THE DYNAMICS OF ECONOMIC GROWTH ACROSS COUNTRIES AND REGIONS OF THE WORLD

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RESEARCH ARTICLE

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Abstract

Dynamic growth is an economy's ability to create more products and services over time. The long-run trend of Economic growth of a country or region depends on Technological advancement, Progress in Research and Development, Stock of Capital, Labour force Participation, Net inflow of FDI, Participation in Education, Rate of inflation etc. This article endeavor to find out the reasons behind the variation of economic growth across countries and regions of the World and the factors significantly responsible for variation of economic growth.

**Keywords:** *Economic, Growth, Countries, Regions, Dynamic Panel, Index*

Introduction

The issue of achieving higher economic growth dynamics is the greatest interest to the economists and policy makers for long years. Today's empiricists and policy analysts have taken a genuine interest in this concern. Recently in the age of tremendous competition among the countries of the world, each country tries to win the race by first position in each year, especially India and China the two developing countries of the world.

It is easy to perceive those two countries interest of competition. Achieving high rate of growth dynamically means achieving rate of change of economic growth, which affects per capita income, higher level of social welfare, better standard of living and so on. Higher growth rates enable the countries to reduce poverty and unemployment, greater prosperity in a more equitable manner.

However, there are the reasons behind the potentialities of higher economic growth rates of countries and regions in future by which different countries can achieve different rates of economic growth. Of course, any such assessment of growth rate would have to be justified in the context of the past growth performance of the economies. The dynamic economic process could be understood better through the Cobweb Diagram as is shown in the figure 1 The diagram attempts to explain in converging economy, how economic growth rate adjust itself based on the past growth rates and there is a tendency to regain the past growth rate through a series of oscillations. Applying this idea of dynamic idea, we shall try to explain whether growth of GDP of a country or region with time lag significantly affects the growth of GDP for next year or not.

Diagram 1: Cobweb Model-Dynamic economic growth process
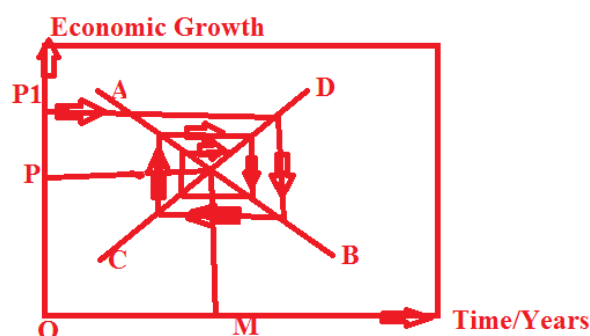
Source: Nicholas Kaldor (1934)

Endogenous growth theory attempts to supply the missing explanation of dynamic economic growth. The approach allows a theory of technical progress, one of the central missing components of the neoclassical model. In neoclassical framework, the induction of a theory of technological change is difficult; instead, it has been considered fruitfully in recent times.

If we can learn about government policy recourse, that have even small effects on long-term growth rates; we can furnish much more to refinements in life style that has been pursuing by the entire history of macroeconomic analysis over long periods of time. Even small rates of growth such as 2% annual increase, have large effects in long run economic growth (Economic Growth Wikipedia).

In this background, we are trying to find the nature of dynamic economic growth of different Developing countries and regions along with the Developed Countries and regions.

Objectives of the Study

    i)   To justify whether growth of GDP depends on dynamic panel variables or not for different countries and regions of the World.

    ii)   To identify the relative importance of different dynamic panel variables on the growth of GDP in different countries and regions of the World.

In this section, the Testing of Hypothesis is:

    i) H_0 (Null Hypothesis): There is no significant difference of GDP growth with time lag, market efficiency, financial efficiency, gender parity index in school education and innovation index, between developing and developed countries and regions of the world in dynamic economic growth.

    H_1 (Alternative Hypothesis): Developed countries and regions has greater GDP growth with time lag, market efficiency, financial efficiency, gender parity index in school education and innovation index, compared to developing countries and regions of the World in dynamic economic growth.

Data Source and Methodology

Economic growth moving under the action of 'dynamic forces' like stock of capital, labour force participation, GDP per person employed, research and development expenditures, high technology exports, Gender disparity in education, net inflow of FDI and inflation rate. Some other factors like application and preservation of energy resources and climate make differences in economic growth in the long run. To measure the differences of growth rates dynamically for different countries, we have accumulated the secondary data set Total 51 Countries and regions of the world among which 19 are developing Countries and regions and remaining 32 are developed countries and regions as per World Bank's classification.

Developing Countries and Zones/Regions

Developing Countries: Argentina, Armenia, Azerbine, Belarus, China, India, Kazakhstan, Mexico, Macedonia, Mongolia, North America, Russian federation, Serbia, Turkey and Ukraine.

Developing Zone/regions: Post-demographic dividend, Europe and Central Asia, South Asia, Upper middle income Zone.

Developed Countries and Zones/Regions:

Developed/High income Countries: Austria, Belgium, Bulgaria, Czech republic, Germany, Denmark, Spain, Finland, France, U.K, Hungary, Israel, Italy, Japan, Kyrgyz republic, Korea republic, Kuwait, Lithuania, Netherlands, Portugal, Romania, Singapore, Slovak Republic, Slovenia and U.S.

Developed Zone/regions: Central Europe and Baltics, Europe and Central Asia, Europe area, European Union, High Income, OECD Members, Europe & Central Asia (IDA & IBRD countries) published by the World Bank.

Methodology

In this literature, we are interested to measure the dynamic nature of economic growth (GDP growth) through panel data. Since we are trying to find out the dynamic nature of economic growth by panel data estimation here, the most exact methodology is linear dynamic panel data estimation, which follows GMM method. Linear dynamic panel data describes the case where a lag of the dependent variable is also used as independent variable in the following form:

$$Y_{it} = \alpha_i + \beta^{/} X_{it} + \gamma Y_{it-1} + u_{it} \ldots \ldots \qquad \ldots \qquad (1)$$

Where Y_{it} is the dependent variable for i^{th} counties for time period t, X_{it} is time variant 1*k regressors matrix, $\beta^{/}$ is number of β_s, α_i is unobserved intercept term and u_{it} is error term.

We want to identify all coefficients of time dependent variables and developed tests for strict exogeneity for a subset of variables. When exogeneity assumptions violated, correlation between time varying coefficients and error terms may be complicated, then static panel data model fixed effects estimators will be inconsistent, then Anderson-Hsiao proposed a solution by instrumental variables (IV) estimation with generalized methods of moments.

The presence of the lagged dependent variable violates strict exogeneity. The fixed effect estimator and the first difference estimator both rely on the consideration of strict exogeneity. Hence, if u_i is considered to be correlated with one of the

The Social Science Review A Multidisciplinary Journal. September-October, 2025. Vol. 3. Issue 5. 45-51

Published by: Pather Dabi Educational Trust, (Regn No: IV-1402-00064/2023), Under Govt. of West Bengal, India

independent variables, another estimation technique must be used. Instrumental variables and GMM techniques are commonly used in this situation. We can describe the model in the following way:

Linear Dynamic Panel Data Method (Arellano–Bond-Generalised Method of Moments-GMM)

To measure dynamic economic growth, dynamic panel data models are relevant for different countries at a time. In dynamic panel data method, we have included a lagged dependent variable model developed by Arellano-Bond and the Generalised Method of Moment (GMM). Firstly, in the Arellano–Bond method, first difference of the regression equation is taken to eliminate the individual effects, but not all individual effects are eliminated. Then, Instrumental Variable (IV) which includes Efficient Generalized method of moments is applied, which provides consistent and asymptotically efficient estimators in the presence of heteroskedasticity. Estimator of deeper lags of the dependent variable are applied as instruments for differenced lags of the dependent variable (which are endogenous) subsequently.

Now, in our analysis, considering the static linear unobserved effects model for n observations and t time periods we get:

$$Y_{Econ.grow.it} = \alpha_i + \beta_1 Y_{Econ.grow.t-1} + \beta_2 \ln(Innov.Index_{it}) + \beta_3 \ln(GPI.School\ edu\ Index_{it}) + \beta_4 \ln(Mkt.effi.Index_{it})$$
$$+ \beta_5(Finan.effi.Index_{it}) + u_{it}$$

…   …   …   (2)

Where, $Y_{Econ.grow.it}$ denotes the Growth of Economy or growth of GDP of the countries in t time periods.

$I_{innov.}\ Index_{it}$ denotes Innovation Index of different countries and regions in t time period.

Which Includes

$H_{export\ it}$, denotes High technology export of different countries and regions in t time period.
$Govt._{R\&D\ it}$, denotes Govt. Exp. on Research and Development in % of GDP of different countries and regions in t time period.
IP_{it} deotes, Intellectual property rights or Patents of the countries and regions for t time period.
$GPI_{Sch.}Edu._{it}$ denotes Gender Parity Index in School education of different countries and regions in t time period.

$M_{kt.}E_{ffi.}Index_{it}$ denotes Market Efficiency Index of different countries and regions for t times.

Which includes,

K_{it}, denotes Stock of capital of the countries and regions in t time periods.
$L_{ft\ it}$, denotes Labour force participation of the countries and regions in t times.
$GDP_{employ.it}$, denotes GDP employed per person as a proxy of employment in labour market for the countries and regions for t time period.
$F_{inan}E_{ffi}Index_{it}$ denotes Financial efficiency Index

Which includes,

$I_{nfr\ it}$, denotes rate of inflation of the countries and regions for t times.
FDI_{it}, denotes Foreign Direct Investment of the countries and regions for t time periods.
β_i denotes coefficient of respective factors. u_{it} is random error term.

t = 1, 2, 3... ,22 (from 1996 to 2017) and i = 1, 2, 3, 4….19 for Developing Countries & Regions and i=1,2,3,4……32 for Developed Countries& Regions (Total 51 countries & Regions among which 19 are Developing and 32 are Developed)

where i stands for the i-th cross-sectional unit and t for the t-th time period.

In this case growth of GDP of different countries($Y_{Econ.grow.it}$) lagged by one period($Y_{Econ.grow.it-1}$) and taking it as an independent variable, initiate to measure the long run consequences on the dependent variable. Growth of GDP ($Y_{Econ.grow.it}$) by Innovation Index (Innov. Index) which includes High technology Exports by the countries and regions.

Research and Development Expenditures of the countries and regions and Patent applications of the countries and regions to create and adopt new technologies. Index of Education that is Gender Parity Index in School education (GPI Sch. Edu.) as an indicator of participation in education with equality and to spread the new technologies throughout the economy with developing the capacity of the workforce.

Market efficiency Index (Mkt. Effi. Index) under which GDP per person as a proxy of employment in labour market, Labour force participation and Capital stock to promote the effective and flexible allocation of resources across sectors and firms. Lastly, Financial efficiency Index includes rate of inflation and Foreign Direct Investment of the economies to measures the performance of the financial activities which significantly affects economic growth.

In nutshell, $Y_{Econ.grow.it}$ is the dependent variable observed for individual at time t, $I_{innov.}\ Index_{it}$, $GPI_{Sch.}Edu._{it}$, $M_{kt.}E_{ffi.}Index_{it}$, $F_{inan.}E_{ffi.}Index_{it}$ is the time variant 1x4 regressor matrix, α_i is the unobserved time-invariant individual effect and u_{it} is the error term. Unlike $I_{innov.}\ Index_{it}$, $GPI_{Sch.}Edu._{it}$, $M_{kt.}E_{ffi.}Index_{it}$, $F_{inan.}E_{ffi.}Index_{it}$ and α , β_i can not be observed.

We have to find out those values of the institutional factors for countries and regions. To find this we are going through the GMM instrumental estimation approach. Here GMM advocates moment conditions with instrument matrix in the following way:

Instrument Matrix in our model

The original Anderson and Hsiao (1981), instrumental variable (IV) estimator uses the following moment conditions:

$$(Y_{Econ.Grow.it-I}, \Delta u_{it}) = 0 \dots \qquad \dots \qquad \dots \qquad (3)$$

for $I \geq 2$ each, using the single instrument y_{it-2}, these moment conditions form the basis for the instrument matrix Z_{di}

$$Z_{dit} = \begin{pmatrix} NA & \cdots & t=2 \\ \vdots & \ddots & \vdots \\ y_{T-2} & \cdots & t=T \end{pmatrix} \quad \dots \quad \dots \quad \dots \quad (4)$$

The Arellano–Bond estimator uses the following moment conditions

$$(Y_{Econ.Grow.it} \Delta u_{it}) = 0 \text{ for } I \geq 2, \ t \geq 3$$

Where first possible observation is t=2, due to first possible transformation.

Using the above moment conditions, the instrument matrix Z_{dit} becomes

$$Z_{dit} = \begin{pmatrix} Y_{Econ..growth.it1} & 0 & 0 & 0 & 0 & 0 \\ 0 & Y_{Econ..growth.it2} & Y_{Econ..growth.it1} & 0 & 0 & 0 & \cdots \\ 0 & 0 & Y_{Econ..growth.it3} & Y_{Econ..growth.it2} & Y_{Econ..growth.it1} & 0 \\ & & & \vdots & & & \ddots & \vdots \\ & & & & & & \cdots \end{pmatrix}$$

$$\dots \qquad \dots \qquad \dots \qquad (5)$$

In future with more lags we are using as instruments with disturbance matrix as.

$$\Delta_{u_i} = \begin{bmatrix} u_{i3} \\ u_{i4} \\ u_{i5} \\ . \\ . \end{bmatrix} \dots \qquad \dots \qquad \dots \qquad (6)$$

Ultimately, the moment conditions are summarized as:

$$E(Z_{dit}^T \Delta_{u_i}) = 0$$

Moment conditions are valid only when the error term does not have serial condition.

System GMM for the model

In case of fixed effect the variance term of individual observations are high; again in stochastic process y_{it} is close to a random walk, then estimator of Arellano–Bond may function very poorly for finite samples. Because, the lagged dependent variables will work as weak instrument in those situations.

Besides, Blundell and Bond (1998) elaborated use an additional set of moment conditions. These additional moment conditions can be applied to improve the small sample test of the Arellano–Bond estimator. Specifically, they advocated using the moment conditions:

$$(\Delta Y Econ. growth. it (\propto_i + u_{it})) = 0 \dots \qquad \dots \qquad \dots (7)$$

These additional moment conditions are valid under conditions provided in their paper. In this case, the full set of moment conditions can be written:

$$E(Z_{SYS,it}^T . P_i) \dots \quad \dots \qquad \dots \qquad (8) \text{ where}$$

$$P_i = \begin{pmatrix} \Delta u_i \\ u_{i3} \\ u_{i4} \\ u_{i5} \\ \vdots \end{pmatrix} \dots \quad \dots \qquad \dots \qquad (9)$$

And the matrix

$$Z_{SYS,it} = \begin{pmatrix} Z_{dit} & 0 & 0 \\ 0 & \Delta Y_{Econ..growth.it2} & 0 \\ 0 & 0 & \Delta Y_{Econ.growth.it3} \\ & & \ddots \end{pmatrix} \dots \quad \dots \qquad \dots (10)$$

This method is known as systems GMM. Where the values of GDP of different countries ($Y_{Econ.grow.it}$) generates "moment conditions" by stochastic random stationary process.

With the help of the above Arellano-Bond approach we got the following results of Linear Dynamic Panel Data (LDPD) model, which follows GMM with robustness of the estimation is given in table 1. The values of z-statistics and p-statistics are also given

The Social Science Review A Multidisciplinary Journal. September-October, 2025. Vol. 3. Issue 5. 45-51

Published by: Pather Dabi Educational Trust, (Regn No: IV-1402-00064/2023), Under Govt. of West Bengal, India

in the same table. The capacity of a country's development depends on multiple factors. We have considered total nine factors like Capital stock, Labour force participation, GDP Per person employed, Govt. Expenditures on R&D, High technology exports and rate of inflation, Patent applications and net FDI inflows which influences short and long term Economic growth of different countries and regions as found in different recent studies. However, in this study we shall try to find out the dynamic effect of factors mentioned here on economic growth.

Empirical Dynamic Panel Results of GDP Growth

Table 1: Dynamic Panel Results

Long run GDP Growth	Developing Countries and Regions			Developed Countries and Regions		
Methodology	Arellano-Bond dynamic panel-data estimation (GMM)		Arellano-Bond dynamic panel-dataestimation (GMM)	Arellano-Bond dynamic panel-data estimation (GMM)		Arellano-Bond dynamic panel-data estimation (GMM)
	Co-efficients	Z-statistics	p- statistics	Co-efficients	z-statistics	p- statistics
$Y_{Econ.Growth.it-1}$/Growth GDP Lag$_1$	0.961	27.70	0.000	0.667	35.73	0.000
Log market Efficiency Index	0.201	8.64	0.000	0.356	16.03	0.000
Financial efficiency. Index	5.86	0.12	0.97	6.70	0.38	0.702
Log Gender Parity Index in School Edu.	-0.001	-0.48	0.63	0.001	1.61	0.108
Log Innovation Index	0.000	0.20	0.845	-0.011	-4.15	0.000
No. of observations	380			640		
No. of Countries	19			32		
Level of Significance	1% &5%			1%&5%		
Arellano-Bond dynamic panel-estimation	Wald X^2=7400.20 Prob.X^2=0.0000			Wald X^2=11585.20 Prob.X^2=0.000		

Source: Author's own calculation from World Bank Data & UNICEF (1996-2017)

Growth of economy is a dynamic process for different countries and regions of the World

The results found from the dynamic Panel data method in table 1 identify the significant findings. From table 1, we find the probability χ^2 and Wald χ^2 carries highly significant value on growth of GDP as we regress its value taking 1(one) year lag (growth GDP L$_1$). Accordingly, we can mention that GMM system estimation is appropriate.

That means, all the independent factors affects growth of GDP significantly at 1% and 5% level of significance. Since Growth of GDP with one period lag (growth GDP L$_1$) shows, significant values with probability value zero (0) for both developing countries and developed countries and regions, it implies growth of GDP of a country or region with time lag significantly affects the growth of GDP for next year. Therefore, growth of economy is time dependent, indicates the growth of economy of one period depends on another period in different countries and regions of the World.

Significant variables affecting dynamic economic growth of countries and regions

Based on the dynamic panel data estimation results of table 1, we find that finance efficiency and market efficiency index are the most significant factor to affect the short term and long term economic growth both for developing world and developed world. Innovation index affects significantly and negatively for growth of GDP in developed world. On the other hand, gender parity in school education and innovation index cannot affect dynamic economic growth significantly.

Both developing and developed countries and regions has to provide importance in development of human capital, research and development expenditures, innovation expenditures, generating new ideas, and increase in high technological enhancement more because these factors plays utmost importance in short run and long run economic growth of a nation. Moreover, the regression

The Social Science Review A Multidisciplinary Journal. September-October, 2025. Vol. 3. Issue 5. 45-51

Published by: Pather Dabi Educational Trust, (Regn No: IV-1402-00064/2023), Under Govt. of West Bengal, India

result reflects that the value of regression coefficients with one period lag for Developing World is 0.961 and for Developed World it is 0.667. Hence, Developing countries have better prospect of GDP growth in the coming years compared to the Developed World since its rate of growth of GDP is higher than Developed World. However, market and financial efficiency will play more important role for developed world in future economic growth compared to the developing world. The picture shows the scenario very clearly for better understanding.

Diagram 2: Dynamic Panel Graph for Developing and Developed Countries and Regions of the World
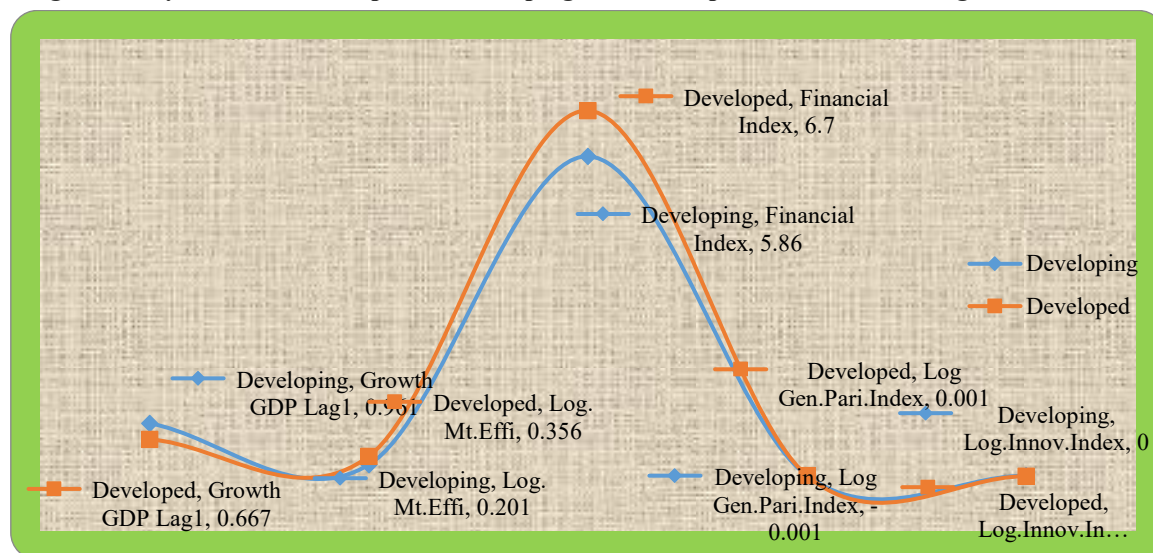
Source: Author's own calculation from World Bank Data & UNICEF (1996-2017)

Series 1=>Developing Countries and regions
Series 2=>Developed Countries and regions

The study of dynamic economic growth or increase in output and more widely human welfare is very much relevant over decades or even centuries in the study of literature. Although economic growth rates from year-to-year differences seemed to be tiny in a short-run perspective, but if such differences are continued over decades, it will build up a significant difference in living standards. In this respect it is seen that Developed countries and regions has more probability to grow rapidly in balanced way for the coming years compared to Developed countries and regions.

Findings from Hypothesis Testing

The table 1 reflects, based on p statistics and z statistics, developed countries and regions has greater significant value of GDP growth with time lag (coefficient value 35.73) compared to developing countries and regions of GDP growth with time lag (coefficient value 27.7). Developed countries and regions have greater value of market efficiency Index (coefficient value 16.03) in comparison with developing countries and regions (coefficient value 8.4). Besides, developed countries and regions have greater significant value of financial efficiency Index (coefficient value 0.38) in contrast with developing countries and regions (coefficient value 0.12). Hence, it can be said that, Null hypothesis (H_0) is rejected subject to the GDP growth with time lag, market efficiency Index and financial efficiency Index at 5% and 1% level of significance.

However, based on p statistics, in case of gender parity Index of school education, both developed countries and regions & developing countries and regions has insignificant coefficient values. On the other hand, subject to innovation Index, developed countries and regions have negative significant values (coefficient value -4.15) and developing countries and regions have insignificant coefficient value. So, we cannot reject null hypothesis (H_0) at 5% and 1% in these two cases.

Conclusion

Since dynamic macroeconomic performance is a forceful driver of the welfare enjoyed by current and future generations, developing countries and regions needs urgent higher economic growth rates as much as possible to avoid wide differences standard of living in long run compared to developed countries and regions. Although maintaining higher economic growth rate for developed countries and regions is a challenging task.

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