A PANEL DATA ANALYSIS OF FERTILITY AND MORTALITY EFFECTS ON ECONOMIC GROWTH AND DEVELOPMENT IN WEST AFRICA[1]

By

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Abstract

In recent times, there appears to have been resurgence in researches investigating effects of population dynamics on economic outcomes in different regions of the world. This has further been inspired by the performances of some Asian economies where demographic transition (declining fertility and mortality) has been observed to play prominent role. Most African countries are beginning to experience declining fertility and mortality trends than what obtained in the 50s and 60s, which is expected enhance economic outcomes. It is against this backdrop that this study examined the impact of declining fertility and mortality on economic growth and development in West Africa over the period 1970 to 2011. It employed panel data technique for the analysis, using the ordinary least squares (OLS), fixed and random effects estimators. The results show that the demographic transition is beginning to yield positive and significant effect on growth in the region, while some negative effect through mortality remains. To maximise the gains from the demographic transition, study recommends among other thing increase investment in education and training of the younger population to enhance their productivity.

JEL Classification: J11, J13, O11, O47

Key words: fertility, mortality, demographic transition, economic growth, economic development, panel data, West Africa.

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1. Introduction

Population dynamics and their implications for economic outcomes have been an age long debate. Studies on population changes have continued to draw the attention of researchers, particularly in the field of demography, economics, development practitioners and policy makers since the era of classical economists such as Thomas Malthus who postulated that any upsurge in population that out-passes means of subsistence would not only produce adverse effect on economic outcomes but could be detrimental to human survival. Although, Malthusian theory appears to have been refuted by technological advancement, other factors and empirical findings; nonetheless, the very fact that nations of the world continue to adopt population policies are pointers to Malthusian postulates having certain influences. Moreover, this theory set the pace for any formal and academic discourse of population issues as they relate to economic prosperity. Ehrlich & Kim (2005, p. 790) reiterated that Malthusian postulate "was the first systematic attempt to offer a complete model of economic growth based on micro foundations" with its focus on "essential behavioural factors contributing to dynamic equilibrium: fertility, mortality, and the production side of the economy." However, the emergence of demographic transition, which has to do with fertility[3] and mortality declines, has re-shaped the focus of this discussion with a wide range of attention and more empirical studies directed at how critical this process has been for economic transformation. Particularly as the population boom associated with the post-Malthusian era gradually disappeared in all regions of the world, with consistent declines in fertility, mortality and population growth (Galor, 2012).

In recent times, there has been resurgence in researches investigating effects of population dynamics on economic outcomes in different regions of the world, which has further been invigorated by the performances of some Asian economies where demographic transition has been observed to play prominent role (see Williamson, 1998; Bloom, Canning & Malaney, 2000; Bloom & Finlay, 2009; and Wei & Hao, 2010).[4] Both theoretical and empirical

[3]Total Fertility rate in a particular year according to OECD (2013, p. 16) is the total number of children that would be born to each woman if she were to live to the end of her child-bearing years and give birth to children in agreement with the prevailing age-specific fertility rates. The Central Intelligence Agency (CIA), (2013) maintains that this measure is better than crude birth rate because it determines fertility level directly, which also indicates "potential for population change." According to the agency, replacement rate, which stabilizes the population, is given as two children per woman while any rate below this will eventually lead to decrease in population size and therefore could make the population to grow older.

[4]Williamson (1998) acknowledges demographic transition as the major contributor to the growth miracle experienced by the East Asian countries. According to him, of the total 6.1 per cent annual output per capita

literature allude to the fact that prior to demographic transition, population variables and economic outcomes related either negatively or showed insignificant effect; however, period after the take-off stage revealed positive and significant association between both variables. The 19th century has been identified as when most developed economies began to experience demographic transition, which continues till mid-20th century when they reached advanced stages while on the other hand, developing nations, particularly those in Latin America, the Caribbean, Asia, and North Africa saw their transition occur in the 20th century (United Nations, Department of Economic and Social Affairs, Population Division, 2012). Since these periods economic performances in the affected countries have witnessed substantial and tremendous improvement, with positive effects on life expectancy and other aspects of the society.

The paradigm is that low fertility and declining mortality are expected to bring about reduction in the number of children contributing to dependency ratio and thereby increase the labour force, with the impact of increased productivity level, followed by a rise in output per capita thereby leading to improved economic growth and development. This trend has been witnessed in European economies and recently in East Asia, and it is assumed that the same scenario should operate in other parts of the world already experiencing declines in these demographic variables. In a cross-country study by Kelley & Schmidt (2005), which covers 1960 to 1995, it was discovered that 20 per cent of growth in income per capita could be ascribed to demographic change with Asia and Europe accounting for the larger share. Also, Lee & Mason (2010, p. 159) developed a simple fertility and human capital model to link economic growth and reported that "low fertility leads to higher per capita consumption through human capital accumulation." According to Galor (2012, p. 1), "demographic transition has enabled economies to convert a larger portion of the gains from factor accumulation and technological progress into growth of income per capita."

It is apparent that most developing countries are witnessing declines in fertility and mortality trends than what obtained in the 50s and 60s, which has led to improvement recorded in average life expectancy in the continent. However, to ascertain whether such improvement has translated into better economic performance and development remains an empirical inquiry that must be confronted with statistics. It is against this backdrop that the present

growth experienced by this sub-region between 1970 and 1995, demographic transition accounted for approximately 1.5 per cent to 2 per cent.

study seeks to determine how far declining fertility and mortality have imparted growth and development in West Africa.

The choice of West Africa is informed by the following facts: firstly, it is observed that West Africa is already witnessing some form of declining trends in fertility and mortality, which suggests that the sub-region has begun demographic transition. Although, the trends do not equate to full transitions witnessed in the European and East Asian regions; however, the current transition may have some positive influence on economic outcomes in the entire sub-region. Ouedraogo (2009) notes that West Africa has already begun its demographic transition, with countries such as Niger, Guinea Bissau, Mali, Liberia and Sierra Leone being in the second stage of the transition while others have already reached the third stage. Secondly, while much emphasis has been placed on other determinants of growth and development in the sub-region, less attention seems to focus on the impact of demographic variables. This is consistent with the assertion of Bloom, Canning & Malaney (1999) that the literature appears to have paid shallow attention to how demographic factors affect economic growth. Furthermore, works along this line is scarce in West Africa. To this end, the present paper employs panel data econometric analysis to investigate how declining fertility and mortality affects economic prosperity in West Africa.

The rest of the paper is structured thus: section two provides stylized facts on growth performance as well as mortality and fertility trends in West Africa. Section three focuses on brief review of related literature, section four highlights theoretical framework and methodology; section five presents empirical results and discussion while section six shows summary, conclusion and policy recommendations.

2. Background Issues

West Africa, a sub-region in the Sub-Saharan Africa, comprises sixteen countries, of which about 50% are Francophone; more than 30%, Anglophone and the remaining have other languages such as Portuguese spoken in Guinea-Bissau and Cape Verde, and Arabic in Mauritania (see Ocrisse-Aka & Bossard, 2009; Ethnologue and Nations Online Project). Nigeria alone accounts for more than 50% of the population of the entire sub-region (see figure 2), with the remaining shared among other fifteen countries.[5] Statistics provided by the

[5]According to Ouedraogo (2009, p. 33), West Africa consists of 39% of the population of sub-Saharan Africa, with Nigeria alone being home to about 50% of the sub-region's population and "the greatest demographic power in Africa and the eighth in the world, with an estimated population of 148 million in 2007."

World Bank (2013) World Development Indicators revealed that Nigeria, whose population was approximately 140 million in 2005 has risen to about 162 million in 2011 while that of Ghana increased from roughly 22 million in 2005 to around 25 million in 2011. Senegal also had her population surged from nearly 11 million in 2005 to 13 million in 2011. Cape Verde, which is the smallest country in the sub-region, was in the neighbourhood of 473 thousand people in 2005 and by 2011, her population rose marginally to approximately 501 thousand. The population of the entire West African sub-region, which was around 86 million in 1960, had increased significantly to 312 million in 2011. Figure 1 below shows the size of the sub-region from 1960 to 2011.

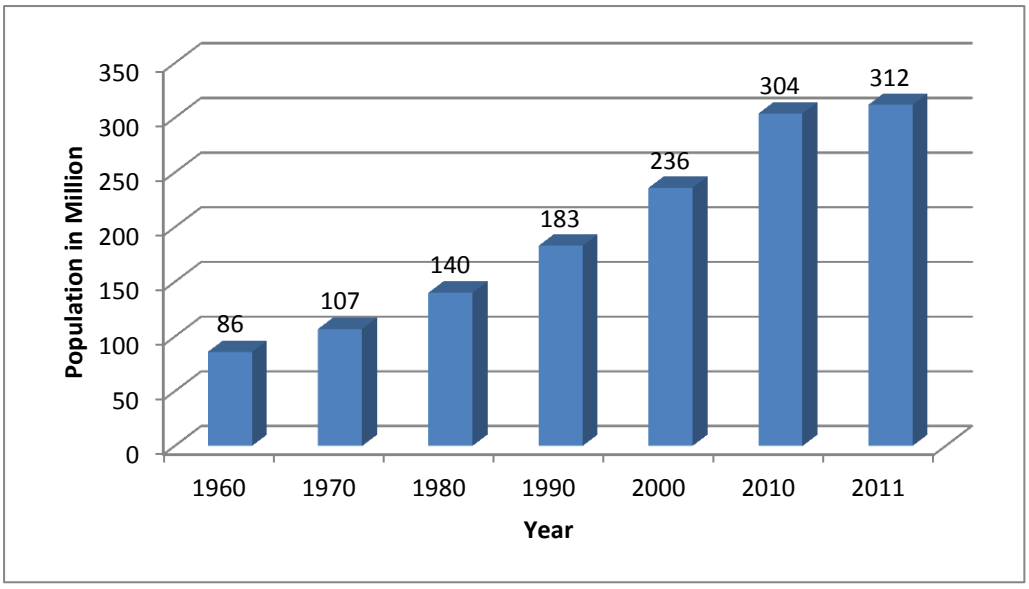

Figure 1: Estimated Population of West African Countries, 1960-2011.

Source: Generated by the Authors from World Bank (2013) World Development Indicators

From Figure 1, it is obvious that the sub-region has witnessed a considerable expansion in its size between 1960 and 2011. The figure, which was below 100 million in 1960 rose above 180 million in 1990, reached 236 million and 312 million in 2000 and 2010 respectively. Her population is predicted to rise beyond 400 million by 2020 and then passes 500 million people between 2030 and 2035, with its annual growth rate estimated as 2.6% for the period 2000-2005, which is expected to decline to 1.2% for the period 2045-2050 (Ouedraogo, 2009). The growth rate however, varies from as high as 3.5% in Niger to as low as 0.9% in Cape Verde (World Bank, 2013). The size of Nigeria alone in 2011 was 162.47 million, the remaining 15 countries of the sub-region shared 149.73 million people. This implies that, the country is the major market in West Africa (WDI, 2013).

Growth Performance in West Africa

Among the five different sub-regions in Africa, West Africa seems to be making head way in terms of growth performance, although this may not be unconnected with Nigeria, the largest country in the sub-region whose economy is largely dominated by oil and gas exportation.

Table 1: Growth Rate of Real Gross Domestic Product for Regions in Africa, 2000-2011

Sub-Region/ Year	2000-2009 (Average)	2009	2010	2011
East Africa	6.6	5.8	7.1	6.0
Central Africa	4.9	1.9	5.7	5.1
North Africa	4.5	3.8	4.1	0.5
Southern Africa	4.7	-1.1	3.5	3.5
West Africa	6.7	3.0	6.9	6.3
Africa	5.2	2.5	5.0	3.4

Source: Africa Statistical Yearbook, 2010, 2011 & 2012

Table 1 presents growth rates of GDP for the five sub-regions in Africa. From the table, the average growth (6.7%) recorded by West Africa for the period 2000-2009 was the highest in the continent. This was followed by East Africa with 6.6% growth performance while the least occurred in North Africa, put at 4.5%. In 2009 and 2010, the best performing sub-region was East Africa, which posted 5.8% and 7.1% growth rates respectively while North and West Africa came second in 2009 and 2010 in that order. In 2011, West Africa had the highest growth rate of 6.3% followed by East Africa. The least performing region has been Southern Africa, whose corresponding growth rates in 2009, 2010 and 2011 stood at -1.1%, 3.5% and 3.5%.

Although, economic performance of West Africa seems to be one of the best in Africa, however, individual country performance differs. Table 2 below shows country level real GDP growth rate from 1961 to 2011.

Table 2: GDP Growth (%) for Individual West African Countries, 1981-2011

Country	1961	1971	1981	1991	2001	2011
Benin	3.14	-1.50	9.95	4.23	6.25	3.53
Burkina Faso	4.04	1.41	4.26	9.07	6.59	4.21
Cape Verde	NA	NA	8.45	1.4	6.14	5.05
Cote d'Ivoire	9.93	9.46	3.50	0.04	-0.02	-4.73
Gambia, The	NA	-0.07	3.32	3.11	5.80	-4.30

Ghana	3.43	5.22	-3.50	5.28	4.00	14.39
Guinea	NA	NA	NA	2.610	3.66	3.91
Guinea-Bissau	NA	-3.91	18.17	5.10	7.22	5.70
Liberia	2.44	4.91	-2.14	-14.23	22.10	9.45
Mali	NA	2.57	-4.41	1.62	12.10	2.70
Mauritania	15.53	1.84	3.45	1.79	2.01	3.95
Niger	4.55	5.68	0.61	2.50	7.10	2.30
Nigeria	0.19	14.24	-13.13	4.76	3.10	7.36
Senegal	2.99	-0.14	5.07	2.56	4.58	2.63
Sierra Leone	1.81	3.47	2.88	2.35	-7.14	6.01
Togo	12.17	0.00	-3.32	-0.70	-1.63	4.87

Source: World Bank (2013) World Development Indicators

From the table, Mauritania and Togo had double digits growth rates of 15.5% and 12.2% respectively in 1961 while the least performed country was Nigeria with a 0.19%. In 1971, Benin, Gambia, Guinea-Bissau, Senegal and Togo recorded very glooming growths. Asides Togo, whose growth rate was 0%, others had negative figure, with the worst experienced by Guinea-Bissau, recording -3.91%. Nigeria and Cote d'Ivoire had bright performances, which are evident in their growth rates of 14.2% and 9.46% in that order. The remaining countries had theirs below 5%. In 1981, countries such as Guinea-Bissau, Benin and Cape Verde show remarkable performances with real GDP growth rates of 18.2%, 9.95% and 8.45% respectively. Nigeria, Mali, Ghana, Togo and Liberia performed poorly, posting negative figures of -13%, -4.4%, -3.5%, -3.3% and -2.2% correspondingly. In 1991 and 2001, Togo continued with negative performances, likewise Liberia in 1991 as well as Sierra Leone and Cote d'Ivoire in 2001. The performance in 2011 seemed exciting in few countries. For instance, Ghana, Liberia, Nigeria and Sierra Leone posted significant positive growths of 14.4%, 9.45%, 7.36%, 6.01% respectively while two countries, Cote d'Ivoire and Gambia recorded negative performances of -4.7% and -4.3% in that order.

Demographic Transition in West Africa

West Africa has been observed as one of the last regions globally to have begun demographic transition, with a good number of its countries being at the latter part of the second stage (Ouedraogo, 2009) while none in the entire Sub-Saharan Africa is yet to complete the transition going by available statistics of demographic variables. Figure 4 below classifies countries in West Africa according to their stages of demographic transition.

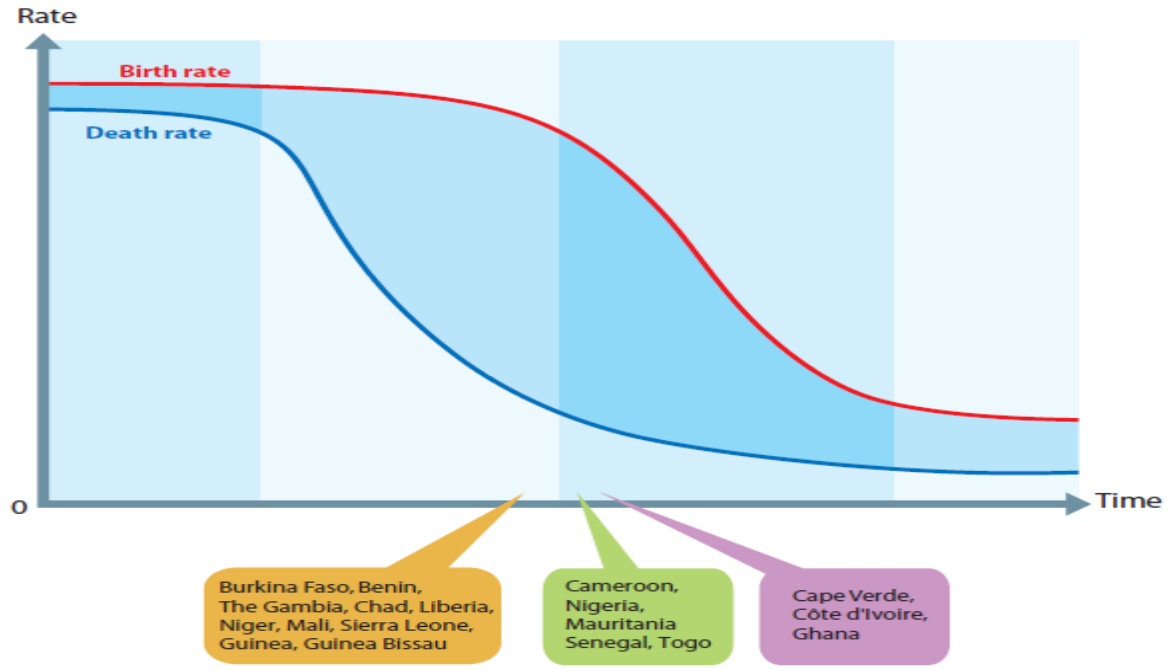

Figure 3: Demographic Transition: Three Groups of West African Countries.
Source: Ouedraogo, D. (2009). Demographic trends. In Bossard, L. (ed), *Regional Atlas on West Africa*. *ECOWAS*[6]*-SWAC*[7]*/OECD*[8].

As presented above, nine countries in West Africa (Benin, Burkina Faso, The Gambia, Guinea, Guinea Bissau, Liberia, Mali, Niger and Sierra Leone) are in the concluding part of the second stage of the transition. At this stage, mortality rates take declining trend while birth rate still remains high, thereby encouraging growth in population. However, as evident in the diagram, the nine countries are already at the tail end of the second stage where birth rate is not as high as it was at the beginning or middle of the stage. Seven countries, Nigeria, Mauritania, Senegal, Togo, Cape Verde, Cote d'Ivoire and Ghana have entered the third stage where both death and birth rates are decreasing, bringing about a declining population growth.

In the literature different criteria are used to determine when a particular country has reached the stage of demographic transition. Demographic transition is observed to occur when a society transforms from a period of high mortality and high fertility associated with the pre-modern world to low mortality followed by low fertility currently being experienced in most countries of the world (Caldwell, 1976; Kirk, 1996, and Wei & Hao, 2010). This implies that declining mortality and fertility are important determinants of this transition. In addition to this, other specific criteria for measuring this transition are available in the literature.

[6]Economic Community of West African States.
[7]Sahel and West Africa Club.
[8]Organization for Economic Co-operation and Development.

Chesnais (1992, p. 19) as cited in Cervellati & Sunde (2011, p. 107) discussed three important benchmarks that should be considered when determining whether a country has entered the period of demographic transition; these include: i) average life expectancy being above 50 years; ii) either fertility or crude birth rate continues to maintain steady decline; and iii) "the crude birth rate has fallen below the threshold of 30/1000."

Using some of the above criteria, it could be concluded that a good number of West African countries are in the stage of demographic transition. However, such stages vary from country to country. Some of the criteria are considered below. Table 3 presents some of the demographic data for West African countries.

Table 3: Demographic patterns in West Africa, 1960-2011

	Life Expectancies			Crude Death Rate			Fertility Rate			Infant Mortality Rate		
Country	**1960**	**1990**	**2011**	**1960**	**1990**	**2011**	**1960**	**1990**	**2011**	**1960**	**1990**	**2011**
Benin	36	49	56	30.61	17.36	11.51	6.28	6.74	5.21	183.7	106.8	67.9
Burkina Faso	36	48	55	27.45	16.78	11.62	6.29	6.84	5.81	157.9	104.8	81.6
Cape Verde	49	65	74	20.01	8.52	5.36	6.89	5.31	2.34	NA	45	18.2
Cote d'Ivoire	40	53	55	23.7	13.41	11.74	7.35	6.26	4.35	217.6	104	81.2
Gambia, The	34	53	58	30.21	13.25	9.04	5.57	6.09	4.81	153.3	78.1	57.6
Ghana	46	57	64	18.56	11.17	7.69	6.75	5.62	4.1	127.4	76.2	51.8
Guinea	32	44	54	32.97	20.89	12.77	6.37	6.75	5.16	195.4	134.8	78.9
Guinea-Bissau	35	43	48	28.3	21.63	16.41	5.83	6.65	4.99	150.3	124.8	98
Liberia	38	42	57	26.27	21.26	10.63	6.41	6.52	5.16	214.5	160.8	58.2
Mali	30	44	51	34.18	20.72	14.19	6.7	7.06	6.23	219.7	131.9	98.2
Mauritania	42	56	59	21.52	11.25	9.5	6.78	5.94	4.46	129.1	80.5	75.6
Niger	38	41	55	25.14	23.87	12.57	7	7.81	7.01	NA	132.6	66.4
Nigeria	38	46	52	25.1	18.91	14.06	6.35	6.4	5.49	NA	126.6	78
Senegal	39	53	59	25.09	12.97	8.76	6.64	6.65	4.74	122.2	68.8	46.7
Sierra Leone	31	39	48	32.9	24.53	15.34	6.03	5.71	4.88	219.5	157.6	119.2
Togo	40	53	57	24.93	13.66	10.63	6.52	6.3	3.99	154.2	85.2	72.9

Note: Crude Death Rate (per 1000 Population), Infant Mortality Rate (Per 1000 Live Births)
Source: World Bank (2013) World Development Indicators

Life Expectancy Criterion

We begin with life expectancy criterion, which is presented in Table 3.
Going by the average life expectancy criterion as a measure of demographic transition, it is evident from the statistics presented in table 3 that none of the countries in West Africa entered the transition in 1960; since life expectancy in all the countries was below 50 years. The story however, began to change in 1980 when, according to the WDI (2013), five countries, Cape Verde, Cote d'Ivoire, Ghana, Mauritania and Togo recorded 60, 51, 53, 53

and 50 years respectively. By 1990, two additional countries have crossed the threshold to raise the number to 7 countries. As at 2011, only two countries, Guinea-Bissau and Sierra Leone were yet to attain average life expectancy of 50 years. Others have crossed the 50 year threshold, with countries such as Cape Verde, Ghana, Mauritania, Senegal and Gambia recording 74, 64, 59, 59 and 58 years in that order.

Crude Birth Rate Criterion

The criterion of crude birth rate per one thousand people falling below the threshold of 30 also confirms the above position. For instance a glance at Table 3 revealed clearly that eleven countries in the sub-region had their death rates below 30 persons per thousand population in 1960. The 1990 figures revealed that all the countries had their estimates below 30 per 1,000 people. By 2011, the data showed that nearly all the countries was less than 15, with Cape Verde, Gambia, Ghana, Mauritania and Senegal recording single digit. This confirms the argument of Ouedraogo (2009) that all West African countries are already in the stage of demographic transition, with some being at the third stage.

Fertility and Mortality in West Africa

There appears to be steady declines in both infant mortality and fertility in West Africa. In the 40s and late 50s these figures were extremely high compared to the present period. Currently, many countries in the sub-region have succeeded in reducing mortality and fertility to certain level, although, compared to the level attained in some other regions in Africa and advanced economies; West African countries still required more efforts to improve on their present achievement in these two areas. Estimates from the World Bank (2013) revealed that fertility rate for most developed nations in 2011 was less than 2 children per woman. A good number of developing countries have theirs ranged between 2 and 6. In West Africa, asides Cape Verde, Cote d'Ivoire (Ivory Coast) and The Gambia whose figures in 2011 were 2.39, 3.73 and 3.98 children per woman respectively, figures for other countries such as Ghana, Mauritania, Guinea Bissau, and Togo hovered between 4.12 and 4.58. Niger recorded the highest figure of 7.03 per woman in the sub-region.

It is obvious from Table 3 that fertility in West African countries has been declining; however, the pace appears to be very slow. For instance, it took Benin 51 years to reduce her fertility rate from 6.28 in 1960 to 5.21 in 2011. Similarly, Burkina Faso, whose rate was 6.29 in 1960, recorded 5.81 in 2011. The rate in most of the countries over the years though

decreasing has consistently remained high. The only countries, which appear to have recorded appreciable improvement, are Cape Verde and Togo, both of which had their fertility figure put at 2.34 and 3.99 in 2011 respectively.

Infant mortality in West Africa has experienced tremendous decline over the years despite high prevalence of diseases such as malaria, HIV/AIDS, tuberculosis and other chronic communicable diseases in the sub-region. From the information contained in Table 3, while the rate per a thousand live births in 1960 was as high as 219.7 in Mali, by 2011, the same country recorded 98.2. Countries, which appear to have performed relatively well in the sub-region are Cape Verde, Senegal, Ghana, Gambia and Liberia (in spite of the civil war Liberia experienced); with their figures in 2011 put at about 18, 47; 52; 52; and 58 respectively. While all the countries recorded triple digits in 1960 and 1970, by 1980, Cape Verde, Gambia, Ghana, Senegal and Togo had reduced theirs to double digits. Other countries later followed suit and by 2011, only Sierra Leone was still left with triple digits of 119.2.

The Figure 4 presents a clearer picture of declining trend of demographic variables in West Africa.

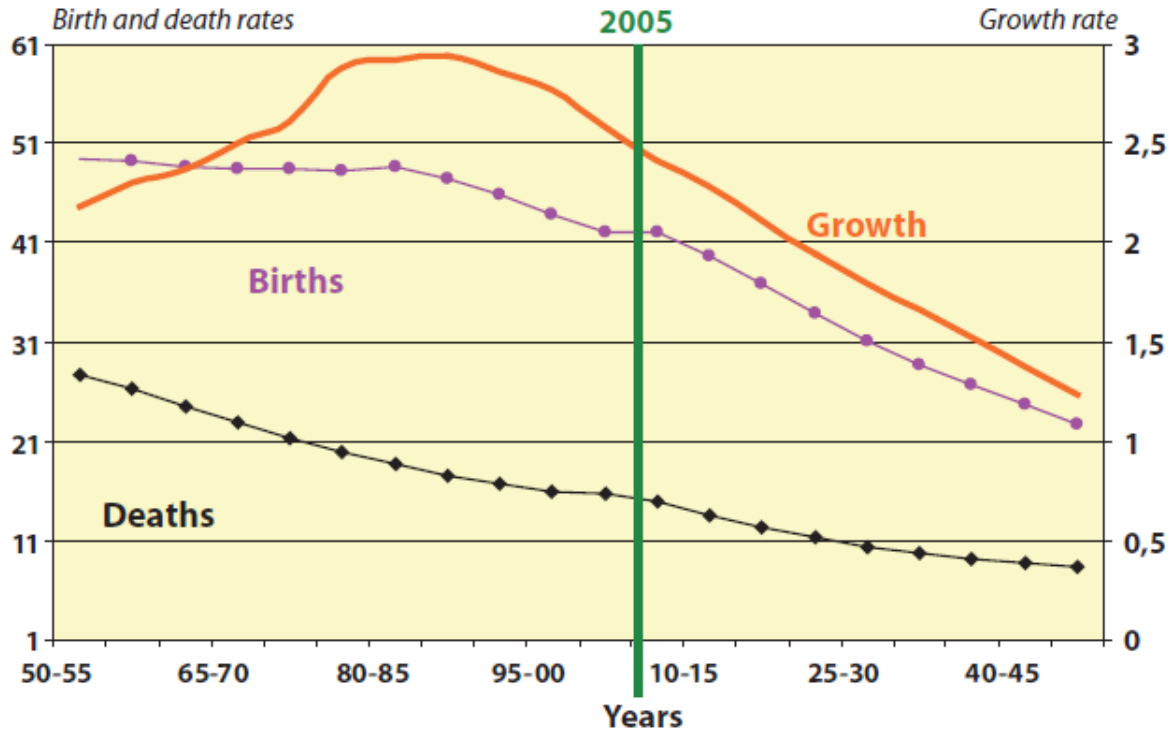

Figure 4: Changes in the birth, death and population growth rates in West Africa

Source: Source: Ouedraogo, D. (2009). Demographic trends. In Bossard, L. (ed), *Regional Atlas on West Africa*. ECOWAS-SWAC/OECD, pp. 29-39

Figure 4 indicates changes in birth, death and population growth rates in West Africa. It shows sharp declining trend in the three variables since 2005, particularly birth and population growth rates. Death rate likewise has been on a declining trend, falling below birth and population growth rates. Although, birth rate was above population growth rate in the 50s; however, in the 60s, population growth overtook births and has since been above it, implying faster fall in mortality than fertility.

Apparently, the facts presented above are indications that the West African sub-region is already experiencing demographic transition. The question that arises is to what extent has this translate to improvement in economic growth of the countries as theory suggests.

3. Brief Literature

The age long debate on population dynamics and economic outcomes, which became more prominent during the Malthusian era, has further been enhanced by the emergence of demographic transition theory. Different empirical works at both country and cross-country levels continue to emerge with divergent views as more and more countries benefit from the dividends of this transition. This section touched briefly on the existing literature, focusing on how population variables have affected economic outcomes in different regions of the world over the years.

Population Dynamics and Economic Performance

There are divergent views on how population dynamics influence economic performance. Both theoretical and empirical evidences seem not to converge in their stance. While some in the spirit of Malthus and neo-Malthus report adverse influence of population variables on economic prosperity, others in the spirit of demographic transition argued that rather than depress per capita output, population increase occasioned by decrease fertility and mortality rates favouring the working age group tends to contribute substantially to better economic performance. Furthermore, there are others who take middle position arguing that population and economic prosperity have no link.

Prominent among the proponents of the first view, who Bloom & Freeman (1986) refer to as 'population pessimists' are Coale & Hoover, (1958) and Ehrlich (1968). These authors reiterated that population explosion appears to be a time bomb waiting to explode, and economic growth may be depressed due to very high fertility in excess of mortality levels. Of the same view was the then World Bank president between 1968 and 1981, Robert Strange

McNamara, who was cited by Kelley (1988) to have noted in 1973 that population explosion could be compared with nuclear war going by its economic and social influence on the society. Some of the explanations proffered by the advocates of this view is based on diminishing returns, which occurs from labour increase to fixed factors and "the dependency effect, which suggests that saving is more difficult for households when there are more children and that higher fertility causes social investment funds to be diverted away from high-productivity uses" thereby having negative impact on output per worker as high fertility and positive population growth persist (Simon, 1976, p. 309). Lorentzen, McMillan & Wacziarg (2008, p. 88) affirm that high mortality shrinks economic growth via its depressing effect on saving and investment because it discourages "incentives for behaviour with short-run costs and long-run payoffs." Of course, this view may not be disputed, particularly as the world population surpasses 7 billion people, with China and India having more than a billion persons each while some developing countries are battling with poverty and famine.

Some of the empirical findings consistent with the above assertion include: Kelley & Schmidt, (1994); Barro (1996)

Kelley & Schmidt, 1994 in their cross-country study covering 135 countries, found negative and significant association between population growth and the growth of per capita income for the 1980s. Secondly, while negative correlation was found for relatively poor countries, positive correlation was reported for wealthy nations for the entire period of the study. The findings presented by the authors show a slight departure from the earlier studies reporting insignificant relationship between per capita income growth and demographic variables. This notwithstanding, the analysis was based on simple correlations approach, without control for important determinants of growth, which might have influenced the results. The study further admits lack of substantial explanations for the sudden statistically significant and robust results.

Barro (1996), which explores determinants of economic growth in a convergence type of growth model for a panel of 100 countries over the period 1960 to 1990, incorporated fertility, a demographic variable into the model. The findings among others showed a negative and significant relationship between per capita GDP growth and log of fertility rate. One of the conclusions of the author was that growth in per capita income is enhanced by lower fertility while high fertility depresses growth. Although, the study employed data on

several countries, it however adopts a system of equations, using three stage least squares estimator as against panel data approach. In addition, some West African countries were excluded from the study. Finally, it was not clear whether any of the West African countries had entered the stage of demographic transition within the period covered by the study.

One of the studies that report a no-association between population variables and per capita income growth include is Bloom & Freeman (1986). The authors, apart from using linear regression, the data set employed differs in terms of the variables used as well as sample sizes. Their study reported insignificant relationship between population growth and per capita GNP across countries with very low coefficients.

Conversely, other empirical evidences seem to diverge from the above stance (see Simon, 1976; Kremer, 1993; and Kelley & Schmidt, 1995 & 2005). For instance, Simon (1976, p. 312) in his study on some less developed economies found that "moderate population growth produces considerably better economic performance in the long run (120 to 180 years) than does a slower-growing population" while the long run effect of decreasing population was negative. In the same vein, Kremer (1993) who modeled population growth together with technology, found that higher population growth is associated with technological advancement rather than depressing it and this by implication enhances growth of the economy. Furthermore, Kelley & Schmidt (1995) applying convergence approach of modelling and focusing on three periods of growth (1960-70, 1970-80, and 1980-90) "and 89 market-oriented countries with populations exceeding 1 million in 1960" revealed among other things that population density and economic growth relate positively while demographic process also appears to be very important for growth process. However, for the stretch period of 30 years, the growth of population has negative influence on economic growth.

Furthermore, subsequent works after this period using different specifications together with the disaggregation of population variables have reported significant impact of these variables on economic performance. As a matter of fact, in recent times, more rigorous studies are digging into the critical role of demographic transition in economic prosperity, particularly with the level of growth accomplished by countries of East Asia, where demographic transition has been proven to have played significant role, accounting for approximately 1.9% growth, the greatest ascribed to any of their growth determinants (see Mason, 2005; Caldwell

& Caldwell, 2005; Lee & Mason**,** 2006; Wei & Hao, 2010, and African Development Bank, 2011).

Using a Solow-Swan type of economic growth model, and following the Asian Development Bank (1997) framework, Bloom & Williamson (1998) incorporated demographic variables, such as growth rates of total population and economically active population into their model to determine how demographic transitions influenced growth performances of some Asian economies. Their findings revealed among other things that demographic transition was one of the major drivers of growth miracle experienced by East Asia. The transition worked to favour upsurge in the working-age group, which outweighed the dependent population and as such led to productivity boost with its attendant effect of substantial increase in per capita output in these economies.

Kelley & Schmidt (2005) employed population variables (dependency, size, and density) in a cross-country panel regression model covering 86 countries over a period of 1960-1995 to determine the influence of population on economic growth. The authors disaggregate per capita output growth into productivity and translations components, given as:

$$\frac{Y}{N_{gr}} \equiv \frac{Y}{L_{gr}} + \left(L_{gr} - N_{gr}\right)$$

Where:

$\frac{Y}{N_{gr}}$ = per capita output growth; $\frac{Y}{L_{gr}}$ = productivity component; and $\left(L_{gr} - N_{gr}\right)$ = the translations component, which translates output growth per labour hour into output growth per person. Note that N_{gr} signifies population growth rate while L_{gr} stands for growth rate of labour force/number of workers. The authors maintained that decomposition of per capita output growth into two components could enhance the understanding of the role played by demographic variables in growth process if they are modeled separately. One of the important demographic variables in this study describes the effect of labour force during demographic transmission. This variable was measured by the authors using population of working ages. Findings of the study suggest about 20% growth per capita output occasioned by the combined effects of demographic change, with Asia and Europe accounting for the large shares of the impact. However, this was made possible within the productivity component, which was primarily through the youth age structure; whereas, little or no impact of transactional demography was discovered on economic production. Although, the framework

employed by Kelley & Schmidt, is not completely novel, as it builds on an existing structure in Bloom & Williamson (1998); however, the idea of disaggregating per capita output growth to both productivity and translations components brings out distinctly, effects of demographic variables on economic outcome. In addition, the authors emphasized that the rendering helps to clarify any inconsistent reported in previous empirical studies and aids future researches in the field of demographic studies.

Galor (2012, pp. 1& 2) specified three important channels through which demographic transition could have assisted in boosting productivity and economic growth process, which include: i) "the decline in population growth reduced the dilution of the growing stocks of capital and infrastructure, increasing the amount of resources per capita"; ii) fertility decline encourages resource reallocation from production of quantity of children to their quality, thereby "enhancing human capital formation and labour productivity"; and iii) fertility decline operates in favour of high labour force and low dependent population, which could invariably raise productivity level in the economy, thereby resulting to economic growth.

A look at the studies reviewed above suggest majority of them focusing on other economies outside Africa. Secondly; the period covered in the studies are not recent while a good number of them, although being cross country studies prefer other estimation techniques rather than panel data approach.

Fertility, Mortality and Economic Outcomes in West Africa

Apparently, while literature supports the fact that West African countries have begun their demographic transition process (see Ouedraogo, 2009; and Bloom, Finlay, Humair, Mason, Olaniyan & Soyibo, 2010); which is evident in the declining trends of mortality and fertility in the sub-region, there appears to be lack of empirical studies to investigate and confirm this. Some of the available studies include: Jeon et al (2010); Bloom et al, (2010); AfDB (2012); and Choi (2013). These studies asides Ouedraogo(2009) do not focus exclusively on West Africa while all the studies with the exception of Jeon et al (2010), are descriptive studies.

Theoretical Framework and Methodology

The framework employed in this study follows the standard cross-country growth equation in several studies. However, for the purpose of the determination of effects of demographic variables on economic outcomes; Bloom & Williams (1998) and Bloom & Finlay (2009) becomes more relevant.

Given a Cobb-Douglas production function of the form:

$$Y = AK^{\beta}L^{1-\beta} \quad (1)$$

Where: Y = level of income in the economy; A = efficiency/ productivity factor, K = physical capital; L = labour; and β=elasticity.

The per capita form of equation (1) is given as:

$$y = Ak^{\beta} \quad (2)$$

Where: $y = \frac{Y}{L}$

Letting $z = \log\left(\frac{Y}{L}\right)$ as in Bloom & Finlay (2009), per worker GDP growth rate can then be specified as:

$$g_z = f(z* - z_0), \quad (3)$$

Where: g_z denotes growth rate of per worker income, z* is the long run steady state log income per worker; z_0 signifies initial level of log of per worker income; while *f* is the speed of convergence.

Assume z* = Xα with X signifying a vector of variables that influence z*, equation (3) can then be given as:

$$g_z = f(X\alpha - z_0), \quad (4)$$

Per capita income equation can be derived thus:

$$\frac{Y}{P} = \frac{Y}{L}.\frac{L}{W}.\frac{W}{P}, \quad (5)$$

With Y, P, L, and W being level of income, total population, labour and working age population respectively. When the log of equation (5) is taken and using $z = \log\left(\frac{Y}{L}\right)$ in equation (4); then per worker income growth is given

$$g_z = f\left(X\alpha - y_0 + \log\left(\frac{L}{W}\right)_0 + og\left(\frac{W}{P}\right)_0\right) \quad (6)$$

While per capita income growth becomes

$$g_y = g_z + g_L - g_P \quad (7)$$

The combination of equations (6) and (7) would yield the empirical equation estimated by Bloom & Finlay (2009) in their paper. However, the present study assumes away both speed of convergence and initial income level. This is to focus on the primary purpose of the study which is to examine the influence of demographic variable on economic growth. In addition, the estimated equation is not a dynamic panel rather, it is a static panel. A further work could focus on using dynamic panel approach.

The empirical model estimated in the study is semi-logged and it is specified as:

$$PGDPg_{it} = \alpha_0 + \alpha_1 INFg_{it} + \alpha_2 FERg_{it} + \alpha_3 \ln FC_{it} + \alpha_4 OPEN_{it} + \alpha_5 \ln DEP_{it} + \alpha_6 \ln LEP_{it} + \varepsilon_{it} \quad (8)$$

Where:

$$\varepsilon_{it} = \mu_i + \nu_{it} \quad (9)$$

PGDPg = growth rate of per capita GDP; INFg = growth of infant mortality; FERg = fertility growth; lnFC = log of fixed capital; OPEN = trade openness; lnDEP = log of dependency population; and lnLEP = log of life expectancy. μ_i = country effects; and ν_{it} = error term, assumed to be normally distributed with zero mean and constant variance.

INFg and FERg are the variables of interest. In the remaining three models, these variables were replaced with population growth as well as growth rate of labour force. Theoretically, demographic transition is expected to affect labour force and population growths, thereby resulting in positive association between them and per capita income growth. Infant mortality ordinarily, is expected to influence growth negatively while fertility should have positive effect on income growth. The stand of theoretical and empirical literature on fertility and income nexus is mixed. The sign could be negative or positive. Fixed capital, trade openness and life expectancy are expected to have positive effect on income growth while dependency population and income level are expected to be inversely related.

Data and Sources

The data employed in the study were collected from various sources such. Specifically, data on fertility, infant mortality, life expectancy, dependency population, labour force, and population were collected from The World Bank (2013) World Development Indicators. Fixed capital was obtained from the United Nations National Accounts Main Aggregates Database; trade openness from the Penn World Table Version 7.1; and per capita GDP from the Federal Reserve Bank of St. Louis and PENN World Table, 7.1.

5. Empirical Analysis and Discussion of Results

This study investigates the impact of demographic variables-fertility and mortality on economic growth and development of West African countries from 1970 to 2011. For the estimation, the entire period was further split into two sub-periods, 1970-1990 and 1991-2011 to explore the effect of demographic transition, which has already begun in most countries in the sub-region. Four models were estimate with each using alternative demographic variables. The first model employed growth rates of infant mortality and fertility, the second model used labour force growth, the third used population growth rate, without the inclusion of labour force variable while the fourth model employed both population growth rate and the log of labour force. Each model was estimated using four panel data estimation techniques - Ordinary Least Squares (OLS), Fixed Effects (FE) and Random Effects (RE). Moreover, given the relative size of Nigeria in region, the estimations were carried out with and without Nigeria.

A summary of the results are presented in Table 8 while the entire results are reported in Tables A-1 to A-4, and B-1 to B-4 in appendices A and B. The first panel of Table 8 reports the results with Nigeria, while second panel reports the results without Nigeria. Overall, the Wald test and F-statistics overwhelmingly showed joint significance for all the estimators, the entire sample and the two sub-samples for the entire region as well as those without Nigeria. On the choice of appropriate estimator, while the Hausman test supports random effects estimator for the first model, fixed effects estimator was supported for the remaining three models.

On how demographic variables affect economic growth in the region, the evidence presented in Table 8 suggests substantial impact of the variables on per capita income growth. Analysis for all the countries shows a significant negative effect of infant mortality on per capita income growth for the three periods under consideration with the exception of the fixed effects result in the 1970-1990 period, which was positive but statistically insignificant. Approximately, a unit reduction in per capita income growth was caused by a unit change in infant mortality growth between 1970 and 2011. The same result was recorded for the period 1990-2011, with the exception of fixed effects, whose coefficient was -2.1.

Fertility growth has a direct relationship with per capita income growth. Nonetheless, the fixed effects results for 1970-1990 period and all estimators for 1991-2011 were insignificant. The negative and significant coefficients of infant mortality as well as the

positive influence of fertility on growth were not unexpected. It is obvious from the information provided under the background section that although, both variables continued to decline substantially, the level of infant mortality in the region appears relatively high, with virtually all countries still having double digits.

The impact of labour force growth on per capita income growth remains positive and significant for the entire 1970-2011 period as well as 1991-2011. However, for the 1970-1990 period; the impact was positive but insignificant. A unit change in labour force growth rate led to 1.2, 1.94 and 1.2 units' increases in per capita income growth for the pooled, fixed and random effects results respectively within 1970 and 2011. For 1990-2011, when demographic transition appears to be more pronounced; a change in the growth of labour force brought about corresponding up-surge in per capita income growth of around 2.91, 3.64 and 2.73 under the pooled, fixed and random effects respectively. It is observed that the coefficients returned for the 1990-2011 period are larger than those of 1970-2011, which obviously revealed the influence of demographic transition.

Table 8 Demographic Impact on Economic Growth

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			**1970-1990**			**1991-2011**		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
INFgr	-1.06***	-1.20***	-1.06***	-1.35**	0.13	-1.35**	-1.06***	-2.10***	-1.06***
	(0.00)	(0.00)	(0.00)	(0.02)	(0.88)	(0.02)	(0.00)	(0.00)	(0.00)
FERgr	0.82**	0.83**	0.82**	1.50***	1.05***	1.50***	0.50	0.61	0.50
	(0.02)	(0.04)	(0.02)	(0.01)	(0.14)	(0.01)	(0.46)	(0.57)	(0.46)
LBFgr	1.20***	1.94***	1.20***	-0.25	0.73	-0.25	2.91***	3.61***	2.91***
	(0.00)	(0.00)	(0.00)	(0.68)	(0.31)	(0.68)	(0.00)	(0.00)	(0.00)
POPgr[a]	1.36***	2.37***	1.36***	-0.27	0.37	-0.27	2.73***	3.64***	2.73***
	(0.00)	(0.00)	(0.00)	(0.68)	(0.68)	(0.68)	(0.00)	(0.00)	(0.00)
POPgr[b]	1.61***	2.63***	1.61***	-0.20	0.40	-0.20	2.99***	3.79***	2.99***
	(0.00)	(0.00)	(0.00)	(0.76)	(0.65)	(0.76)	(0.00)	(0.00)	(0.00)

Results Without Nigeria

	1970-2011			**1970-1990**			**1991-2011**		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
INFgr	-1.01***	-1.26***	-1.01***	-1.30**	-0.06	-1.21**	-1.05**	-2.31***	-1.05**
	(0.00)	(0.00)	(0.00)	(0.02)	(0.94)	(0.03)	(0.01)	(0.00)	(0.01)

FERgr	0.73**	0.65	0.73**	1.32**	1.04	1.32**	0.51	0.65	0.51
	(0.03)	(0.10)	(0.03)	(0.01)	(0.11)	(0.01)	(0.49)	(0.56)	(0.49)
LBFgr	1.30***	2.06***	1.30***	-0.10	0.71	-0.05	2.96***	3.63***	2.96***
	(0.00)	(0.00)	(0.00)	(0.86)	(0.28)	(0.94)	(0.00)	(0.00)	(0.00)
POPgr[a]	1.47***	2.47***	1.47***	-0.09	0.46	-0.02	2.81***	3.64***	2.81***
	(0.00)	(0.00)	(0.00)	(0.88)	(0.56)	(0.98)	(0.00)	(0.00)	(0.00)
POPgr[b]	1.68***	2.68***	1.68***	-0.06	0.49	0.001	3.02***	3.78***	3.02***
	(0.00)	(0.00)	(0.00)	(0.92)	(0.54)	(1.00)	(0.00)	(0.00)	(0.00)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Population growth rate also has positive effect on the growth rate of income per capita in all the three periods as well as in both models with or without log of labour force. However, the results for the 1970-1990 period were not significant. This was the time when none of the countries in West Africa had entered the demographic transition. Whereas, for 1990-2011 period, not only that the coefficients were positive and significant, the coefficient appear to be larger than what was reported for 1970-2011. This is an indication of demographic transition influence. It is observed that although both fertility and mortality are falling, the latter appears to be falling faster than the former, which facilitate increase in labour force and population. Since both variables relates to younger age groups, when infant mortality falls faster than fertility, the tendency is to favour young population, which helps to boost the labour force. If appropriate policies are put in place to train and develop them; it has the propensity to enhance better economic growth and development. Empirical literature has found that demographic transition was one of the major factors that enhanced the growth miracles experienced by the East Asian countries (see Bloom & Williamson, 1998; Kelley & Schmidt, 2005; and Bloom & Finlay; 2009; Bloom et al, 2010).

Results without Nigeria

Apparently, the findings presented show slight influence of Nigeria in the region. While most of the results reported for estimations that excluded Nigeria were consistent with the earlier ones reported; however, few slight differences were observed. For instance, while infant mortality growth maintains negative influence on per capita income growth all through, the coefficients appear to be slightly lower than what was reported for all countries in the entire region. In addition, the result of fixed effects for the 1970-1990 period, which was positive for the entire countries, turns out negative for estimations without Nigeria, although it was not statistically significant. With respect to fertility impact on growth, recall that for the entire

region, results for the periods of 1970-2011 and 1970-1990 were significant. In the case of estimations without Nigeria, although the positive sign was maintained; however most of the coefficients were not significant. For example, only pooled and random effects results for the 1970-2011, and 1970-1990 were observed to be significant, others remain statistically insignificant. Another observation was that, the coefficients for nearly all the variables were lower than what was reported for the entire region. The import of the above is that the influence of Nigerian demographic variables on growth in the entire region cannot be down played.

With respect to labour force growth rate, the same pattern in terms of the positive sign and statistical significance reported for the entire region emerged for analysis that excluded Nigeria. However, it was observed that the coefficients of all the variables with respect to estimations without Nigeria were slightly greater than those of estimations involving all countries. The same pattern was also observed with population growth results. The coefficients remained overwhelmingly positive and significant for the entire period of 1970-2011 and 1990-2011 while those of 1970-1990 were insignificant. The coefficients were also observed to be larger with respect to estimations without Nigeria.

Control Variables

Coefficients of two out of the four control variables included in the model maintained the expected signs and were overwhelmingly significant. The variables are fixed capital and dependency population. Fixed capital shows positive association with economic growth for nearly all the periods covered in all the estimations both for the entire region and those that excluded Nigeria. It is only in few instances that the results were insignificant. The same pattern emerged for dependency variable, except that the coefficients were all negative, which agree with the a priori expectation. Trade showed negative influence on growth; however, all the coefficients were insignificant. Trade seems not to have really benefited most West African countries, since majority of them are net importers and depend mainly export of primary products. The influence of life expectancy also remained insignificant with mixed signs.

From the results presented above, the overwhelmingly evidence suggests that declining fertility and infant mortality show some positive influence on economic growth in West Africa; particularly as they affect the level of labour force and population growth. The findings are not unexpected since available empirical evidence suggests positive and significant impact of demographic transition on the growth performances of some advanced

economies as well as the East Asian countries (see Bloom & Williamson, 1998; Kelley & Schmidt, 2005; and Bloom & Finlay; 2009; Bloom et al, 2010; Guinnane, 2011).

6. Summary, Conclusion and Policy Implication of the Study

This study attempts to investigate how demographic variables-fertility and mortality declines affect economic outcomes in the West African sub-region. To achieve this objective, we estimated four models. While the first model included growth rates of fertility and mortality, the second focused on labor force growth while the third and fourth used population growth rates, as variables of interest. Three static panel data models were employed for the estimation analysis, which are ordinary least square (OLS), fixed and random effects estimators respectively. Hausman specification test suggests random effects as the most appropriate for the first model while fixed effects estimator was favoured for the remaining three models. To capture the effect of the changing demography the study period of 1970-2011 was further divided into two sub-periods. The first sub-period, 1970-1990, corresponds to when both fertility and mortality declines were still very low. Precisely, it was a period in which most countries in the sub-region were yet to begin demographic transition. The second sub-period, 1990-2011, represents a period when a good number of countries in the region have begun the transition, with some being at the latter end of the second stage of the demographic transition.

Overwhelmingly, it was found that fertility trend tends to enhance economic growth for the entire period as well as during the 1990-2011 period. However, it was observed that the positive impact of the variable for the 1970-1990 period was insignificant. This suggests the emerging positive influence of the demographic transition as fertility and mortality situation experience systematic decrease. Furthermore, infant mortality returned negative and significant coefficients for the 1970-2011 and 1990-2011 periods while the results for 1970-1990 were insignificant. This is not surprising, given that the mortality rates during the period 1990-2011 still remain high, even though it has experienced some decline over the years. Thus, for the full dividend of demographic transition to be realised, the mortality rate in the region must reduce further. Other results overwhelmingly suggest positive effects of labour force growth and population growth on per capita income growth in West Africa. Furthermore, the results of the analyses without Nigeria tend to produce less significant results with lower coefficients.

In conclusion, declining fertility and mortality in West Africa will continue to engender positive influence on economic outcomes if better policies are put in place. Therefore, this study recommends aggressive investment in the young population, since the on-going demographic transition in the sub-region tends to produce a large army of young population graduating into the labour force. Such investment should focus on education and training.

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Appendix A

Results of Econometric Analysis of Demographic Impact on Economic Growth in all the sixteen West African Countries

Table **A-1** Demographic Impact on Economic Growth-1

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			**1970-1990**			**1990-2011**		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
INFgr	-1.06***	-1.20***	-1.06***	-1.35**	0.13	-1.35**	-1.06***	-2.10***	-1.06***
	(0.00)	(0.00)	(0.00)	(0.02)	(0.88)	(0.02)	(0.00)	(0.00)	(0.00)
FERgr	0.82**	0.83**	0.82**	1.50***	1.05	1.50***	0.50	0.61	0.50
	(0.02)	(0.04)	(0.02)	(0.01)	(0.14)	(0.01)	(0.46)	(0.57)	(0.46)
lnFC	1.21***	1.03	1.21***	0.74	1.32	0.74	1.55**	0.97	1.55**
	(0.01)	(0.16)	(0.01)	(0.26)	(0.55)	(0.26)	(0.03)	(0.35)	(0.03)
OPEN	-0.02	0.02	-0.02	-0.02	0.03	-0.02	-0.02	0.01	-0.02
	(0.35)	(0.38)	(0.35)	(0.55)	(0.53)	(0.55)	(0.38)	(0.78)	(0.38)
lnDEP	-0.96*	0.96	-0.96*	-0.06	-11.92	-0.06	-1.33*	2.71	-1.33*
	(0.05)	(0.67)	(0.05)	(0.95)	(0.12)	(0.95)	(0.06)	(0.51)	(0.06)
lnLEP	1.93	-2.39	-1.93	0.24	19.37	0.24	-2.61	-17.88	-2.61
	(0.31)	(0.81)	(0.31)	(0.96)	(0.34)	(0.96)	(0.26)	(0.30)	(0.26)
CONS	-2.40	0.60	-2.40	-15.07	70.39	-15.07	-1.14	7.11	-1.14
	(0.66)	(0.92)	(0.66)	(0.46)	(0.27)	(0.46)	(0.83)	(0.34)	(0.83)
No. Of Obs	160	160	160	80	80	80	96	96	96
R.Squared	0.13	0.14	0.12	0.19	0.24	0.16	0.14	0.19	0.14
F-Stat.	3.84	3.73		2.86	2.97		2.37	2.92	
	(0.00)	(0.00)		(0.02)	(0.01)		(0.04)	-0.01	
Wald Stat.			23.06			17.18			14.2
			(0.00)			(0.01)			(0.03)
Hausman Stat.			8.89			7.89			9.65
			(0.18)			(0.25)			(0.14)
B-P LM St.			0.64			0.04			3.09
			(0.42)			(0.84)			(0.08)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Table **A-2** Demographic Impact on Economic Growth-2

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			**1970-1990**			**1990-2011**		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
LBFgr	1.20***	1.94***	1.20***	-0.25	0.73	-0.25	2.91***	3.61***	2.91***
	(0.00)	(0.00)	(-0.00)	(0.68)	(0.31)	(0.68)	(0.00)	(0.00)	(0.00)
lnFC	1.14**	1.15*	1.14**	1.44**	1.36	1.44**	1.43**	0.23	1.43***
	(0.02)	(0.09)	(0.01)	(0.05)	(0.53)	(0.04)	(0.01)	(0.78)	(0.01)
OPEN	-0.01	0.04	-0.01	-0.01	0.01	-0.01	-0.01	0.03	-0.01
	(0.67)	(0.12)	(0.67)	(0.68)	(0.76)	(0.68)	(0.66)	(0.25)	(0.66)
lnDEP	-1.14**	0.52	-1.14**	-1.49*	-16.85**	-1.49*	-1.39**	4.52	-1.39***
	(0.02)	(0.81)	(0.02)	(0.08)	(0.01)	(0.08)	(0.01)	(0.17)	(0.01)
lnLEP	-2.82	-11.75	-2.82	-2.44	22.79	-2.44	-3.79*	-23.13*	-3.79**
	(0.12)	(0.22)	(0.12)	(0.61)	(0.25)	(0.61)	(0.05)	(0.09)	(0.05)
CONS	2.70	8.32	2.70	4.23	126.07	4.23	-0.80	7.46	-0.80
	(0.61)	(0.16)	(0.61)	(0.83)	(0.03)	(0.83)	(0.86)	(0.20)	(0.86)
No. of Obs	160	160	160	80	80	80	96	96	96
R.Squared	0.10	0.17	0.14	0.05	0.22	0.10	0.39	0.48	0.43
F-Stat.	3.55	5.72		0.85	3.32		11.46	13.6	
	(0.01)	(0.00)		(0.52)	(0.01)		(0.00)	(0.00)	
Wald Stat.			17.73			4.26			57.31
			(0.00)			(0.51)			(0.00)
Hausman Stat.			28.49			21.52			22.42
			(0.00)			(0.00)			(0.00)
B-P LM Stat.			0.17			0.41			0.36
			(0.68)			(0.52)			(0.548)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Table **A-3** Demographic Impact on Economic Growth-3

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			1970-1990			1990-2011		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
POPgr	1.36***	2.37***	1.36***	-0.27	0.37	-0.27	2.73***	3.64***	2.73***
	(0.00)	(0.00)	(0.00)	(0.68)	(0.68)	(0.68)	(0.00)	(0.00)	(0.00)
lnFC	1.16**	0.95	1.16**	1.44**	1.65	1.44**	1.83***	0.75	1.83***
	(0.01)	(0.15)	(0.01)	(0.05)	(0.45)	(0.043)	(0.00)	(0.36)	(0.00)
OPEN	-0.01	0.03	-0.01	-0.01	0.01	-0.01	-0.01	0.02	-0.01
	(0.58)	(0.19)	(0.58)	(0.70)	(0.78)	(0.70)	(0.64)	(0.33)	(0.64)
lnDEP	-1.27**	0.77	-1.27***	-1.48*	-15.90**	-1.48*	-2.02***	2.79	-2.02***
	(0.01)	(0.72)	(0.01)	(0.08)	(0.02)	(0.08)	(0.00)	(0.38)	(0.00)
lnLEP	-2.01	-11.38	-2.01	-2.70	21.15	-2.70	-3.02	-18.88	-3.02
	(0.26)	(0.22)	(0.26)	(0.56)	(0.29)	(0.56)	(0.12)	(0.15)	(0.12)
CONS	0.78	6.71	0.78	5.24	113.81	5.24	-1.34	7.12	-1.34
	(0.88)	(0.24)	(0.88)	(0.78)	(0.05)	(0.78)	(0.77)	(0.21)	(0.77)
No. of Obs	160	160	160	80	80	80	96	96	96
R.Squared	0.11	0.21	0.17	0.05	0.21	0.11	0.38	0.49	0.44
F-Stat.	3.98	7.16		0.85	3.1		10.87	14.5	
	(0.00)	(0.00)		(0.52)	(0.02)		(0.00)	(0.00)	
Wald Stat.			19.88			4.26			54.36
			(0.00)			(0.51)			(0.00)
Hausman Stat.			36.9			17.69			33.99
			(0.00)			(0.00)			(0.00)
B-P LM Stat.			0.71			0.13			0.00
			(0.34)			(0.72)			(0.96)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Table **A-4** Demographic Impact on Economic Growth-4

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			1970-1990			1990-2011		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
POPgr	1.61***	2.63***	1.61***	-0.20	0.40	-0.20	2.99***	3.79***	2.99***
	(0.00)	(0.00)	(0.00)	(0.76)	(0.65)	(0.76)	(0.00)	(0.00)	(0.00)
lnLBF	7.95*	8.82*	7.95*	14.01	4.04	14.01	9.23*	9.56	9.23**
	(0.07)	(0.072)	(0.07)	(0.14)	(0.78)	(0.14)	(0.06)	(0.12)	(0.05)
lnFC	1.00**	0.70	1.00**	1.25*	1.72	1.25*	1.51**	0.33	1.51**
	(0.03)	(0.29)	(0.03)	(0.09)	(0.44)	(0.08)	(0.01)	(0.70)	(0.01)
OPEN	-0.02	0.02	-0.02	-0.02	0.01	-0.02	-0.02	0.01	-0.02
	(0.32)	(0.40)	(0.32)	(0.55)	(0.80)	(0.55)	(0.26)	(0.58)	(0.26)
lnDEP	-9.114**	-7.89	-9.11**	-15.28	-19.36	-15.28	-10.95**	-5.59	-10.95**
	(0.04)	(0.13)	(0.04)	(0.10)	(0.17)	(0.10)	(0.02)	(0.37)	(0.02)
lnLEP	-1.77	-10.87	-1.77	3.45	21.89	3.45	-2.89	-21.50	-2.89
	(0.32)	(0.24)	(0.32)	(0.58)	(0.278	(0.58)	(0.14)	(0.10)	(0.13)
CONS	0.48	6.29	0.48	-18.56	100.79	-18.56	-0.87	7.58	-0.87
	(0.93)	(0.27)	(0.93)	(0.45)	(0.17)	(0.45)	(0.85)	(0.18)	(0.85)
No. of Obs	160	160	160	80	80	80	96	96	96
R.Squared	0.13	0.22	0.187	0.082	0.21	0.09	0.40	0.51	0.46
F-Stat.	3.91	6.61		1.09	2.56		9.96	12.73	
	(0.00)	(0.00)		(0.375)	(0.03)		(0.00)	(0.00)	
Wald Stat.			23.45			6.55			59.77
			(0.00)			(0.36)			(0.00)
Hausman Stat.			40.21			16.87			54.56
			(0.00)			(0.01)			(0.00)
B-P LM Stat.			0.87			0.35			0.04
			(0.35)			(0.55)			(0.84)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Appendix B

Results of Econometric Analysis of Demographic Impact on Economic Growth in West African Countries Excluding Nigeria

Table **B-1** Demographic Impact on Economic Growth-1

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			1970-1990			1990-2011		
	Pooled	FE	RE	Pooled	FE	RE	Pooled	FE	RE
INFgr	-1.01***	-1.26***	-1.01***	-1.30**	-0.06	-1.21**	-1.05**	-2.31***	-1.05**
	(0.00)	(0.00)	(0.00)	(0.02)	(0.94)	(0.03)	(0.01)	(0.00)	(0.01)
FERgr	0.73	0.65	0.73**	1.32**	1.04	1.32**	0.51	0.65	0.51
	(0.03)	(0.10)	(0.03)	(0.01)	(0.11)	(0.01)	(0.49)	(0.56)	(0.49)
lnFC	1.15**	1.17	1.15**	0.71	2.26	0.80*	1.61**	1.24	1.61**
	(0.01)	(0.10)	(0.01)	(0.25)	(0.28)	(0.23)	(0.03)	(0.26)	(0.03)
OPEN	-0.01	0.03	-0.01	-0.01	0.05	-0.01	-0.02	0.01	-0.02
	(0.45)	(0.26)	(0.45)	(0.65)	(0.30)	(0.83)	(0.42)	(0.79)	(0.42)
lnDEP	-1.02**	-0.30*	-1.02**	-0.19	-6.47	-0.32	-1.41*	3.11	-1.41*
	(0.04)	(0.90)	(0.04)	(0.83)	(0.36)	(0.72)	(0.07)	(0.47)	(0.07)
lnLEP	-1.52	-5.87	-1.52	0.31	6.84	-0.004	-2.67	-20.99	-2.67
	(0.45)	(0.56)	(0.45)	(0.95)	(0.71)	(1.00)	(0.31)	(0.25)	(0.31)
CONS	-2.09	0.94	-2.09	-12.98	18.95	-11.80	-1.09	8.61	-1.09
	(0.69)	(0.88)	(0.69)	(0.52)	(0.74)	(0.57)	(0.84)	(0.30)	(0.84)
No. Of Obs	150	150	150	75	75	75	90	90	90
R.Squared	0.13	0.14	0.12	0.19	0.24	0.17	0.13	0.19	0.14
F-Stat.	3.44	3.63		2.68	2.86		2.09	2.74	
	(0.00)	(0.00)		(0.02)	(0.02)		(0.06)	(0.02)	
Wald Stat.			20.62			15.64			12.52
			(0.00)			(0.02)			(0.05)
Hausman Stat.			10.51			7.88			9.8
			(0.11)			(0.25)			(0.13)
B-P LM Stat.			0.27			0.13			2.92
			(0.60)			(0.72)			(0.09)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Table B-**2** Demographic Impact on Economic Growth-2

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			**1970-1990**			**1990-2011**		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
LBFgr	1.30***	2.06***	1.30***	-0.10	0.71	-0.05	2.96***	3.63***	2.96***
	(0.00)	(0.00)	(0.00)	(0.86)	(0.28)	(0.94)	(0.00)	(0.00)	(0.00)
lnFC	0.98**	1.06	0.98**	1.20*	2.4	1.26*	1.36**	0.24	1.36**
	(0.04)	(0.10)	(0.04)	(0.08)	(0.26)	(0.07)	(0.02)	(0.77)	(0.02)
OPEN	-0.004	0.04**	-0.004	-0.004	0.03	-0.001	-0.01	0.03	-0.01
	(0.82)	(0.05)	(0.82)	(0.86)	(0.43)	(0.97)	(0.68)	(0.25)	(0.68)
lnDEP	-1.21**	1.36	-1.21**	-1.52*	-11.90*	-1.62*	-1.54**	4.44	-1.54***
	(0.02)	(0.53)	(0.01)	(0.07)	(0.06)	(0.06)	(0.01)	(0.18)	(0.00)
lnLEP	-1.95	-14.64	-1.95	-1.78	11.3	-2.49	-3.07	-22.94*	-3.07
	(0.30)	(0.12)	(0.30)	(0.69)	(0.53)	(0.59)	(0.15)	(0.09)	(0.14)
CONS	3.13	8.75	3.13	6.10	75.16	8.71	-0.35	8.57	-0.35
	(0.54)	(0.13)	(0.54)	(0.75)	(0.15)	(0.65)	(0.94)	(0.17)	(0.94)
No. of Obs	150	150	150	75	75	75	90	90	90
R.Squared	0.12	0.21	0.17	0.05	0.22	0.17	0.41	0.50	0.45
F-Stat.	3.99	6.86		0.79	3.13		11.74	13.65	
	(0.00)	(0.00)		(0.56)	(0.02)		(0.00)	(0.00)	
Wald Stat.			19.95			4.13			58.72
			(0.00)			(0.53)			(0.00)
Hausman Stat.			42.07			21.77			20.69
			(0.00)			(0.00)			(0.00)
B-P LM Stat.			0.67			0.05			0.32
			(0.41)			(0.82)			(0.57)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Table B-**3** Demographic Impact on Economic Growth-3

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			**1970-1990**			**1990-2011**		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
POPgr	1.47***	2.47***	1.47***	-0.09	0.46	-0.02	2.81***	3.64***	2.81***
	(0.00)	(0.00)	(0.00)	(0.88)	(0.56)	(0.98)	(0.00)	(0.00)	(0.00)
lnFC	1.00**	0.87	1.00**	1.19*	2.65	1.29*	1.77***	0.82	1.77***
	(0.03)	(0.17)	(0.03)	(0.08)	(0.21)	(0.07)	(0.00)	(0.32)	(0.00)
OPEN	-0.01	0.04*	-0.01	-0.004	0.03	0.001	-0.01	0.02	-0.01
	(0.73)	(0.09)	(0.73)	(0.87)	(0.46)	(0.98)	(0.66)	(0.34)	(0.66)
lnDEP	-1.39**	1.49	-1.39***	-1.51*	-10.91*	-1.67*	-2.25***	2.46	-2.25***
	(0.01)	(0.48)	(0.00)	(0.07)	(0.08)	(0.06)	(0.00)	(0.44)	(0.00)
lnLEP	-0.99	-13.82	-0.99	-1.90	9.38	-2.86	-2.11	-17.98	-2.11
	(0.59)	(0.12)	(0.59)	(0.66)	(0.61)	(0.52)	(0.32)	(0.18)	(0.32)
CONS	1.19	6.92	1.19	6.64	64.24	10.09	-0.86	7.64	-0.86
	(0.81)	(0.21)	(0.81)	(0.72)	(0.21)	(0.59)	(0.85)	(0.22)	(0.85)
No. of Obs	150	150	150	75	75	75	90	90	90
R.Squared	0.14	0.25	0.21	0.05	0.21	0.17	0.4	0.51	0.47
F-Stat.	4.57	8.55		0.79	2.91		11.32	14.36	
	(0.00)	(0.00)		(0.56)	(0.02)		(0.00)	(0.00)	
Wald Stat.			22.86			4.25			56.62
			(0.00)			(0.51)			(0.00)
Hausman Stat.			54.22			17.91			28.87
			(0.00)			(0.00)			(0.00)
B-P LM Stat.			1.72			0.07			0.00
			(0.19)			(0.80)			(0.96)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.

Table **B-4** Demographic Impact on Economic Growth-4

Dependent Variable = Growth Rate of Per Capita Gross Domestic Product (Purchasing Power Parity)

	1970-2011			**1970-1990**			**1990-2011**		
	Pooled	**FE**	**RE**	**Pooled**	**FE**	**RE**	**Pooled**	**FE**	**RE**
POPgr	1.68***	2.68***	1.68***	-0.06	0.49	0.001	3.02***	3.78***	3.02***
	(0.00)	(0.00)	(0.00)	(0.92)	(0.54)	(1.00)	(0.00)	(0.00)	(0.00)
lnLBF	6.51	7.17	6.51	10.41	4.41	10.09	7.9	8.43	7.90
	(0.13)	(0.12)	(0.12)	(0.25)	(0.74)	(0.27)	(0.11)	(0.18)	(0.10)
lnFC	0.87*	0.67	0.87*	1.08	2.76	1.16	1.51**	0.44	1.51**
	(0.06)	(0.30)	(0.06)	(0.12)	(0.20)	(0.11)	(0.01)	(0.61)	(0.01)
OPEN	-0.01	0.03	-0.01	-0.01	0.03	-0.01	-0.02	0.01	-0.02
	(0.46)	(0.21)	(0.46)	(0.72)	(0.49)	(0.85)	(0.33)	(0.56)	(0.32)
lnDEP	-7.81*	-5.54	-7.81*	-11.71	-14.72	-11.52	-9.86**	-4.86	-9.86**
	(0.07)	(0.27)	(0.06)	(0.19)	(0.26)	(0.20)	(0.04)	(0.44)	(0.04)
lnLEP	-0.84	-13.44	-0.84	2.67	10.22	1.81	-2.13	-20.54	-2.13
	(0.65)	(0.13)	(0.65)	(0.65)	(0.58)	(0.76)	(0.31)	(0.13)	(0.30)
CONS	0.91	6.59	0.91	-12.33	50.18	-9.2	-0.51	8.30	-0.51
	(0.86)	(0.23)	(0.86)	(0.61)	(0.45)	(0.72)	(0.91)	(0.18)	(0.91)
No. of Obs	150	150	150	75	75	75	90	90	90
R.Squared	0.15	0.26	0.22	0.07	0.21	0.13	0.42	0.52	0.47
F-Stat.	4.24	7.6		0.89	2.41		10.07	12.42	
	(0.00)	(0.00)		(0.51)	(0.04)		(0.00)	(0.00)	
Wald Stat.			25.44			5.39			60.41
			(0.00)			(0.50)			(0.00)
Hausman Stat.			67.56			17.54			41.48
			(0.00)			(0.01)			(0.00)
B-P LM Stat.			1.93			0.00			0.03
			(0.17)			(0.97)			(0.85)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively. Probability in Parenthesis.
Source: Authors' Computation.