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Abstract

The dynamics of world economic change has been interesting particularly for last 10-20 years as this period has seen rapid growth and improvement in economic, demographic and health factors. This study tries to find out how far demographic component of deceasing dependency ratio in BRICS countries is affecting efficiently in the growth of their economies compared to few selected developed economies. The potential growth of BRICS economies is largely dependent on its skill formation capacity of its population, particularly working age population.

Key Words: BRICS, Population Growth, Economic Growth, Demographic Dividend

Introduction

The phenomenon of demographic transition is associated with a change in age structure due to reduction in both mortality as well as fertility. Change in mortality leads the first phase of the transition process, where the later part is guided by fertility decline. Many developed countries are at the last stage of the demographic transition whereas most of the African countries are at the second stage of it. Fortunately for many developing nations, the second to third stage of demographic transition is associated with the stage of demographic dividend. Demographic dividend is the window of opportunity to a nation for rapid economic growth and human development if effective policies are implemented.

During the course of the demographic dividend there are four mechanisms that the benefits are delivered through. The first is the increased labour supply. The magnitude of this benefit depends on the ability of the economy to absorb and productively employ the extra workers. The second is the increase in savings. As the number of dependents decreases individuals can save more. This increase in national savings rates increases the stock of capital in developing countries already facing shortages of capital and leads to higher productivity as the accumulated capital is invested. The third mechanism is human capital. Decreases in fertility rates result in healthier women and fewer economic burdens. This also allows parents to invest more resources per child, leading to better health and educated people. The fourth mechanism for growth is the increasing domestic demand brought about by the increasing GDP (Gross Domestic Products) per capita and the decreasing dependency ratio.

The dynamics of world economic change has been interesting particularly for last 10-20 years as this period has seen rapid growth and improvement in economic, demographic and health factors. World economy has also faced extreme recession (second biggest after the great depression in 1930s),the apparent US housing market turbulence metamorphosed into full blown recession often called the 'Great recession' in late 2007. For last few years the world is

struggling to cope with the economic recession (started in 2007 and picked in September 2008) triggered by fall in US economy which caused large scale unemployment and resource scarcity even in some of the world's strongest developed economies and adversely affected world economy as a whole. Some of the world's big and strong economies like UK, USA, Japan, and European countries were unable to encounter recession to a large extent and many development plans were dropped during this period because of scarcity of resources.

At the same time some interesting economic observations attracted attention of economic discussion. Amongst worldwide economic crisis generated by world financial recession China and India stood as the nations which were least affected by it and showed an appreciable rate of growth of GDP (Gross Domestic Product) in spite of world economic slowdown. Economists are trying to find whether this growth is due to the sheer size and hence population of these two big nations, or their less dependence on trade (particularly for India) or any other factors. Even before China and India sustained world recession as the least affected developing economy, a group of four countries (BRICs) were viewed as the future economic power by some economic predictions. The acronym BRICs was coined in 2001 by the Investment Bank Goldman Sachs to emphasise the economic growth potential of the countries Brazil, Russian Federation, India and China (thus the name BRIC) in the coming decades. Ever since then world economy has kept a vigilant eye on the growth path of these countries. Along with the four countries South Africa has recently joined (2010) the group to make it BRICS. The BRICS economies differ greatly in terms of their growth prospects. The demographic trends, labour supply dynamics seem to remain favourable for Brazil, India and South Africa. In Brazil, India and South Africa the working age population continues to expand until the middle of the current century, hence the possibility of reaping demographic dividend is present while in China it may decline after 2015 and in Russia it is already declining. The relative and absolute economic importance of BRICS is expected to continue

to rise for the foreseeable future. It is estimated that BRICS will be one of the major players in world economic scenario in next 30 years. By 2018 the cumulative GDP (US$) of BRICS will overtake that of USA and is expected to overtake G7 countries by 2030.

The past decades (2000-2010) performance of BRICs shows its growth from share of one sixth of global GDP to almost a quarter (in PPP terms) and has contributed over a third of world GDP growth (50% of world GDP growth in last three years is contributed by BRICS). According to the World Bank estimation (2010) China overtook Japan in its total GDP and became second largest economy in the world (GDP in nominal value) followed by Brazil in 7th, India in 9th and Russian Federation in 11th position. [1]With almost 30% of world territory and 45% of world population BRICS potential to emerge as an important global player in economic field as well as in global political scenario is immense.

Fig. 1

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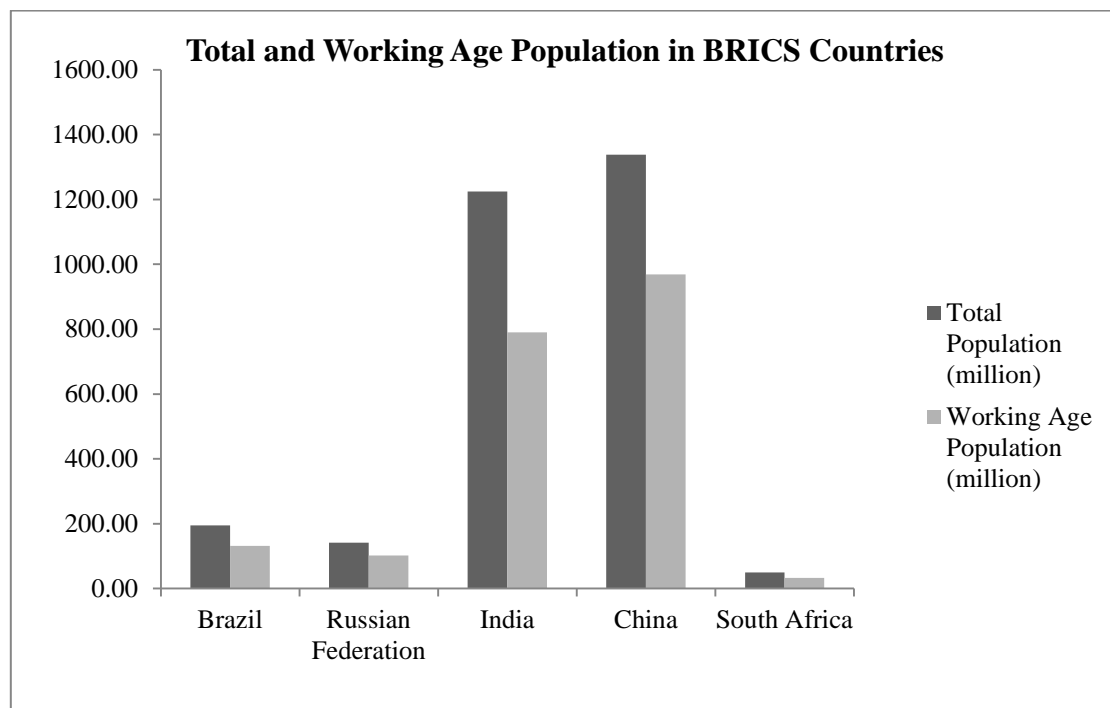
[1] If the ranking is in GDP purchasing power parity term (PPP) then China ranks second behind USA ,whereas India , Russia and Brazil rank in fourth , sixth and ninth position (World Bank ranking 2010).

Except Russian Federation all BRICS countries are developing economies and most of them have a large number of working age population. From the estimates of United Nations World Population Prospects (2010 Revision), Demographic Dividend due to Demographic Transition currently taking place in these countries are likely to continue for at least another 30 years (except Russia). For China and Brazil the Demographic Window is expected till 2025 but for India it is projected longer until 2050 and in case of South Africa it is projected for much longer duration. The potential for BRICS countries economic growth can be partly attributed to the demographic dividend component. In this study an attempt is made to assess how far the demographic dividend component is responsible for the economic growth of the BRICS countries. To compare the potential for economic growth of BRICS, selected developed nations (Japan, UK and USA) are also included in the analysis along with BRICS countries.

Literature Review

Previous studies on the economic growth potential of developing nations are many but studies of demographic impact on the economic growth are very limited. Particularly there are large number of studies focussing on the future economic prospects (and hence market) of the developing nation including African continent from purely business point of view. Studies relating economic growth with demographic dividend component and prospects of future growth as well as development in developing countries are limited. There have not been many scientifically focussed studies to determine the effect of demographic variables on economic growth focussing on comparative assessment of demographic dividend. Barro (1991) had observed for 98 countries in the period 1960-1985, the growth rate of real per capita GDP was positively related to initial human capital (proxied by 1960 school enrolment rates) and negatively related to the initial (1960) level of real per capita GDP. Countries with

higher human capital also had lower fertility rates and higher ratios of physical investment to GDP.

Lee et al. (1997) examined the growth and convergence in a multi country Solow Model. The empirical analysis of the logarithm of per-capita output, in their paper indicates that data for 102 countries over 30 years (1960-1989) strongly rejects the hypothesis that technology growth rates are equal across countries. Bloom and Williamson study on East Asia (1998) showed empirical analyses indicating that population growth had a purely transitional effect on economic growth; this effect operated only when the dependent and working-age populations were growing at different rates. From these results they concluded that future demographic change would tend to depress growth rates in East Asia, while it would promote more rapid economic growth in Southeast and South Asia. Bloom and Canning (2005) studied global economic change and its economic significance. The per capita GDP growth and productivity has been studied by Marattin and Salotti (2009). Bosworth et al. working paper titled Sources of growth in the Indian economy examined the growth experience of India during 1960-2004. Bloom, Canning (2010) studied effect of health and demographic change on economic growth in China and India. In their study of cross-country model of economic growth they track the growth take-off in China and India. The major contributors in the take-off are improved health, increased openness to trade, rising labour force to population ratio. Esterwood and Lipton (2011) studied demographic transition in Sub Saharan Africa arising more from falling dependency than reduced natural increase, and could be increased by accelerating the fertility decline.

Rationale and Research Questions

In this study we have tried to find out whether there are any relationships between economic growth and demographic components like the bulging working age population share of

BRICS countries (except Russia). And if there are any causation between the two what direction it is and how much the factor is affecting the economic growth or likely to affect in future. To compare the prospects of future economic growth of the BRICS with developed nations, three major world economic powers like Japan, UK and USA are taken in this analysis.

In this study of BRICS countries and selected developed nations we have tried to address the following questions

1. How demographic component is related with the GDP per capita growth rate.

2. What may be the other possible components that are contributing to the growth of GDP per capita.

3. Whether there are any sectoral effects that is playing major role in this growth.

4. How far the Demographic Dividend component (which is also affecting the growth of share of working age to total population) is responsible for the growth of GDP per capita in the BRICS countries and what can be the future consequences of demographic window to the growth of the economies.

5. Whether India has more potential to emerge as strong economic power amongst BRICS countries in future.

Objectives

The specific objectives of the study are as follows

1. To examine comparative trends in demographic and economic variables in the BRICS countries and selected developed nations.

2. To assess relative strength of economic and demographic variables of economic growth in BRICS countries and the impact of demographic dividend on Economic Growth.

3. To assess effects of economic vis-a-vis demographic factors and compare the economic growth between BRICS countries and selected developed nations.

Data

For decomposition, data from World Development Indicators (WDI) of World Bank (2011) have been taken. For the regression analysis, we have formed two panels of single year data of eight countries (BRICS and Japan, UK, USA), from 1961 to 2009 and another from 1991-2009. Data on GDP per capita and the ratio of investment to GDP are obtained from Penn World Table Version 7.0 (Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011)[2].

The data on working age population (aged 15-64), total population, Life expectancy at birth, Infant Mortality Rate and Under Five Mortality are taken from World Bank (2011)[3]. Education data on average total years of schooling   is taken from Barro and Lee (2000).

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[2] As stated by Bloom, Canning et al in their paper 'The contribution of population health and demographic change to economic growth in China and India' – Journal of Comparative Economics 38 (2010) Data on GDP per capita (PPP) is more reliable in Penn World Table, hence that data has been taken for regression purposes.

[3] World Development Indicators Data on demographic and employment variables are derived from sources such as: (1) United Nations Population Division. World Population Prospects, (2) United Nations Statistical Division. Population and Vital Statistics Report (various years), (3) Census reports and other statistical publications from national statistical offices, (4) Eurostat: Demographic Statistics, (5) Secretariat of the Pacific Community: Statistics and Demography Programme, (6) U.S. Census Bureau: International Database, Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA, UNPD), International Labour Organization, Key Indicators of the Labour Market database.

Methodology

In most of the economic literature economic growth of a country is measured by growth of Gross National Product (GDP) per capita of that country (taken as a proxy of standard of living). For comparing the economic growth of different countries GDP is measured in Purchasing Power Parity (PPP) terms.

In our analysis we tried to find how far the change in per capita GDP (PPP) can be explained by change in labour productivity, labour participation rate and working age to total population ratio. Further we tried to find intersectoral change in productivity of the BRICS countries and compare it with some of the Developed Nations like Japan, UK and USA.

Income per capita can be seen as the following identity

$$\frac{Y}{N} = \frac{Y}{E}\frac{E}{WA}\frac{WA}{N} \quad (1)$$

It implies GDP per capita (Y/N) is a product of income per worker or labour productivity (Y/E), labour participation rate (E/WA) and ratio of working age to total population (WA/N) where Y is total income (GDP), N is total population, E is the total number of employed and WA is the working age population (aged 15-64). Now taking log to both sides of equation (1) and differentiating the identity with respect to time (t) the following equation is obtained

$$\overset{\bullet}{y} = \overset{\bullet}{z} + \overset{\bullet}{e} + \overset{\bullet}{w}\,^{4} \quad (2)$$

Where y = log (Y/N), z = log (Y/E), e = log (E/WA) and w = log (WA/N)   (3)

and $\overset{\bullet}{x}$ is the growth rate of the variable x over time i.e. $\overset{\bullet}{x} = \frac{1}{x}\frac{dx}{dt}$.

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[4] The most common approaches to solve this equation are either estimate the employment elasticity of growth and TFP growth via growth regression or to calculate the employment elasticity of growth as the percentage change in employment over the percentage change in GDP, or the partial elasticity of employment with respect to growth. Both the approaches cannot capture the effect of change in labour force due to change in population growth as employment elasticity of growth does not take into account changes in employment rate (E/WA) rather only consider level of employment.

Growth of per capita GDP (PPP) has been decomposed[5] into three factors: growth of output per worker, growth linked to change in employment and growth of working age to total population ratio and further in the study it is tried to find out the sectoral effects (three sectors in the economy are taken - agriculture, industry and service) as well as effect of intersectoral shifts.

In the next section of this study a panel data (1961-2009) of eight countries (BRICS and Japan, UK, and USA) has been constructed to know the effect of selected independent variables on the growth rate of per capita GDP. In cross-country growth studies, the concept of Solow growth model (1956)[6] is largely used. Here it is assumed that the production function is same for all the countries and it is a constant return to scale production function (like Cobb-Douglas Production Function: CDPF).

Cross country growth econometrics is largely based on the so called 'convergence' or 'technology gap' framework (Barro 1991, 1997; Kelly and Schmidt 2005, 2007). The underlying concept is that economic growth is partly dependent on the speed of 'catch-up'. From the concept of steady-state equilibrium as stated in growth theory, a demography oriented elaboration of the convergence frame work (see Barro-Sala-i-Martin 1995) can be stated as: the rate of growth of productivity (here labour productivity $\dot{z}$) depends on how far productivity falls short of its steady-state value. If z_0 is the initial level of output per worker and z* steady-state value then

$$\dot{z} = \lambda (z^* - z_0), \text{ where } \lambda \text{ is the speed of the convergence.} \tag{4}$$

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[5] For Decomposition we have used Shapely Decomposition Approach.

[6] Solow, Robert M. (1956). "A Contribution to the Theory of Economic Growth". *Quarterly Journal of Economics* (The MIT Press) 70 (1): 65–94.

The steady-state level of output per worker depends on many factors like education level, health, capital stock, political stability etc.

Now from previous equation (1) it can be written

$$y_0 = z_0 + e_0 + w_0 \tag{5}$$

Incorporating equation (5) in (4) and using equation (2) the following equation is formed

$$\dot{y} = \lambda\,(z^* + e_0 + w_0 - y_0) + \dot{e} + \dot{w} \tag{6}$$

Now it has been observed in literature for empirical purpose the effect of the labour participation rate is not included and only the effect of the share of working age to total population is included. Moreover, since the available data on labour participation is in 15+ age group and including that in calculation of labour participation rate may give some biased results particularly since the old age labour participation rate (for 65+ population) varies widely in these eight countries in this study it has opted to drop this effect from the regression analysis. Hence the equation becomes

$$\dot{y} = \lambda\,(X^*\beta + w_0 - y_0) + \dot{w} \tag{7}$$

Where X is the range of variables that affect the steady-state level of output. In this study the variables included are Investment to GDP ratio, Average total years of schooling, Life Expectancy at Birth (LEB), and under five mortality rate (U5MR) (as proxies for health variable). Equation (7) is similar in the form to a standard empirical growth regression.

Results

Decomposition of per capita growth of GDP

Decomposition of growth of GDP per capita into growth of labour productivity, employment rate and share of working age to total population is done as shown in equation (2). Table (1) shows the level of this decomposition for all eight countries. The decomposition is done for two periods one for 1991-2000 and another for 2000-2009. But because of data unavailability particularly labour data for some countries this time period selection is slightly different for some countries. Again for South Africa data on employment is not available before 2000 hence it is not possible to compare its growth path for consecutive two decades.

Table 1: Decomposition of Growth in GDP per capita by labour productivity, employment rate and demographic factor (Percent of total change in per capita growth) (1991-2009)					
Country	**Year**	**Growth linked to output per worker**	**Growth linked to changes employment rate**	**Growth linked to changes in the share of population of working Age**	**Total Growth in per capita GDP (value added)**
Brazil	1992-2000	97.84	-19.99	**22.15**	100
	2000-2009	75.50	15.52	**8.98**	100
China	1991-2000	98.75	-0.92	**2.17**	100
	2000-2008	95.90	-2.75	**6.84**	100
India	1994-2000	99.25	-7.97	**8.72**	100
	2000-2010	99.86	-6.88	**7.02**	100
Russian Federation	1991-2000	93.18	35.72	**-28.90**	100
	2000-2009	91.05	4.83	**4.12**	100
South Africa	2000-2009	71.17	19.70	**9.13**	100
Japan	1991-2000	106.15	4.04	**-10.19**	100
	2000-2009	114.28	10.64	**-24.92**	100
UK	1991-2000	94.66	5.17	**0.16**	100
	2000-2009	101.31	-6.83	**5.52**	100
USA	1991-2000	86.45	11.45	**2.10**	100
	2000-2009	128.68	-33.15	**4.47**	100

From table (1) it is seen that growth rate of GDP per capita (in PPP) is mainly linked with faster growth of productivity of the workers. For all countries and both the periods the rate of growth of GDP was more than 90 percent (except Brazil, South Africa in 2000-2009 and USA in 1991-2000). Growth due to change in employment rate fluctuates for countries and

over time. The demographic component i.e. growth of share of worker in population contribute modestly in growth of per capita GDP. The share of this component is higher in BRICS countries (except Russian Federation) compared to that of the developed nations. In case of Russian Federation (1991-2000) and Japan (both the periods) a negative growth rate of the share of working age population captures the demographic phenomena of these two countries which are low fertility and ageing. Growth due to change in participation rate is negative for China and India for both the period indicating higher rate of growth of working age population than job creation. This characteristic is also supported by the recent NSSO report (66th round) for India which has shown considerable decline in employment rate. For UK and USA declining employment rate can be justified with the current economic slowdown and high unemployment rates.

Growth linked to labour productivity

A further look on change in labour productivity gives more insight about the sectoral effects causing growth in per capita GDP. Table (2) shows a movement of workers from agricultural sector to industry and service in BRICS countries. In developed countries the movement is from both agriculture and industry to service sector. Contribution of service sector is highest in growth of labour productivity followed by industry and agriculture which is almost half of

the total labour productivity. Table (3) shows the effect due to intersectoral shift on total labour productivity. It is showing higher values for BRICS nations (particularly for India, China and South Africa) clearly indicating sectoral shift in employment and hence some impact on growth of economy. The changing pattern of employment in BRICS is discussed in the next section.

Table (4) explicitly shows the three sectors contribution to inter sectoral shift in the economy. The changes in per capita output due to intersectoral shift can be further decomposed into

within sector shift. Agricultural sector contributes largely in intersectoral shift effect (as can be seen from Table (4) the shift is largely from agriculture to other sector) implying structural change in the pattern of employment in the economy. In 1994-2000 there is a large share of service sector's contribution in intersectoral shift in case of India justifying the fact that there was an increase in tertiary sector employment rate and total productivity after liberalisation happened (1991).

Growth linked to changes in employment rate

The effect of changes in growth of employment rate on growth of per capita output shows rather mixed pattern. As explained earlier, employment rate indicates overall employment-unemployment scenario in an economy. Table (5) shows overall decrease in employment in agriculture sector for all countries over the last two decades consistent with the fact that as economy develops,the share of agriculture employment in total employment falls because of increasing capital intensive pattern of cultivation. Increase in employment in both industry and service sectors are observed in last one decade for all BRICS countries. But this improvement in secondary and tertiary sector employment failed to offset the decrease in agriculture sector employment leading to overall fall in employment rate in China and India. In other words it can be said that lack of skill formation left workers from agricultural sector unable to find job in either industry or service sectors. From Table (6)contribution of employment changes to overall change in per capita GDP can be observed. Per capita GDP contributed by change in agriculture employment is decreasing over time for all nations. India and China show a negative total contribution to growth rate of per capita GDP due to employment change. It is the extension of the effect of decline in employment rate during 2000-2010. In case of UK and USA the effect of change in employment on per capita GDP growth is the aftermath of global financial crisis leading sharp increase in unemployment and eventually decreases in employment. It can be further observed that though effect of

employment change on per capita GDP growth is negative for all the four countries (India, China, UK and USA) , agriculture contributes a major part in case of China and India whereas industry contributes in case of UK and USA. It may be observed that the pattern of effect in these two groups of countries is significantly different, for the developed countries the negative effect is rather because of the temporary impact of world economic recession whereas in case of the developing countries it addresses structural shift in employment. Once recession is overcome by the developed nations, there are possibility that the change in employment may have positive effects on change in per capita income (assuming it is increasing), but it will be difficult for the developing nations to make the effect positive since it will take some time for skill formation in the workers so that they can be absorbed in the secondary or tertiary sectors.

Effects of Demographic variables on Economic Growth

From the above discussion, it is seen that decomposition approach addresses more structural aspect of an economic growth but very little can be inferred about demographic component measured by share of working age population in total population. Thereafter to understand the effect of the demographic component on growth of per capita GDP , we use Barro panel data regression model.

Results of Barro Panel Data Regression Model

In this study, a panel of countries (eight countries: Five countries of BRICS and three developed economies Japan, UK and USA) is constructed taking yearly data on economic and demographic variables from 1961 to 2009. Data for some variables in case of Russian Federation is not available before 1990 (since it was formed in 1989). Hence a modified panel of same countries with the annual observation of the variables from 1991 to 2009 is constructed.

In view of non-availability of data for entire duration we estimate panel regressions for period 1991-2009 for three separate panels of countries: first taking all the eight countries together, then taking only the BRICS countries and finally taking three Non BRICS i.e. developed countries to find out the effects of different variables on growth rate of GDP per capita.

Following neo-classical economic growth theory, the model taken in the analysis is shown in equation (7). The dependent variable is the growth rate of GDP per capita measured in PPP[7] terms. As shown in the model growth rate of share of working age population to total population is taken as independent variable. Other independent variables included are initial year share of working age population, initial level of per capita GDP and factors that determine steady state equilibrium like Investment to GDP ratio, life expectancy at birth, under five mortality rate (U5MR) and average total years of schooling[8]. Panel data analysis combines time series data with cross-section observation giving " more informative data , more variability, less collinearity among variables, more degrees of freedom and more efficiency."[9] Panel data can be analysed using either fixed[10] or random effect model.[11] To choose between the two models few tests can be done. Here after using Hausman Test it is found for almost all panels fixed effect model is better than random effect model[12]. Only for the panel of BRICS during time period 1961-2009 random effect model is better than fixed

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[7] Purchasing Power Parity (PPP) approach is often used to compare different economy. Though in some literature real income measure is preferred than PPP approach.

[8] Initially analysis has been done using either IMR or under five mortality rate (U5MR) which shows almost similar results. Hence the following discussion is based on analysis using U5MR only.

[9] Baltagi, op. cit., pp 3-6
[10] Fixed effect model controls the impact of time invariant variables.
[11] There are other types of estimation for Dynamic Panel, Simultaneous Model , SURE model etc.
[12] Even in some models it is seen that OLS method is better fit than Random effect model (using BPLM test)

Table 10

Demographic and economic predictors	Model 1 (All countries)[13]	Model 2 (BRICS)[14]	Model 3 (Non BRICS)[15]
Barro Regression Estimates (β coefficients) of panel data of the demographic and economic determinants of growth in per capita of GDP, 1991-2009			
Log initial GDP per capita	-0.0852***	-0.123***	-0.4149***
	0.0225	0.0279	0.0778
Investment to GDP ratio	0.0017*	0.0029**	0.0114***
	0.0009	0.0012	0.0019
Log initial working age over total population	0.4474532**	1.9945***	-0.2044803
	0.2216	0.4288	0.2335
Growth of share of working age population	5.563311***	10.4337***	0.1009
	1.2413	1.9349	1.8704
Life expectancy at Birth	-0.0032	0.0055	0.0168
	0.0029	0.0038	0.0107
Under five mortality rate	-0.0000872	0.0014	-0.0107
	0.0008	0.0011	0.0071
Average of total years of Schooling	0.0337***	-0.0166	0.0276
	0.011	0.0208	0.022
Constant	0.8792***	1.519***	2.4468***
	0.2664	0.4819	0.7631
R squared	0.1159	0.3522	0.0035

*p<0.10, **p<0.05, ***p<0.01

effect model. Hence in the analysis we concentrate on the panel of 1991-2009 for all countries, BRICS countries and Non BRICS [16]countries.

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[13]Brazil, China, India, Japan, Russian Federation, South Africa, UK and USA.
[14]Brazil, China, India, Russian Federation and South Africa.
[15]Japan, UK and USA.

Table (10) presents the panel data regression values of the coefficients of the independent variables.[17] The effect of initial GDP per capita on the growth rate of GDP per capita is negative and highly significant. This supports the convergence theory that poorer countries with low per capita income tend to grow faster. The coefficient value of initial per capita GDP for BRICS is greater than that of all country regression results. This strongly indicates that the speed of convergence to steady state equilibrium income for BRICS is faster than that of the eight countries together.

The effect of investment to GDP ratio is positive and significant as expected. Increase in investment share in GDP will accelerate the growth of the economy. It also supports the theoretical notion that with economic improvement secondary and tertiary sectors flourish. Both life expectancy at birth and under five mortality rate show negative effect in case of eight countries panel regression whereas a positive effect in BRICS regression though they are insignificant. This is not expected as it has been observed that with economic improvement life expectancy increases and under five mortality rate decreases. The results

are as expected in case of Non BRICS countries however they are insignificant from statistical point of view.

Education variable is showing a positive effect on economic growth in the eight country model and it is also highly significant, which was not observed by Bloom and Canning (2010). This supports the prior evidence that schooling improves workers' productivity hence income. Constant term in the fixed effect model captures the effects of those variables which were not included in the model and which do not fluctuate very much over time (e.g.

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[16] The Test result shows fixed effect model better fit than random effect model for non BRICS, but it also showed that OLS is also better fit than random effect model. Results of fixed effect model are used here. OLS model may have been explained the effects of independent variables better.

[17]Figures in bracket are showing the standard error values. From the R^2 value it is observed that for Non BRICS countries the model is unable to describe the fluctuation in per capita GDP due to fluctuation in its determinants.

race, religion etc.). In both the panels, constant term is significant and positive, indicating a positive impact on growth of economy arising from time invariant variables which were not included in the model.[18]

The main interest of the study is how far the demographic component is affecting the growth of economy. Both the effects of initial level of working age population and growth rate of that population is seen highly significant in this study. Both the variables affect growth of an economy positively and effect of growthrate of working age population is very high. In this study, we tried to find out whether the presence of demographic window in most of the BRICS countries is potentially contributing to its economic growth or not. From the regression results, it is evident that the effect (β coefficient) of growth of working age population to population ratio on growth in per capita GDP is more in case of BRICS countries (β=10.43) taken together than overall eight countries (β=5.56)[19]. This indicates the substantial effect of demographic component on economic growth of BRICS countries particularly for China, India and South Africa since they are still going through the demographic dividend phase of transition.

Conclusions

From the analysis the following outcomes have been ascertained

Growth rate of GDP per capita (in PPP) is mainly linked with faster growth of productivity of the workers. Contribution of service sector is highest in growth oflabour productivity followed by industry and agriculture which is almost half of the total labour productivity.

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[18] This variables are specific to the individual, here countries.

[19] The high standard error may be due to the inability of the data (of only two decades 1991-2009) to capture the effect of a larger period.

Increase in employment in both industry and service sectors are seen in last one decade for all BRICS countries. Growth in per capita GDP due to change in participation rate is negative for China and India for both the periods (1991-2000 and 2000-2010).

The effect of initial GDP per capita on the growth rate of GDP per capita is negative and highly significant. The coefficient value for BRICS is greater than that of all country regression result. This strongly indicates that the speed of convergence to steady state equilibrium income for BRICS is faster than that of the eight countries together.

Education variable is showing a significantly positive effect on economic growth for eight country model.The effect of growth of working age population to population ratio on growth in per capita GDP is more in case of BRICS countries (β=10.43) taken together than overall eight countries (β=5.56).

Now the question is how far this effect of demographic dividend can be realised largely depends on efficiency of the skill formation factor of these working age population. As seen in the decomposition analysis labour productivity is contributing a major part in growth rate of per capita GDP and also there are significant evidences of sectoral change in economy mainly from agriculture to industry and services. Increase in labour productivity is also necessary in secondary and tertiary sectors and this requires skill formation. Overall, it can be stated that growth of GDP in BRICS is determined by demographics as well as sectoral factors. The ultimate effect will largely depend on the labour force skill formation capacity of these nations.

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Appendices

Table 2: Sectoral share of employment (in %)				
Country	Year	Agriculture	Industry	Service
Brazil	1992	28.3	20.4	51.4
	2000	18.5	21.2	59.1
	2009	17.0	22.1	60.7
China	1991	59.7	21.4	18.9
	2000	50.0	22.5	27.5
	2008	39.6	27.2	33.2
India	1994	61.9	15.7	22.4
	2000	59.8	16.1	24.1
	2010	51.1	22.4	26.5
Russia	1991	14.2	39.8	45.7
	2000	14.5	28.4	57.1
	2009	9.7	27.9	62.3
S. Africa	2000	15.6	24.2	59.4
	2009	5.1	25.0	69.8
Japan	1991	6.7	34.4	58.4
	2000	5.1	31.2	63.1
	2009	3.9	25.9	69.0
UK	1991	2.2	30.0	65.7
	2000	1.5	21.9	73.1
	2009	1.1	19.5	78.7
USA	1991	2.9	25.5	71.6
	2000	2.6	23.2	74.3
	2009	1.5	17.1	80.9

Table 3: Contribution of within Sector Changes in Output per Worker and Inter-sectoral Shifts to Change in GDP per capita						
Percent of total change in GDP per capita						
Country	Year	Agriculture	Industry	Service	Inter-sectoral shift	Total output per worker
Brazil	1992-2000	8.9	-14.6	73.4	30.2	**97.8**
	2000-2009	7.0	12.1	52.8	3.5	**75.5**
China	1991-2000	12.7	45.4	27.4	13.2	**98.8**
	2000-2008	10.8	36.9	33.6	14.5	**95.9**
India	1994-2000	13.6	22.7	53.7	9.3	**99.2**
	2000-2010	19.7	15.7	51.6	12.9	**99.9**
Russian Federation	1991-2000	67.7	4.8	-9.8	30.3	**93.2**
	2000-2009	5.6	28.8	54.2	2.4	**91.0**
South Africa	2000-2009	12.6	19.4	24.4	14.8	**71.2**
Japan	1991-2000	2.2	24.8	75.3	3.9	**106.2**
	2000-2009	2.1	31.8	76.5	3.8	**114.3**
UK	1991-2000	0.8	32.1	62.4	-0.6	**94.7**
	2000-2009	0.8	24.2	77.8	-1.5	**101.3**
USA	1991-2000	0.0	19.5	66.7	0.2	**86.4**
	2000-2009	3.3	40.1	86.2	-0.9	**128.7**

Table 4: Decomposition of contribution of Inter-sectoral Shifts to change in GDP per capita

Country	Year	Sectoral contributions	Contribution to Inter-sectoral Shifts (%)			Total Contribution of inter-sectoral shifts
			Agriculture	Industry	Service	
Brazil	1992-2000	Direction of shift	-	+	+	
		Share (%)	83.87	7.39	8.74	100
	2000-2009	Direction of shift	-	+	+	
		Share (%)	80.96	10.31	8.73	100
China	1991-2000	Direction of shift	-	+	+	
		Share (%)	53.76	9.27	36.98	100
	2000-2008	Direction of shift	-	+	+	
		Share (%)	57.09	29.67	13.24	100
India	1994-2000	Direction of shift	-	+	+	
		Share (%)	37.25	8.06	54.69	100
	2000-2010	Direction of shift	-	+	+	
		Share (%)	54.38	19.75	25.87	100
Russian Federation	1991-2000	Direction of shift	+	-	+	
		Share (%)	1.58	71.12	27.30	100
	2000-2009	Direction of shift	-	-	+	
		Share (%)	108.53	-4.93	-3.61	100
South Africa	2000-2009	Direction of shift	-	+	+	
		Share (%)	97.02	2.76	0.22	100
Japan	1991-2000	Direction of shift	-	-	+	
		Share (%)	114.35	-25.41	11.07	100
	2000-2009	Direction of shift	-	-	+	
		Share (%)	90.10	-14.64	24.54	100
UK	1991-2000	Direction of shift	-	-	+	
		Share (%)	-78.35	140.07	38.28	100
	2000-2009	Direction of shift	-	-	+	
		Share (%)	-32.56	107.34	25.22	100
USA	1991-2000	Direction of shift	-	-	+	
		Share (%)	140.06	-60.92	20.86	100
	2000-2009	Direction of shift	-	-	+	
		Share (%)	-189.28	257.45	31.84	100

Table 5: Contribution of employment changes to overall change in employment rate

Contribution to change in total employment rate (percent points)

Country	Year	Agriculture	Industry	Service	Total employment rate
Brazil	1992-2000	-7.35	-0.03	3.73	**-3.64**
	2000-2009	-0.41	1.38	3.21	**4.19**
China	1991-2000	-8.29	0.75	6.86	**-0.68**
	2000-2008	-9.23	3.28	3.97	**-1.98**
India	1994-2000	-2.35	-0.03	0.65	**-1.74**
	2000-2010	-6.90	3.13	0.63	**-3.15**
Russian Federation	1991-2000	-0.30	-8.75	5.77	**-3.28**
	2000-2009	-2.80	0.54	5.30	**3.04**
South Africa	2000-2009	-4.10	1.12	6.44	**3.47**
Japan	1991-2000	-1.14	-2.11	3.95	**0.70**
	2000-2009	-0.80	-3.36	5.94	**1.77**
UK	1991-2000	-0.48	-4.00	6.12	**1.64**
	2000-2009	-0.30	-4.27	3.22	**-1.36**
USA	1991-2000	-0.13	-0.89	4.40	**3.38**
	2000-2009	-0.92	-5.61	0.22	**-6.31**

Table 6: Contribution of employment changes to overall change in per capita GDP

Percent of total change in per capita GDP

Country	Year	Agriculture	Industry	Service	Total contribution
Brazil	1992-2000	-40.3	-0.2	20.5	**-20.0**
	2000-2009	-1.5	5.1	11.9	**15.5**
China	1991-2000	-11.2	1.0	9.2	**-0.9**
	2000-2008	-12.8	4.5	5.5	**-2.7**
India	1994-2000	-10.8	-0.1	3.0	**-8.0**
	2000-2010	-15.1	6.8	1.4	**-6.9**
Russian Federation	1991-2000	3.3	95.3	-62.8	**35.7**
	2000-2009	-4.4	0.9	8.4	**4.8**
South Africa	2000-2009	-23.3	6.4	36.6	**19.7**
Japan	1991-2000	-6.5	-12.1	22.6	**4.0**
	2000-2009	-4.8	-20.2	35.6	**10.6**
UK	1991-2000	-1.5	-12.6	19.3	**5.2**
	2000-2009	-1.5	-21.5	16.2	**-6.8**
USA	1991-2000	-0.4	-3.0	14.9	**11.5**
	2000-2009	-4.8	-29.5	1.1	**-33.2**

Country	Year	GDP (in 1000000's)	Total population	Total population of working age	Total number of employed	GDP per capita	Output per worker	Employment rate	Share of population of working age
Table 7 : Employment, Output, Productivity and Population (% change)									
Brazil	1992-2000	47.8	12.8	19.8	13.5	31.01	30.23	-5.22	3.75
	2000-2009	64.9	10.8	14.8	22.1	48.87	35.12	6.33	2.35
China	1991-2000	193.0	9.7	11.9	11.0	167.04	164.02	-0.83	1.32
	2000-2008	175.3	4.9	11.6	8.9	162.38	152.79	-2.44	4.31
India	1994-2000	59.2	11.4	14.9	11.7	42.98	42.59	-2.78	1.86
	2000-2010	163.3	16.2	22.7	16.4	126.60	126.27	-5.18	3.43
Russian Federation	1991-2000	-14.3	-1.6	2.5	-2.5	-12.96	-12.13	-4.83	2.72
	2000-2009	168.0	-3.0	0.8	5.6	176.44	153.85	4.71	2.78
South Africa	2000-2009	70.9	12.1	16.5	26.5	52.50	35.13	8.62	2.44
Japan	1991-2000	30.0	2.4	-0.1	0.9	26.93	28.79	0.96	-1.67
	2000-2009	25.8	0.5	-4.9	-2.6	25.10	29.13	2.40	-3.68
UK	1991-2000	60.8	2.6	2.6	5.0	56.81	53.14	2.32	0.05
	2000-2009	38.8	5.0	6.6	4.6	32.23	32.71	-1.88	1.01
USA	1991-2000	66.9	11.5	12.5	17.7	49.65	41.76	4.68	0.55
	2000-2009	41.9	8.7	10.0	0.8	30.53	40.76	-8.36	0.79

Country	Year	Agriculture	Industry	Service	Total output per worker
Brazil	1992-2000	42.71	-11.37	39.10	30.23
	2000-2009	61.25	20.00	36.55	35.12
China	1991-2000	93.60	175.91	110.19	164.02
	2000-2008	127.40	116.08	124.43	152.79
India	1994-2000	20.85	35.87	49.68	42.59
	2000-2010	115.21	63.24	123.22	126.27
Russian Federation	1991-2000	-61.15	-1.55	2.97	-12.13
	2000-2009	175.88	129.32	157.46	153.85
South Africa	2000-2009	286.81	29.71	17.09	35.13
Japan	1991-2000	29.50	18.08	33.40	28.79
	2000-2009	34.52	27.28	28.22	29.13
UK	1991-2000	29.23	62.26	50.34	53.14
	2000-2009	31.20	32.13	33.68	32.71
USA	1991-2000	-0.51	36.94	44.33	41.76
	2000-2009	110.01	62.18	34.60	40.76

Table 8: Changes in Output per Worker by Sectors (% change)

Table 9 : Employment by Sectors of Economic Activity						
Country	Year	% change in	Agriculture	Industry	Service	Total
Brazil	1992-2000	E*	-24.82	19.51	32.23	13.51
		E/WA**	-37.22	-0.20	10.42	**-5.22**
	2000-2009	E	11.04	25.97	24.11	22.06
		E/WA	-3.27	9.73	8.12	**6.33**
China	1991-2000	E	-7.05	16.68	61.48	10.91
		E/WA	-16.95	4.26	44.29	**-0.83**
	2000-2008	E	-13.76	31.64	31.46	8.89
		E/WA	-22.73	17.94	17.78	**-2.44**
India	1994-2000	E	7.88	14.51	20.14	11.67
		E/WA	-6.08	-0.30	4.60	**-2.78**
	2000-2010	E	-0.56	61.90	27.95	16.37
		E/WA	-18.97	31.93	4.26	**-5.81**
Russian Federation	1991-2000	E	-0.73	-30.63	21.47	-2.49
		E/WA	-3.11	-32.30	18.55	**-4.83**
	2000-2009	E	-29.30	3.83	15.32	5.58
		E/WA	-29.88	2.97	14.36	**4.71**
South Africa	2000-2009	E	-58.93	29.77	47.61	26.5
		E/WA	-64.74	11.43	26.74	**8.62**
Japan	1991-2000	E	-23.12	-8.40	9.13	0.90
		E/WA	-23.07	-8.34	9.20	**0.96**
	2000-2009	E	-25.06	-18.65	7.16	-2.60
		E/WA	-21.22	-14.48	12.65	**2.40**
UK	1991-2000	E	-28.90	-15.84	16.02	5.10
		E/WA	-30.73	-18.00	13.05	**2.32**
	2000-2009	E	-23.00	-18.43	13.04	4.58
		E/WA	-27.75	-23.46	6.07	**-1.88**
USA	1991-2000	E	5.46	7.01	22.06	17.74
		E/WA	-6.24	-4.85	8.52	**4.68**
	2000-2009	E	-41.48	-25.24	10.44	0.82
		E/WA	-46.81	-32.05	0.39	**-8.36**

*E= Total Employment

**E/WA= Total Employment/ Population of Working Age

Growth Decomposition: Brazil

Table 10a: Percent Contribution to Total Growth in GDP (value added) per capita, Brazil 1992-2000

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	8.87	-40.32	25.33	-6.12
Industry	-14.61	-0.16	2.23	-12.54
Service	73.38	20.49	2.64	96.51
Subtotals	*67.64*	*-19.99*	*30.20*	*77.85*
Demographic component	-	-		22.15
Total				100.00
Total % change in value added per capita 1992-2000				**31.01**

Table 10b: Percent Contribution to Total Growth in GDP (value added) per capita, Brazil 2000-2009

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	7.04	-1.50	2.85	8.39
Industry	12.11	5.12	0.36	17.60
Service	52.82	11.90	0.31	65.02
Subtotals	*71.97*	*15.52*	*3.52*	*91.02*
Demographic component	-	-		8.98
Total				100.00
Total % change in value added per capita 2000-2009				**48.87**

Growth Decomposition: China

Table 11a: Percent Contribution to Total Growth in GDP (value added) per capita, China 1991-2000

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	12.70	-11.15	7.11	8.66
Industry	45.40	1.01	1.23	47.63
Service	27.43	9.23	4.89	41.55
Subtotals	*85.53*	*-0.92*	*13.22*	*97.83*
Demographic component	-	-		2.17
Total				100.00
Total % change in value added per capita 1991-2000				**167.04**

Table 11b: Percent Contribution to Total Growth in GDP (value added) per capita, China 2000-2008

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	10.79	-12.80	8.30	6.29
Industry	36.95	4.54	4.31	45.80
Service	33.63	5.51	1.92	41.06
Subtotals	*81.37*	*-2.75*	*14.53*	*93.16*
Demographic component	-	-		6.84
Total				100.00
Total % change in value added per capita 2000-2008				**162.38**

Growth Decomposition: India

Table 12a: Percent Contribution to Total Growth in GDP (value added) per capita, India 1994-2000

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	13.62	-10.79	3.45	6.28
Industry	22.69	-0.14	0.75	23.30
Service	53.68	2.96	5.06	61.70
Subtotals	*90.00*	*-7.97*	*9.25*	*91.28*
Demographic component	-	-		8.72
Total				100.00
Total % change in value added per capita 1994-2000				**42.98**

Table 12b: Percent Contribution to Total Growth in GDP (value added) per capita, India 2000-2010

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	19.73	-15.08	6.99	11.64
Industry	15.66	6.83	2.54	25.03
Service	51.62	1.37	3.33	56.31
Subtotals	*87.01*	*-6.88*	*12.85*	*92.98*
Demographic component	-	-		7.02
Total				100.00
Total % change in value added per capita 2000-2010				**126.60**

Growth Decomposition: Russian Federation

Table 13a: Percent Contribution to Total Growth in GDP (value added) per capita, Russian Federation 1991-2000

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	67.74	3.28	0.48	71.50
Industry	4.85	95.29	21.58	121.72
Service	-9.75	-62.85	8.28	-64.32
Subtotals	*62.84*	*35.72*	*30.35*	*128.90*
Demographic component	-	-		-28.90
Total				100.00
Total % change in value added per capita 1991-2000				**-12.96**

Table 13b: Percent Contribution to Total Growth in GDP (value added) per capita, Russian Federation 2000-2009

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	5.59	-4.44	2.65	3.80
Industry	28.80	0.86	-0.12	29.54
Service	54.22	8.41	-0.09	62.54
Subtotals	*88.61*	*4.83*	*2.44*	*95.88*
Demographic component	-	-		4.12
Total				100.00
Total % change in value added per capita 2000-2009				**176.44**

Table 14:Percent Contribution to Total Growth in GDP (value added) per capita, South Africa 2000-2009

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	12.60	-23.26	14.39	3.73
Industry	19.38	6.37	0.41	26.16
Service	24.36	36.59	0.03	60.98
Subtotals	*56.34*	*19.70*	*14.83*	*90.87*
Demographic component	-	-		9.13
Total				100.00
Total % change in value added per capita 2000-2009				**52.50**

Table 15a: Percent Contribution to Total Growth in GDP (value added) per capita, Japan 1991-2000

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	2.21	-6.52	4.43	0.13
Industry	24.75	-12.09	-0.99	11.67
Service	75.31	22.65	0.43	98.38
Subtotals	*102.27*	*4.04*	*3.88*	*110.19*
Demographic component	-	-		-10.19
Total				100.00
Total % change in value added per capita 1991-2000				**26.93**

Table 15b: Percent Contribution to Total Growth in GDP (value added) per capita, Japan 2000-2009

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	2.12	-4.83	3.44	0.73
Industry	31.82	-20.16	-0.56	11.10
Service	76.52	35.63	0.94	113.09
Subtotals	*110.46*	*10.64*	*3.82*	*124.92*
Demographic component	-	-		-24.92
Total				100.00
Total % change in value added per capita 2000-2009				**25.10**

Growth Decomposition: United Kingdom (UK)

Table 16a: Percent Contribution to Total Growth in GDP (value added) per capita, UK 1991-2000

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	0.75	-1.52	0.48	-0.29
Industry	32.13	-12.60	-0.86	18.67
Service	62.39	19.30	-0.23	81.45
Subtotals	*95.27*	*5.17*	*-0.61*	*99.84*
Demographic component	-	-		0.16
Total				100.00
Total % change in value added per capita 1991-2000				**56.81**

Table 16b: Percent Contribution to Total Growth in GDP (value added) per capita, UK 2000-2009

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	0.83	-1.52	0.50	-0.19
Industry	24.19	-21.49	-1.64	1.06
Service	77.82	16.19	-0.39	93.62
Subtotals	*102.84*	*-6.83*	*-1.53*	*94.48*
Demographic component	-	-		5.52
Total				100.00
Total % change in value added per capita 2000-2009				**32.23**

Growth Decomposition: United States of America (USA)

Table 17a: Percent Contribution to Total Growth in GDP (value added) per capita, USA 1991-2000

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	-0.02	-0.44	0.35	-0.11
Industry	19.48	-3.03	-0.15	16.31
Service	66.73	14.92	0.05	81.70
Subtotals	*86.20*	*11.45*	*0.25*	*97.90*
Demographic component	-	-		2.10
Total				100.00
Total % change in value added per capita 1991-2000				**49.65**

Table 17b: Percent Contribution to Total Growth in GDP (value added) per capita, USA 2000-2009

	Contribution of within sector changes in output per worker (%)	Contribution of changes in Employment (%)	Contributions of Inter-sectoral Shifts (%)	Total (%)
Sectoral contributions				
Agriculture	3.27	-4.82	1.70	0.14
Industry	40.06	-29.47	-2.31	8.29
Service	86.25	1.14	-0.29	87.10
Subtotals	*129.58*	*-33.15*	*-0.90*	*95.53*
Demographic component	-	-		4.47
Total				100.00
Total % change in value added per capita 2000-2009				**30.53**