhile, reveals both negative and positive coefficients, thus challenging conventional wisdom and posing questions about the resilience and adaptability of economic systems in the face of adversity. The study recommends tailored policy interventions, calling for greater specialization and resource allocation in countries with lower productivity levels and sustained innovation in countries with higher productivity levels.

Keywords: Cobb-Douglas, Function, Productivity, Countries, Returns to scale, Factor, and Output.

INTRODUCTION:

Economic productivity is an important aspect of a country's well-being and progress. In fact, it is popularly believed that a country cannot considerably improve its standard of living without increasing its economic productivity (Krugman, 1997; Bonna and Akter, 2023).

As a result, the topic of economic productivity has been a subject of timeless fascination for economists and policymakers alike. Understanding the relationships between various economic factors and their impact on GDP can provide valuable information regarding the economic dynamics of a country. This study examines such relationships using the famous Cobb-Douglas production function (Cobb and Douglas, 1928). The Cobb-Douglas production function provides a mathematical framework for studying how different factors of production contribute to an economy's total output. Over time, the model has adapted to varying contexts, allowing researchers to conduct both microeconomic and macroeconomic analyses of economic productivity. A modified version of the Cobb-Douglas production function was adopted in this study to address the limitations of previous models by including non-continuous variables (Cheng and Han, 2014). Non-continuous variables included external factors such as the governing party and the severity of natural disasters to make this analysis more consistent with reality. This analysis covers 44 countries and provides a cross-national perspective on economic productivity.

As proxies were being decided for each of the variables, one challenge involved coming up with adequate mathematical adjustments that could increase comparability and reduce distortions in the estimates of factor productivity. A prior study using the Cobb-Douglas production function failed to take similar adjustments into account and so ended up producing much distorted results with extreme fluctu-ations (Khatun and Afroze, 2016).

By utilizing the modified Cobb-Douglas function, this study aimed to reveal insights into factor productivity, uncovering patterns, differences and potential explanatory factors across the 44 countries. The findings not only contributed to a deeper comprehension of the economic dynamics of the countries under the study but also offered valuable methodological insights into the application of the Cobb - Douglas production function in contemporary economic analysis.

Rationale of the study

The significance of this study goes beyond merely searching for patterns and differences in factor productivity. It provides methodological insights by improving the application of the Cobb-Douglas production function in contemporary economic analysis. As countries deal with economic challenges influenced by global dynamics, the technological progress and environmental concerns, comprehendsive research on economic productivity is essential. By revealing the complex relationships within the production function, this research aims to provide valuable insights to policymakers, economists and researchers, ultimately helping them make informed decisions and promote sustainable economic development.

Limitations of the study

Some limitations that were faced during this study were as follows:

1) Lack of representativeness: Only 44 countries were selected for this study due to the availability of their data. In such cases, these countries are usually not representative of the entire world as the countries that tend to be omitted consist largely of third-world countries whose data is difficult to collect due to political instability and lack of transparency.
2) Temporal constraints: The study covers a 26-year time period from 1991 to 2017. The lack of available data prevented a longer time period for analysis. As a result, the effects of some radical game-changing events that took place after 2017 like the Covid-19 pandemic and the Russia-Ukraine war could not be considered in this study.
3) Constraints in model development: The modified Cobb-Douglas model used in this study is more multifaceted in nature than the conventional Cobb-Douglas model as it encompasses considerations of economic, technological, political and environmental factors. Nevertheless, it excludes the incorporation of certain categories of factors such as social factors which are also considered influential for business activities (Aguilar, 1967). This omission is primarily attributable to the scarcity of annual secondary data related to social factors, such as public perceptions and opinions, over the temporal scope of this study.

Model Specification

The Cobb-Douglas production function is one of the most widely used production functions in economics because of its versatility. It can be used in both microeconomic and macroeconomic studies, allowing researchers and decision-makers to better comprehend and model economic production. Its scope for mathematical analysis allows for the quantitative estimation of economic parameters and provides valuable insights into the determinants of factor demand and economic growth. As a result, the Cobb-Douglas production function, despite its limitations, continues to remain a cornerstone of economic theory and empirical research, contributing significantly to our understanding of production processes and the allocation of resources in modern economies. The form of the general Cobb - Douglas production is expressed as:

$$Y = AX_1^{\beta_1}X_2^{\beta_2}\ldots X_n^{\beta_n}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

In the equation above, X_i (i = 1, 2, ..., n) denotes the input of the ith factor and Y denotes the output; β_i (i = 1, 2, ..., n) is the output elasticity of the factor X_i and A denotes the level of technical progress or total factor productivity (TFP). However, one problem with the conventional Cobb - Douglas approach is that it does not take into account the influence of some quality non-continuous variables. The conventional Cobb - Douglas function also fails to capture the multifaceted effects on production, especially when faced with external non-economic factors.

Therefore, a modified Cobb - Douglas production function model will be used in this paper (Cheng and Han, 2014). Its form is expressed as:

$$Y = AX_1^{\beta_1} X_2^{\beta_2} \ldots X_n^{\beta_n} e^{p_1 D_1 + p_2 D_2 + \ldots + p_N D_N} \ldots\ldots\ldots (2)$$

Where,

$$D = \begin{cases} 1 \\ 0 \end{cases}, \text{Dummy Variable}$$

Both sides of equation (2) undergo log transformations in order to be converted into a linear form:

$$\ln(Y) = \ln(A) + \sum_{i=1}^{n} \beta_i \ln(X_i) + \sum_{i=1}^{n} p_i D_i + \varepsilon_i \ldots\ldots (3)$$

For the sake of this paper, the modified Cobb-Douglas function is expressed as follows:

$$\ln(Y_{jk}) = \ln(A_k) + \beta_1 \ln(K_{jk}) + \beta_2 \ln(L_{jk}) + \beta_3 \ln(E_{jk}) + p_1 G_{jk} + p_2 N_{jk} + \varepsilon_{jk} \ldots\ldots (4)$$

Where,

Yj_k = Gross Domestic Product,
A_k = Long-term Total Factor Productivity,
Kj_k = Adjusted Gross Capital Formation,
L_{jk} = Adjusted Total Labor Hours,
E_{jk} = Adjusted Primary Energy Consumption,
G_{jk} = Governing Party,
N_{jk} = Natural Disaster Incidence

In the equation above, j = 1, 2, …, 27, representing the number of years in the 27-year period from 1991 to 2017 and k = 1, 2, …, 44, representing the number of countries analyzed. ε_i is the error term which is assumed to be normally distributed. Total labor hours, gross capital formation and primary energy consumption were adjusted by scaling so that all three of them have minimal effects on the total factor productivity. It was done to isolate the effects of total factor productivity and the elasticities and also to prevent the total factor productivity figures from deviating significantly among the countries studied.

There are two non-continuous variables in the modified Cobb-Douglas function: 'Government' (represented by G) and 'Natural disaster' (represented by N). The 'government' variable was included as the conventional Cobb-Douglas production function contains an economic component (reflected by the economic inputs of labor, capital and energy) and a technological component (reflected by total factor productivity) but no political component (Aguilar, 1967). The 'natural disaster' variable was added as an attempt to contribute further to the study of the relevance of natural disasters to economic growth (Cavallo and Noy, 2009). Both the non-continuous variables are dummy variables. G_{ik} = 1 for country k in the ith year such that the political party that was in power for most of 2017 in country k was also in power for most of the ith year and G_{ik} = 0 for every other year for country k. Meanwhile, N_{ik} = 1 for country k in the ith year such that the deaths from natural disasters as a share of total deaths in the ith year in country k was at least 0.01%. The coefficients p_1 and p_2 are such that when G_{ik} = 1, the expected annual percentage GDP growth will increase by p_1% and when N_{ik} = 1, the expected annual percentage GDP growth will increase by p_2%. If the sum of β_1, β_2 and β_3 is negative, that will imply negative returns to scale. In other words, this will mean that the country's outputs are actually rising even as inputs are falling.

If the sum of β_1, β_2 and β_3 is non-negative (either positive or 0) but less than 1, it will imply that output growth is less than proportional to input growth. If the sum of β_1, β_2 and β_3 is 1, it will mean that output growth is exactly proportional to input growth. Finally, if the sum of β_1, β_2 and β_3 is greater than 1, this will imply that output growth is more than proportional to input growth.

METHODOLOGY:

The methodology for this study involved a comprehensive data collection process from various reputable sources. 44 countries were chosen for the study as necessary data from 1991 to 2017 was mostly available for those countries. 'Total Labor Hours' was calculated using the following formula:

Total Labor Hours =
Population aged 15-64 x
(1-Unemployment Rate) x
Working hours per year……(5)

Data for the population aged 15-64 and working hours per year for each of the countries was obtained from the 'Our World in Data' website. Data for the unemployment rate was obtained from the 'Macrotrends' website. Data for 'Gross Capital Formation' was sourced from The World Bank's Data Bank. Data for 'Primary Energy Consumption' data was also collected from the 'Our World in Data' website.

The 'Natural Disaster Incidence' variable was derived by assigning a value of 1 for each year in which the number of deaths from natural disasters as a share of total deaths exceeded 0.01% in a particular country. Meanwhile, the data for the number of deaths from natural disasters as a share of total deaths itself was sourced from the 'Our World in Data' website. For output, the proxy used was gross domestic product (GDP) at purchasing power parity expressed in international dollars at 2017 prices. The data was also obtained from the 'Our World in Data' website.

One issue that arose during the data collection process was the occurrence of missing values. Only 44 countries were selected for this study as relevant data was not available for other countries. Even among the 44 countries, data was occasionally missing. For instance, GDP data for Canada was not available from 1991-1996 and GDP data for Iceland was not available from 1991-1994. As a result, analysis was done using only data from 1997-2017 for Canada and only 1995-2017 for Iceland.

RESULTS AND DISCUSSION:

The estimated coefficients and exponents of the production functions of each of the 44 selected countries along with their respective returns to scale and coefficients of determination are shown in **Table 1**.

Table 1: Estimated figures for selected countries.

Countries	TFP (A) (in trillions)	β_1	β_2	β_3	$\beta_1+\beta_2+\beta_3$	p_1	p_2	Adjusted R^2
Argentina	0.62	0.39	0.19	0.69	1.27	-0.01	0.01	0.993
Australia	0.68	2.71	0.03	-0.16	2.57	0.02	-0.01	0.994
Austria	0.06	-1.88	0.72	0.87	-0.29	0.00	-0.01	0.962
Bangladesh	0.27	-0.13	0.81	-0.14	0.54	0.01	-0.08	0.995
Belgium	0.17	0.18	0.68	0.11	0.98	0.01	-0.01	0.965
Brazil	0.14	1.00	0.10	0.39	1.49	0.04	0.02	0.995
Canada	0.32	2.59	-0.04	0.27	2.82	0.00	-0.01	0.994
Chile	0.51	0.86	0.26	0.59	1.71	0.07	-0.02	0.996
China	0.42	-0.13	1.02	-0.48	0.40	0.00	0.00	0.996
Colombia	0.50	0.98	-0.09	0.70	1.59	0.04	0.00	0.993
Costa Rica	0.44	0.31	0.38	0.40	1.09	0.15	-0.03	0.962
Denmark	0.04	-0.49	0.55	-0.22	-0.16	0.03	0.03	0.950
Finland	0.06	-0.24	0.76	-0.04	0.49	0.03	-0.06	0.957
France	0.27	-0.32	0.78	-0.19	0.26	-0.03	-0.01	0.949
Germany	1.82	-1.29	0.75	-0.51	-1.05	0.02	0.00	0.933
Greece	0.48	-0.91	0.28	0.93	0.30	0.01	-0.01	0.942
Hungary	0.04	-2.52	0.70	0.14	-1.69	0.03	0.00	0.885
Iceland	0.64	0.44	0.17	0.50	1.11	-0.04	0.02	0.995
India	0.03	0.83	0.01	0.87	1.71	0.01	0.03	0.998
Ireland	0.69	-1.32	0.45	1.90	1.02	0.12	-0.02	0.948
Italy	1.35	-1.21	0.61	-0.17	-0.77	-0.02	0.00	0.888
Japan	6.40	-0.95	0.26	0.23	-0.46	0.00	0.00	0.921
Luxembourg	13.38	1.20	0.53	0.22	1.94	-0.10	0.00	0.961
Malaysia	0.17	1.45	0.21	0.07	1.73	0.00	0.00	0.994
Mexico	0.14	1.14	0.20	-0.11	1.23	0.00	0.01	0.997
Netherlands	0.26	0.00	0.55	0.97	1.52	0.09	-0.04	0.956
New Zealand	1.17	1.77	0.27	-0.27	1.77	0.06	0.03	0.972
Norway	0.05	-0.39	0.65	0.06	0.32	0.04	-0.01	0.931
Pakistan	0.02	1.40	0.49	-0.22	1.68	0.03	0.01	0.988
Peru	0.49	0.74	0.17	0.58	1.49	0.02	-0.03	0.995
Philippines	0.03	1.63	0.11	-0.03	1.72	0.05	0.00	0.997
Portugal	0.69	0.11	0.11	0.61	0.83	0.09	-0.01	0.946
Singapore	1.36	0.97	-0.01	0.71	1.67	0.00	0.00	0.989
South Korea	1.21	-1.46	0.47	0.65	-0.33	0.01	-0.01	0.996
Spain	0.63	-1.89	0.67	1.15	-0.07	-0.01	-0.05	0.883
Sri Lanka	0.54	0.07	0.43	0.43	0.92	0.05	-0.01	0.993
Sweden	0.64	1.62	0.45	-0.27	1.81	-0.01	0.03	0.970

Switzerland	1.25	2.51	0.58	-0.07	3.02	0.02	0.02	0.918
Thailand	0.25	0.65	0.16	0.63	1.44	0.10	-0.01	0.985
Turkey	0.59	0.27	0.23	0.56	1.05	0.07	0.00	0.992
United Kingdom	0.12	2.39	0.20	-0.24	2.34	-0.02	-0.06	0.950
United States	3.32	0.05	0.91	-1.13	-0.17	-0.01	0.00	0.942
Uruguay	0.12	-0.46	0.50	0.44	0.49	0.02	0.02	0.972
Vietnam	0.48	0.33	0.03	0.60	0.97	0.00	0.00	0.996

In the table above, the adjusted coefficients of determination (R^2) for each and every one of the 44 countries was very high (above 0.85). Even the lowest one, that of Spain, was 0.883. That suggested that for all of the countries concerned, the modified Cobb-Douglas model in this paper provided a very good fit.

Interpretations of the total factor productivity figures

Out of all the countries analyzed, it was discovered that the five countries with the lowest total factor productivity were Denmark, Hungary, India, Pakistan and the Philippines. The figures of none of the five countries had crossed the 50-billion figures. For developing countries like India, Pakistan and the Philippines, low total factor productivity figures could be due to their lack of specializations in high-value industries with global demand. Other developing countries like Bangladesh and Vietnam that specialized, for instance, in the textile industry had higher total factor productivity figures (The Daily Star, 2023).

In the case of developed countries like Denmark and Hungary, the low total factor productivity figures are especially surprising considering that both are high-income countries whose exports largely consist of high-value products like cars and other electronic goods (World Population Review, 2024; Observatory of Economic Complexity, 2023). There may be some factors at play such as the presence of regulations or the allocation of resources but the exact economic impacts of those factors on Denmark and Hungary will require further study in the future. Meanwhile, on the other side, the five countries with the highest total factor productivity were Germany, Japan, Luxembourg, Singapore and the United States. Each of those countries had a figure of over 1 trillion. It is expected of Singapore and Luxembourg to have high factor productivity given the fact that both countries have very limited resources due to their extremely small respective land areas and need high productivity to compete economically with the rest of the world. Germany, Japan and the United States, meanwhile, are known for their robust manufacturing sectors (United Nations Statistics Division, 2024).

Interpretations of the factor exponents and returns to scale

Out of all the countries analyzed, it was discovered that nine of the countries (Austria, Denmark, Germany, Hungary, Italy, Japan, South Korea, Spain and the United States) had negative returns to scale. The negative returns to scale were caused exclusively by negative output elasticity of labor for Austria, Hungary, Japan, South Korea and Spain. As per data trends from the 'Our World in Data' and the 'Macrotrends' websites, the negative returns to scale could be explained by severe drops in working hours in the case of Austria, Hungary and South Korea, declining working population in the case of Japan and relatively high rate of unemployment in the case of Spain. In the United States, meanwhile, the negative returns to scale were caused exclusively by negative output elasticity of energy. This could be explained by the fact that the primary energy consumption in the United States had been following a downward trend for the latter half of the 27-year period according to data trends from the 'Our World in Data' website. Finally, for Denmark, Germany and Italy, the negative returns to scale were caused by both negative output elasticities of labor and energy. They were caused respectively by falling working hours and falling primary energy consumption in all three countries as per data trends from the 'Our World in Data' website.

Meanwhile, nine of the countries (Bangladesh, China, Finland, France, Greece, Norway, Portugal, Sri Lanka and Uruguay) had positive but decreasing returns to scale. This means that the output growth in each of those countries was less than proportional to their input growth. A similar prior study on the economic dynamics of Bangladesh and China using the Cobb-Douglas productivity function revealed increasing returns to scale for Bangladesh and China, a sharp contrast to this study (Khatun and Afroze, 2016). That might have been because the study assumed that output elasticities of labor and capital cannot be negative; something which is not necessarily true given the fact that countries with declining working hours might have negative output elasticities of labor as their output continues to grow despite decreasing labor input. In the case of this study, both Bangladesh and China were found to have negative output elasticities of labor as well as negative output elasticities of energy. Four of the countries analyzed (Belgium, Ireland, Turkey and Vietnam) had near-constant returns to scale. The output growths of each of those countries were almost proportional to their respective input growths. Even though Ireland had a negative output elasticity of labor, its output elasticities of capital and energy were more than enough for the country to achieve near-constant returns to scale. The rest of the countries all had increasing returns to scale. Switzerland had the largest returns to scale at 3.02.

Interpretations of the 'Government' variable

The coefficient of the 'Government' variable was positive for the majority of the 44 countries. Costa Rica had the highest coefficient at 0.15. This suggests that annual percentage growth in output for the majority of the countries including Costa Rica was around 15% to over 0% higher in the years during which the governing party for the majority of 2017 was in power most of the time. It was, however, zero for eight countries (Austria, Canada, China, Japan, Malaysia, Mexico, Singapore, Vietnam) and negative for another nine countries (Argentina, France, Iceland, Italy, Luxembourg, Spain, Sweden, United States, United Kingdom). While due credit is undoubtedly attributable to the governing parties of countries exhibiting positive coefficients, it is crucial to recognize the more subtle nature of these results. Given the temporal scope of this study, it is essential to consider that the observed relationship might have been significantly influenced by the broader context of the historic global economic growth.

Interpretations of the 'Natural Disaster' variable

The coefficient of the natural disaster variable was either negative or zero for most countries. This means that the economic output of most countries was either lower or remained unchanged in the years during which the share of deaths from natural disasters was 0.01% or more. In countries with negative coefficients, severe natural disasters were expected to cause large-scale destruction to human capital, thus impeding quick short-term recovery. Countries with a coefficient of zero were more able to exhibit remarkable resilience even in the face of severe natural disasters. They were possibly able to recover more quickly in the short-run from severe natural disasters, mostly due to the presence of proper institutions and effective policymaking that allowed for quick and efficient allocation of resources at times of crises (Kern, 2010). However, what was really surprising was the finding that 11 countries (Argentina, Brazil, Denmark, Iceland, India, Mexico, New Zealand, Pakistan, Sweden, Switzerland and Uruguay) had positive coefficients. In other words, they saw higher economic output in years with relatively severe natural disasters. That could have been due to temporary boosts in output and employment caused by increased recovery spending and investment in those countries in the aftermath of disasters (Baily, 2011).

CONCLUSION:

This study used a modified Cobb-Douglas production function to analyze the relationships among various factor inputs and outputs in 44 countries. The purpose of this modified model was to make the analysis more consistent with reality by accommodating non-continuous variables. The results revealed rather interesting information on factors affecting factor productivity and the impacts of government and natural disasters on economic output. Returns to scale in some countries were negative, caused by factors such as reduced working hours, unemployment and diminishing energy consumption. The "government" variable, despite revealing mostly positive coefficients, continued to remain nuanced due to the historic nature of economic growth. The "natural disaster" variable showed both negative and positive coefficients, thus challenging conventional wisdom. Differences in total factor productivity data among countries meant that targeted policy interventions are required for the countries analyzed. Specialization and resource allocation are required for low-productivity countries while continuous innovation and resource optimization are required for high-productivity countries. This study not only provided valuable insights into the economic dynamics of the analyzed countries, but it also offered methodological improvements for the use of the

Cobb-Douglas production function in modern economic analysis. In today's continuously evolving global economic landscape, this study aims to serve as a foundation for policymakers, economists, and rese-archers to make well-informed choices in their pursuit of sustainable economic development.

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CONFLICTS OF INTEREST:

The author has declared no potential conflicts of interest with respect to his research work.

REFERENCES:

1) Aguilar, F. J. (1967). Scanning the business environment. *Macmillan*.
2) Baily, M. N. (2011). Can natural disasters help stimulate the economy? *Brookings.* https://www.brookings.edu/articles/can-natural-disasters-help-stimulate-the-economy/
3) Bonna S., and Akter L. (2023). Socio-economic status of pineapple growers in Bangladesh: a study on Tangail district, *Asian J. Soc. Sci. Leg. Stud.*, **5**(3), 67-76. https://doi.org/10.34104/ajssls.023.067076
4) Cavallo, E. A., & Noy, I. (2009). The Economics of Natural Disasters: A Survey.
5) Cheng, M. L., & Han, Y. (2014). A Modified Cobb-Douglas Production Function Model and its Application. *IMA J. of Management Mathematics*, **25**(3), 353-365. https://doi.org/10.1093/imaman/dpt012
6) Cobb, C. W., & Douglas, P. H. (1928). A Theory of Production. *Papers and Proceedings of the Fortieth Annual Meeting of the American Economic Association*, **18**(1), 139-165.
7) The Daily Star, (2023). Bangladesh widens market share in global RMG trade. *The Daily Star*. https://www.thedailystar.net/business/news/bangladesh-widens-market-share-global-rmg-trade-3384261
8) Kern, W. S. (2010). The economics of natural and unnatural disasters. W. E. Upjohn Institute for Employment Research.
9) Khatun, T., & Afroze, S. (2016). Relationship between Real GDP and Labour & Capital by applying the Cobb-Douglas Production Function: A Comparative Analysis among Selected Asian Countries. *J. of Business Studies*, **37**(1), 113-129.
10) Krugman, P. R. (1997). The Age of Diminished Expectations. *MIT*.
11) Observatory of Economic Complexity, (2023). The best place to explore trade data. https://oec.world/en
12) United Nations Statistics Division, (2024). Basic data selection. *United Nations*. https://unstats.un.org/unsd/snaama/Basic
13) World Population Review, (2024). High-income countries 2024. https://worldpopulationreview.com/country-rankings/high-income-countries

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