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Testing the Conditional Convergence Hypothesis for Pakistan

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Abstract

This study investigates for the existence or non-existence of conditional convergence across the provinces of Pakistan. The annual output data from 1973 to 2000 is pooled for the four Pakistani provinces. The cross-sectional specific effects, the time specific effects, the manufacturing output, and the structural variable for aggregate supply or production shocks are used to control the different steady state levels of per capita incomes of the different provinces. The equation for conditional convergence is estimated through generalized least squares (GLS) method, after controlling for the different steady states of the provinces. The result shows that the provinces of Pakistan converge to their own respective steady states with a convergence speed of 11% per annum. At the same time manufacturing output is also statistically significant and positively affects the economic growth in the provinces. However the structural variable is not statistically significant.

Keywords: Conditional Convergence, Steady State Level of Income, Gross Provincial Product (GPP), Provinces of Pakistan

1. Introduction

The concept of convergence is derived from the neoclassical model of economic growth put forward by Solow (1956). It has been studied in many cross-country and cross regional growth empirics. Barro and Sala-i-Martin (1995, 2003) explain the concept of convergence by assuming two types of economies. The first type of economies is rich and the second type of economies is poor. They say that if both types of the economies have the same rates of saving and investment, population growth rate, depreciation rate, and technological progress, the poor economies will grow faster than the rich economies. As a result, per capita product and income of the poor economies will catch up to that of the rich economies. They differentiate between conditional and unconditional convergence. The convergence is said to be unconditional if both types of the economies have the same determinants of steady state or long run level of per capita income, i.e. saving rate, population growth rate, depreciation rate, and technology. In this case poor economies grow faster than rich economies and all the economies converge to the same steady state level of per capita income. On the other hand convergence is said to be conditional if both types of the economies are heterogeneous in all or some aspects, i.e. their steady states' determinants are different. In this case, both types of the economies still converge, but to their own steady state level of per capita income instead of a common steady state level of per capita income.

To study convergence across different economic units in a conditional convergence framework, we have to include various determinants of the steady state level of per capita output along with the initial level of per capita output in the regression equation. By doing so we are not only able to estimate the speed of convergence, but we are also able to find out the determinants of the long run or steady state level of per capita output. The present study tries to look into the issue of regional imbalances in Pakistan. The conditional convergence framework is used to study the economic growth performance of the Pakistani provinces. The speed of convergence of the Pakistani provinces towards their respective steady states is estimated. The steady state level of per capita output of the provinces is controlled by the time and cross-section specific fixed effects, the manufacturing output, and the structural variable.

The pool time series and cross-sectional (TSCS) data is used in this study. The generalized least squares technique (GLS) is used to test the conditional convergence hypothesis across the four provinces of Pakistan. The period under study is 1973-2000 because of availability of province wise data on output and other variables for the said period. However the situation in Pakistan and especially in Baluchistan and the North West Frontier Province (NWFP), now called Khyber Pukhtoonkhwa, after 9/11 has not been normal and therefore the period after 2000 is dropped from the study.

The remainder of the paper is organized as follows:

The literature review is given in section 2, while section 3 discusses theoretical background and empirical framework of the study. Estimation results are presented and interpreted in section 4. The conclusion and policy implications are given in section 5.

2. Literature Review

The convergence property of the neo-classical growth model is the underlying framework of many of the cross- country/region studies. But there are so many studies that highlight the controversy on the concept of unconditional convergence. Mankiw et al. (1992), and Coulombe and Day (1999) mention that the endogenous growth models assume non-decreasing returns to private inputs or constant returns to per capita capital. These models predict non-convergence among different countries and the gap among rich and poor regions/countries widens over time. Similar views are expressed by Islam (1995) and Coulombe (2003) when they mention in their studies that although the neoclassical growth theories predict convergence, the empirical evidence has been a subject of debate. They further explain that it is the concept of unconditional convergence, which is most controversial. There is no consensus on the concept of unconditional convergence among the followers of the neoclassical and endogenous growth theories. The existence of convergence is presented as an approval of the neo-classical growth theories, while the non existence of convergence is considered as approving the endogenous growth theories.

However this controversy has given rise to the concept of "conditional convergence" as is mentioned by Barro and Sala-i-Martin (1992), and Mankiw et al. (1992), Islam (1995), and Coulombe (2003). These studies postulate that the neo-classical model of Solow (1956) does not imply unconditional convergence; instead what it implies is the concept of conditional convergence. Whereas the conditional convergence means that if determinants of the steady state levels of incomes of different countries are controlled for, the countries converge to their respective steady states.

Testing the hypothesis of conditional convergence across different economic units requires that the steady states or long run levels of incomes of the economic units are held constant. Different variables are used by the researchers in their studies as determinants of the steady state level of income. Rodan (1943) emphasizes the importance of industrialization, skilled and educated work force, and the state intervention for the economic development of a country. Lewis (1954) mentions the importance of structural changes in a country for the process of development to proceed. According to his theory, the modern urban industrial sector replaces the primitive rural agricultural sector as an economy gets developed. Myrdal (1957) mentions historical legacies, comparative advantage and disadvantage, and appropriate infrastructure as determinants of backwardness and underdevelopment of one region and prosperity and development of another region. Krugman (1991) points out the importance of technological progress for the long run economic growth of a country. Mankiw et al. (1992) conclude that physical capital along with human capital adequately explains the economic growth differential in the long run across different countries of the world. Siriopoulos and Asteriou (1997) use the shares of manufacturing and industrial sectors in GDP, the North South dummy variable, and the share of investment in GDP as proxies for the steady state level of income to test the conditional convergence hypothesis for the regions of Greece. Sala-i-Martin (1997) mentions 60 variables that are significantly correlated with economic growth in the long run. He mentions the initial level of income, quality of government, life expectancy, trade openness, and institutions, as the most important and robust variables that affect long run economic growth. Hall and Jones (1999) mention institutions and government policies, which are given the name of social infrastructure, as the most important determinants of capital accumulation, productivity increase, and thus economic growth in the long run.

Coulombe (2000, 2001) uses the relative rate of urbanization and the dummy variables for supply/production shocks to control the steady state levels of incomes of the Canadian provinces in a conditional convergence framework. Easterly and Levine (2001) emphasize the importance of technology or total factor productivity in the standard Cobb-Douglas production. They mention that the different levels of technology across different economies cause them to grow differently. Barro and Sala-i-Martin (1991, 1992, and 2003) use regional dummies and structural variable as proxies for the steady state levels of incomes of different US states to test the conditional convergence hypothesis across these states. Barro (1991, 2003) uses the initial level of income and human capital along with a number of control or environmental variables (reflecting policies, institutions, and national characteristics) as determinants of the long run income growth in a cross-sectional regression framework for different countries of the world. Coulombe and Tremblay (2007) use the percentage of the population aged between 15 and 25 with at least one university degree, literacy test scores as a measure of the mean skill level of the labor market entrants, the relative rate of urbanization, and the dummy variables for Alberta and Quebec structural breaks as determinants of the long run level of income in the ten Canadian provinces. Coulombe and LEE (1995), Coulombe (2000), Coulombe and Tremblay (2007) follow the procedure of taking the variables as deviations from the cross sectional mean for eliminating the time specific effects.

Zaidi (2005) emphasizes the importance of the study of regional imbalances in Pakistan, as most of the conflicts and controversies between the regions and between regions and the center revolve around this issue. He terms technology, infrastructure, physical and human capital, and historical legacies of the British Colonial era as the most important factors behind the development gap between the different regions of Pakistan.

3. Theoretical Background and Empirical Framework

3.1 Theoretical Background

Islam (1995) points out that most of the studies have used OLS in a cross-sectional regression framework for testing the convergence hypothesis. However this procedure is unable to account for the unobservable cross-section specific and time specific effects of the technology parameter and preferences. The basic assumption of the OLS is about the independence of the error term. It means that the error term is not correlated with the explanatory variables. However, Islam (1995) explains that the error term includes unobservable factors of the initial level of technology, so it is most probable that the error term is correlated with the initial level of income and other explanatory variables, thus resulting in biased estimates of the coefficients. A way out of this problem is to use a panel data framework. The individual differences across different cross sectional units can easily be controlled through fixed effects estimation procedure.

Islam (1995) picks up the textbook Solow (1956) model and derives equation for testing the convergence hypothesis in a panel data framework. Using this framework he is able to account for the time invariant cross-sectional specific effects. Our data is also pooled time series and cross-sectional data, so we use the modified form of the equation as given by Islam (1995) to test the convergence hypothesis across Pakistani provinces. The general form of the equation is given as follows

$$\ln\left(\frac{y_{it}}{y_{it-1}}\right)=\alpha_0-(1-e^{-\beta})y_{it-1}+(1-e^{-\beta})X_{it}+u_i+\eta_t+\varepsilon_{it} \quad (1)$$

In the above equation "i" stands for different countries/regions or cross-sectional units, "t" represents time, "y_{it}" is the per capita output of country 'i' in time 't', y_{it-1} is the per capita output of country 'i' in time t-1, X_{it} represents those variables that change across the cross-sectional units through time, and $u_i \, and \, \eta_t$ are time invariant cross-section specific effects and cross-section invariant time specific effects respectively. The term β shows the rate or speed of convergence, ε_{it} is the error term, and α_0 is the common intercept term.

The basic issue in this study is how to control the steady state level of per capita output in the four provinces of Pakistan. What types of variables should be taken as proxies for the determinants of the steady state level of output? There are two types of variables used in the above equation that can possibly affect the steady state level of output of countries or regions of the same country: One type of variables are those variables that have both cross-sectional and time variations, i.e. 'X_{it}'; The other type of variables are those variables that have either cross-sectional variations or only time variations and are known as cross-sectional specific and time specific effects in panel data literature. Both of the cross-section and time specific effects can be controlled quite easily in a panel data framework. As far as the first type of variables are concerned, different proxies are used for the term ‘ X_{it} ’ in the above equation for studying the cross-country growth empirics. However, we are studying the growth empirics across the four provinces of Pakistan, which are regions of the same country and thus are more homogeneous, so a limited number of variables are used to proxy the term ‘ X_{it} ’. In this study, we use the manufacturing output of the provinces, and the structural variable for a possible structural break, to proxy the term, ‘ X_{it} ’.

As we are studying the convergence phenomenon among the regions of the same country, i.e. four provinces of Pakistan, so we can easily take the following assumptions:

1. Initial level of technology (which includes efficiency, knowledge, resource endowments, climate, geography etc.), GCR (Geography Climate and Natural Resources) characteristics, historical legacies, attitudes and behavior of the people, and all other unobservable or observable factors that are time invariant and cross-section specific are assumed as cross-section specific effects.
2. Technological progress, aggregate production or supply shocks, external effects such as wars and conflicts, changes in government regulatory and/or tax policies, political, institutional, and social (PIS) characteristics and all other unobservable or observable variables that are cross-section invariant and time specific are assumed as time specific effects.
3. In case of conditional convergence, we assume that cross sectional specific effects are correlated with the initial level of income and thus treat these effects as fixed effects. This assumption is justified in our case because of the fact that we include initial level of technology, GCR characteristics and so many other factors in the individual or cross section specific effects. The provinces having high initial level of technology and favorable GCR characteristics would also have the high level of initial level of per capita income.

3.2 Empirical Framework

To estimate the conditional convergence hypothesis across the provinces of Pakistan, we have to control for the different steady state levels of per capita income of the four provinces of Pakistan. To proxy the steady state level of per capita income of the different provinces, we use; the level of manufacturing output in the four provinces of Pakistan; the structural variable; the cross sectional specific fixed effects; the time specific fixed effects.

Manufacturing output in different provinces capture the effects of productivity changes due to changes in capital (human capital, public and private physical capital) labor ratio, technological progress, and government regulatory and/or tax policies. According to Kaldor (1966, 1967), the growth of manufacturing output is strongly and positively correlated with the growth of GDP, the growth of productivity in manufacturing, and the growth of productivity outside manufacturing.

To capture the effects of such aggregate supply or production shocks that affect different provinces differently at different points of time, we follow Barro and Sala-i-Martin (1992, 2003), and use the following modified form of the structural variable in our study.

$$S_{it} = \sum_{j=1}^{3} w_{ijt-1}.[\ln(Y_{jt} / Y_{jt-1})] \qquad (2)$$

i=1,…, 4 j=1, 2, 3 t=1973,1974,1975,…,2000

Where 'j' represents agriculture, industry, and services sectors, 'i' represents the four provinces of Pakistan, 't' represents different years from 1973 to 2000, w_{ijt-1} is the weight of sector j in province 'i' GDP at time t-1, and Y_{jt} is the national average of output produced in sector j at time t. Examples of these types of shocks are harvest failures, oil shock and civil wars. Afghan war of the Eighties is an important example of this type of shock. Pakistan was an important ally of the USA in that war. The NWFP was the most affected province in that war. Shortage of electricity, gas and oil is another type of shock. The most industrialized provinces of Punjab and Sindh that rely heavily on these sources of energy are the most affected provinces of this shock. There might be other types of supply shocks that affect the GDP of different provinces differently. Omitting these types of shocks from the regression will bias the estimates of the coefficients of other explanatory variables.

We can control both types of the above effects, i.e., the time specific fixed effects and the cross-sectional specific fixed effects, in a panel data framework. One way to control the above mentioned effects is to estimate the regression equation through E-Views 5.1 following the Fixed Effects Estimation procedure. This program automatically controls both types of the above mentioned effects. Moreover first differencing, and/or taking deviations from cross sectional and time means, is the other method to eliminate both types of the effects. We follow the first method while testing for the conditional convergence hypothesis across the four provinces of Pakistan.

The estimation equation for conditional convergence is given as follows:

$$GY_{it} = \alpha_0 + \alpha_1 Y_{it-1} + \alpha_2 Manuf_{it} + \alpha_3 S_{it} + u_i + \eta_t + \varepsilon_{it} \qquad (3)$$

i=1,…, 4t=1973,1974,1975,…,2000

The subscript 'i' represents the four provinces of Pakistan, and 't' stands for different years from 1973 to 2000. The variable '$Manuf_{it}$' is the level of manufacturing output for the four provinces of Pakistan, 'S_{it}' is the structural variable, $u_i \, and \, \eta_t$ are time invariant cross-section specific effects and cross-section invariant time specific effects respectively, and ε_{it} is the error term. The other variables have the usual meaning. All the variables have been taken in natural log form. We take the cross-sectional weights to allow for the cross-sectional heteroskedasticity and use the Generalized Least Squares (GLS) method for estimating the above equation for the conditional convergence. The fixed effects estimation procedure is followed for estimating the above equation.

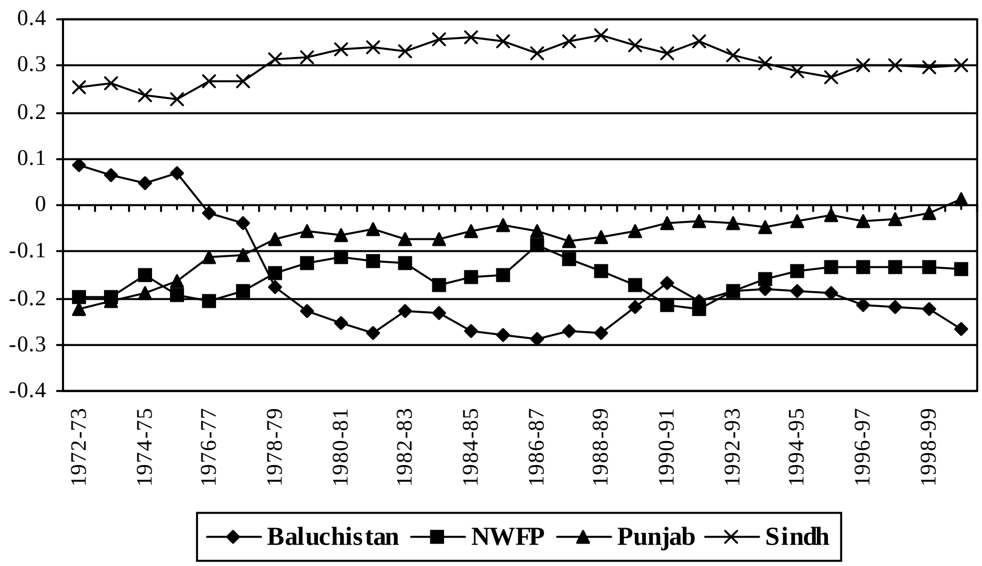
3.2.1 The Data

The annual data on all the variables used in this study is available on national level. The official data is very hard to find for sub national levels in Pakistan on annual basis for a sufficiently long period of time. However the valuable work of Bengali (1995) and

Bengali and Sadaqat (2006) have solved this problem. They have disaggregated the national level data and generated the annual data for the provinces of Pakistan from 1973 to 2000. This data has been used in this study. The following figure shows the relative position of each province's per capita GPP from 1973 to 2000. The per capita GPP of each province is taken as relative to the cross-sectional/Pakistani average.

Figure 1: GPP Per Capita

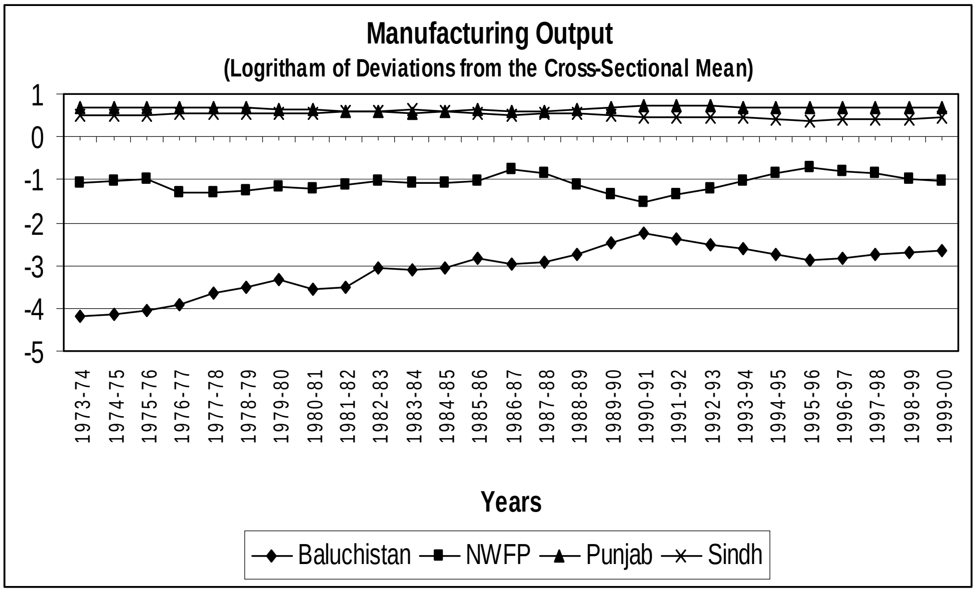
(Logarithm of Deviation from the Cross-Sectional Mean)



The relative per capita GPP of Sindh is over and above the cross sectional mean for the whole period and remains almost the same. Sindh stands first among all the provinces for the whole period. Punjab starts from the lowest relative per capita GPP in 1973, but it crosses the cross-sectional average at the end of the period and reaches to the second position among the provinces. The NWFP has maintained its third position among the provinces and remains below the provincial average for the whole period. The situation is most discouraging in Baluchistan; it starts from a position that is far above the cross-sectional average. Its relative per capita GPP is just below the relative per capita GPP of Sindh. But it starts to fall in 1977 from its higher position to the lowest position among all the provinces. Its per capita GPP has been far below the provincial average for the whole of the period.

The following figure shows the case of manufacturing output which is a little different. The figure shows some fluctuations in relative manufacturing output of the provinces at different points of time. The relative position of Baluchistan has improved, but it is still below all the provinces. On average, the other provinces have maintained their relative positions. Punjab and Sindh have remained above the cross-sectional average for all the time, while the NWFP has remained below the average for the whole period.

Figure: 2



4. Estimation Results

We estimate equation (3) through Generalized Least Squares (GLS) technique and obtain the results. We take into account the cross-sectional heteroskedasticity and apply the cross-sectional weights. All the variables are taken in natural log form. The cross sectional specific and time specific effects are controlled through the options given in E-Views 5.1 by following the Fixed Effects Estimation procedure. This program automatically controls both types of the above mentioned effects. The results are given in the following table (1).

Table 1: Estimation of Equation (1) Through Generalized Least Squares (GLS)

Dependent Variable: $GY_{i,t}$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
$Y_{i,t-1}$ **	-0.103870	0.051755	-2.006969	0.0484
$Manuf_{i,t}$ *	0.026218	0.015113	1.734789	0.0869
$S_{i,t}$	0.007722	0.038416	0.201014	0.8412
R^2	0.567337			
F-statistic	3.073288			0.000034
Durbin-Watson stat	1.958925			

** denotes statistical significance at 5 % level.

*denotes statistical significance at 10 % level.

The coefficient on the initial level of per capita GPP is highly significant having negative sign showing strong inverse relationship between the initial level of per capita GPP and the subsequent growth rate. The implied speed of convergence is 0.10967 or 11 % per annum which is estimated as follows:

$$\alpha_1 = -(1-e^{-\beta}) \Rightarrow \beta = -[\ln(1+\alpha_1)]$$

This means that 11% of the gap between the initial level of per capita GPP and the respective steady state levels of per capita GPP of the provinces vanishes in one year. The R-squared value is 0.567337. The half life of convergence-the time that it takes for 50% of the initial gap to be eliminated-is little more than 6 years. This half life of convergence is computed with the help of the following formula as is given and defined by Barro and Sala-i-Martin (2003).

$$e^{-\beta T} = 1/2 \Rightarrow T = \ln 2/\beta \Rightarrow T = 0.69/\beta$$

Where 'T' denotes the half life of convergence.

The implied speed of convergence is quite high than the 2% per year that is reported in most of the studies. However, as is mentioned by Barro and Sala-i-Martin (2003), this high speed of convergence is not uncommon in the panel data literature with fixed effects estimation procedure.

The variable for manufacturing out put in Pakistani provinces is also significant at 10% level. Growth of manufacturing out put positively affects the economic growth directly as well as indirectly through its positive effects on the growth of productivity in manufacturing and in other sectors of the economy as is mentioned by Kaldor (1966, 1967). The value of the coefficient on manufacturing out put shows that if manufacturing out put increases by 1%, the out put per capita grows by .026 percent. So the provinces that have performed better in manufacturing sector also have experienced good out put growth.

The result shows that the structural variable is not statistically significant. This means that there are no such aggregate supply or production shocks that affect different provinces differently at different points of time.

5. Conclusion And Policy Implications

5.1. Conclusion

This study estimates the conditional convergence equation across the Pakistani provinces. The different steady states of the Pakistani provinces are controlled by the time and cross-sectional specific effects, the manufacturing output, and the structural variable. The results show that the gaps between the initial levels of per capita gross provincial products (GPP) and the respective steady states of provinces vanish at a speed of 11% per annum. This also means that the income gap between the provinces will vanish if there exists homogenous social and political institutions; the geography, climate, natural resource endowments, initial level of technology, and technological progress are identical; and all the provinces have the same level of industrialization. In other words, we can say that the income and development gap between the provinces of Pakistan does not vanish, because: the geography, climate, and natural resource endowments are different in different provinces; different provinces have different initial levels of technology and technological progress due to historical legacies, federal government intervention etc.; and some provinces are more industrialized than the others due to the availability of complementary factors like human capital, physical infrastructure, and peace.

5.2. Policy Implications

There are two types of factors that are responsible for the consistent development gap between the Pakistani provinces. The first types of factors are attitudes of the people, cultural values, traditions, historical legacies, geography, climate, and natural resource endowments. These factors are difficult to be changed, and need broader and comprehensive political, social, and economic policy reforms. The other types of factors are associated with industrialization and favorable structural changes in the provinces of Pakistan. Many studies mention so many factors that are responsible for the different industrialization levels of the Pakistani provinces. The most important of these factors are human capital, physical infrastructure, and peace and security. These factors are seemed to be the most important factors behind different levels of industrialization in Pakistani provinces, which has caused the development gap between the provinces.

The state must take the initiative of industrializing and bringing favorable structural changes in the poorer provinces by investing directly in the physical infrastructure and human resource development of the poorer provinces. People of the poorer provinces should be provided with free or subsidized education and health facilities. People of the remote tribal areas must be linked with the rest of the country through modern means of communication, and true democratic political process should be allowed to work in these areas. Tax free industrial zones should be established in different parts of the NWFP, and

Baluchistan. This will encourage the private investors to come and invest in these backward provinces of the country.

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