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India in the World Economy: Inferences from Empirics of Economic Growth

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India in the World Economy:[$]
Inferences from Empirics of Economic Growth

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Abstract

The aim of this study is to investigate the growth experiences of India in relation to the experiences of around one hundred countries in the world during the last half-century by exploiting the inferences drawn from the cross-country growth regressions. This study obtains the following findings. First, the outcome of growth regression supports the conditional convergence hypothesis. In contrast, both India's growth rate and income level have increased, breaking the convergence hypothesis. Second, the growth regression shows life expectancy at birth, investment ratio and external openness contributes to economic growth. In India these three were improved. Third, the growth regression suggests human capital has a non-linear effects on economic growth and that the schooling years beyond 3 years raise the growth rate. In India both schooling years and growth rate have increased. Fourth, the growth regression shows that total fertility rate has a negative effect on the growth. In India the growth rate increased as the total fertility rate declined. Fifth, the growth regression shows that government consumption reduces the growth rate. Contrary to the regression results both India's growth rate and government consumption have increased. Sixth, the growth regression suggests inflation has a negative effect on growth rate. However, there are no clear relationship between inflation and growth in India. Seventh, the growth regression shows the improvement of terms of trade contributes to economic growth. The same was observed in India where terms of trade fluctuated over time. Finally the growth regression supposes that democracy and economic growth have a non-linear complex relationship and that the relationship differs depending on the position of the distribution of growth rates. There are no clear relationship between democracy and growth in India where the India's status of democracy has hardly varied.

JEL classification: O11, O47, O53
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1. Introduction

This study investigated the growth experiences of India in relation to the experiences of approximately one hundred countries during the last half-century. It also reveals hidden common factors that contribute to different growth performance based on an economic growth model. For providing growth stories of India from a comparative perspective, this study exploits inferences drawn from the cross-national regression studies of historical development processes.

Economic growth affects the well-being of the people to a considerable degree. A country with a growth rate of 7 per cent per year, which is India's current growth rate, doubles its income level every 10 years, whereas a country with a growth rate of 3.5 per cent per year, i.e. ``the Hindu rate of growth'', doubles its income level every 20 years. That observation illustrates that persistent differences in growth rates generate vast differences in incomes in the long run. A country's income level must be regarded as an important determinant of its national well-being.

India and China have grown rapidly over the past two decades. Because India and China are two of the largest developing countries, this study especially sets China's growth experiences as a reference to India's growth story. This study thereafter examines the economic growth paths that China and India have taken.

This study is presented as the following. Section 2 presents the economic growth model as a main theoretical benchmark. It introduces the notions of ``absolute convergence'' and ``conditional convergence'' in the neoclassical growth model. Section 3 investigates India's growth experience from empirics of the neoclassical growth model. China's experience is set as a reference in this section. Section 4 concludes this paper by summarizing the main results.

2. Economic Growth Model as a Theoretical Benchmark

This study uses the neoclassical growth model (Solow 1956; Swan 1956) as a theoretical framework[1]. As the property of the production function, the neoclassical growth model includes the assumptions of constant returns to scale, diminishing returns to each input, and smooth substitution between inputs. Another crucially important aspect of the neoclassical growth model is a constant-saving rate assumption. These two basic assumptions underpin the simple general-equilibrium model of economic growth.

The fundamental equation of the neoclassical growth model is given as

[1] See Barro and Sala-i-Martin (2004: Chapter 1) for more details of the neoclassical growth model.

$$\dot{k} = sf(k) - nk,$$

where a dot over k denotes differentiation with respect to time, k is the capital–labor ratio, s is saving rate, f is the previously described neoclassical production function, and n is population growth rate. This differential equation depends only on k. It is also noteworthy that the dynamics of k is the crucial factor determining the growth rate of per-capita income.

Figure 1 presents dynamics of the neoclassical growth model. In Figure 1, the $sf(k)$ is curve proportionate to the production function $f(k)$, and nk is a straight line from the origin. The dynamics of k results from the vertical gap separating $sf(k)$ and nk. We assume a poor country in a sense of small capital–labor ratio: k^{poor}. The vertical distance between $sf(k)$ and nk at $k= k^{poor}$ is positive, implying $\dot{k} > 0$, which means that the capital–labor ratio k increases toward the steady-state level of capital–labor ratio k^* over time. The steady-state k^* is determined at the crossing point of the $sf(k)$ curve and the nk straight line. Then, consider a rich country with k^{rich}. The vertical distance between $sf(k)$ and nk at $k= k^{rich}$ is positive, which implies that k increases toward k^* over time. Consequently, the neoclassical growth model predicts that any country converges to the same income level irrespective of whether the nation is poor or rich initially, which is designated as the absolute convergence hypothesis.

[Figure 1 inserted here]

By dividing both sides of the described above fundamental equation by k, the following growth-term equation is obtained.

$$\frac{\dot{k}}{k} = \frac{sf(k)}{k} - n$$

Specific examination of the growth rate of k is convenient, whereas the growth rate of per-capita income is investigated in next section. It is noteworthy that the growth rate of per-capita income is expressed as $S_k \dot{k}/k$, where S_k is the capital income share. In the Cobb–Douglas function, as one specification of the neoclassical production function, the capital income share is constant. Therefore, the growth rate of per-capita income exactly follows $\dot{k}/k$.

Figure 2 portrays the growth rate version of Figure 1. The growth rate of k is determined by the gap separating $sf(k)/k$ and n. It clearly illustrates that the growth rate of the poor country is higher than that of the rich country. The poor country catches up with the rich country. Over time, the growth rate converges to zero.

[Figure 2 inserted here]

Contrary to the prediction of the absolute convergence hypothesis, the growth experiences in the real world are remarkably heterogeneous. Relaxation of the implicit assumptions of the neoclassical growth model on the same preference and technologies across countries generates a concept of conditional convergence. Panel A of Figure 3 presents the cases of different saving rates in poor and rich countries: $s^{poor} < s^{rich}$. In this case, the poor country's gap separating $sf(k)/k$ and n is less than the rich country's. Panel B shows the case of different population rates: $n^{poor} > n^{rich}$. Consequently, the growth rate of the rich is higher than that of the poor in both cases, contrary to the prediction of absolute convergence. Taking account of the different steady-state positions in the countries, the result implies that a country grows faster when it is more distant from its own steady state. In other words, a poor country tends to generate a higher growth rate once the determinants of the steady state are controlled. This tendency is designated as conditional convergence hypothesis. The concept of conditional convergence is consistent with the neoclassical growth model allowing heterogeneous technology and preference.

[Figure 3 inserted here]

3. Growth Experience of India from Inferences of Growth Regression

3.1. Absolute versus Conditional Convergences

The existing empirical evidence for a panel dataset of a number of countries supports the existence of conditional convergence. For given values of variables affecting the growth rate, growth is negatively related to the initial level of real per-capita GDP. A higher initial level of per-capita GDP implies a lower growth rate, all other things being equal. It is also noteworthy that poor countries would not grow rapidly if they were to have low steady-state positions. Rich countries would grow faster than poor countries if the rich countries were further below their own respective steady states. These effects represent the general idea of conditional convergence. In contrast, a concept of the absolute convergence implies that countries with the same preference and technologies converge to the same steady state. Therefore, the poor countries can catch up with rich countries unconditionally.

Figure 4 presents a scattered diagram of the growth rate and the initial level of real per-capita GDP across approximately a hundred countries observed during 1960–2010. The data of real per-capita GDP in constant 2005 US dollars are generated using the World Bank's World Development Indicators (WDI) & Global Development Finance (GDF), as shown in Table 1. The vertical axis in Figure 4 shows observations of growth rates of per-capita GDP for 1960–1965, 1965–1970, 1970–1975, 1975–1980, 1980–1985, 1985–1990, 1990–1995, 1995–2000, 2000–2005, and 2005–2010. The horizontal axis shows corresponding values of the logarithm of per-capita GDP in 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005. The relation between growth and initial GDP is almost imperceptible from the graph.

[Figure 4 inserted here]

[Table 1 inserted here]

In fact, when no explanatory variable other than the initial GDP is applied for the regression (henceforth, parenthesis implies *t* statistics), the estimated coefficient of the log of initial GDP is positive but not statistically significant: 0.0005 (0.64).

Growth Rate of GDP=0.017***+0.0005 log(Initial GDP)

(3.08) (0.64)

NOB=651, Adj. R^2=-0.0009, F statistics=0.41

The regression result shows that no evidence exists of absolute convergence. However, it does not directly suggest rejection of the neoclassical growth model. The neoclassical growth model is consistent with the lack of absolute convergence when each country has its own steady-state because of differences in preferences and technology.

Figure 4 presents the historical trend of the GDP growth rate and the initial GDP in India and China. As shown in Table 2, the growth rate of India has increased from 2.25 per cent to 6.38 per cent during 1965–1970 to 2005–2010. Moreover, the per-capita GDP has risen from 5.26269 (193 US dollar) to 6.35957 (578 US dollar) during 1965–2005. India's growth pattern does not follow the convergence hypothesis. China's growth rate fell from 12.36 per cent to 7.32 per cent from 1990–95 to 1995–2000, but then it increased to 10.19 per cent during 2005–2010. It is readily apparent in this Figure that China's economic growth rate is the highest among the world after 1965. The per-capita GDP of China has risen from 5.971262 (392 US dollar) to 7.286192 (1460 US dollar) during 1990–2005. China has a higher growth rate and income level than India has.

[Table 2 inserted here]

3.2 Urbanization and Economic Growth

Table 1 presents variables used in growth regression analysis in the conditional sense and also shows the expected sign of explanatory variable. The regression analysis applies to a panel dataset of around one hundred countries during 1960–2010. The dataset includes a broad range of experiences from poor to rich countries for last half-century. The covered countries were determined solely by data availability.

The main strength of using a panel data is to expand the sample information. Not only cross-sectional but also time-series variations are exploited for comparative study of the growth experience of India among numerous countries, with special reference to China.

The estimation of this study uses an ordinary least squares (OLS) method. The fixed effects technique addressing an unobserved time-invariant country-specific effect depends on time-series information within countries. Therefore, the fixed effects estimation excludes cross-sectional information, which is the main advantage of the comprehensive cross-national data. The OLS regression might be suitable for comparative analysis because it can exploit the between-country dimension of panel data as well as within-country information[2].

Considering the fusion of rural areas and cities in the Indian socioeconomic historical context, we first verify the relation between urbanization and growth. The dependent variable is the annual growth rate of real per-capita GDP over ten periods from 1960–1965 to 2005–2010. The regression shown in column 1 in Table 3 includes conventional measurement of the urban population ratio as an explanatory variable.[3] Although the concept of ``urban area'' in the conventional measurement of urban population varies across countries, the definition of urban agglomeration is uniform across countries. The estimated coefficient of this variable is 0.00008121233 (0.99), which is positive but not significantly different from zero. Turning to column 2 of Table 3, population of urban agglomerations with 300,000 inhabitants or more to total population is included as an alternative proxy variable for urbanization. The result shows the non-significant positive estimated coefficient of the agglomerated urban area population ratio, 0.00008434908 (1.03), which implies that urban agglomeration does not raise the growth rate.

[Table 3 inserted here]

[2] According to Barro (1997), the fixed effect technique can exaggerate the measurement error bias, which tends to overestimate the coefficient of the initial GDP per capita from exclusion of the cross-national information instead of eliminating the fixed-effect bias which tends to underestimate the coefficient of the initial GDP per capita.

[3] All explanatory variables other than urbanization variables were used much the same as the variables used by Barro and Sala-i-Martin (2004: Chapter 12). As shown later, this study replicates most of the results obtained by Barro and Sala-i-Martin (2004: Chapter 12) despite the differences in sample periods. Insightful arguments for growth regression which this study cannot refer are found in a study by Helpman (2004).

The regression results show that neither the urban population ratio nor the agglomerated urban population ratio is apparently a candidate as a determinant of economic growth[4]. The regression results in column 3 of Table 3 are used for the main analysis in this study.

3.3 Basic Growth Regression

When the other explanatory variables are given, the neoclassical model predicts a negative relation between the growth rate of GDP and the initial level of GDP. The estimated coefficient of the initial GDP, -0.00975309785 (-6.95), in column 3 of Table 3 is highly significant. It supports the conditional convergence prediction. The conditional rate of convergence is less than 1 per cent per year. The speed of convergence is slow in the sense that it would take 31 years for the economy to reach 50 per cent of the goal of steady-state level of GDP. It would take 103 years to reach 90 per cent of the goal of the steady-state position[5].

The partial relation between the growth rate and the initial GDP is shown in Figure 5. This is implied by the regression from column 3 of Table 3. The horizontal axis measures the log of the initial GDP for ten periods of 1960–65 to 2005–10 drawn from observations in the regression sample. The vertical axis shows the corresponding growth rate of GDP after removing the parts explained by all explanatory variables except for the log of initial GDP and the constant term. In other words, the contribution from a constant term and the initial level of GDP is excluded to compute the values of the GDP growth rate on the vertical axis in the scattered diagram. The negative relation between the unexplained part of the GDP growth rate and the initial GDP in Figure 5 shows the conditional convergence graphically. In contrast, it is noteworthy that no simple correlation is apparent from Figure 4, implying that the absolute convergence hypothesis is rejected.

[Figure 5 inserted here]

Figure 5 presents the common historical pattern of growth and initial GDP in India and China, as shown in Figure 4, which confirms that India's growth pattern does not follow the convergence hypothesis in the sense that the growth and income level simultaneously increased.

The regression includes average schooling years after secondary education, it's square values and the log of the inverted value of life expectancy at birth as explanatory variables. These variables are regarded as representing human capital. Results show a nonlinear effect of schooling

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4 The same results were obtained by Bloom, Canning and Fink (2008).

5 $\log_e(2)/ 0.00975309785=31$, and $\log_e(10)/ 0.00975309785=103$. Barro and Sala-i-Martin (2004: p. 58) present details of the calculation of the convergence speed.

years on the growth rate given the initial level of GDP. The estimated coefficients of schooling years and its square are, respectively, -0.00504294983 (-1.60) and 0.0008961371 (2.25). The *P* value for *F* test of joint significance of schooling years and its square is 0.0178, which suggests that educational attainment has statistically significant effects on economic growth. The estimated coefficients imply that the schooling years beyond three years raise the GDP growth rate in the range of the schooling year from 0.043 years as a minimum value to 8.054 years as a maximum value in the regression sample[6].

Figure 6 portrays a partial relation between the growth rate and the schooling years after secondary education. This figure also presents the historical trend of schooling years after secondary education in India and China. As shown in Table 2, the schooling years of India have increased from 0.211 years to 1.614 years during 1965–2005. India's human capital accumulation has steadily grown. China's schooling years also increased from 1.398 years to 2.706 years during 1990 to 2005. It is readily apparent in this figure that China's human capital is higher than India’s.

[Figure 6 inserted here]

The result in column 3 of Table 3 presents the significant and negative estimated coefficient of the log of inverted value of life expectancy, -2.28121 (-3.05), which suggests that life expectancy as a measure of quality of human capital or health capital raises the growth rate. Consequently, these findings also support human capital as a key to economic growth.[7]

Figure 7 presents a partial relation between the growth rate and the inverted value of life expectancy at birth. This figure also presents the respective historical trends of the inverted value of life expectancy for India and China. Table 2 shows that, the life expectancy of India has increased from 47.1 years (0.021231 in Table 2) to 64.1 years (0.015601) during 1965–2005. India's health capital has steadily improved. China's life expectancy also rose from 69.9 years (0.014306 in Table 2) to 72.6 years (0.013774) from 1990 to 2005. It is readily apparent from this figure that China's health level is better than India’s.

[Figure 7 inserted here]

The neoclassical growth model predicts that a higher rate of population growth has a

[6] Similar results are also presented by Azariadis and Drazen (1990), Barro (1991), Knowles and Owen (1995), Easterly and Levine (1997a), Krueger and Lindahl (2001), Blis and Klenow (2000), and Sachs and Warner (1995).

[7] Similar results are also reported by Bloom, Canning and Sevilla (2004), Barro and Lee (1994), Bloom and Malaney (1998), and Bloom and Williamson (1998).

negative effect on the steady-state level of per-capita GDP. It implies for given initial GDP a total fertility rate, representing population growth, reduces the GDP growth rate. Returning to column 3 of Table 3, the significant negative estimated coefficient of total fertility rate, -0.0067656385 (-4.75), supports the prediction of the neoclassical growth model.[8]

The partial relation between growth and fertility is shown in Figure 8. This figure also presents the historical trend of the total fertility rate in India and China. As shown in Table 2, the total fertility rate of India has decreased from 5.69 to 2.74 during 1965–2005. India's total fertility rate has declined substantially. China's total fertility rate also decreased from 2.12 to 1.64 during 1990 to 2005, which suggests that China's total population is projected to decline in the long run. In fact, according to United Nation's World Population Prospects, India's population will become larger than China's population from 2025.

[Figure 8 inserted here]

The result in column 3 of Table 3 shows a significant and negative effect of government consumption to GDP on economic growth. The estimated coefficient is -0.00066431844 (-2.51). The government consumption ratio is regarded as the proxy variable for the magnitude of the waste of economic resources.[9]

Figure 9 presents a partial relation between growth rate and the government consumption to GDP. This figure also presents the historical trend of government consumption relative to GDP in India and China. As Table 2 shows, the government consumption ratio of India has increased from 8.91 per cent in 1965 to 12.1 per cent in 1985. It subsequently fell gradually to 10.9 per cent in 2005. China's government consumption ratio has fluctuated between 13.7 per cent and 15.2 per cent during 1990–2005. China's government consumption level is higher than India’s.

[Figure 9 inserted here]

The neoclassical growth model predicts that a higher saving rate has a positive effect on the steady-state level of per-capita GDP. The neoclassical growth model includes the assumption that the saving rate is exogenous and equal to the investment rate. In the open economy, the investment rate is a more appropriate explanatory variable than the savings rate. The neoclassical growth model implies for given the initial GDP investment rate raises the growth rate of GDP. The result in column 3 of Table 11 presents a significant and positive effect of the investment rate on the

[8] Similar results are also presented by Barro (1991),(1996),(1998).
[9] Similar results are also presented by Barro (1991),(1996),(1998), Sachs and Warner (1995), Acemoglu, Johnson and Robinson (2002).

per-capita GDP growth rate. The estimated coefficient is 0.00073882296 (2.96).[10]

The partial relation between growth rate and investment rate is shown in Figure 10. This figure also presents the historical trend of the investment rate in India and China. As Table 2 shows, the investment rate of India has increased from 15.0 per cent to 35.9 per cent during 1965–2005. India's investment ratio has risen remarkably: its level in 2005 is in the highest class over the world. China's investment also rose from 39.3 per cent to 43.8 per cent during 1990–2005. It is readily apparent from this figure that China's level of investment is higher than India’s.

[Figure 10 inserted here]

The inflation rate can be regarded as an indicator of macroeconomic stability. The estimation reported in column 3 of Table 3 presents the estimated coefficient of the inflation rate as -0.01536566114 (-3.32). It implies that inflation has a significant and negative effect on economic growth.[11]

The partial relation between the growth rate and the inflation rate is presented in Figure 11. Figure 11 has two panels because the inflation rates show remarkable variation. Evidence from the left panel of Figure 11 shows that inflation is harmful for growth, as indicated by the experience of countries with hyper-inflation, which are shown as outliers. Evidence from the right panel, which shows a limited range of inflation rate from -5 per cent to 20 per cent, shows that no clear relation exists between inflation and growth.

This figure also presents the historical trend of inflation rates in India and China. As Table shows 2, the inflation rate of India has fluctuated in the range of 3.88 per cent in 1975–1980 and 11.14 per cent in 1970–1975 during 1965–2005. It is difficult to identify a clear relation between inflation and growth in India. China's inflation rate has declined as a trend from 12.1 per cent to 2.8 per cent during 1990–2005. The range of China's inflation rate is wider than India’s.

[Figure 11 inserted here]

The regression results shown in column 3 of Table 3 present a significant positive coefficient for the change in terms of trade. The estimated coefficient of the change in terms of trade is 0.1003872931 (4.17). Improvement of the terms of trade has a positive effect on growth. The partial relation between growth rate and the change in terms of trade is presented in Figure 12. India's terms of trade varied from -6.3 per cent in 1975–1980 to 4.6 per cent in 1990–1995

[10] Similar results are also presented by Barro (1991),(1996),(1998), Barro and Lee (1994), Sachs and Warner (1995), and Caselli, Esquivel and Lefort (1996).

[11] Similar results are also available in reports by Barro (1998), Levine and Renelt (1992), Bruno and Easterly (1998), Motley (1998), Li and Zou (2002), and Fisher (1993).

during the period from 1965–1970 to 2005–10. Figure 12 shows the positive relation between terms of trade and growth rate in India. In contrast, no such clear relation is apparent for China in Figure 12.

[Figure 12 inserted here]

The ratio of exports plus imports to GDP is regarded as reflecting the degree of external openness. The regression in column 3 of Table 13 shows a significant positive coefficient for the external openness index. The estimated coefficient of external openness is 0.00005693621 (2.35).[12]

The partial relation between growth rate and the external openness is presented in Figure 13. Several countries have remarkably high values such as more than 300 per cent. Therefore, the figure is divided into a left panel for the entire world and a right panel limiting the sample countries to those with the openness index from 0 per cent to 100 per cent. This figure also presents the historical trend of external openness in India and China. As Table 2 shows, the external openness of India increased from 9.04 per cent to 45.9 per cent during 1965–2005. India's openness ratio has risen remarkably, especially after 1990. China's openness ratio also rose from 36.0 per cent to 63.7 per cent during 1990–2005. China's openness is greater than India’s.

[Figure 13 inserted here]

The polity score drawn from the Center for Systemic Peace's Polity IV project reflects the extent of qualities of governing authority from dictatorship to democracy. The polity score includes components reflecting competitiveness of executive recruitment, openness of executive recruitment, constraints on chief executives, regulation of participation, and competitiveness of political participation. In this study, the original score of -10 to +10 was revised to 0 to 10, with 0 denoting the worst and 10 denoting the best level of democracy.

The regression includes this democracy index, its own square, and its own cube. The results show a significant nonlinear effect of the democracy on economic growth. The estimated coefficients of the democracy index, its own square, and its own cube are, respectively, -0.010946744 (-2.59), 0.00217649398 (2.41), and -0.0123252181 (-2.23). The growth rate decreases as the democracy index increases from 0 toward 3.6. Then the growth rate increases as the democracy index increases from 3.6 to 8. Again, the growth rate decreases as the democracy

[12] Similar results were also reported by Harrison (1996), Sachs and Warner (1995), Wacziarg and Welch (2008), Levine and Renelt (1992), Frankel and Romer (1999), Dollar and Kraay (2003), and Alcala and Ciccone (2004).

index increases from 8 to 10. The maximum value of the growth rate is at 0 of the democracy index and minimum value of growth rate is at 3.6 of the democracy index.[13]

The partial relation between economic growth and the democracy index is presented in Figure 14. The growth rates of low-democracy vary more than those of high-democracy. A group of low-democracy countries includes both China, which is the country with the most growth, and sub-Saharan African countries, which are growing less. To elucidate the complex relation between political regimes and economic growth might require some caution about simple conclusions drawn from a point estimation of coefficients obtained by OLS. Consequently, a scatter diagram can provide useful graphical information about the democracy–growth relation.

[Figure 14 inserted here]

The regression equation for the 1-th percentile of the unexplained growth rate of per-capita GDP based on the democracy index and its square in the data shown in Figure 14 is the following.

$$\text{Unexplained Growth} = \underset{(11.08)}{0.0808^{***}} + \underset{(3.57)}{0.0120^{***}}\text{Democracy} - \underset{(-2.35)}{0.0007247^{**}}(\text{Democracy})^2$$

NOB=651, Pseudo R^2=0.1550

The regression equation for the 99th percentile of the unexplained growth rate is shown below.

$$\text{Unexplained Growth} = \underset{(11.08)}{0.0808^{***}} - \underset{(-3.17)}{0.0221^{***}}\text{Democracy} + \underset{(3.19)}{0.0018235^{***}}(\text{Democracy})^2$$

NOB=651, Pseudo R^2=0.1801

These results tell a different story. Although the growth rate of the highest growing countries is determined in a U-shaped manner by democracy, the growth rate of the least growing countries is determined as an inverted U-shaped manner by democracy.

This figure also presents the historical trend of the democracy index for India and China.

[13] Earlier studies examined the relation between democracy, finding that growth can be positive, negative, or nonexistent depending on the types of proxy variable employed for polity and model specification. Relevant studies are those reported by Barro (1996)(1998), Alesina, Ozler, Roubini and Swagel (1996), Minier (1998), Dollar and Kraay (2003), Kormendi and Meguire (1985), Levine and Renelt (1992), Barro and Lee (1994), Sachs and Warner (1995), Barro (1991), Salai-i-Martin (1997a)(1997b), Acemoglu, Johnson and Robinson (2001) and Feld and Voigt (2003), Easterly and Levine (2001), Alcala and Ciccone (2004), and Rodrik, Subramanian and Trebbi (2004).

As Table 2 shows, in contrast to other explanatory variables, the democracy index has not varied in either country. India's index was 9.0–9.5 during 1965–2005. China’s index was 1.5 during 1990–2005. India's democracy index is remarkably higher than China’s.

The regression includes a constant term and time dummies for the nine periods to 1965–1970 to 2005–2010. The reference period of time dummies is 1960–1965. The later six period dummies 1980–1985 to 2005–2010 are significant and negative. Results show that the overall growth rate of the world economy declined after 1980.

Figure 15 presents the estimated mean of growth rate obtained using the estimated constant term interacting with time dummies at the right axis and the simple average of the growth rate at the left axis. Both growth rates peak in 1965–1970 and then reach troughs in 1980–1985. After 1985, both rates increase modestly. The growth rate of India grew steadily from 1980, remaining higher than the overall growth rate of the world economy from 1980. It is again noteworthy that China's growth rate is much higher than those of India and the world economy.

[Figure 15 inserted here]

3.4 Robustness of Basic Growth Regression

The basic growth regression described in the previous section might be adversely affected by endogeneity bias, partly because of the possible correlation between the unobservable country-fixed effects and the explanatory variables. To address this issue, the fixed effects model is applied to eliminate the country-fixed effect. The regression results of columns 1–4 of Table 4 show that, even controlling for the country-fixed effect, no evidence exists of a relation between urbanization and economic growth. Turning to column 5 of Table 4, the estimated coefficients of the schooling years are negative, but not significant. However, the *p* value for chi-squared test of joint significance of slope coefficients of schooling years and its square is 0.0276. That result confirms that human capital has significant effects on economic growth. All other main explanatory variables have significant coefficients with the same sign, as shown in column 3 of Table 3. Consequently, the results of fixed-effect regression are not at all inconsistent with those of basic growth regression.

[Table 4 inserted here]

Although they have the same sign, the degree of the estimated coefficient differs. For example, the overestimated variables in the basic regression compared with the fixed-effect regression are the square of schooling years, with 54 per cent more coefficient value, schooling years with 51 per cent more value, total fertility rate with 11 per cent more value, the cube of the democracy index with 9 per cent more value, the investment rate with 8 per cent more value, and the square of the democracy index with 3 per cent more value. The estimated coefficients of schooling years with nonlinear effects imply that the schooling years beyond two years raise the GDP growth rate. The estimated coefficients of democracy index implies that the growth rate decreases as the democracy index increase from 0 to 3.6; then the growth rate increases as the democracy index increases from 3.7 to 8.7. Again, the growth rate decreases as the democracy index increase from 8 to 10. The maximum value of the growth rate is at 0 of the democracy index; the minimum value of the growth rate is at 3.7 of the democracy index. These nonlinear relations shown in the fixed-effect regression are not substantially different from those of the basic regression.

The underestimated variables in the basic regression relative to the fixed-effect regression are the government consumption ratio with 20 per cent less coefficient value, life expectancy at birth with 18 per cent less value, initial per-capita GDP with 17 per cent less value, inflation rate with 14 per cent less value, external openness ratio with 13 per cent less value, change in terms of trade with 7 per cent less value, and democracy index with 1 per cent less value.

Consequently, endogeneity bias caused by the possible correlation between the unobservable country-fixed effects and the explanatory variables generates overestimation or underestimation of coefficients of the explanatory variable, more or less. The estimated coefficients from the fixed-effect regression and basic regression, however, do not differ substantially. We infer that the reliability of the results of basic growth regression becomes greater.

Concluding Remarks

Over the past few decades, the Indian economy has grown rapidly compared to the world’s economies. This study clarified patterns and features of long-term economic growth in India using growth regression analysis. The following main findings can be pointed out.

First, the results of growth regression support the conditional convergence hypothesis. In contrast, both India's growth rate and income level have increased, breaking the convergence hypothesis. Second, growth regression shows health capital, investment ratio, and external openness contributing to economic growth. Results show that life expectancy at birth, the investment ratio and the export–import ratio were improved in India. Thirdly, the growth regression suggests that human capital has a nonlinear effect on economic growth. It is noteworthy that schooling years beyond three years raise the growth rate. Both schooling years and growth rates have increased in India. Fourth, it is supported by the growth regression that the total fertility rate has a negative effect on growth. It has also been observed in India that the growth rate increased as the total fertility rate declined. Fifth, the growth regression shows that government consumption reduces the growth rate. Contrary to the regression results, both India's growth rate and government consumption have increased. Sixth, according to results drawn from the growth regression, inflation has a negative effect on the growth rate. However, no clear relation is apparent between inflation and growth in India. Seventh, the growth regression results show that the improvement of terms of trade contributes to economic growth. The same was observed in India, where terms of trade fluctuated over time. Finally, growth regression results imply that democracy and economic growth have a nonlinear complex relation and that the relation differs depending on the position of the distribution of growth rates: while in the highest group the growth rate and democracy are U-shaped, in the lowest group they are inverted U-shaped. No clear relation is apparent between democracy and growth in India where India's status of democracy has varied only slightly.

Economic growth is important. With one-third of the India's total population living below the poverty line, long-term high economic growth will contribute to improvement of the well-being of the populace. Our findings show that well-being itself, such as life expectancy at birth and schooling years, has a beneficial effect on economic growth. A virtuous cycle of prosperity involving economic growth and well-being is more important for India.

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Figure 1

The Dynamics of the Neoclassical Growth Model

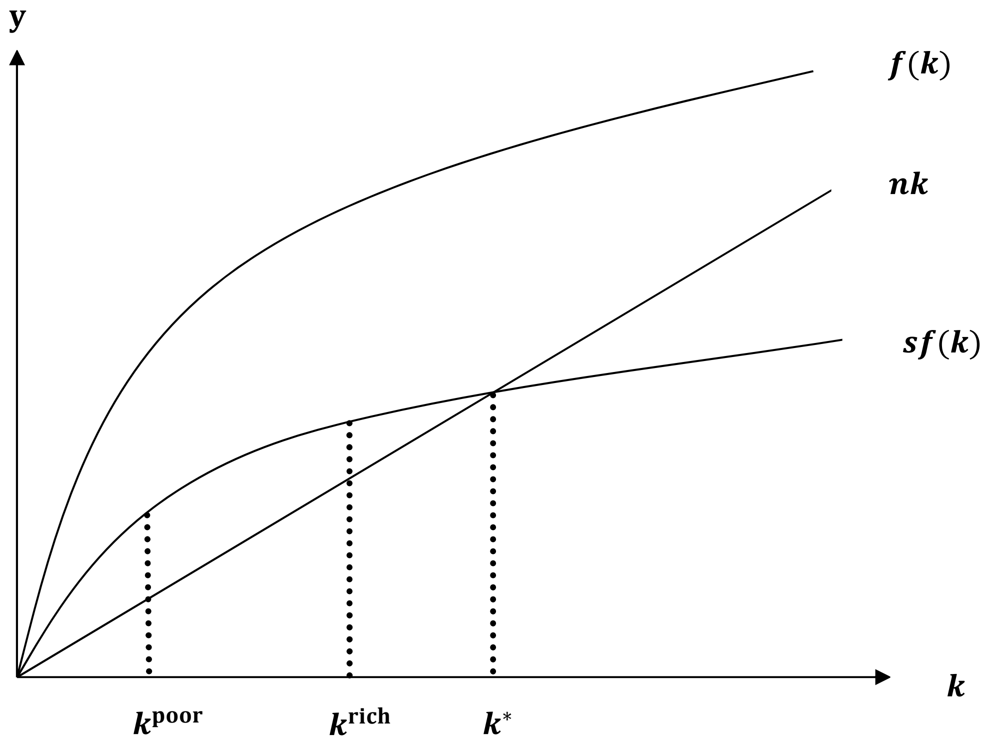


Figure 2

Absolute Convergence in the Neoclassical Growth Model

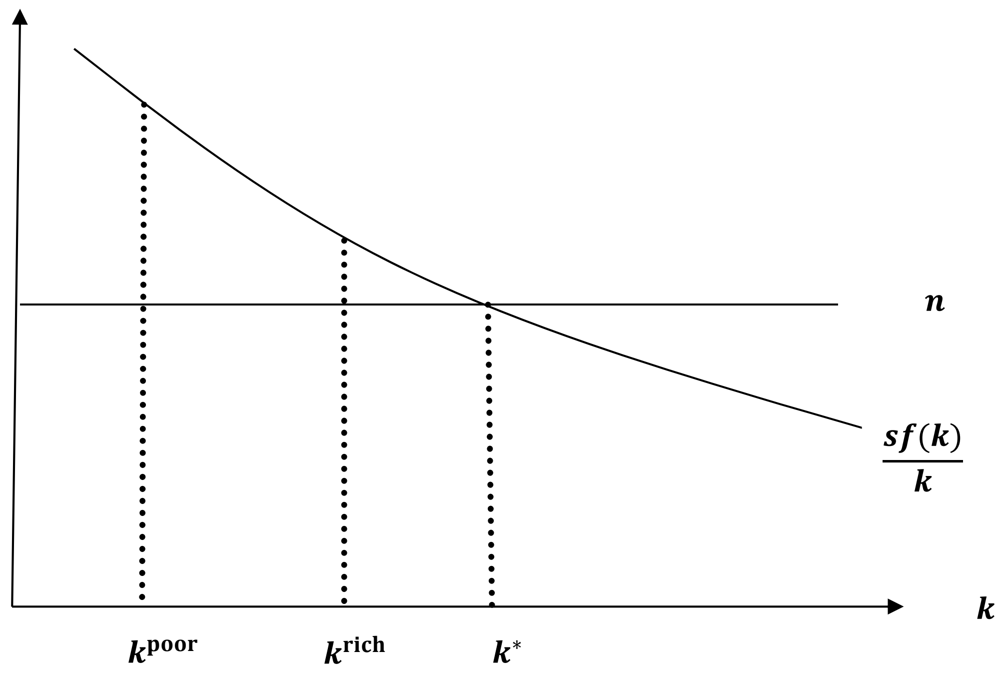
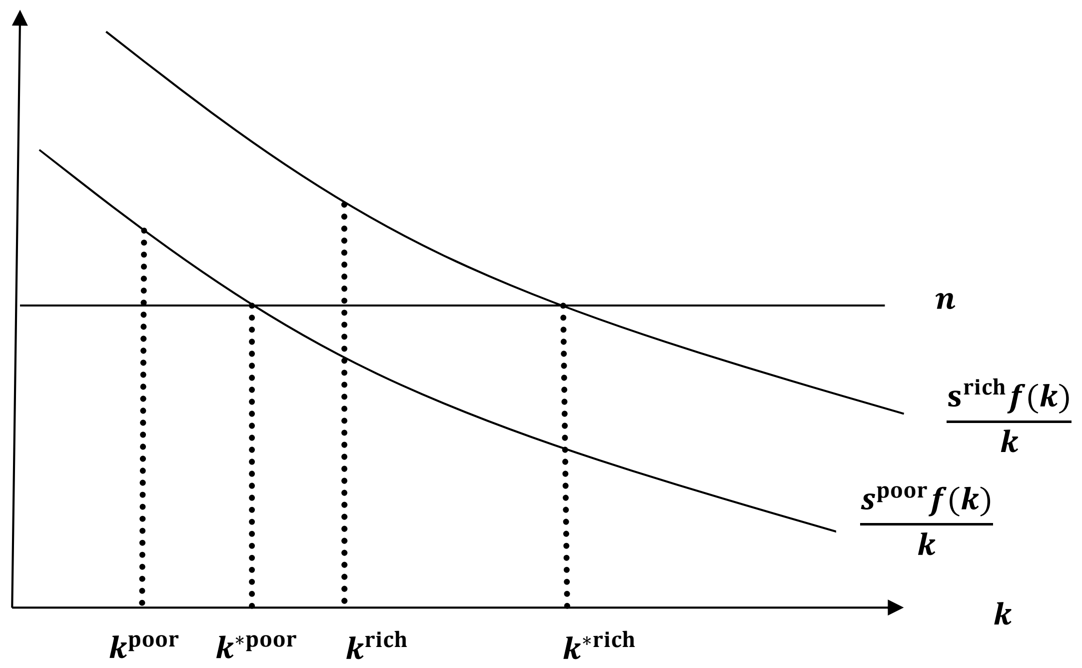


Figure 3

Conditional Convergence in the Neoclassical Growth Model

Panel A: Different Saving Rates



Panel B: Different Population Growth Rates

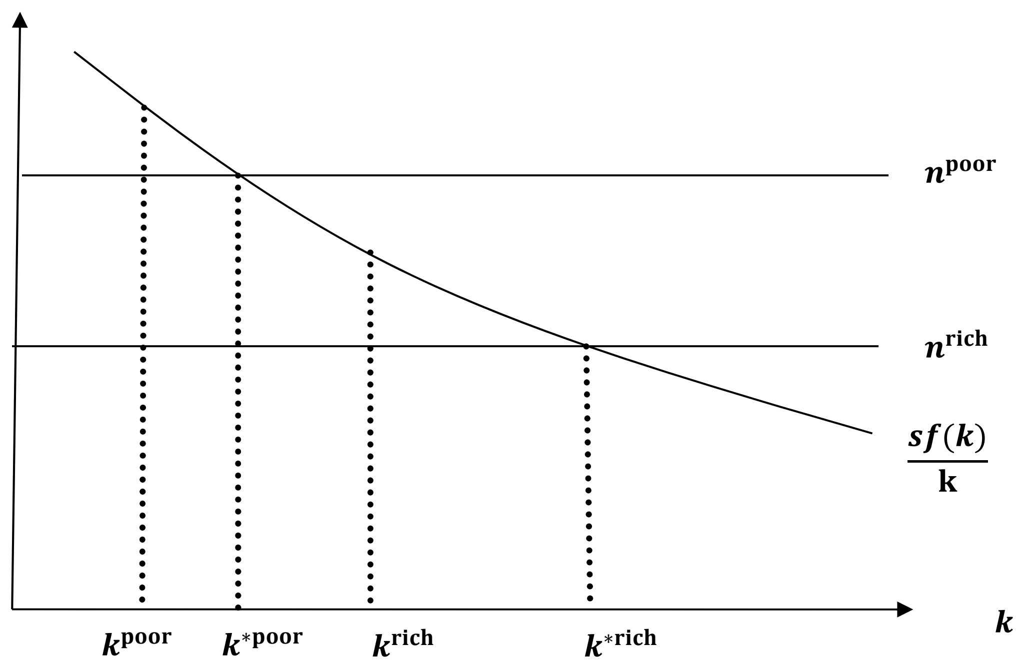


Figure 4

Simple correlation between the growth rate of per capita GDP and log of initial per-capita GDP.

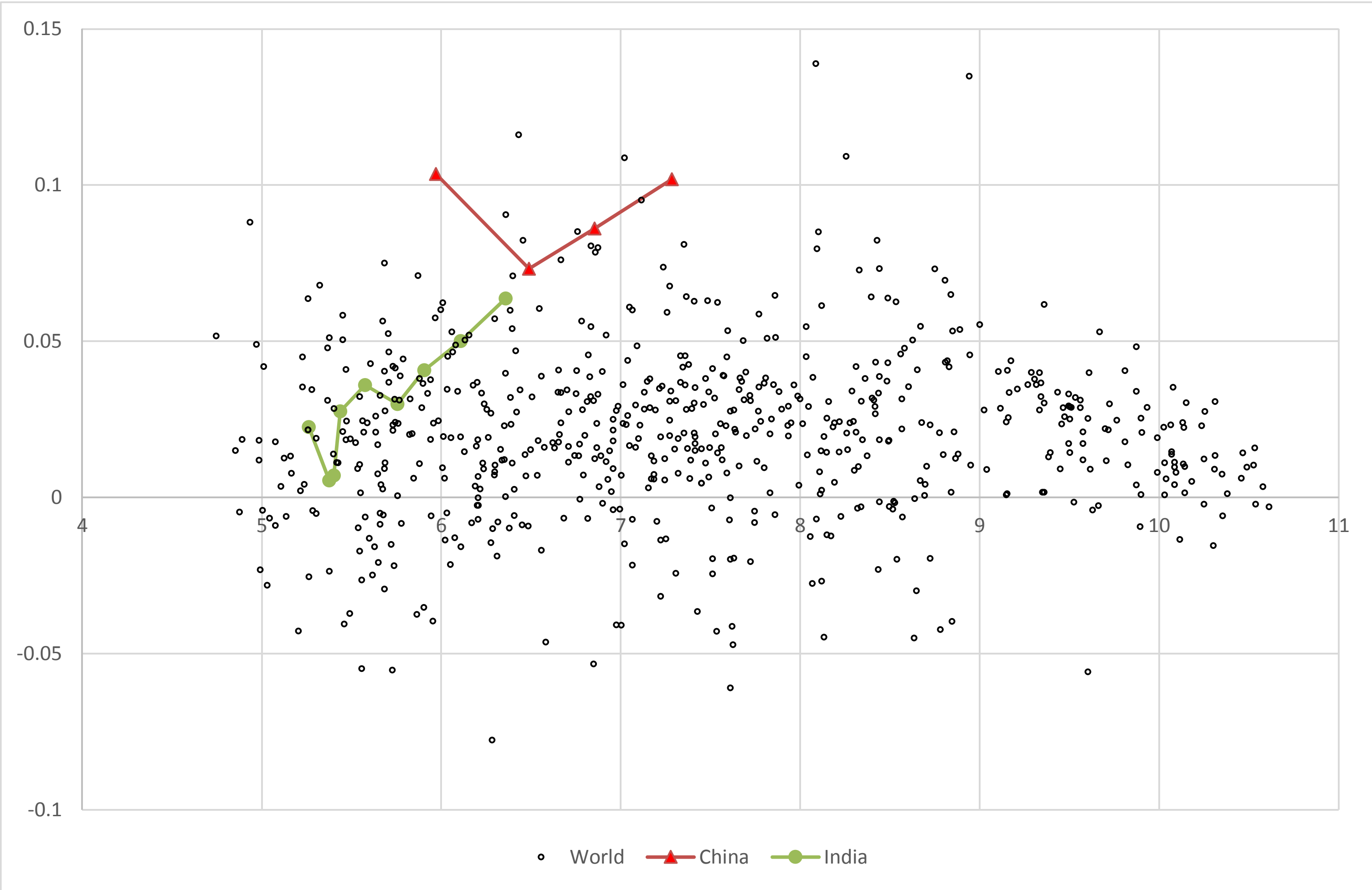


Figure 5

Partial relation between the growth rate of per-capita GDP and log of initial per capita GDP.

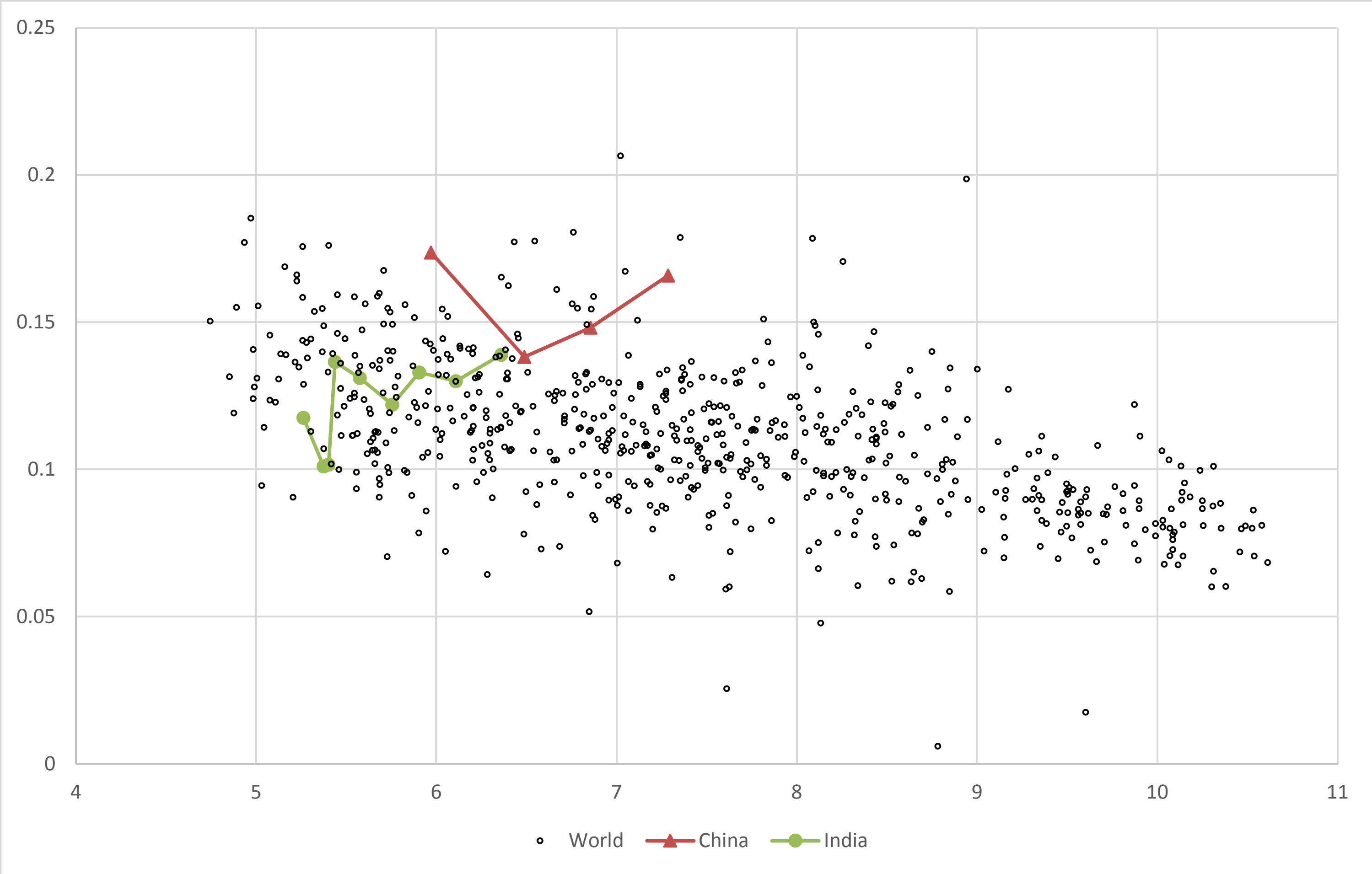


Figure 6

Partial relation between the growth rate of per-capita GDP and upper-level schooling years.

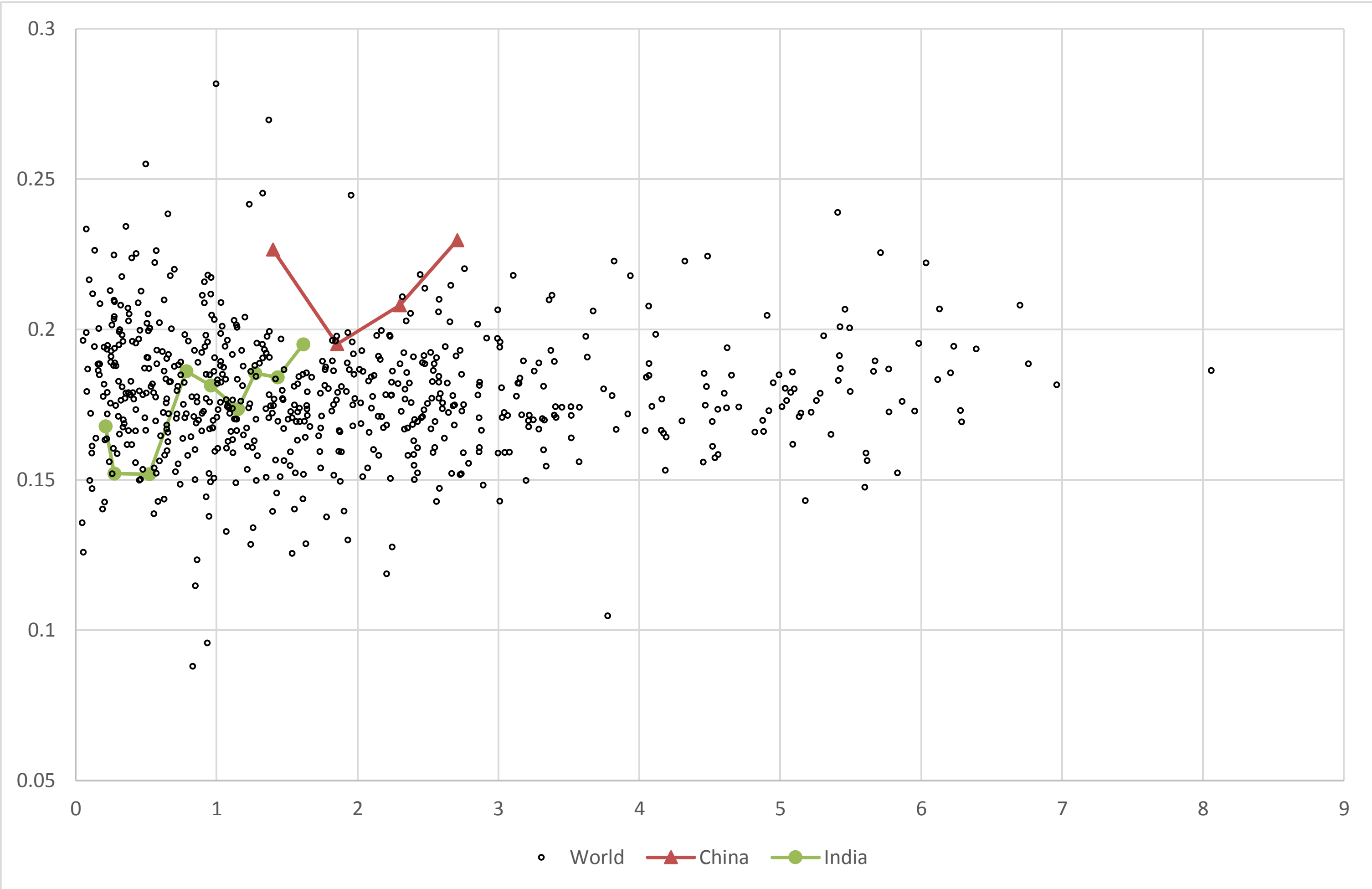


Figure 7

Partial relation between the growth rate of per-capita GDP and inverted value of life expectancy at birth.

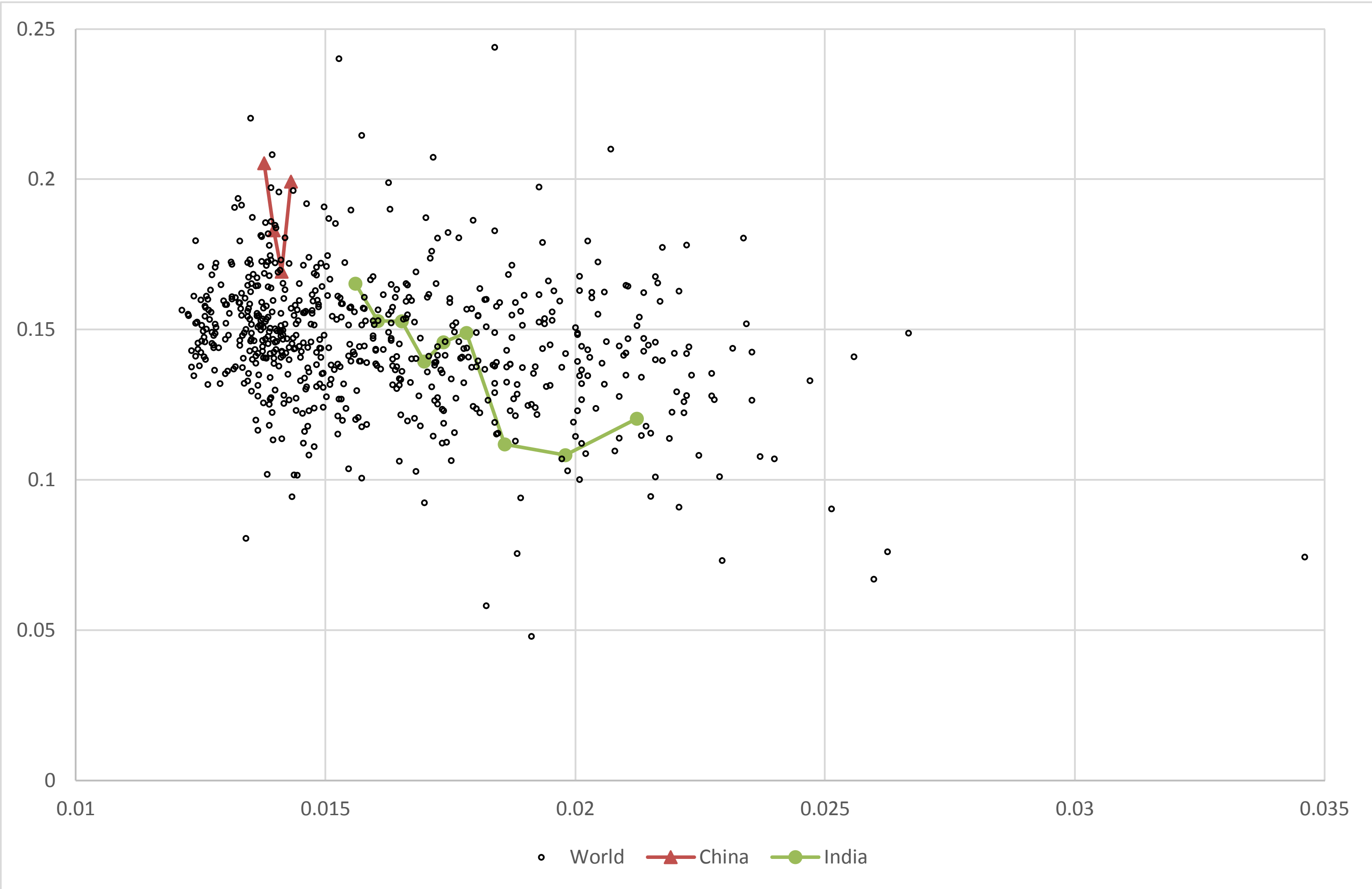


Figure 8

Partial relation between the growth rate of per-capita GDP and total fertility rate.

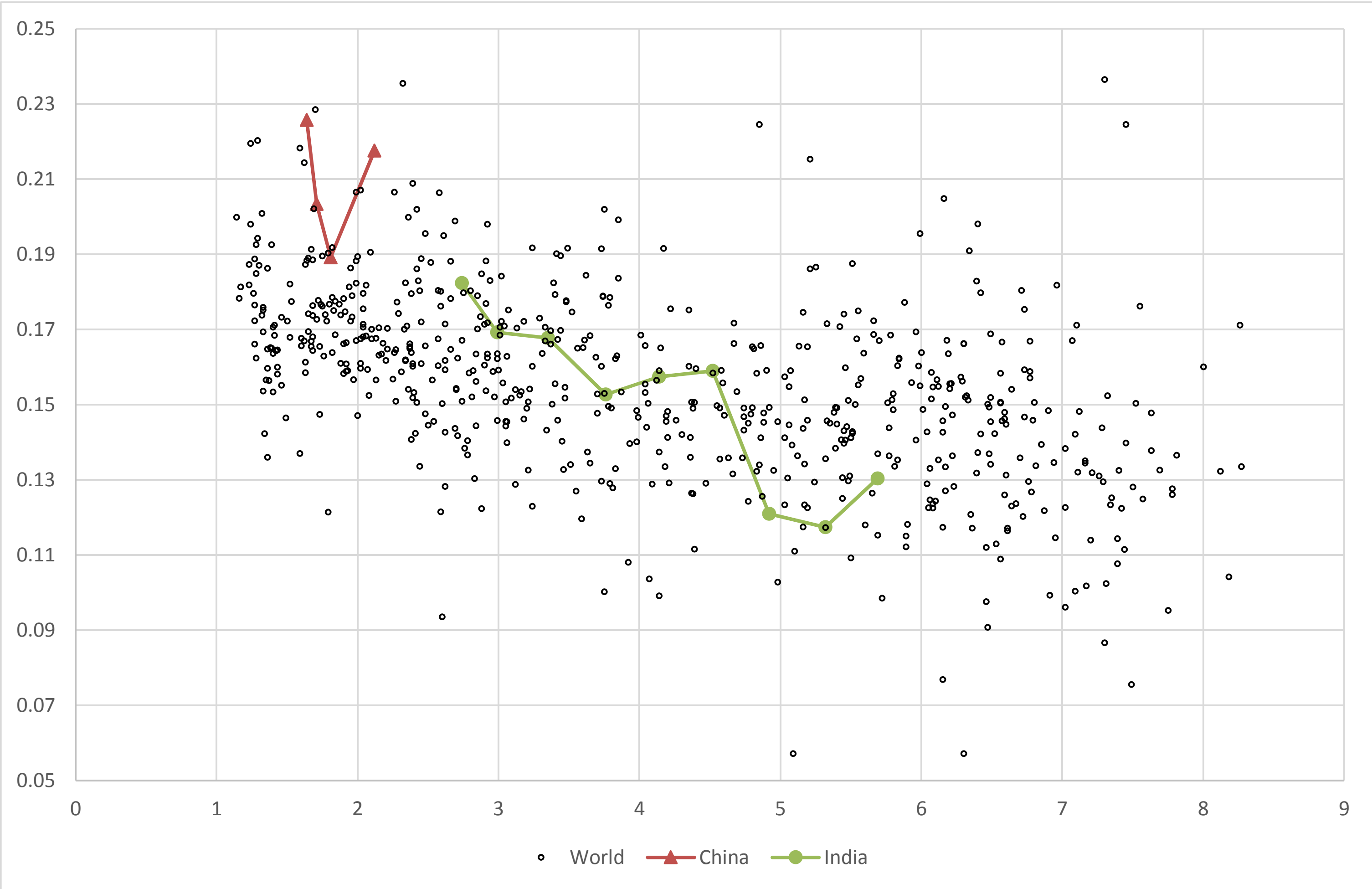


Figure 9

Partial relation between the growth rate of per-capita GDP and government consumption to GDP.

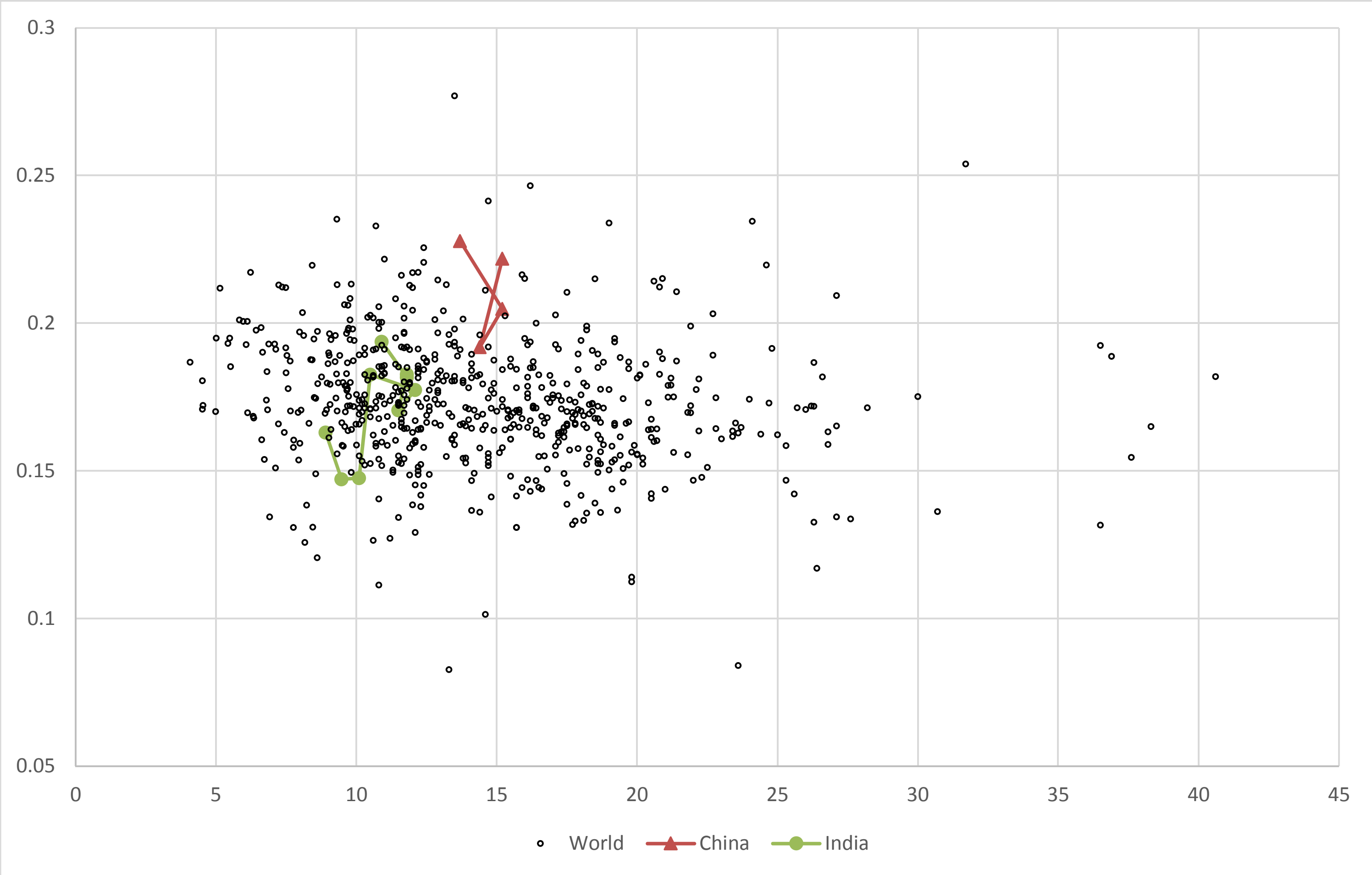


Figure 10

Partial relation between the growth rate of per-capita GDP and investment to GDP.

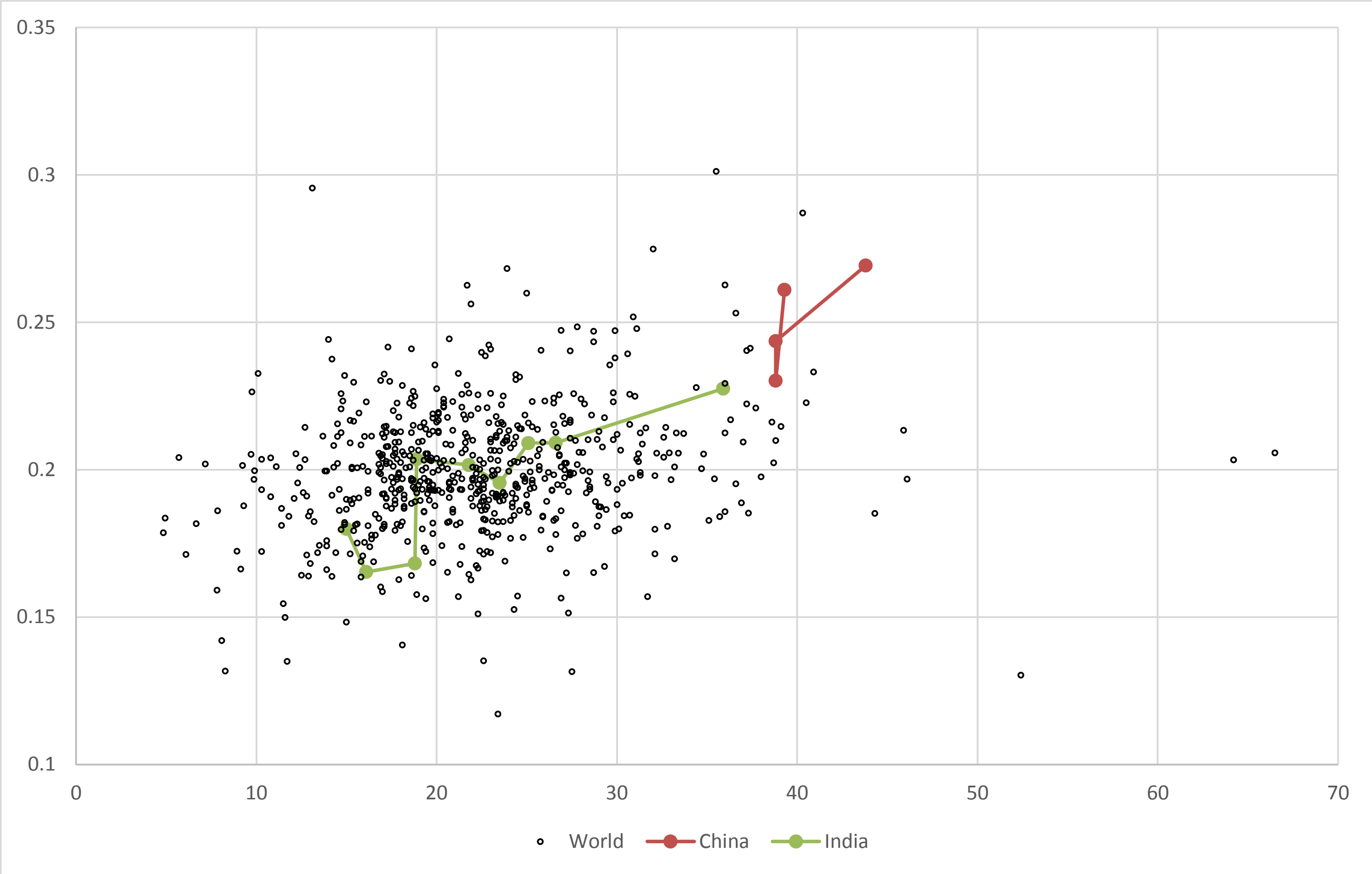


Figure 11

Partial relation between the growth rate of per-capita GDP and inflation rate.

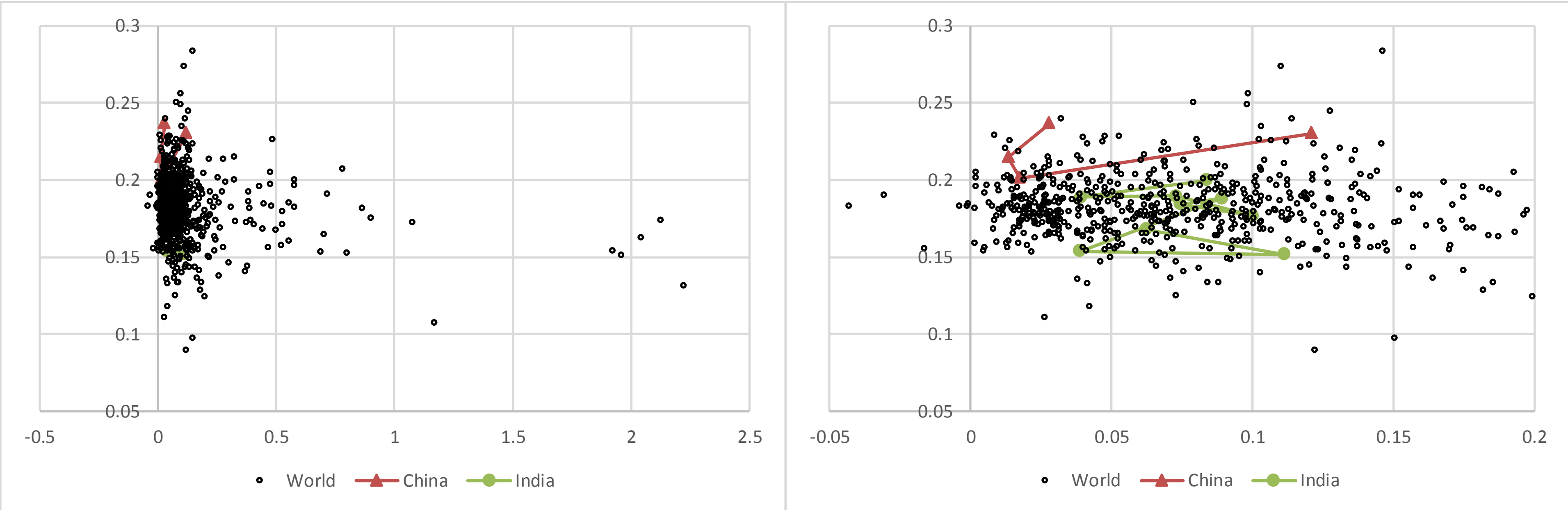


Figure 12

Partial relation between the growth rate of per-capita GDP and change in terms of trade.

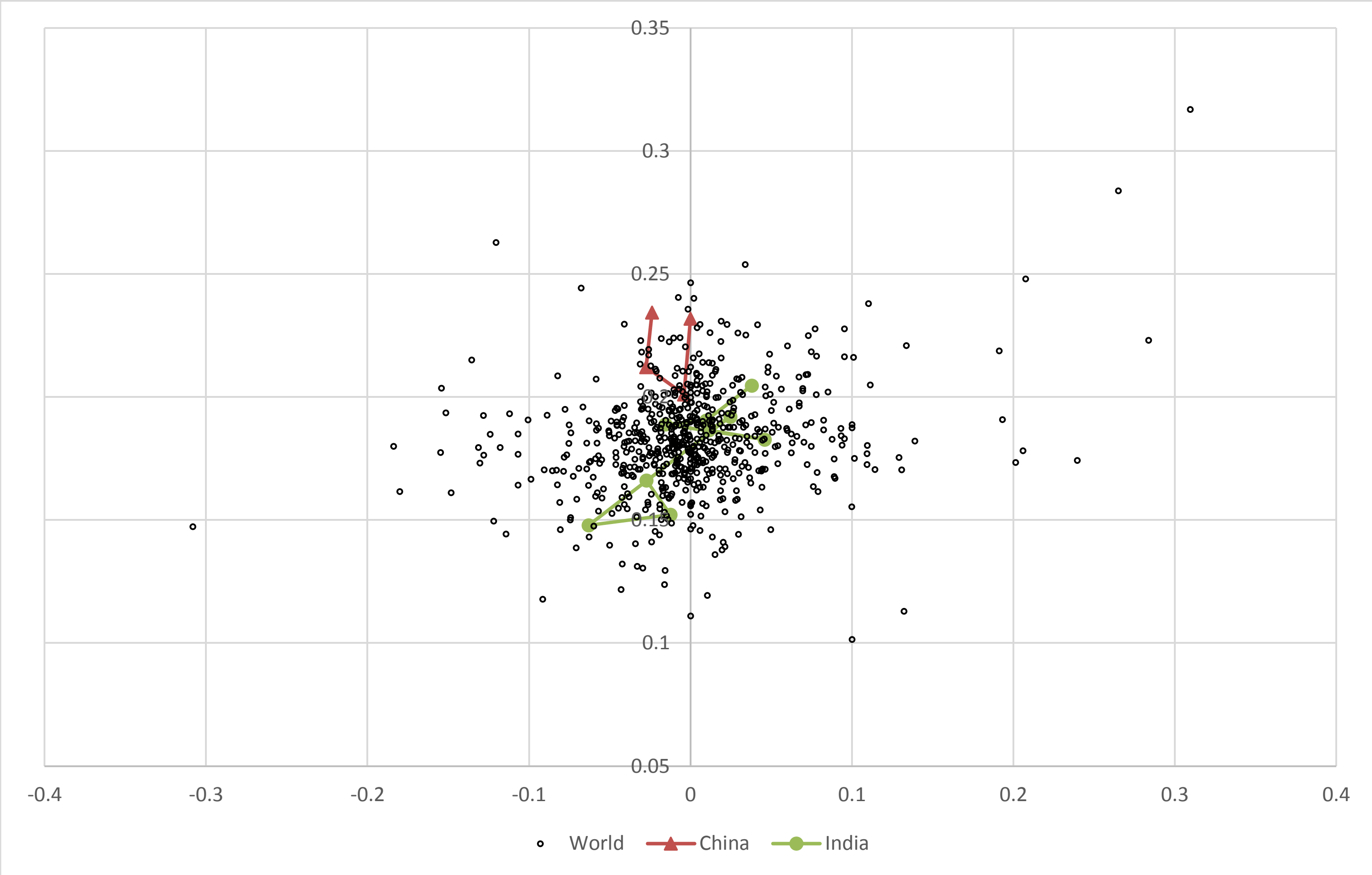


Figure 13

Partial relation between the growth rate of per-capita GDP and external openness ratio.

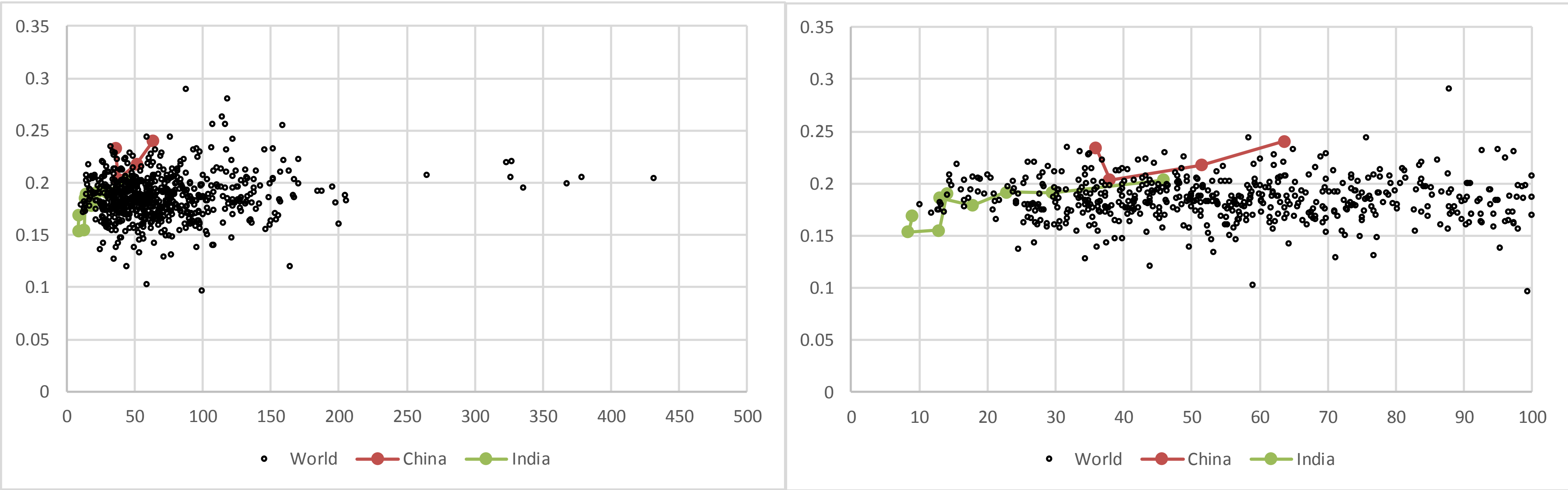


Figure 14

Partial relation between the growth rate of per-capita GDP and democracy index.

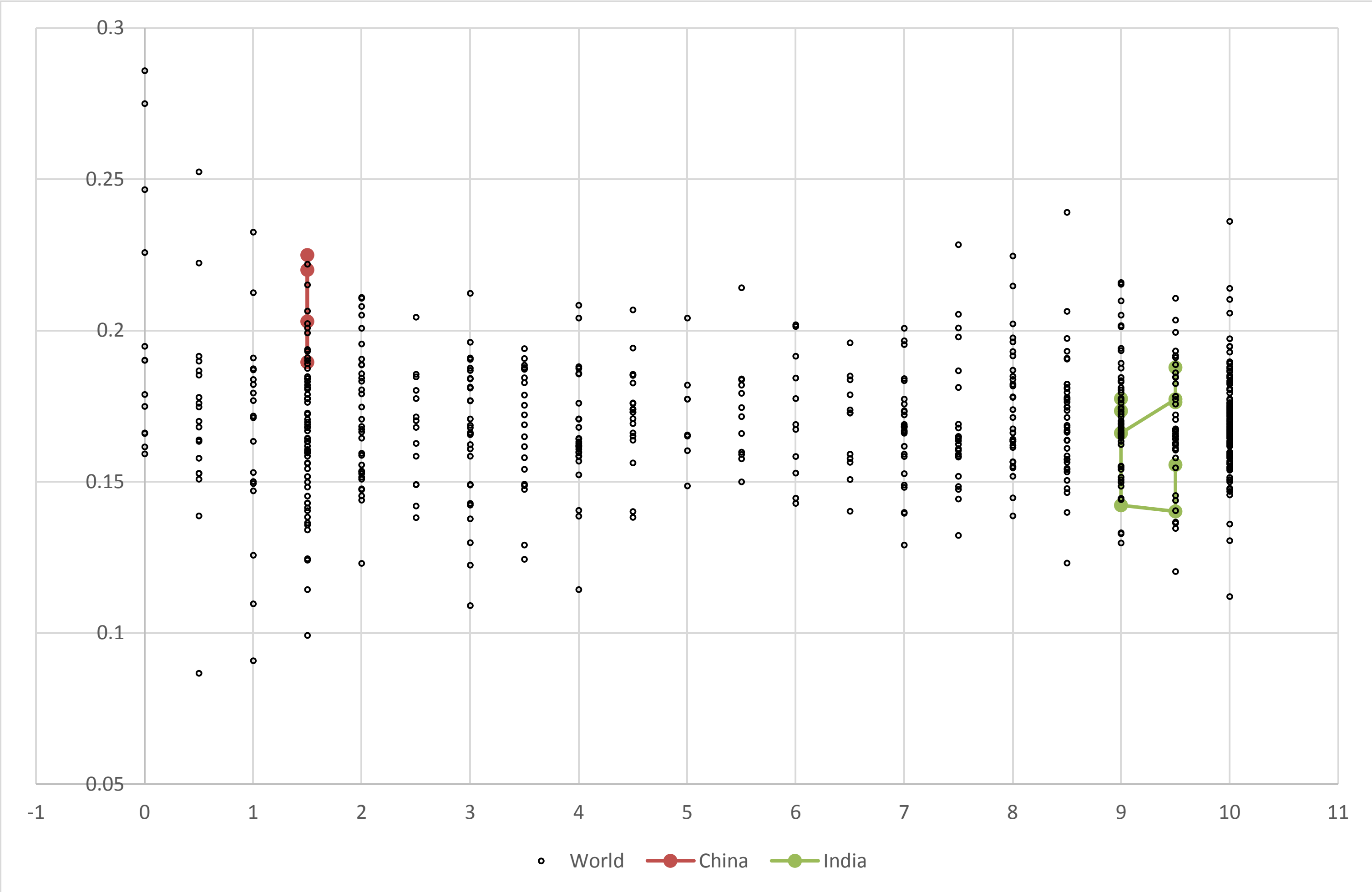


Figure 15

Growth Rates during 1960–2010

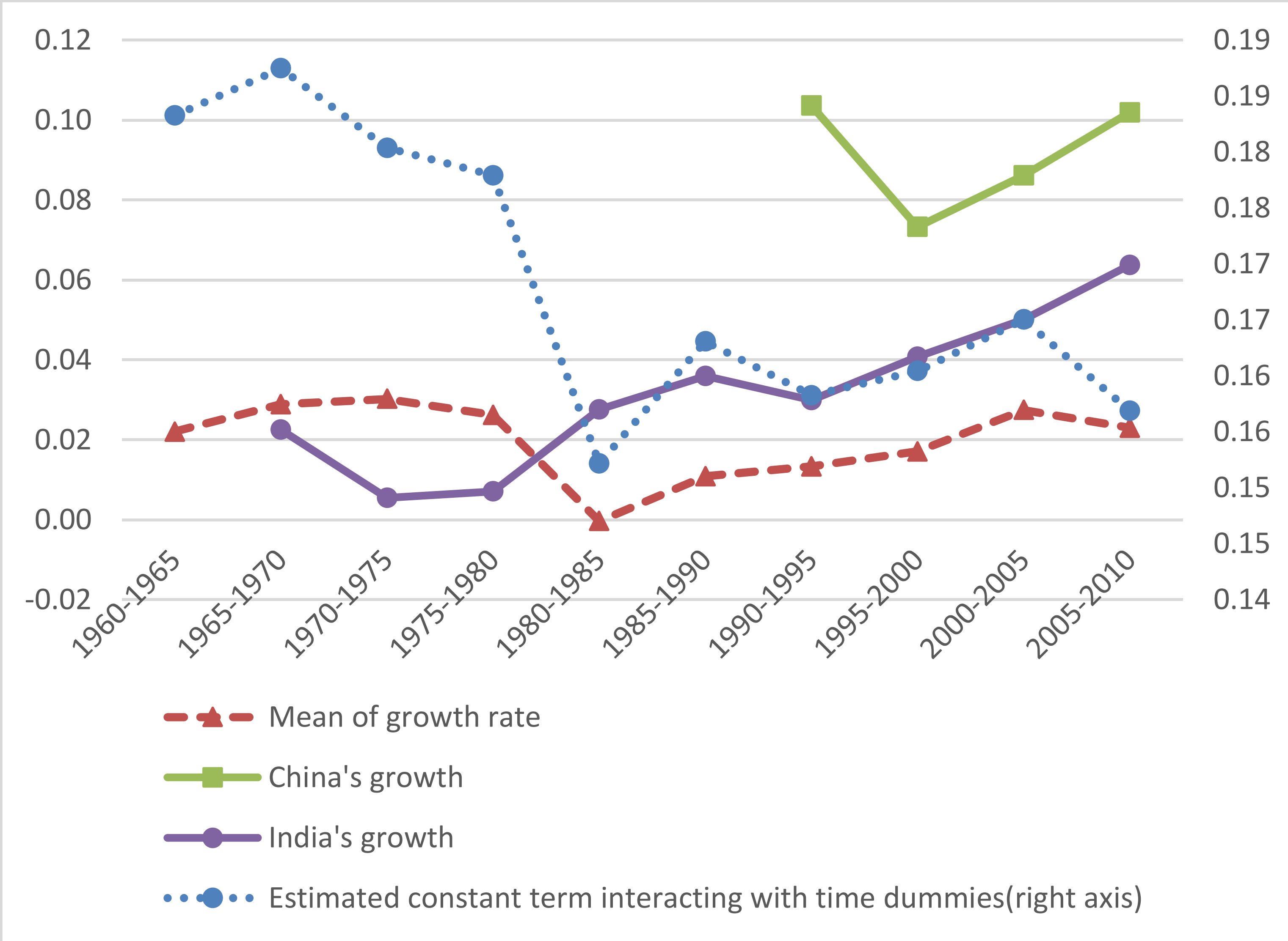


Table 1

Descriptive Statistics and Expected Sign of Growth Regression

Variable	Mean	S.D.	Min	Max	Source	Expected sign
Annual growth rate of per capita GDP	0.020901	0.0277236	−0.077573	0.138937	WDI & GDF	−
Log of initial per capita GDP	7.409063	1.456383	4.744932	10.61152	WDI & GDF	Negative
Change in terms of trade	−0.0003132	0.0551926	−0.308356	0.309547	Barro and Lee (1994), WDI & GDF	Positive
Inflation rate	0.1200026	0.2157444	−0.043022	2.22353	WDI & GDF	Negative
Total fertility rate	4.068003	1.921397	1.14	8.27	WDI & GDF	Negative
Government consumption ratio	14.51339	5.396524	4.08	40.6	WDI & GDF	Negative
Investment ratio	22.33189	7.213002	4.84	66.5	WDI & GDF	Positive
External openness ratio	70.24896	48.26262	8.43	431	WDI & GDF	Positive
1/(Life expectancy at birth)	0.0162308	0.0030151	0.012121	0.034602	WDI & GDF	Negative
Democracy index	6.067588	3.415694	0	10	Polity IV	?
Upper−level schooling years	1.949184	1.557857	0.043	8.056	Barro and Lee (2013)	Positive
Urban agglomerated population ratio	24.55164	18.27939	0	100	World Urbanization Prospects	?
Urban population ratio	47.6638	23.36899	2.294	100	World Urbanization Prospects	?

Note 1: These panel data cover observations for 23 countries in 1960-1965, 39 countries in 1965-1970, 59 countries in 1970-1975, 67 countries in 1975-1980, 48 countries in 1980-1985, 56 countries in 1985-1990, 59 countries in 1990-1995, 61 countries in 1995-2000, 120 countries in 2000-2005, and 119 countries in 2005-2010.

Note 2: Expected sign is drawn from the previous studies shown in footnotes 4 and 6-13.

Table 2

Data for China and India

Variable	Country	1965–1970	1970–1975	1975–1980	1980–1985	1985–1990	1990–1995	1995–2000	2000–2005	2005–2010
Annual growth rate of per capita GDP	China						0.1036	0.0732	0.0862	0.1019
	India	0.0225	0.0055	0.0071	0.0276	0.0360	0.0299	0.0408	0.0501	0.0638
Log of initial per capita GDP	China						5.971262	6.489205	6.855409	7.286192
	India	5.26269	5.375278	5.402678	5.438079	5.575949	5.755742	5.905362	6.109248	6.359574
Change in terms of trade	China						0.000000	−0.003961	−0.027393	−0.023844
	India	−0.027248	−0.012443	−0.063016	0.024671	0.011514	0.046022	−0.015392	0.009758	0.038045
Inflation rate	China						0.1210	0.0174	0.0134	0.0280
	India	0.0622	0.1114	0.0388	0.0892	0.0746	0.1000	0.0728	0.0390	0.0837
Total fertility rate	China						2.12	1.81	1.71	1.64
	India	5.69	5.32	4.92	4.52	4.14	3.76	3.35	2.99	2.74
Government consumption ratio	China						15.2	14.4	15.2	13.7
	India	8.91	9.47	10.1	10.5	12.1	11.5	11.8	11.8	10.9
Investment ratio	China						39.3	38.8	38.8	43.8
	India	15.0	16.1	18.8	18.9	21.8	23.5	25.1	26.6	35.9
External openness ratio	China						36.0	38.0	51.5	63.7
	India	9.04	8.43	12.9	14.1	13.1	17.8	22.8	29.6	45.9
1/(Life expectancy at birth)	China						0.014306	0.014124	0.013966	0.013774
	India	0.021231	0.019802	0.018587	0.017825	0.017361	0.016978	0.016529	0.016051	0.015601
Democracy index	China						1.5	1.5	1.5	1.5
	India	9.5	9.5	9.0	9.0	9.0	9.0	9.5	9.5	9.5
Upper-level schooling years	China						1.398	1.854	2.298	2.706
	India	0.211	0.273	0.522	0.785	0.957	1.150	1.273	1.432	1.614
Urban agglomerated population ratio	China						14.19	17.74	23.64	27.32
	India	9.97	10.63	11.41	12.29	13.06	14.01	14.84	15.85	16.72
Urban population ratio	China						26.44	30.96	35.88	42.52
	India	18.79	19.76	21.33	23.10	24.35	25.55	26.61	27.67	29.24

Table 3

Regression for annual growth rate of per capita GDP

Independent variable	(1)	(2)	(3)
Log of initial per capita GDP	−0.010678665	−0.010478348	−0.009753098
	(6.25)***	(6.42)***	(6.95)***
Change in terms of trade	0.099725032	0.100014692	0.100387293
	(4.10)***	(4.14)***	(4.17)***
Inflation rate	−0.016248543	−0.016156654	−0.015365661
	(3.43)***	(3.44)***	(3.32)***
Total fertility rate	−0.006823	−0.006881247	−0.006765639
	(4.76)***	(4.78)***	(4.75)***
Government consumption ratio	−0.000667124	−0.000632891	−0.000664318
	(2.54)**	(2.45)**	(2.51)**
Investment ratio	0.000745331	0.000739132	0.000738823
	(2.98)***	(2.98)***	(2.96)***
External openness ratio	5.77231E−05	5.58079E−05	5.69362E−05
	(2.42)**	(2.36)**	(2.35)**
1/(Life expectancy at birth)	−2.21803	−2.22951	−2.28121
	(3.01)***	(3.02)***	(3.05)***
Democracy index	−0.011100604	−0.010942424	−0.010946744
	(2.56)**	(2.53)**	(2.59)**
$(\text{Democracy index})^2$	0.002190142	0.002151512	0.002176494
	(2.39)**	(2.34)**	(2.41)**
$(\text{Democracy index})^3/100$	−0.012269806	−0.011975205	−0.012325218
	(2.19)**	(2.12)**	(2.23)**
Upper−level schooling years	−0.005846181	−0.005448386	−0.00504295
	(1.80)*	(1.78)*	(1.60)
$(\text{Upper−level schooling years})^2$	0.000986954	0.000923958	0.000896137
	(2.39)**	(2.39)**	(2.25)**
Urban agglomerated population ratio		8.43491E−05	
		(1.03)	
Urban population ratio	8.12123E−05		
	(0.99)		
1965−1970 dummy	0.004384338	0.004394625	0.00421406
	(0.95)	(0.96)	(0.91)
1970−1975 dummy	−0.002581883	−0.002627022	−0.002890901
	(0.49)	(0.50)	(0.55)
1975−1980 dummy	−0.004942937	−0.005036779	−0.005341155
	(0.86)	(0.88)	(0.93)
1980−1985 dummy	−0.030577011	−0.030673538	−0.031098867
	(5.98)***	(6.04)***	(5.98)***
1985−1999 dummy	−0.019757402	−0.019840701	−0.020197373
	(3.07)***	(3.11)***	(3.10)***
1990−1995 dummy	−0.024792394	−0.024779299	−0.025009051
	(4.34)***	(4.36)***	(4.36)***
1995−2000 dummy	−0.022823731	−0.02272799	−0.022842623
	(3.86)***	(3.88)***	(3.86)***
2000−2005 dummy	−0.018111016	−0.017823258	−0.018236434
	(3.03)***	(3.03)***	(3.05)***
2005−2010 dummy	−0.026234225	−0.025882281	−0.026401349
	(4.06)***	(4.06)***	(4.09)***
Constant	0.18621079	0.185897317	0.1832629
	(7.35)***	(7.36)***	(7.46)***
Observations	651	651	651
Adj. R−squared	0.37	0.37	0.37

Cluster−robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4

Fixed-effect regression for annual growth rate of per capita GDP

Independent variable	(1)	(2)	(3)	(4)	(5)
Log of initial per capita GDP	−0.045981672	−0.046280034	−0.046004265	−0.04619971	−0.011768485
	(8.13)***	(8.20)***	(8.16)***	(8.14)***	(7.87)***
Change in terms of trade	0.096436112	0.094969023	0.096373784	0.09540463	0.107774654
	(4.59)***	(4.69)***	(4.61)***	(4.71)***	(4.47)***
Inflation rate	−0.021996961	−0.02192844	−0.022006668	−0.021863992	−0.017810829
	(4.03)***	(4.13)***	(4.04)***	(4.10)***	(3.70)***
Total fertility rate	−0.003109308	−0.003165137	−0.003181183	−0.002723534	−0.006116146
	(1.47)	(1.62)	(1.74)*	(1.73)*	(4.17)***
Government consumption ratio	−0.001196826	−0.001202735	−0.001197987	−0.001196647	−0.000829771
	(3.28)***	(3.34)***	(3.27)***	(3.31)***	(3.12)***
Investment ratio	0.000768285	0.000772291	0.000768643	0.000771067	0.000683254
	(2.63)***	(2.62)***	(2.63)***	(2.63)***	(2.85)***
External openness ratio	0.000217042	0.00022419	0.000217139	0.000224142	6.51444E−05
	(3.35)***	(3.46)***	(3.35)***	(3.45)***	(2.40)**
1/(Life expectancy at birth)	−2.31395	−2.55256	−2.31596	−2.52501	−2.7663
	(2.02)**	(2.36)**	(2.02)**	(2.35)**	(3.61)***
Democracy index	−0.014531634	−0.015429699	−0.014504884	−0.015595021	−0.011054152
	(2.46)**	(2.49)**	(2.43)**	(2.52)**	(2.54)**
(Democracy index)^2	0.002813827	0.002966593	0.002807123	0.00300495	0.002107156
	(2.24)**	(2.29)**	(2.21)**	(2.31)**	(2.29)**
(Democracy index)^3	−0.015584051	−0.016347366	−0.015539936	−0.016594793	−0.011312696
	(2.01)**	(2.06)**	(1.97)*	(2.08)**	(2.01)**
Upper-level schooling years	0.005089882	0.002536348	0.004711603	0.004455278	−0.003331301
	(1.08)	(0.64)	(1.74)*	(1.73)*	(1.04)
(Upper-level schooling years)^2	−5.43193E−05	0.000284868			0.000698279
	(0.09)	(0.51)			(1.75)*
Urban agglomerated population ratio		−0.00087614		−0.000872885	
		(1.64)		(1.61)	
Urban population ratio	−0.000456236		−0.000451489		
	(1.40)		(1.48)		
1965−1970 dummy	0.012094259	0.012572434	0.012098065	0.012501026	0.005550647
	(2.95)***	(3.00)***	(2.94)***	(2.98)***	(1.25)
1970−1975 dummy	0.011666789	0.012470965	0.011676902	0.012361632	−0.001032628
	(2.00)**	(2.05)**	(1.99)**	(2.02)**	(0.20)
1975−1980 dummy	0.013277846	0.014520038	0.01330016	0.014349644	−0.003467755
	(2.03)**	(2.10)**	(2.01)**	(2.05)**	(0.63)
1980−1985 dummy	−0.00916332	−0.007740405	−0.009136502	−0.007930204	−0.030162858
	(1.39)	(1.09)	(1.37)	(1.10)	(5.96)***
1985−1999 dummy	0.002254225	0.00344972	0.002295063	0.003178423	−0.020363597
	(0.29)	(0.44)	(0.29)	(0.40)	(3.22)***
1990−1995 dummy	−0.001086567	5.23258E−05	−0.00105	−0.000226362	−0.025988456
	(0.13)	(0.01)	(0.12)	(0.02)	(4.63)***
1995−2000 dummy	0.003769555	0.004716973	0.003795397	0.004483134	−0.023768752
	(0.43)	(0.51)	(0.43)	(0.47)	(4.12)***
2000−2005 dummy	0.012749927	0.013665617	0.012766768	0.013471548	−0.018413247
	(1.34)	(1.36)	(1.33)	(1.31)	(3.23)***
2005−2010 dummy	0.009155143	0.009812906	0.009154126	0.00970458	−0.026457555
	(0.85)	(0.87)	(0.86)	(0.85)	(4.24)***
Constant	0.4223924	0.431177353	0.423019395	0.426588767	0.204181477
	(7.74)***	(8.03)***	(7.86)***	(7.92)***	(8.31)***
Observations	651	651	651	651	651
Adj. R-squared	0.54	0.55	0.54	0.55	0.54
Number of cid	122	122	122	122	122

Cluster-robust t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%