Population Matters

More Aid + More People ≠ Less Poverty

A Study into How Different Types of Development Aid Have Influenced the Absolute Levels of Poverty in Countries with High Fertility Rates

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Sponsor: Population Matters

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Executive Summary

Background and Purpose

The client, Population Matters, is a membership organization and a charity which is concerned with how population growth influences the environment and people's living standards. During the past several decades, a massive amount of development aid has been invested into the world's poorest countries to reduce poverty and to improve living standards. The total amount can reach trillions of US dollars. Population Matters is concerned with where the aid comes from, how the huge amount of aid is distributed, and whether the usage of aid is effective and achieves the purpose of poverty reduction. It also wishes to know which methods might improve the efficiency of aid usage. Among all of these, Population Matters is particularly concerned with how aid might affect total fertility rate (TFR) reduction in the poorest and highest fertility rate countries. Moreover, it also wishes to find out what percentage of development aid actually contributes to the reduction of total fertility rate.

Methodology

The research analysed data from the twenty highest fertility rate countries in the world over the past ten years. Most of these countries are located in the Sub-Saharan African region and they are amongst the poorest countries around the world. A graphical analysis was first used to illustrate trends and sources over the past five decades and distributions of development aid in the past ten years from 2002 to 2011. Then, a simple spreadsheet calculation was used to explore an approximate result of percentage and the absolute number of people living below the poverty line ($1.25 per day) and efficiency of poverty reduction in the twenty highest fertility rate countries. Next, fixed-effect panel data model was produced to investigate which aspects of development aid contribute to total fertility rate reduction. Finally, a causal loop diagram was created to demonstrate how economic, social and cultural factors lead to high total fertility rates in the twenty highest fertility countries and to help consider how development aid contributes to the total fertility rate reduction.

Main Findings

High fertility rates and rapidly increasing population size were shown to be the main reasons for the absolute number of people living below the poverty line to increase in the twenty highest fertility countries during the past three decades, despite a sharp increase in the number of aid recipients. In these countries, the rate of TFR decrease is very slow and compared with the world average, TFR levels remain significantly high. How to reduce TFR to a reasonable level therefore becomes the key factor. Based on the results of an empirical model, three aspects of development aid directly contribute to reduction of the fertility rate: family planning; education; and economic infrastructure. However, the average percentage of aid spent on these three aspects are small compared with total development aid disbursement - only 16.38% in the past ten years, with only 0.31% on the most important, family planning. Since fertility reduction is the key to reducing poverty, aid donors should consider investing more aid in these three areas, especially family planning.

Table of Contents

1. Introduction

1.1 Background

The research was sponsored by Population Matters. Population Matters was previously known as the Optimum Population Trust, which is a membership organization and a charity which is concerned with how population growth influences the environment, resources and quality of life through education and research [14].

During the past five decades, huge amounts of development aid have flown into the world's poorest countries. The sum of the money exceeds trillions of US dollars. Population Matters is concerned with where the money came from and where it went, whether the money was used effectively and whether any improvements of development aid distribution can be made on reducing poverty and improving living standards in developing countries. Specifically, since the rapid growth size of population is one of the major causes of poverty, Population Matters wishes to know what percentage of aid contributed to reducing total fertility rate in these poorest and highest fertility countries, whether total fertility rate was reduced effectively and whether any improvements can be made.

There is an enormous amount of previous research on development aid or total fertility rate, however, not many studies on how development aid affects total fertility rate. Many previous reports investigate whether development aid work is effective in reducing poverty through macro social-economic factors such as quality of life, economic growth and so on. This research tries to explore whether development aid works effectively on reducing poverty through total fertility rate and size of population.

1.2 Population Matters

The aim that Population Matters had in sponsoring this project was to find out how development aid performs on reducing poverty and improving living standards in high fertility developing countries. It is concerned that although huge amounts of development aid is invested in developing countries every year to reduce poverty, the outcome is not as good as donors' expectations. Population Matters believes that even though the percentage of people living below poverty line is decreasing, the absolute number of people living in poverty keeps rising due to the slowly decreasing and significantly high total fertility rate in developing countries. The original plan of the project was to analyse what and how aspects of development aid affect the total fertility rate of one high fertility developing country for fifty years. However, after large amounts of sources and websites had been searched, only ten years of previous data was found to be available for the different aspects of development aid spent in each country. Due to the limitation of data, compromises have to be made. After this had been agreed with the client, the research changed to analyse the twenty highest total fertility rate developing countries for ten years. The twenty high fertility rate countries used in spreadsheet analysis and empirical models are presented in Table 1. They are the highest fertility rate countries in the world in 2011 and most of them are located in the Sub-Saharan regions of Africa.

1.3 Objectives of the Report

The report has four main objectives. The first objective is to classify source and distribution of development aid disbursement in these twenty countries which have the poorest and the highest fertility rate countries around the world. The second objective is to discover whether the huge amounts of development aid works effectively in reducing poverty through analysis of trends of percentage and absolute number of people living below the poverty line $1.25 per day. The third objective is to analyse aspects of development aid which contribute to reducing fertility rates in these twenty highest fertility rate countries and obtain the percentage of aid distributed on these aspects. The final objective is to discuss factors which lead to an increase in people living in poverty and identify possible solutions to alter the situation.

The twenty highest fertility rate countries used for analysis are presented in Table 1. The average total fertility rate for these twenty countries in 2011 was 5.62, which means that on average every woman in these countries would have 5.62 children during their lifetime. This obviously is a very high number compare with other countries in the world, especially developed countries. The average total fertility rate in the European Union was only 1.6 in 2011 [19].

Table 1: Twenty Countries with the Highest Fertility Rate

Country	Fertility Rate (2011 World Bank) [19]
Niger	7.0
Zambia	6.3
Mali	6.2
Afghanistan	6.2
Uganda	6.1
Malawi	6.0
Chad	5.9
Burkina Faso	5.8
Democratic Republic of the Congo	5.7
Tanzania	5.5
Nigeria	5.5
Timor-Leste	5.5
Rwanda	5.3
Angola	5.3
Benin	5.2
Guinea	5.2
Liberia	5.2
Republic of Yemen	5.0
Mozambique	4.8
Kenya	4.7

1.4 Structure of the Report

The report describes in section 4.1 the source and distribution of the international development aid given to the twenty highest fertility developing countries. Then it indicates many interesting but hard to understand relationships between poverty, fertility rates and size of population in the twenty highest

fertility rate countries in section 4.2. Recently, many social economists have investigated factors affecting fertility rates using statistical methods, especially panel data models due to the nature of the data structure. This report follows the tradition of building a panel data empirical model to study aspects of development aid which contribute to reducing fertility rate in section 4.3. It then demonstrates how various factors affect fertility rates through a causal loop diagram. At the end, the report uses various charts to discuss the percentage of development aid contributing to fertility rate reduction and sets out the conclusions of the study.

2. Literature:

A great many pieces of research have been carried out on development aid and fertility rate respectively. This section specifies the main findings from previous research in three separate parts: development aid, fertility rate and using panel data model for fertility rate analysis.

2.1 Previous Literature Relating to Development Aid

Countries analysed in this report are categorised by Keeley (2012) [10] as the **stagnating or declining countries**. In his book, he pointed out that "these countries gain little from globalisation, but are among the most vulnerable to it's adverse effects, such as climate change and higher natural resource prices". He mentioned several main reasons why these countries stay in extreme poverty, including civil wars, reliance on exportation of commodities such as oil or diamonds, a lack of incentive to develop industries due to rich natural resources, landlocked and bad governance.

The aid most generally discussed normally refers to Official Development Assistance (ODA). ODA has three key characteristics:

1. It comes from governments or from their official agencies;

2. The main objective is improving the economic development and welfare of developing countries; and

3. It is either given as a grant or a loan at a rate less than market interest rates. Developing countries who receive the grants do not need to pay it back and around 90% of ODA is given as grants. Most of the rest are given as a loan but charged with a very low interest rate. [10]

Sub-Saharan Africa is the largest recipient region of development aid in recent years and the amount keeps rising [10]. Most countries analysed in this report are located in the Sub-Saharan African region which means that these countries should be the biggest beneficiaries.

The reason leads to the recent ten years, especially in 2005 and 2006, sharp increase of aid which was due to the setting of the **Millennium Development Goals**. The eight Millennium Development Goals include:

Eradicate extreme poverty and hunger
Achieve universal primary education
Promote gender equality and empower women
Reduce child mortality
Improve maternal health
Combat HIV/AIDS, malaria, and other diseases
Ensure environmental sustainability
Develop a global partnership for development [26]

The key of all these goals is poverty reduction. The eight Millennium Development Goals document was signed by 189 countries which targeted to help developing countries reducing poverty until 2015. The efforts made from developed countries to achieve the Millennium Development Goals can be measured using many aspects: increase developing countries' debt forgiveness, boost grants and so on. The strong willingness and ambition to help given by developed countries can be seen from the sharp increasing aid after 2000.

Although in the Millennium Development Goals, donor countries increased the amount of aid in many aspects, the effectiveness of aid in the Sub-Saharan African countries is not obvious and involves several problems. As pointed out by Abegaz (2005)[1], Sub-Saharan African is the only region where **real income per capita** is falling for a significant portion of the population, capital accumulation only has a limited impact on growth, the risk-adjusted private rates of return are low; political instability is widespread; and primary export earnings and aid flows are vulnerable.

In Abegaz (2005) [1] paper, he stated several problems which caused aid inefficiency: serious agency problems, highly asymmetrical power relations between donors and recipients, coordination failures among donors and recipients, and inadequate attention paid to local circumstances. He also stated that the aid inefficiency is caused by failure of involved institutions, including domestic institutions (sub-national governments, the business community, and civic groups) and the global governance system (donor governments and international institutions).

Pedersen (2001) [13] specified that the organizations and developed countries, eager to reduce poverty, are counter-productive that their activities may lead to more poverty and more uneven distribution of income in recipient countries than without of aid. The reason is recipient countries put less effort on reducing poverty because there are foreign aid organizations anxious to help the poor. The recipient governments know that the more poverty a generous donor organization observes the more aid it will give. These selfless organizations create an incentive to distort the true picture.

2.2 Previous Literature Relating to Fertility Rate

Hemmi (2003) [8] said that **high fertility is not only the result of poverty, but also the cause of the poverty.** They found the reason of **negative correlation between income and fertility**. In low-income countries, high fertility rates lead to higher educational costs. Low income and higher educational costs cause fewer children who can get an advanced level of education, reduce in the income level which children face in the next period and thus reducing the opportunity cost of having children. Therefore, low-income families tend to have more children.

Bongaarts and Casterline (2012) [2] stated that the fertility transition of the Sub-Saharan African region is still in the early stages and the high fertility rate is caused by a high desire for family size. Two main reasons make couples want as many children as possible: more labour force in traditional farming business and for security purposes due to high child mortality rates. In addition, **high child mortality** leads parents to have additional children to protect against losses. **Fertility decline occurs with rising levels of urbanization, education and declining children mortality** (Gayawan et al 2010) [5]. Moreover, **fertility decline followed with human capital accumulation and economic growth**. Caldwell (1980) had similar findings. He pointed out that one reason for high fertility rate is that the lifestyle of most of the population in African countries is commonly rural and less industrialized than the rest of the world [3]. This rural lifestyle encourages people to engage in farming. As a result, large family size is considered as an asset. Kokole (1994) [11] stated that costs associated with raising a child also affect fertility rate. When costs rise, children become less affordable for actual and potential parents. Parents rely on **contraception, abortion** or **family planning programs** to control the fertility rate in many countries. Therefore, family planning aid should have a negative relationship with fertility rate. However, from Gayawan et al (2010) [5], the high fertility rate in African countries is caused by low use of contraception products and a high level of social value of childbearing. The **usage increases with the education** level of a woman. Generally speaking, **family planning was not practiced very effectively in Africa.** It is widely agreed that **education, especially female education,** is the main motivation of fertility modernization.

Gayawan et al (2010) [5] also found some significant differences of fertility transition between African and non-African countries**.**

1. The recent speed of fertility decline in Africa is noticeably slower than the speed of decline in Asia and Latin America during their early stage of fertility transition. In fact, in many African countries the fertility rate appears to have stalled to around 5. The static fertility rate is highly unusual. Non-African countries such as Asian countries typically experienced an acceleration of the fertility decline when they were in early stages.

2. Birth intervals are longer in Africa. This is probably caused by the widespread traditional breastfeeding in Africa.

3. Ideal family size is larger in Africa**. In fact, the larger ideal family size is one of the main reasons of the slowly decreasing fertility rate.**

John et al (2012) [9] stated that although HIV-infected women has significantly lower fertility rates, local community HIV prevalence has had no significant effect on non-infected women's fertility. Therefore the development aid on STD control and HIV protection is not relevant with the change of fertility rate.

Cultural factors also have great impact on fertility rate. D'Addio and d'Ercole (2005) [4] found that transformation of women's role played in society would change childbearing. The values and beliefs of women's role in work and family has changed, which may contribute to delaying childbearing in all countries. They pointed out that **women's income level, education level** and **unemployment rate** would influence childbearing. Because having a child involves trading-off time and energy between paid work and childbearing. Higher earnings increase the opportunity cost of not working. Similarly, higher

education level increases earning potential and the opportunity cost of childbearing. The general relation suggested women have **fewer children when they have higher income and higher educational achievement**, and **that fertility rate and labour market participation of women are negatively related**. The relationship between unemployment rate and fertility rate is complicated. D'Addio and d'Ercole (2005) [4] found negative relationship. When unemployment rate is high, young people may decide to remain longer in the parents' home or in school. However, as females may also expect a lower probability of finding job, unemployment may also increase childbearing.

Gayawan et al (2010) [5] found other reasons of high fertility rate in African including **early and universal marriage** and **competition among co-wives,** resulting in child bearing which begins early and continues for much of the reproductive life span.

Romaniuk (2011) [18] said three culture factors seriously affect fertility rate in most African countries: **kinship, polygamy and lactation**. The **kinship system** can influence fertility behaviours seriously. In traditional African societies, **large amounts of pressure on couples produce as many children as possible in order to enhance the power of family and to ensure the continuity of the lineage.** The second feature is polygamy. As partners, **polygamous women on average are less prolific than monogamous ones**. This is a result the lower frequency of coitus and greater age difference between spouses in such unions. However, at general level, polygamy **maximizes** the reproductive capacity of the lineage and thus maximise the number of children a family can have. The third feature is **postnatal abstinence and breastfeeding**. Long breastfeeding duration leads to longer birth interval in Africa. Heisel (1990) [7] has similar findings with Romaniuk (2011) but from different perspective. The importance of agriculture and lineage conducted early marriage and continuous childbearing in Africa.

2.2 Previous Literature of Using Panel Data Model

There are a large number of previous papers on fertility rate using panel data models. In the D'Addio and d'Ercole (2005) paper [4] "policies, institutions and fertility rates: a panel data analysis for OECD countries", the dynamic two-way fixed effect panel data model used to determine factors affect fertility rate is adopted by D'Addio and d'Ercole. The only difference between the model adopted in D'Addio and d'Ercole (2005) and this research is that the authors have one more lag dependent variable in the fertility rate equation. The reason to include this lag factor is to account for the potential dynamic effects of policies on the fertility rate, which is not relevant with the goal of this report. Therefore, the two-way fixed effect panel model is used without the lag factor.

3. Methodology

3.1 Data

The data used in the research was found from several multilateral agencies using official websites, such as the United Nations, the Organisation for Economic Co-operation and Development (OECD) and the World Bank. All data of development aid includes total development aid disbursement, development aid distributed on each sector for each country were searched using the OECD website. The OECD is an international economic organisation which focuses on policy and practice of world economics [27]. Members of Development Assistance Committee (DAC) are 26 countries selected from OECD [Table 5] which are putting much effort into helping developing countries [12].

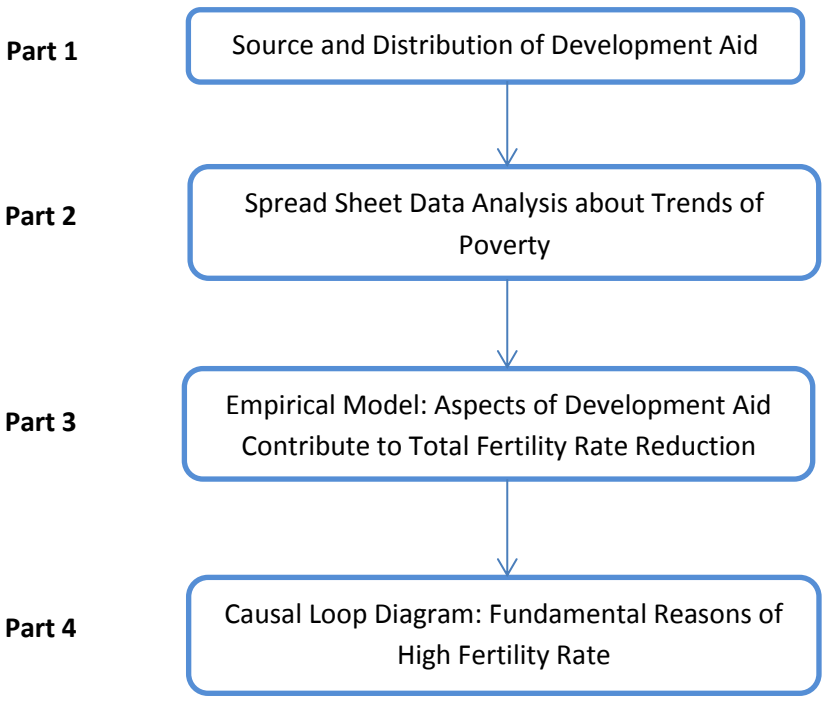
The data used in this research relates to the twenty highest fertility rate countries in the world in 2011. Most of them are Sub-Saharan African countries except Afghanistan, the Democratic Republic of Timor-Leste and Republic of Yemen. These twenty countries are shown in Table 1 in section 1.3. Although Somalia and Equatorial Guinea have a higher fertility rate than Mozambique and Kenya in 2011, the former two countries have incomplete data records. Therefore the report uses Mozambique and Kenya, which fertility rates are also unreasonably high, to do analysis instead of Somalia and Equatorial Guinea. Data about development aid comes from OECD website, according to the website, the sectors of development aid used in the report means that development aid is of one country which is received from all donors around the world, not only developed countries which are regular donors to developing countries such as the United Kingdom, Finland, Japan, but also many multilateral agencies, such as the United Nations and the World Health Organization. Table 2 displays part data sources. This data is very important for building an empirical model. The full data sources are presented in Appendix C. Data associated with social and economic aspects including **Total Fertility Rate, Children Mortality Rate under 5, Life Expectancy, GDP per capita and size of population** are from the United Nations data website, known as the UNdata, where most data is sourced from the World Bank. Aggregate data of poverty headcount ratio below $38 per month was obtained from the World Bank Website. The unit of the value for aid is US dollars in millions. Since the data is found from many different sources and the terminology might be different, the definition of terminology used in this report is provided in **Appendix B.**

Table 2: Sources of Data

Variable	***Sources***
Total Fertility Rate	the World Bank **[19]**
Life Expectancy	the World Bank **[20]**
Size of Population	the World Bank **[21]**
Children Under 5 Mortality Rate	United Nations Statistic Division **[23]**
GDP per Capita	United Nations Statistic Division **[25]**
Total Development Aid Disbursement[13]	
Development Aid on Education	
Development Aid on Health	Organisation for Economic Co-operation and
Development Aid on Reproductive Health	Development (OECD) **[16]**
Development Aid on Family Planning	
Development Aid on STD Control	
Development Aid on Economic Infrastructure	

Aggregate Value of Poverty Headcount Ratio	The World Bank **[22]**

3.2 Approach



Graph 1

There are four parts of the analysis, which are presented as Graph 1, in the report to find out answers for the three main questions: how development aid has been used, whether the aid was used effectively to reduce poverty and why the aid spent does not reduce poverty effectively. The first two questions will be solved in part 1 and 2 respectively; the final question will be answered by parts 3 and 4.

Generally, the analysis in the report follows the logic in Graph 1. It starts with investigating the source and distribution of development aid to answer the question where aid came from and where the aid went. Part two studies trends of poverty through analysing percentage and absolute number of people living below the poverty line by comparing the twenty highest fertility rate countries, the Sub-Saharan African region, China and the worldwide. Then it goes to the core of the research – the reasons development aid does not appear to work very effectively in these countries. Part three builds a two-way fixed effect panel data model to explore aspects of development aid related with fertility rate in the twenty highest fertility rate countries and part four constructs a causal loop diagram to explain all possible fundamental variables that affect fertility rate. Finally, in the discussion, the percentage of development aid which actually contributed to fertility rate reduction over the past five and ten years are displayed by pie charts.

3.3 Data Preparation and Model Building

3.3.1 Analysis Part 1: Source and Distribution of Development Aid

Part 1 uses various charts to explain the sources of development aid for past five decades and the average distribution of development aid of the twenty countries in the most recent ten years from 2002 to 2011. The source of total development aid for the twenty countries from DAC, G7 and Multilateral Agencies is calculated by summing up the aid given from 1961 to 2011. The average distribution for the twenty highest fertility rate countries is calculated by summing up ten years aid on each sector for all twenty countries and then divided by the number of countries and the number of years to get the average percentage of distribution for each country in each year (See equations below). The report points out the most interesting similarities and notable differences of aid distribution between these twenty highest fertility rate countries.

$$Total\ Aid\ for\ the\ Twenty\ Countries = \sum Aid\ Disbursement_{it}$$

$$Average\ Aid\ Distribution\ for\ Each\ Sector = \frac{\sum Aid\ Disbursement\ on\ Each\ Sector_{it}}{i \times t}$$

$$\forall i \in country, t \in year$$

3.3.2 Analysis Part 2: Poverty Analysis

The second part of the research analysed the percentage and absolute number of people living below the poverty line through a simple spreadsheet calculation of the poverty headcount ratio and the size of population [Definition in Appendix B]. It also discussed percentage change of the poverty headcount ratio and the total fertility rate through scatterplot. Data of poverty headcount ratio is from the World Bank aggregate value. It also explains the reason that although a huge amount of development aid was spent in these developing countries, the living standard did not actually improve. This is caused by fast increasing population as it can be seen from displaying trends of total fertility rate and the size of population in these twenty highest fertility rate countries from 1961 to 2011. The absolute number of people living below poverty line $1.25 per day is calculated by the equation:

$$Absolute\ Number\ of\ People\ Living\ Below\ Poverty\ Line_{it} = Poverty\ Headcount\ Ratio_{it} \times Size\ of\ Population_{it}$$

$$\forall i \in country, region \quad \forall t \in year$$

$$Percentage\ Change\ of\ Poverty\ Headcount\ Ratio = \frac{Poverty\ Headcount\ Ratio_{t} - Poverty\ Headcount\ Ratio_{t-1}}{Poverty\ Headcount\ Ratio_{t-1}}$$

3.3.3 Analysis Part 3: Empirical Research

1) Justification of Using Panel Data Model

In the empirical research, the report explores which aspects of development aid affects the total fertility rate in these twenty highest fertility rate countries. As stated in section 2.3, there are many previous panel data models which have been used to investigate; social, economic or cultural factors affecting fertility rate. The reason behind using panel data model is not only because normally fertility rate analysis involves a wide range of countries, but also because it usually involves a time scale to show the trends of fertility rates. According to previous literature, development aid on education, health, reproductive health, family planning, STD control and economic infrastructure may have a relationship with the total fertility rate. The statistical software used in the model building process includes Minitab and Stata. Data preparation did in both software and fixed effect panel model built in Stata.

2) Data Observation

The original dataset contains 20 countries over a period of 10 years. The approach used is fixed effect panel data model. Table 3 shows a statistical summary of the original dataset. The number of observations in the original dataset is 200 which are shown in Table 3 below N column. The number of observations containing missing values is 27. In the original dataset, there are 3 observations which have a negative value, which are development aid on family planning. The negative value on development aid is unusual; the negative value observations were aid on family planning in Burkina Faso, Mali in 2005 and in Zambia in 2007. The donor of the former two countries is Germany and of the latter is Canada. The reason of negative value of family planning aid is unknown. After removing the 30 unusual observations, there were 170 observations left in the model dataset. After removing missing value observations, the panel data became unbalanced: five countries contained 10 years value, seven countries contained 9 years value, three countries contained 8 years value, four countries contained 7 years value and one country had 5 years value. Table 3 shows the summary statistics before removing any unusual observations.

Table 3: Summary Statistics of Original Data

	N	*N**	*Mean*	*St Dev*	*Min*	*Q1*	*Median*	*Q3*	*Max*
Total Fertility Rate	200	0	5.93	0.61	4.68	5.51	5.87	6.29	7.45
Country	200	0	*	*	1	*	*	*	20
Year	200	0	*	*	2002	*	*	*	2011
Life Expectancy	200	0	51.87	4.51	42.34	48.39	51.10	54.12	65.45
GDP per Capita	200	0	718.40	866.30	104.80	302.60	452.90	737.50	5318
Size of Population	200	0	25741379	31019988	888099	1002409 1	1494103 5	30648720	162470737
Children Under 5 Mortality (among 1000)	200	0	128.69	37.68	54.10	96.90	126.00	161.93	206.70
Aid on Education	200	0	74.03	59.19	1.38	35.41	56.57	101.42	391.81
Aid on Health	200	0	83.71	82.60	1.02	24.10	56.20	108.53	528.42
Aid on Reproductive	199	1	8.17	11.28	0.14	2.40	4.86	9.56	86.01
Aid on Family Planning	175	25	3.91	5.65	-0.04	0.32	1.91	5.15	41.50
Aid on STD control	198	2	71.86	104.34	0.01	5.96	18.29	108.26	455.19
Aid on Economic	199	1	128.60	179.90	0.00	30.60	66.20	160.20	1164.50

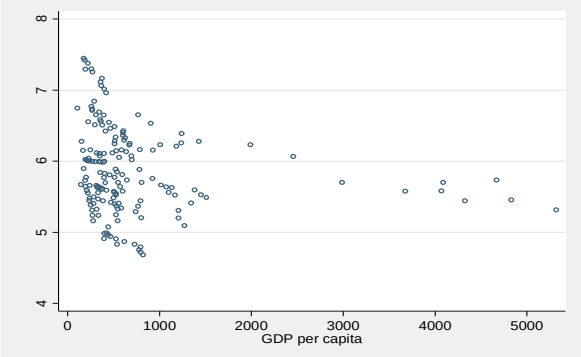
Infrastructure

After investigating the original dataset, it was found that some observations were close to zero value of development aid on family planning, to avoid Stata treating these values as zero, all family planning aid had a constant term 0.1 added.

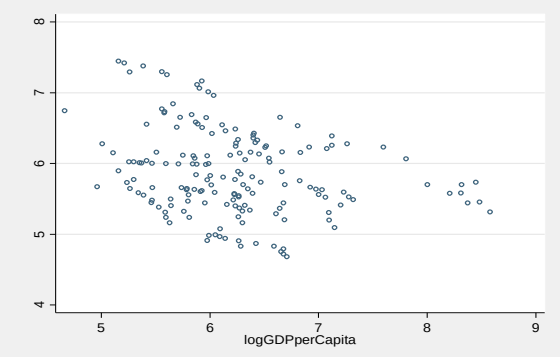
Below are two graphs that show the scatter of observations of variable total fertility rate against GDP per capita before and after logarithmic transformation of variable GDP per Capita. In the graphs, the vertical axis is total fertility rate and the horizontal axis are GDP per capita and log GDP per capita respectively. It is obvious that before logarithmic transformation to variable GDP per capita, observations were concentrated on the left side of the graph [Graph 2]. After the transformation, observations were more scattered [Graph 3]. More scattered observations will improve the accuracy of empirical model.

The problem of observations concentrated on the left also happens to variable development aid on education, health, STD control, family planning, reproductive health and economic infrastructure. It can be seen from the first matrix plot [Appendix D4] that observations of variable GDP per capita and all development aid variables are concentrated on the left hand side of each plot. The reason might be caused by the fact that although these values are increasing steadily with time, the differences between the values are not significant, therefore most data is concentrated together. To resolve this problem, a logarithmic transformation was applied to these variables. It can be seen from the second matrix plot, after the transformation, the variables GDP per capita, development aid on education, health, reproductive health, family planning, STD control and economic infrastructure become much more scattered.

Graph 2



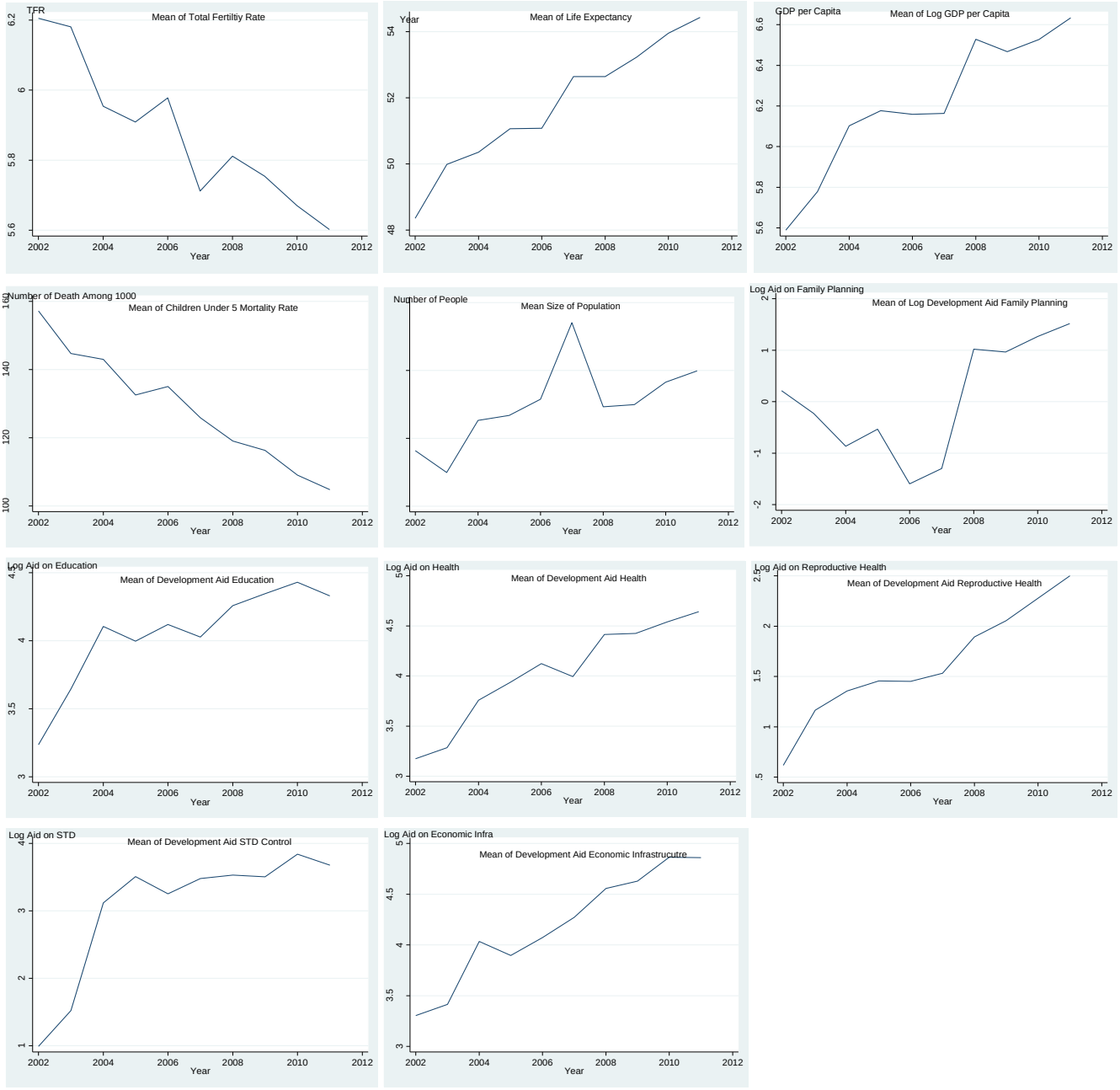
Graph 3



Graph 4, which contains a set of line plots, shows changes of the twenty countries with the average value of each variable used in the empirical model from 2002 to 2011. All plots below have years from 2002 to 2011 on the horizontal axis, and mean of total fertility rate, life expectancy, log GPD per capita, children under five mortality, size of population, log development aid on family planning, education, health, reproductive health, STD control and economic infrastructure for each year on the vertical axis. The purpose of using mean value of variables of each year is to display the general trends of these variables.

It is clear that the total fertility rate and the children under 5 mortality rate have downward trends in the ten years. Variable life expectancy, log GDP per capita, size of population and six aspects of development aid generally have an upward trend. It can be seen there is a sharp decreasing trend in

development aid on the family planning plot and the huge drop of the size of population. They are caused by removing several unusual and missing value observations from the original dataset.



Graph 4

Table 4 shows the description of the panel data variables after dealing with unusual observations and logarithmic transformation. It can be seen from the table that the standard deviation of variable country does not vary within individual observations. This means variable country does not vary with time – set country as a fixed variable. Variable year, log aid on reproductive health and log aid on family planning vary more within individual than between individual. However, other variables vary more between individuals than within individual. The "within" standard deviation of TFR is smaller than the "between" standard deviation of TFR. This indicates that if two countries are randomly selected from the dataset, the difference of total fertility rate between two countries is expected to be smaller than the difference for the same country in two randomly selected years. The number of observations used to build the

fixed effect panel model was 170, which contained 20 countries and on average 8.5 years since after removing missing value observation, the dataset became unbalanced. There are some negative value observations in variable aid reproductive health, family planning, STD control and economic infrastructure. The reason of these negative values is caused because after applying logarithms to these variables some very small values became negative, which does not affect the accuracy of model.

Table 4 Panel Data Statistical Summary with Model Dataset

Variable		*Mean*	*Std Dev.*	*Min*	*Max*	*Observations*	
Country	*Overall*	10.77647	5.743793	1	20	*N*	170
	Between		5.91608	1	20	*n*	20
	Within		0	10.77647	10.77647	*T-bar*	8.5
Year	*Overall*	2006.659	2.971474	2002	2011	*N*	170
	Between		0.5530596	2005.5	2008.2	*n*	20
	Within		2.935606	2001.087	2011.23	*T-bar*	8.5
Total Fertility Rate	*Overall*	5.877235	0.6012394	4.68	7.447	*N*	170
	Between		0.5616263	4.8438	7.214375	*n*	20
	Within		0.2402732	5.195458	6.962236	*T-bar*	8.5
Life Expectancy	*Overall*	51.83833	4.499133	42.34254	65.45166	*N*	170
	Between		4.424156	45.63558	63.58979	*n*	20
	Within		1.724606	46.65422	55.58939	*T-bar*	8.5
Log GDP per Capita	*Overall*	6.227191	0.7377703	4.65996	8.578861	*N*	170
	Between		0.6928062	5.135456	7.808372	*n*	20
	Within		0.3730171	4.452002	7.063143	*T-bar*	8.5
Size of Population	*Overall*	27300000	32700000	931324	162000000	*N*	170
	Between		31700000	1087538	146000000	*n*	20
	Within		3183563	11600000	442000000	*T-bar*	8.5
Children under 5 Mortality(among 1000)	*Overall*	127.9947	37.98176	54.1	206.7	*N*	170
	Between		36.11948	65.64	190.2556	*n*	20
	Within		16.12488	89.60582	185.1058	*T-bar*	8.5
Log Aid on Education	*Overall*	4.058962	0.8369787	0.3244719	5.970773	*N*	170
	Between		0.6908725	2.342775	4.939646	*n*	20
	Within		0.5284894	1.918353	5.534985	*T-bar*	8.5
Log Aid on Health	*Overall*	4.052629	0.9867621	1.142519	6.269889	*N*	170
	Between		0.8187898	2.488533	5.164634	*n*	20
	Within		0.6044056	2.183631	5.220017	*T-bar*	8.5
Log Aid on Reproductive Health	*Overall*	1.660315	1.028602	-1.942292	4.454507	*N*	170
	Between		0.6831634	0.6780774	2.848349	*n*	20
	Within		0.7878377	-1.824449	3.266473	*T-bar*	8.5
Log Aid on Family Planning	*Overall*	0.1690259	2.115976	-8.859683	3.730489	*N*	170
	Between		1.231541	-3.446169	1.494908	*n*	20
	Within		1.76245	-5.480622	4.738595	*T-bar*	8.5
Log Aid on STD Control including Aids/HIV	*Overall*	3.028374	2.081957	-4.438978	6.120706	*N*	170
	Between		1.82404	-0.473213	5.065977	*n*	20
	Within		1.143893	-0.937391	5.706414	*T-bar*	8.5
Log Aid on Economic Infrastructure	*Overall*	4.212915	1.345145	-3.307543	7.060068	*N*	170
	Between		1.039048	2.086538	5.979427	*n*	20
	Within		0.9203744	-1.181166	6.779774	*T-bar*	8.5

Since the unit of all development aid variables is US dollars in millions, after logarithmic transformation the number of these aid variables becomes relatively small. The range of variable size of population for different countries is huge, which can be seen from the difference between the minimum and the maximum value. The life expectancy for these developing countries is generally quite small, even the maximum life expectancy is only around 65 years old, which is much lower than the life expectancy in developed countries.

In order to show there were no significant outliers in the dataset, boxplots were plotted and these are presented in the Appendix D2. From the boxplots, it can be seen that there are only a few outliers in variable life expectancy, size of population, log GDP per capita, log Aid on Education, log aid on reproductive health, log aid on STD control and log aid on economic infrastructure. The number of outliers is not significant and none of them is an error. Therefore, the outliers were kept in the model dataset.

In addition, to see the structure of data, histograms of variables are presented in Appendix D3. It can be seen from the histogram that several variables have a negative value, including development aid on reproductive health, family planning, STD control and economic infrastructure. As stated before, the reason of these negative values is caused because before logarithmic transformation, the original values of these observations were very small. After transformation, the value of observations become more scattered and some small values become negative. The variable size of population has a wide range between these twenty countries. It is worth noticing that the general fertility rates are very high in these countries, even though the minimum value is higher than 4.5.

3) Panel Data Model

The two-way fixed effect panel data model used is:

$$Yit = \alpha + \boldsymbol{\beta Xit} + \gamma i + \delta t + \varepsilon it \qquad \forall i \in country, t \in year \qquad (1)$$

The Y_{it} indicates the dependent variable total fertility rate in twenty different countries over a period of ten years, X_{it} indicates independent variables including GDP per year, Children under 5 mortality rate, life expectancy, size of population, development aid on education, health, reproductive health, family planning, STD control and economic infrastructure. The γ_i represents fixed effect variable country and δ_t is fixed effect variable year. This is a two-way fixed effect model. In the software package, when apply fixed effect, the model becomes:

$$Yit - \overline{Yi} = (\boldsymbol{Xit} - \overline{\boldsymbol{Xi}})\boldsymbol{\beta} + (\varepsilon it - \overline{\varepsilon i}) \qquad \forall i \in country, t \in year \qquad (2)$$

The $\overline{Yi}$ represents the average of dependent variable total fertility rate Yit, $\overline{\boldsymbol{Xi}}$ is average of $\boldsymbol{Xit}$ and $\overline{\varepsilon i}$ is average of εit.

3.3.4 Analysis Part 4: Causal Loop Diagram

In order to illustrate why it is difficult to decrease the fertility rate in developing countries a causal loop diagram was constructed. Several alternative approaches of causal loop diagram were considered, such

as an illustrative simulation through Simul8 or a simulation of development aid allocation through @Risk. However, after comparing the causal loop diagram with illustrative simulation, it has been found that the causal loop diagram can not only display all characteristics of illustrative simulation, but also show some extra features. Moreover, the simulation of development aid allocation does not fit the research topic very well. Therefore, the causal loop diagram was chosen.

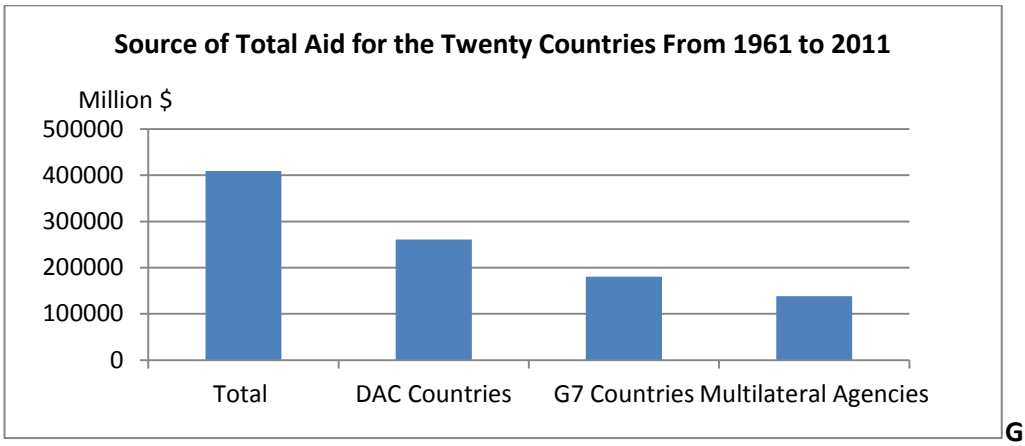
The causal loop diagram illustrates cause and effect relationships and feedback processes. [24] It involves interrelated elements which might affect fertility rates as many as possible according to previous findings. It shows both factors related with fertility rates through arrows and the direction they affect fertility rates through the minus and plus sign. The minus sign indicates negative relationship between two elements. For example, when the level of female education increases, the fertility rate would go down and vice versa. The diagram displays factors which affect fertility rate through three major areas: social, economic and cultural. The most vital causes of high fertility rate will be discussed through the diagram. The software used to build the diagram is called Vensim.

4. Results and Interpretations

4.1 Source and Distribution of Development Aid

4.1.1 Source of Development Aid

The development aid comes from a wide range of sources, not only from many generous developed and developing countries, but also a large number of multilateral agencies. Several well-known groups of countries are the main sources of development aid, such as members of Development Assistance Commitment (DAC) and G7. DAC countries include nineteen European countries, two North American countries, one country in the Australasian continent, one country in New Zealand region, two Asian countries and the European Union. Table 5 displays DAC countries and all of them are well developed. G7 countries are seven developed countries covered by DAC countries [12].



Graph 5

Graph 5 shows the main sources of total development aid disbursement to the twenty highest fertility rate countries from 1961 to 2011. It is clear that DAC countries made a great contribution and are very ambitious in helping developing countries to reduce poverty; more than 60% of the total development aid in the past fifty years has come from these twenty five countries (DAC) in the world. The sum of development aid from DAC exceeds 26000 million US dollars. OECD's DAC are traditional donors of development aid, but there are some other governments which also made a great contribution on development aid, such as Brazil, Russia, India, China, South Africa, Saudi Arabia and Turkey. It is worth to noticing that private donations have also started to become involved in recent years, such as the Bill & Melinda Gates Foundation.

Members of G7 countries are included in DAC and they are the major donors in the DAC. Multilateral Agencies played a significant role when dealing with international development aid. They are not only fund donors, but also involved in the allocation of these huge amounts of money. The most well-known multilateral donors include the United Nations, the World Bank, the Global Funds and so on.

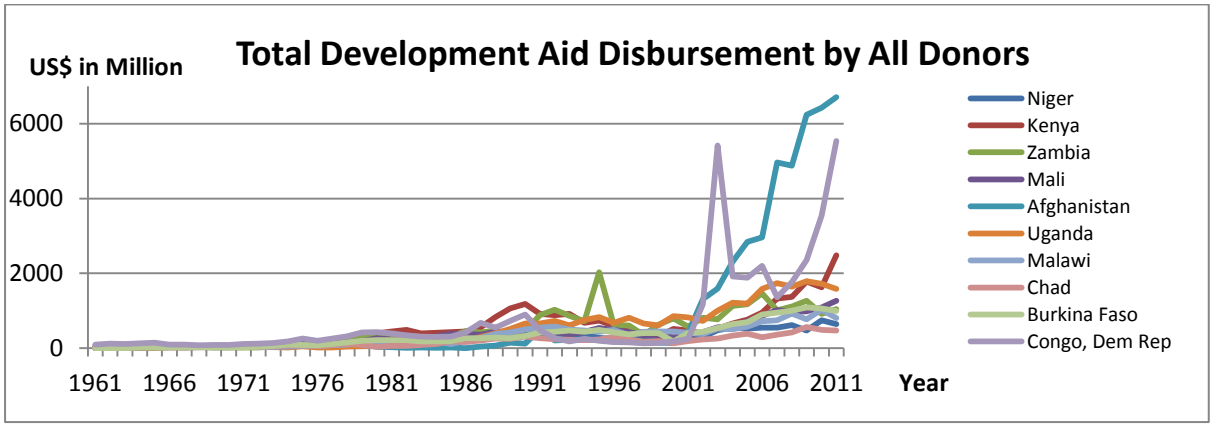
Table 5: Development Assistance Commitment Countries [12]

Australia	Austria	Belgium	Canada	Denmark	European Union

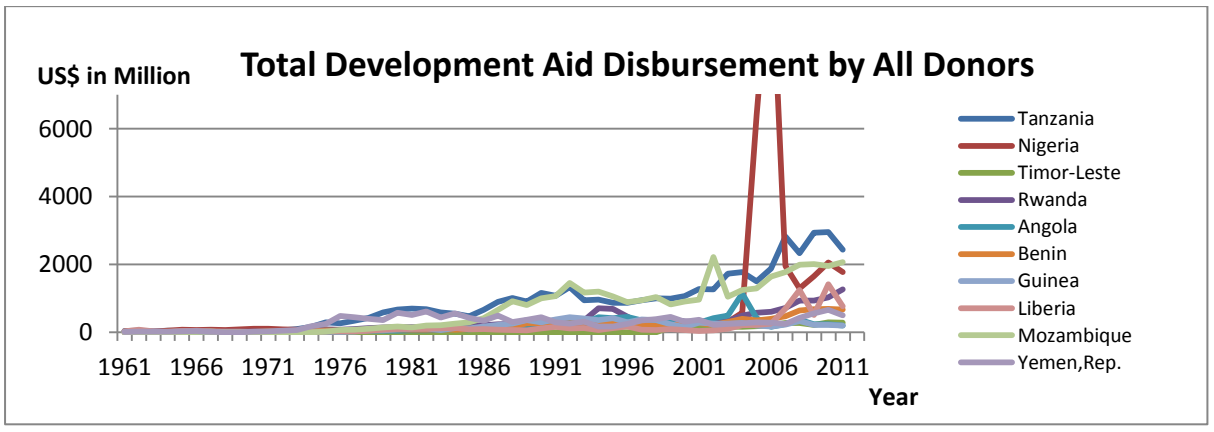
Finland	France	Germany	Greece	Ireland	Italy
Japan	Korea	Luxembourg	The Netherlands	New Zealand	Norway
Portugal	Spain	Sweden	Switzerland	United Kingdom	United States

4.1.2 Distribution of Development Aid

The distribution of development aid is complicated because the amount of money is large and the purpose is vital. More importantly it involves not only recipients and donors, but also multilateral agencies play a vital role as intermediate. Some researchers even think that the institutions involved in aid distribution directly influence the effectiveness of aid [1]. In order to illustrate the trends clearer, the data has been displayed into two graphs.



Graph 6



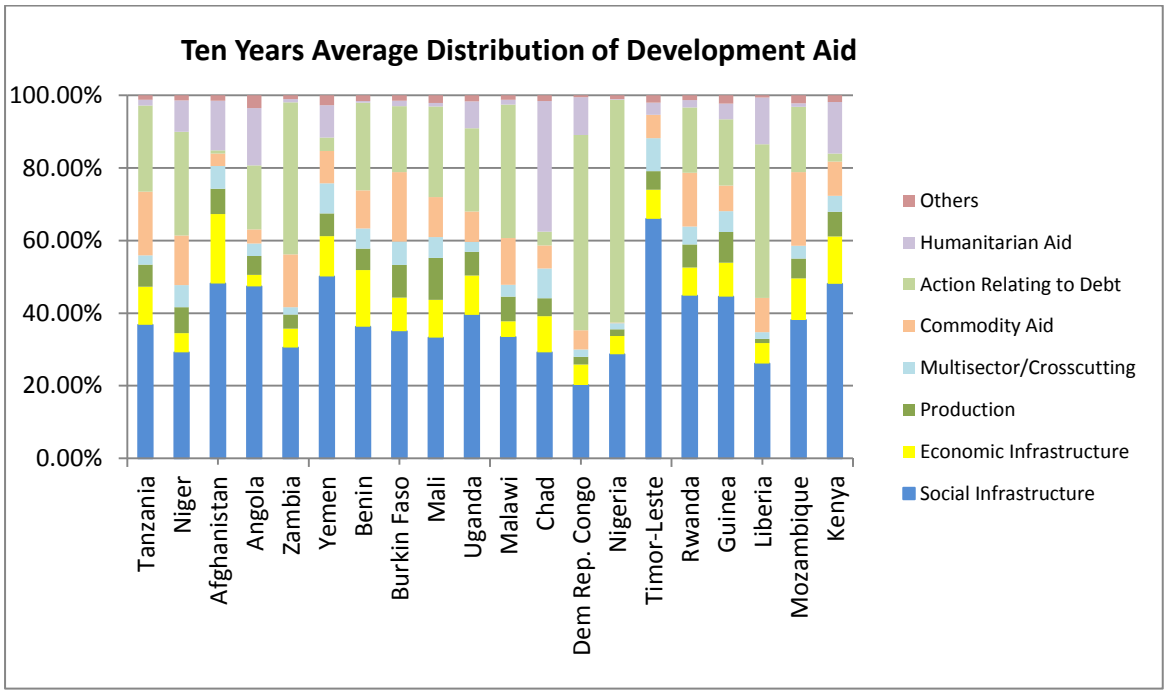
Graph 7

Graph 6 and 7 show that in these twenty highest fertility rate countries, the total development aid disbursements generally have upward trends, especially after the year 2000. The most dramatic increase happened in Afghanistan where from around 400 million US dollars in 2001 there was a sharp increase to more than 6700 million in 2011. In most countries, total development aid increased steadily and fast during the past fifty years. However, a few countries seem to have a large level of fluctuations, such as the Democratic Republic of Congo and Nigeria. The large fluctuation which happened in these two countries was caused by a large amount of debt forgiveness on action relating to debt. The debt "forgiveness" is not real money, but the cancellation of loan repayment for these developing countries. Donor countries sometimes agree to defer loan repayments or cancel them altogether. This is where the large amount of activities relating to debt comes from in 2006 in Nigeria and 2003 in Congo.

Many researchers thought that the total amount of development aid normally differs from donor and recipient perspectives and it is difficult to count an exact figure [10]. This is because of too many institutions that are involved and the way funds are disbursed in many different ways such as loans, grants and so on. This research uses development aid disbursement from recipient countries' perspectives. Generally speaking, until the end of 2011, Tanzania was the country which received the highest amount of aid in Sub-Saharan Africa and Afghanistan was the country which received the highest amount of aid in the Middle East region amongst these twenty highest fertility rate countries. In total, there are ten countries where aid disbursement exceeded 1000 million US dollars in 2011, including Kenya, Zambia, Mali, Afghanistan, Uganda, Democratic Republic of Congo, Tanzania, Mozambique, Nigeria and Rwanda. If one considers the accumulated amount aid disbursement for past fifty years from 1961 to 2011, fourteen out of twenty countries disbursed more than 10000 million US dollars in the fifty years. Afghanistan, Tanzania and Democratic Republic of Congo are the biggest beneficiary. If we only consider the accumulated amount over the past ten years, these three countries still are the biggest beneficiaries. The Democratic Republic of Congo and Tanzania are two countries which have a very large proportion of their land in the Sub-Saharan African region.

Two graphs are shown below to illustrate the distribution of development aid in the twenty highest fertility rate countries. One graph shows the distribution by general categories and the second gives a breakdown of the social category of aid. The development aid is distributed into eight categories: social infrastructure, economic infrastructure, production, multi-sector (crosscutting), commodity aid (general programme assistance), action relating to debt, humanitarian aid and others. The last sector "Others" includes administrative costs of donors, refugees in Donor countries and unallocated aid.

Graph 8



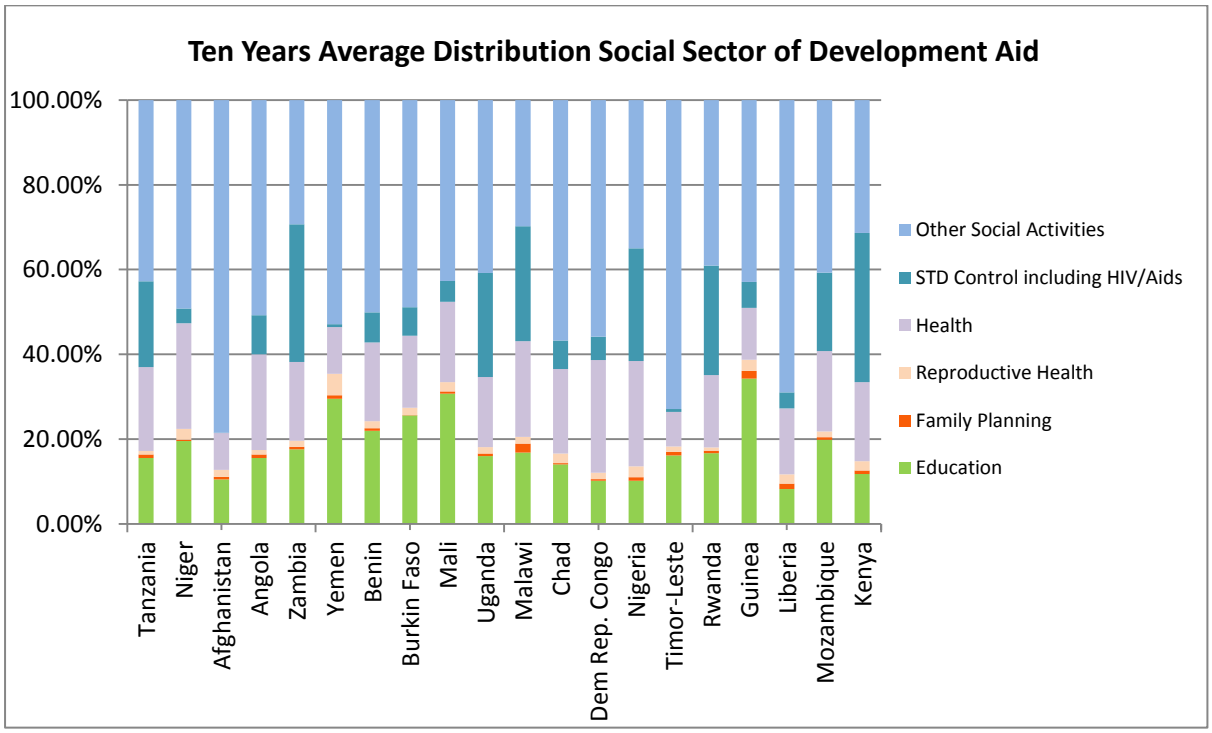
Graph 8 shows the average aid distribution for these twenty countries in the past ten years from 2002 to 2011. Most countries spent the largest percentage of aid on social infrastructure sector, except Zambia, Malawi, Chad, Democratic Republic of Congo, Nigeria and Liberia. The largest percentage of development aid disbursement of these countries, except Chad, is Action relating to the debt sector,

which is mostly the debt forgiveness from donor countries, not real money transfers. Therefore, in general, almost all countries spend the largest percentage of aid on social infrastructure. Chad has a large percentage of aid which is humanitarian aid, which is quite unusual compared with the other countries. The reason of high humanitarian aid in Chad is caused by political violence and active conflict happening over the past decade.

Action relating to debt is the second largest sector where development aid distributed. However, the majority of this sector has no real money inflow since a large percentage belongs to debt forgiveness from donor countries. As mentioned in earlier, since DAC countries wish to help developing countries to achieve the Eight Millionaire Development Goals until 2015, aid investment increased on every aspect during the past ten years, including debt forgiveness which reduced huge amount of pressure to pay debt in these developing countries.

In most countries the production sector dominates less than 10% of total development aid, which is not very significant. Comparing with the production sector, economic infrastructure has greater input. Eight countries have economic infrastructure higher than 10% of their total aid disbursement. They are Tanzania, Afghanistan, Yemen, Benin, Mali, Uganda, Mozambique and Kenya. But comparing with social infrastructure, economic infrastructure is still a very small proportion. It will be discussed in section 4.3 that economic infrastructure sector is one of the three aspects of development aid which actually contributes to fertility rate reduction and it is also the largest aspect which contributes on fertility reduction comparing with the other two.

Graph 9



Since the social sector has the largest percentage of total development aid and quite a few aspects in social infrastructure are related with fertility rate reduction, graph 9 specifies the detail of social sector. It has been divided into education, health, reproductive health, family planning, STD control and other social sectors. The other social sector includes water supply, sanitation, population policy except

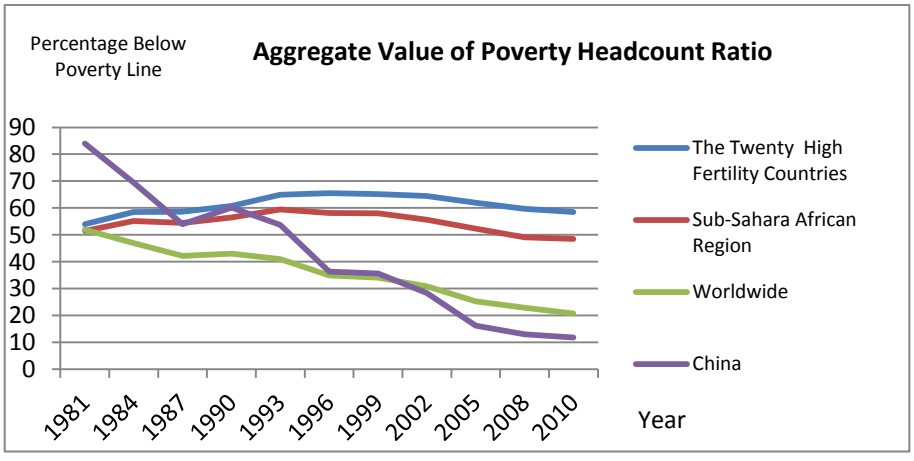
reproductive health, family planning, STD control, government & civil policy, conflict prevention and so on. Although, normally the social infrastructure sector would be divided by more general categories, graph 9 divides them into the way which is more appropriate for the core of the research.

It is clear from graph 9, when considering development aid disbursement on social sector during recent ten years, the aid disbursed on family planning has very small percentage compared with other parts of population policies, such as STD control. Later analysis will point out how important the relationship between development aid on family planning and reduction of fertility rate is. Thus, the tiny percentage of development aid allocated to family planning is worthy of notice by authorities which can control the aid distribution since fertility rate reduction is vital in these developing countries if donor countries want to reduce number of people living below the poverty line effectively.

It is clear from graph 9 that in over half of the countries, the sum of proportion for education and family planning is less than 20% of the social sector. From the statistical model in section 4.3, it has been found that the development aid on education and family planning contributes directly to the reduction of fertility rate. Graph 9 indicates that the percentage of input of development aid on reduction of fertility rate is still very small.

4.2 Trends of Poverty

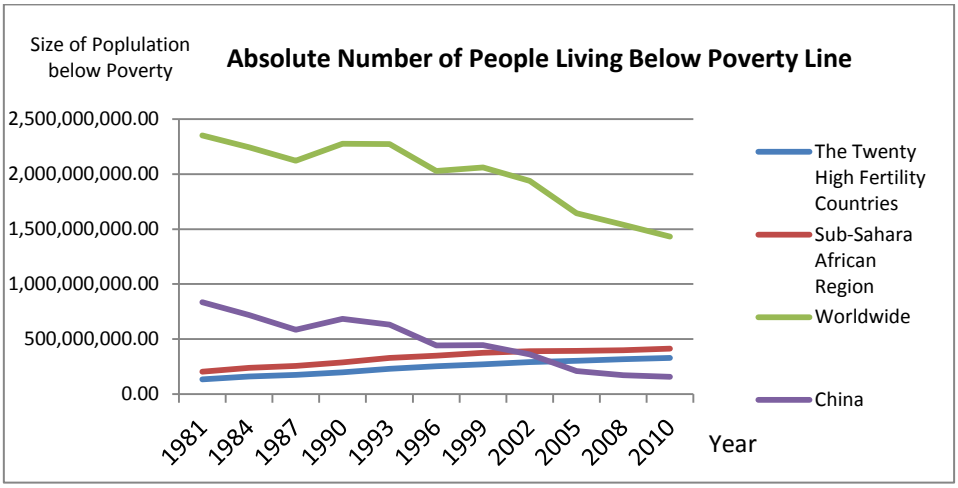
This section discusses the effectiveness of poverty reduction in these twenty highest fertility rate countries through analysing trends of percentage and the absolute number of people living below the poverty line ($1.25 per day). Moreover, it concludes that the main reason which causes the increasing absolute number of people living below the poverty line is high fertility rate.



Graph 10

The above graph shows the past thirty years trend of aggregate value of poverty headcount ratio [Definition in Appendix B] through comparing the twenty highest fertility rate countries, the Sub-Saharan African region, worldwide and China [Appendix D1]. Through definition it can be known the poverty headcount ratio displays trend of percentage of people living below the poverty line $1.25 per day (equivalent to $38 per month). Through the graph 10, it shows that on average of these twenty countries [Dark Blue Line], the percentage of people living below the poverty line reached a peak in 1999 and then decreased slowly. The percentage of people living below the poverty line in 1999 was

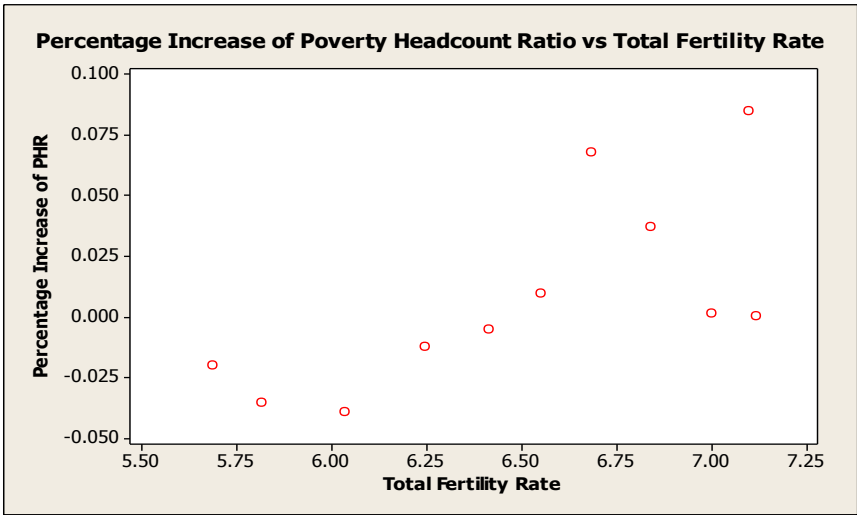
more than in 1981. It also can be seen from the graph 10 that although most of these twenty highest fertility rate countries are located in the Sub-Sahara Africa region, they are actually poorer than the average level of the Sub-Sahara region. In 1981, China had much more percentage of people living below poverty line than the Sub-Saharan African region, but it decreased fast during the past thirty years. In 2010, the percentage in China is even lower than the world average level. This let us think about the dramatic improvement made in China which is due to the strict fertility control – one child policy.



Graph 11

Graph 11 displays the trends of absolute number of people living below the poverty line $1.25 per day. It can be seen the absolute number of people living below the poverty line in the twenty highest fertility countries and the Sub-Saharan African region rose to around 500 million. The difference of poverty people in these two areas is only about 83 million in 2010, but the difference between sizes of population in these two areas is close to 300 million in 2010. It indicates the density of poverty people in the twenty highest fertility countries is much larger than the Sub-Sahara African region. **It can be seen that the number of people living below the poverty line worldwide and in China have very distinct downward trends, but the trends in the twenty highest fertility rate countries and the Sub-Saharan African are clearly upward from 1981 to 2010.** If one thinks about the huge amount of development aid invested in these twenty countries in the past several decades, it raises a big question: What did the development aid actually do if number of people living below the poverty line increased? To answer this question, it is important to find out the causes of the increasing number of poor people at first.

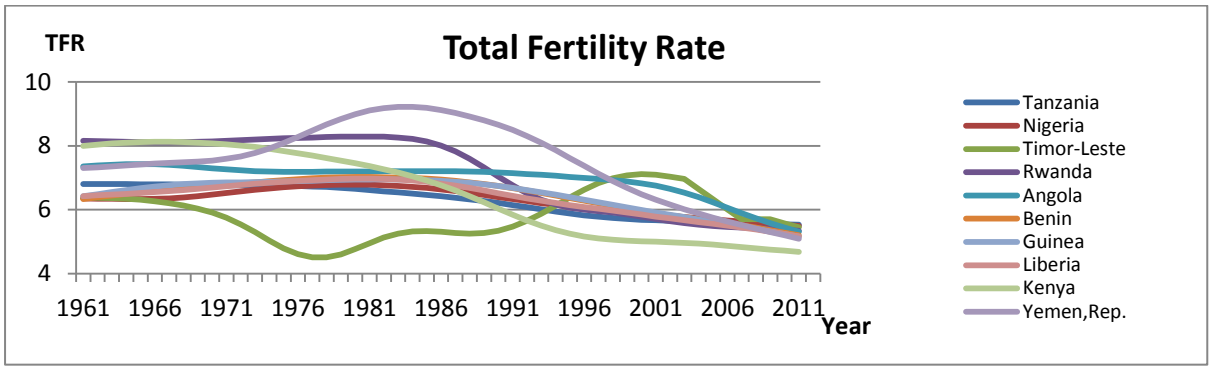
Below graph 12 illustrates the scatterplot of percentage change of poverty headcount ratio versus the total fertility rate in the twenty highest fertility rate countries. The scattered observations indicate that when the percentage of people living below the poverty line increased, which is positive, the corresponding total fertility rate during the year is high. When the percentage of people living below the poverty line decreased during the years, which is negative, the corresponding total fertility rate is low. The graph tells us the percentage change of people living below the poverty line is positively related with total fertility rate.



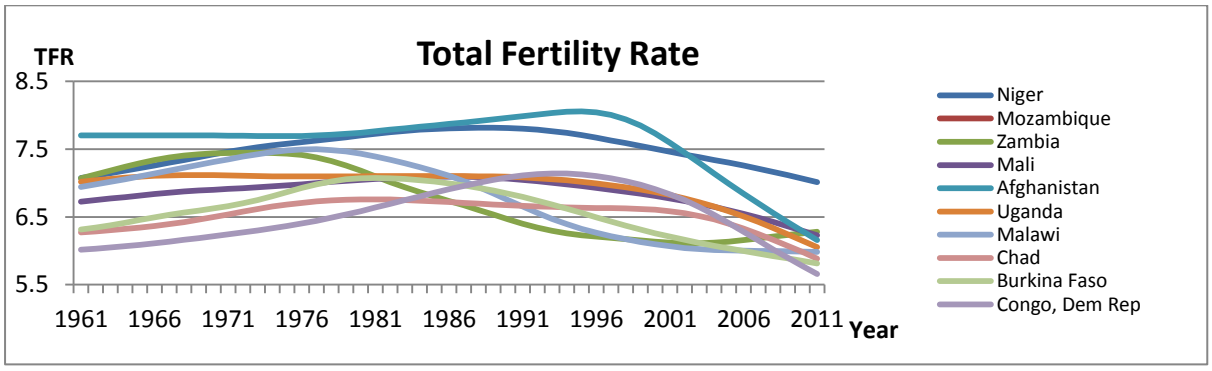
Graph 12

The direct cause of increasing absolute number of people living below the poverty line is actually quite obvious – **fast increasing size of population**. In most countries, the relatively apparent decreasing trends of fertility rate start after 2002 [Graph 13 and 14], which was probably caused by conducting the eight Millennium Development Goals. During the past fifty years, although the fertility rate keeps decreasing in these highest fertility rate countries, the general level is still significantly high if comparing with other countries in the world, especially developed countries. The fertility rate of all twenty countries is higher than 4 in 2011, which indicates in these countries, every woman would have at least four children during their lifetime on average.

Graph 13



Graph 14

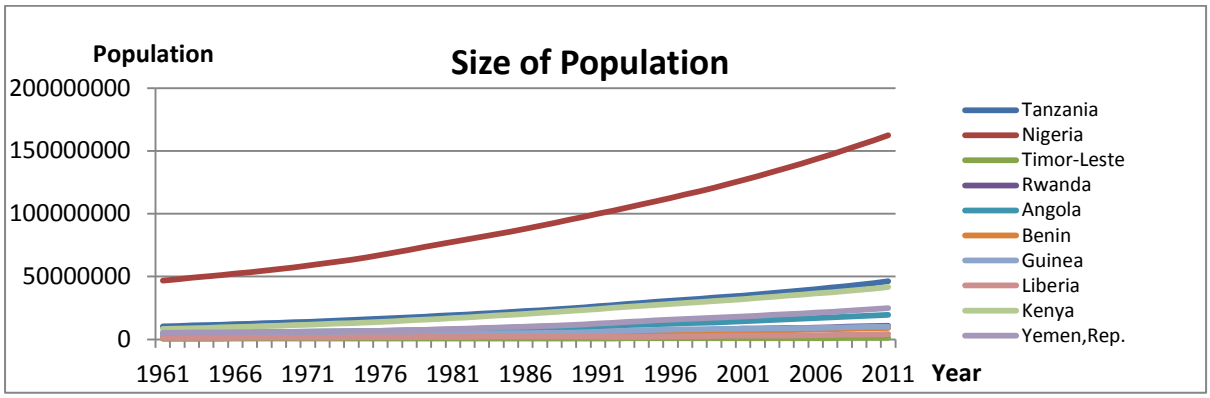


Although many developed countries and organizations invested huge amounts of development aid in the poorest countries, the absolute number of people living below the poverty line in these countries

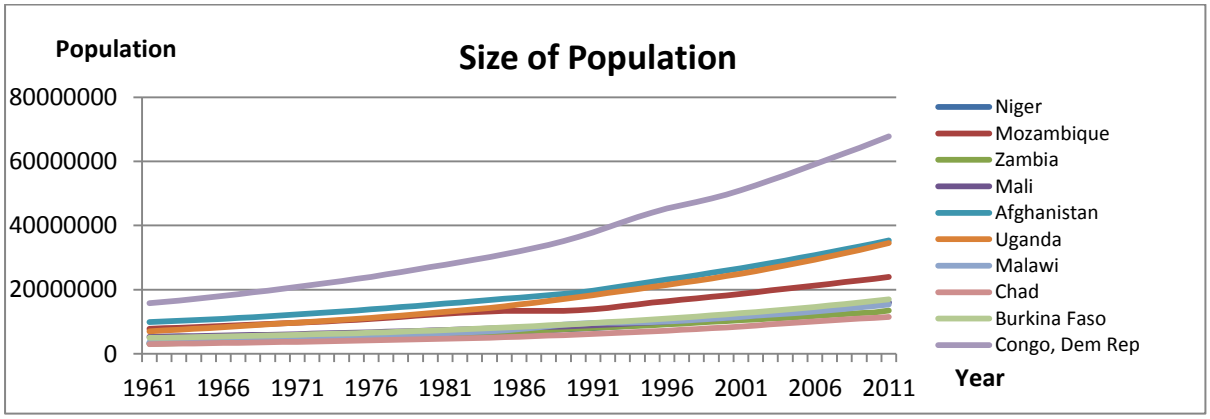
did not reduce. One of the major reason is the absolutely high fertility rate makes size of population growing fast, especially in the Democratic Republic of Congo and Nigeria, which can be seen from graph 15 and 16. There are eight countries size of population increased more than four times during past fifty years. Almost all countries increase more than three times. This is a very huge increase if compared with 2.29 times world population increase during past fifty years.

Since the fast increasing population is caused by the absolutely high fertility rate, this brings another issue – how to control the high fertility rate. From the empirical model in section 4.3, fertility rate is influenced by development aid on education, family planning and economic infrastructure. One way might be to increase the amounts of development aid which directly contributes to reduction of fertility rate. Because the main goal of development aid is to reduce poverty, if the fertility rate does not obtain real control, the vast amount of development aid is just waste of money since the past several decades; the absolute number of people living below poverty line increased in the twenty countries.

Graph 15



Graph 16



There are some other countries which have performed well on fertility control for example– China. Through the adoption of one child policy during past thirty years, the population growth in China has been controlled strictly. This directly led to the percentage of people living below poverty line to be dropping dramatically in China from around 40% in 1981 to about 3% in 2009 (graph 10). Although there might be some other factors also contributing to reduction of poverty in China, the effective fertility control should play an important role. However, it is difficult to adopt the same policy in African countries due to different cultural backgrounds and political conditions. The next two sections analyse and discuss which social, economic and culture factors are the fundamental reasons which led to the

high fertility rate in these twenty countries, which aspects of development aid contribute to reduction of fertility rate and suggestions for allocating development aid.

4.3 Empirical Model

The empirical research model is used to investigate which aspects of development aid contribute to reducing fertility rate in the twenty highest fertility rate countries. The model is a two-way fixed effect panel data model. The panel variables are country (which includes the twenty countries in Table 1) and time (in years from 2002 to 2011). The results in table 6 are ranked by the level of influence of the coefficients. Generally, development aid affects total fertility rate in a very small level, see details are discussed below. Table 6 shows the final empirical model with all significant variables and one non-significant variable.

Table 6: Results of Empirical Model

Variables	Coefficients (t-values)
Log_GDP per Capita	-0.3099233000 (6.59)
Life Expectancy	0.0772527000 (4.18)
Log_Education (development aid)	-0.0377718000 (1.42)***
Log_Economic Infrastructure (development aid)	-0.0354165000 (2.44)*
Log_Family Planning (development aid)	-0.0241570000 (4.10)
Children under 5 mortality (per 1000)	-0.0072044000 (4.66)
Size of Population	0.0000000123 (3.49)

*****represent no evidence against the null hypothesis (P>0.1), the variable non-significant; *represent moderate evidence against the null hypothesis (p<0.05), the variable significant at 5% level; all other variables significant at 1% level; Brackets contain the t value of coefficient. When t value larger than 1.96, it means the variable significant at 5% level (Definition in Appendix B)**

Although some previous literature believes that health, reproductive health, education, family planning, STD control and economic infrastructure might be related to fertility rate in different levels, the research here only explores development aid on education, family planning and economic infrastructure is significantly related with total fertility rate. It is worth mentioning that development aid on health, STD control and reproductive health are not significantly related with total fertility rate in these twenty highest fertility countries since the P-value is larger than 0.05 and t value of these variables are very small.

The development aid on education, family planning and economic infrastructure has a negative relationship with total fertility rate. Holding other factors fixed, when the amount of education, family planning or economic infrastructure aid increases, the average number of children a woman would have during her lifetime goes down.

It has been widely recognised that when females are better **educated**, the fertility rate would reduce. This finding is consistent with D'Addio and d'Ercole (2005) [4], better education improved non-family role of a woman, thus increased probability to find a job and earning potential. The opportunity cost of having a child rises, which negatively affects total fertility rate.

The **family planning aid** helps family do more preparation before couples have a child and increases the chance of using contraception. It is reasonable to say that the more development aid spent on family planning, the better promotion and adoption of using contraceptives, the more the total fertility rate decreases. The table demonstrates that this factor is significant at the 1% level.

Moreover, the **economic infrastructure aid** also contributes to reduction of the total fertility rate. This is related with economic growth and urbanization. When a country becomes more modernized, women's role in workforce is more important. The involvement of work is higher and potentially reduces the number of children a woman might have. However, all countries the research was analysed with are still living on agriculture, whether the female role in workforce has improved is not clear. The aspects of development aid contributing to reduction of total fertility rate are only education, family planning and economic infrastructure. The sum of three aspects is only 16.38% of total amount of development aid on ten years average (results in Section 4.5). Although the research found these three aspects of development aid contribute to fertility rate reduction, the degree of influence is weak. This can be seen from the coefficients of the three aspects of aid. Holding other factors fixed, a one percentage increases of development aid on education can reduce the fertility rate by 0.0003758 unit (= 0.0377718*ln(1.01)). Similar results can be obtained from development aid on economic infrastructure and family planning, which are 0.0003524 unit (= 0.0354165*ln (1.01) and 0.0002404 unit (= 0.024157*ln(1.01) respectively. The reason of the minor level of influence the three aspects of aid occur might be that there are many other important social, economic and culture variables which affect the total fertility rate in the twenty highest fertility rate countries.

Social factors such as **life expectancy** are positively related with fertility rate and **children under 5 mortality rate** is negatively related with fertility rate. When the life expectancy goes up, the reproductive duration of a woman also would increase, especially for these in developing countries where life expectancy is around 40 to 50. With one year increase of life expectancy in these twenty highest fertility rate countries, the total fertility rate would increase 0.07725 units when holding other factors fixed. The factor of child mortality rate appears to be negatively related with fertility rate which is opposite with finding in many previous studies. From Table 6 when the children mortality rate is higher in these twenty countries, the total fertility rate tend to decrease holding other factors fixed. The difference with previous finding is difficult to explain. The negative relationship between children under 5 mortality rate and total fertility rate might worth further investigation.

The relationship between **size of population** and fertility rate is also difficult to explain. It is easy to imagine when fertility rate increases, size of population goes up. However, it is difficult to think about the reason when the size of population rises, the fertility rate would increase. It can be seen from Table 6 that the coefficient of size of population is very close to zero, which indicates the total fertility rate is weakly related with the size of population. It is believed by the author that the size of population might be related with fertility rate through some other changing factors, such as child mortality rates and life expectancy. This has been demonstrated by Heer and Smith (1968). They stated that when the mortality rate is high, the size of population increased slowly and the fertility rate became high [6]. One possible reason is that as the size of population goes up, more people can meet a suitable partner and have children.

GDP per Capita is a typical measurement of living standard even though it is controversial. The GDP per capita negatively affects total fertility rate. Holding other variables fixed, when GDP per capita increases one percentage, the total fertility rate would decrease by 0.0030838 unit (= 0.3099233*ln(1.01)).

From Table 6, all independent variables in the model are at least significant at the 5% level except development aid on education [Definition in Appendix B]. Variable life expectancy, size of population, children under 5 mortality rate, log GDP per capita, development aid on family planning are significant at 1% level; variable log development aid on economic infrastructure is significant at 5% level. Although variable log development aid on education is not significant, it is still sensible to put it into the model according to findings from previous literature. Moreover, the joint test also suggests development aid on education should be included into the model.

Table 7: Test of Model	
R-Square (within)	0.8495
R-Square	0.9760
Adjusted R-Square	0.9697
F-test	47.26
P-value of F-test	0.0000

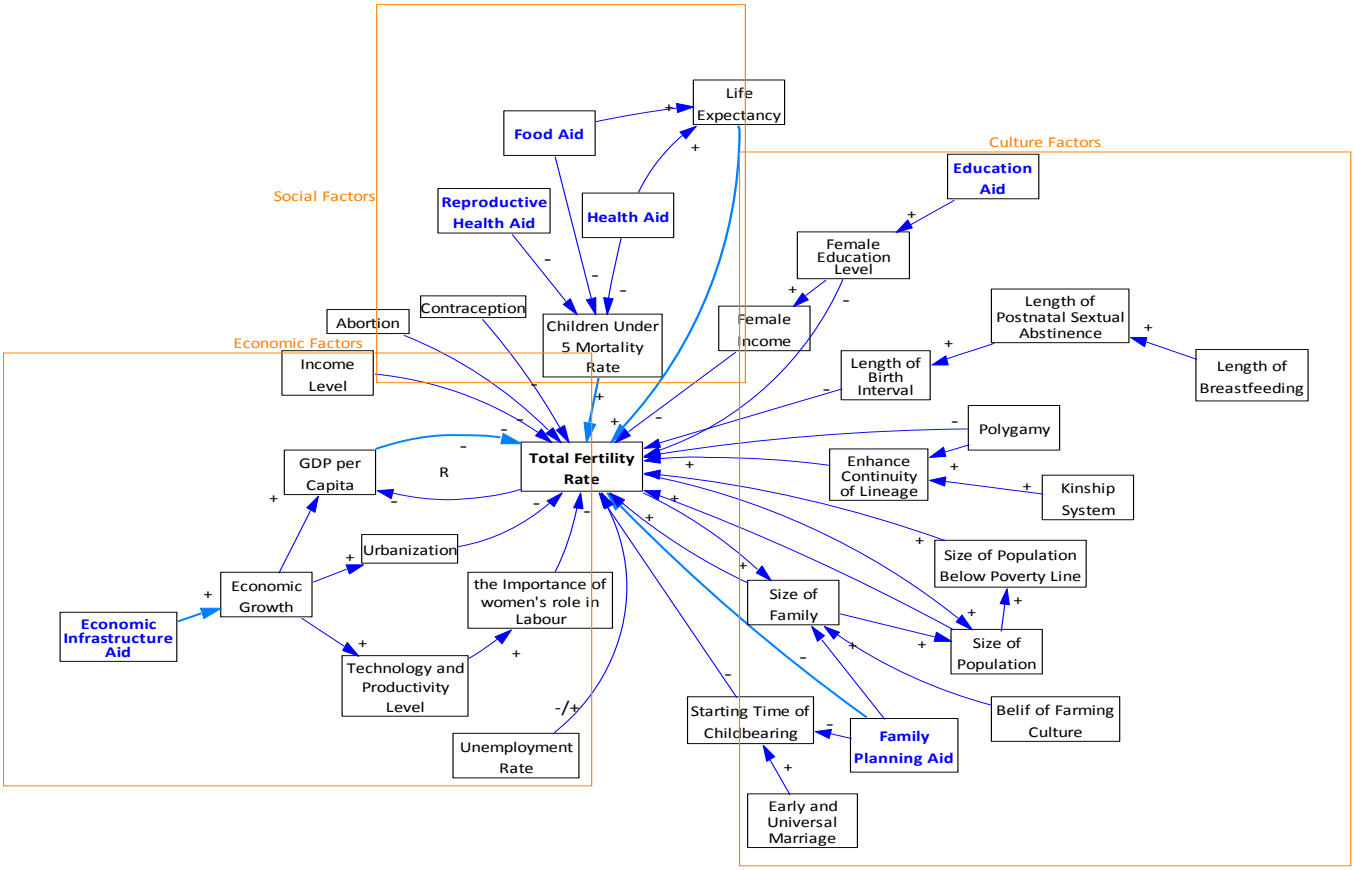
The joint test of fixed effect time factor from the Year 2003 to 2011 are significant, which means fixed factor time should be included in the model and the two-way fixed effect model is appropriate. The within R-square of the model is 0.8495, which indicates that the fitting of mean-deviation model where the group variables country and year are assumed to be fixed is 0.8495. The general R-square obtained from Stata is 0.9760. When general R-square equals to 1, the model is a perfect fit. The R-square of model equal 0.9760 is very close to 1, which indicates the model fitting very well. From F-test, the model is jointly significant.

From the scatterplot of standardized residual vs. fitted value (Appendix D6), there is no obvious unusual observation generally – no extremely large standardized residual in the graph. There is only one observation which has leverage larger than 0.5 according to leverage vs. fitted value plot. After investigating this high leverage observation, it was found that the high leverage is caused by observation of Timor-Leste in 2003. This observation has extremely low GDP per capita, aid on education and family planning in 2003 compared with other years' value. Although some value of this observation has large difference with other observations, there is no reason to believe any error occurred with this observation. Thus the observation is still included in the model to prevent any bias which might occur if removing it.

From section 4.2, it is clear that if the fertility rate in the countries researched stalls at 4 to 5 in recent years and size of population keeps increasing quickly, the absolute number of people living below poverty line will constantly rise, the invested development aid could not solve the poverty problem unless it makes total fertility rate drop sharply and strictly controls the fast growing population. This brings out the key problem, how to control fertility rate and reduce the speed of the ever increasing population. At least it is clear from the empirical model, that the development aid contributing to fertility rate reduction includes education, family planning and economic infrastructure.

4.4 Causal Loop Diagram – Factors Affecting Total Fertility Rate

The previous section illustrated aspects of development aid affect fertility rate through the empirical model. The paragraph below uses a causal loop diagram to discuss the fundamental reasons why these factors might affect fertility rate, why fertility rate is so hard to reduce in these poorest countries and try to discover improvements through analysing the most ultimate causes based on findings from previous literature. The effects of development aid are not unidirectional. Different aspects of development aid lead to mixed influences on total fertility rates. The relationship which has already investigated by the empirical model in section 4.3 presented in **bold light blue arrows** and the relationship which based on previous findings use **dark blue arrows**. Explanations involve results from empirical model, previous findings and understanding from the author. There are mainly three areas influencing the control of fertility rate: economic, social and culture factors. The diagram is built in software Vensim shown in Appendix D7.



Graph 17

4.4.1 Economic Factors:

It has been investigated by many previous studies in the literature that economic conditions seriously influence a country's fertility rate. The model in Table 6 shows that economic factors with development aid on economic infrastructure and GDP per capita both negatively related with total fertility rate. This indicates that when either of economic infrastructure aid or GDP per capita increases, the fertility rate in these twenty highest fertility rate countries would decrease. However, these two economic factors are not independent of each other. The economic growth in the developing countries are positively influenced by the amount of economic infrastructure aid [10] and then positively affect GDP per capita which has contribute to the reduction of the fertility rate. The economic growth not only positively

affects GDP per capita, it also influences developing countries' economics in other aspects, such as improving urbanization, technology and productivity levels. When the technology and productivity level becomes higher, the women's role in labour would be more important. Moreover, the improvement of modernization and urbanization also contribute to the reduction of fertility rate [7]. In addition, the way unemployment rates affect fertility rate is quite complex. When the unemployment rates are higher, youth may increase the length of time staying with parents and reduce the probability of having a child, thus reducing fertility rates. On the other hand, when unemployment rates becomes high, women tend to feel the chance to find a job is low and the probability of becoming a housewife is higher, thus increasing the chance to have child [4]. Therefore, unemployment rates have both a positive and negative sign in the causal loop diagram.

There is a reinforcing loop between total fertility rate and GDP per capita. The reinforce loop among interrelated variables indicates exponential increasing or decreasing within these variables. From the empirical model, the GDP per capita has a negative relationship with the total fertility rate. The fertility rate also has negative effect with GDP per capita. When the fertility rate is high, the size of population increases quickly. With the steady level of GDP, the GDP per capita decreases. Thus the fertility rate will also cause a negative relationship with GDP per capita.

4.4.2 Social Factors

From the empirical model result in Table 6, social factor children under 5 mortality rate is negatively related with the total fertility rate and life expectancy is positively related with the total fertility rate. The negative relationship between children under 5 mortality rate and the total fertility rate is opposite with the previous findings and it is more reasonable to explain the relationship using the positive relationship which obtained from previous findings at this stage since the rationale behind the negative relationship has not investigated. The rationale behind is that (Bongaarts and Casterline 2012) [2] (Gayawan et al 2010) [5] the positive relationship between child mortality rates and total fertility rates might be when the number of children mortality is high, parents afraid of losing child and lack of labour force on farming, thus they try to produce as many children as possible. When the child mortality decreases, the pressure of losing child becomes smaller, the fertility rate decreasing. The reasons of decreasing child mortality include improved health level, better food and reproductive health. Although in the empirical model, there is no evidence show that development aid on health, food and reproductive health contribute to reduction of fertility rate, it still worth believing that they may have some indirect influences on fertility rate.

The reason behind the positive relationship between life expectancy and fertility rate might be that when people become healthier and length of living becomes longer, their production length will also become longer. This probably will be more obvious in developing countries, especially those countries increasing to 40-50 years life expectancy. Not if the years go up to beyond 50 as few women have children above that age. According to the similar reason of the factor of child mortality rates, it is worth considering that development aid on health and food are positively affecting life expectancy.

It is believed by the author that development aid on food and health should have an indirect influence on total fertility rates through affecting the rate of mortality for children under five and life expectancy. It is reasonable to think the development aid on food and health can positively affect life expectancy

since quality of life will be better when the amount of aid on food and health increases. For similar reasons, they should have negative influence on children under five mortality rates since when quality of life improved with the rising amount of development aid on food and health, fewer children would die. Moreover, reproductive health aid should also negatively relate with children under five mortality rates. As found in the empirical model, life expectancy and children under five mortality rates directly influenced total fertility rates. Although the empirical model found no significant relationship between development aid on food, reproductive health and health with fertility rate, it is still reasonable to believe these three aspects of aid might affect fertility rates indirectly.

4.4.3 Culture Factors

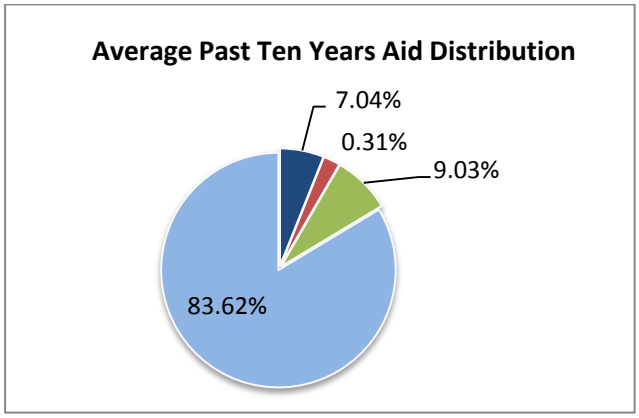
From empirical model results in Table 6, the development aid on education and family planning are negatively related with fertility rates. The increasing amount of education aid or family planning aid would directly contribute to fertility rate reduction. When the family planning aid rises, more contraceptives are promoted and used. As long as the awareness of contraceptives is significantly improved, the fertility rate should be reduced. Although according to Romaniuk (2011) [18] that the usage of contraceptive products is still very low in Africa, it is still in progress, in a slow and steady way. It is widely accepted that education plays a vital role on affecting fertility rate. When female education level is improved, the female non-family role would become more important and the time and energy spent on childbearing would be much later and smaller. Moreover, better female education increases female earning potential and the opportunity cost of having child goes up (D'Addio and d'Ercole 2005) [4]. It has been found by Gayawan et al (2010) [5] that early and universal marriage in Africa leads to a much early starting time of childbearing, which creates longer reproductive duration in a woman's lifetime. The number of children one woman could have during her reproductive period potentially increased. Last but not the least, deep belief of farming culture positively influences the number of children a family would have since farming business requires a large amount of labour force.

After the huge amount of aid investment, the fertility rate in these poorest countries is significantly high compared with developed countries. One of the most uncontrollable reasons is African culture. According to Romaniuk (2011) [18], three cultural factors seriously affect fertility rates in most African countries: kinship, polygamy and lactation. The kinship system gives great pressure on couples to have children. In order to enhance the continuity of the lineage, couples tend to produce as many children as possible to create a large and powerful family. The fundamental reason might also relate with farming culture and less industrialization. Polygamy is another important factor which can lead to high fertility. Although from Romaniuk's finding, the polygamous women are less prolific than monogamous women on average at individual level, the competition between co-wives ensures to maximize the reproductive capacity of the whole family. In addition, the length of breastfeeding in African countries is longer than other countries in the world. The longer duration of breastfeeding leads to longer length of birth interval, which might potentially reduce the number of children per woman.

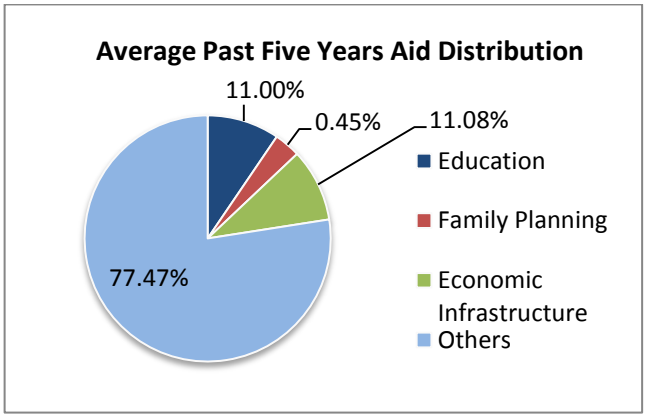
There is a reinforcing loop amongst total fertility rate, size of family, size of population and size of population below poverty line. When the total fertility rate is high, sizes of families tend to be larger, which leads to the size of the population becoming larger and size of population below poverty line is also greater. Moreover, more people living below the poverty line tend to lead to higher fertility rates.

4.5 Discussion

From the model in Table 6, only three aspects of development aid contributed to reducing fertility rates. They are development aid on education, family planning and economic infrastructure. The pie charts below show the average percentage of aid spent on these three aspects in the past five and ten years for the twenty highest fertility rate countries.



Graph 18



Graph 19

From the pie charts, the average percentage of total aid spent on education is 7.04% from 2002 to 2011, on family planning is only 0.31% and on economic infrastructure is 9.03%. The sum of average percentage of aid disbursed which contributes to reduction of fertility rate for the past ten years is 16.38%. However, the average percentage of aid dsbursement on these three aspects increased if only considering past five years from 2007 to 2011. Education and economic infrastructure show a significant increase in the past five years to 11.00% and 11.08% respectively. The sum of percentage of development aid spent which able to contribute on fertility rate reduction rose to 22.53%. Although the total percentages of aid contribute to fertility rate reduction increased in the past five years, it is still a quite a small proportion compared with the rest. Moreover, in these three aspects, only family planning belongs to population policy and the percentage spent on family planning is still very tiny. As mentioned in the earlier section, the amount spent on family planning is much less than other population policies such as STD control.

Although the total amount of development aid disbursed in these countries is rising hugely, the absolute number of people living below the poverty line kept increasing due to the still relatively high fertility rate and fast growing population. If the fertility rates do not at least decrease to the world average level, poverty cannot be controlled effectively no matter what amount of aid is invested in these poorest countries. It is worth considering whether the allocation of development aid on population policy aspects needs to be adjusted to make the fertility control more effective. It is mentioned by other researchers [13], the reason these developing countries are still very poor is not only because of large increase in population, but also the massive amount of aid does not really boost economy in these countries. Only increasing the amount of development aid does not improve poverty situation because people living in these countries know the poorer they are the more aid would be given to them due to the strong willingness and eager to help from developed countries. Therefore, people live in the poorest countries do not have incentive to work hard and maximise the efficiency of development aid invested to them.

4.6 Limitations of the Research

- Models and estimations are approximation and simplification of real world. Although the causal loop diagram tries to include as many factors as possible, there are still many factors that are not included.

- One of the downsides of using fixed effect panel data model is including too many dummy variables into model. If the degree of freedom is not very large, the results could be inaccurate. However, this should not be a serious problem for the empirical model in section 4.3 since the only dummy variables included are fixed variable country and year.

- The report analysed the twenty highest fertility countries, but these countries are not all in the Sub-Saharan region and there are quite a few Sub-Saharan countries which are not included in the analysis, therefore the results might not be accurate in explaining what happens in Sub-Saharan Africa.

- Due to the limitation of data for the poverty headcount ratio for the twenty highest fertility rate countries, the use of aggregate value of poverty headcount ratio might not be accurate. Because of the nature of aggregate value, the poverty headcount ratio and absolute number of people living below poverty line are rough trends.

- Independent variables in the empirical model should be satisfied with the assumption of independency. A few independent variables might have little relationship with each other, such as life expectancy and size of population. However, from the empirical model perspective, this is not a serious problem for the model.

4.7 Recommendations for Further Work

The research has several aspects open to further exploration. One interesting and valuable aspect worth further investigation is to find out how to adjust the percentage of development aid contribute in relation to the reduction of fertility rates which can achieve the adequate level of fertility rate – world average level – in the next ten years through simulation and forecasting. This involves considering many factors, not only on the aspect of contributing to fertility rate reduction, but also how to improve the awareness of people living in these developing countries through education and cultural perspectives. The simulation could be based on the causal loop diagram described in section 4.4.

Another interesting area is to discover the balance amount of different aspects of development aid, especially between development aid on STD control and family planning. Through the research, it has been known that amongst population policies, the percentage of development aid disbursed on STD control including HIV/AIDS is much more than that disbursed on family planning. Since fertility rate control is very vital in the developing countries, it might be valuable if a balance could be found between these aspects of development aid.

The last but not the least, reasons behind the negative relationship between children under five mortality rate and total fertility rate might be worth further investigation since the result is opposite with previous finding.

5. Conclusions

In conclusion, several interesting findings are obtained from the spreadsheet data analysis, the empirical model and the causal loop diagram:

- It can be seen that the total amount of development aid disbursement in the twenty countries kept increasing in the previous ten years from 2002 to 2011.

- However, neither the percentage of people living below the poverty line nor the absolute number of people living below the poverty line declined with increases in aid. The inefficiency of development aid is caused by the high fertility rate and rapidly growing population in the poorest developing countries.

- The fundamental reasons leading to the high fertility rate are complex, and according to previous studies are mainly caused by three factors – economic, social and cultural features in the twenty highest fertility rate developing countries.

There are three aspects of development aid which have been shown in the statistical model in this report to contribute to the reduction of fertility rates: family planning, education, and economic infrastructure. However, the average percentage of development aid spent on these three aspects was only 16.38% in the past ten years from 2002 to 2011, with only 0.31% on the key sector, family planning. Although the average percentage of aid spent on these three aspects increased in the past five years from 2007 to 2011 to 22.53%, it is still small compared with other social sectors of aid. Since the key to reducing poverty is to control the size of the population and fertility rate, it is worth distributing more aid on family planning, education, and economic infrastructure sectors.

6. Reflective chapter

6.1 Challenges Faced

During the process of the project, changes and challenges were always likely to exist. At the first meeting with Dr. Roger Martin and Ms Sue Merchant, the original idea was to analyse the distribution and effectiveness of development aid in reducing poverty in one or two developing countries over the past fifty years, especially on how the aid performed on reducing fertility rate. This is the content we set in terms of reference. However, after searching through a large amount of websites data sources, it had been realised that the data for development aid distributed in different aspects for each country is only available in the most recent ten year period from 2002 to 2011. This is because the OECD started to collect and record the aid disbursement on each specific sector for receipt countries since 2002. Due to the limitation of development aid data on the OECD website, there are only ten years of data available about how the development aid was disbursed in these specific sectors. If only analysing one or two countries for ten years, the sample size would be too small and easy to cause inaccurate results. Thus, the idea of building a panel dataset emerged. Therefore, the analysis changed from one or two high fertility rates in the Sub-Saharan African countries over the past fifty years to the twenty highest fertility countries in ten years. The idea of the study was that the twenty countries in the past ten years is to

build a panel dataset with these countries and to explore which aspects of development aid mostly contributed to reducing fertility rates in these poorest countries in the world.
The use of panel data brought the second challenge that although I have some experiences of cross sectional data analysis; I had not carried out any panel data statistical analysis before. Moreover, the software – Minitab I was familiar as it was taught in my course had limitations with panel data analysis, therefore I had to learn the new and more professional statistical software – Stata. During the panel data analysis process, Dr. David Jarrett gave me great help not only for the knowledge of panel data model but also regarding the usage of Stata.

The third challenge for me was building a causal loop diagram to illustrate fundamental reasons which lead to high fertility rates in the twenty developing countries that were analysed. The causal loop diagram is a new tool for me and when I tried to use Vensim to build the diagram for the first time, I panicked and felt it was very difficult to explain the relationship between each interrelated variables. After a period of systematic practice by myself and with the help from my internal supervisor Ms Sue Merchant, the diagram was completed on time. During the whole project process, Ms Sue Merchant was always very patient and provided me with a massive amount of support. In addition, I devised my own Gantt chart with the help from Ms Merchant to have better time management with the project.

There are several alternative approaches of causal loop diagrams that were considered, such as illustrative simulations through Simul8 and simulate development aid allocation through @Risk. However, after comparing causal loop diagram with illustrative simulations, it has been found that the causal loop diagram can not only display all characteristics of illustrative simulation but also show some extra features. Moreover, the simulation of development aid allocation does not fit the research topic very well. Therefore, the causal loop diagram was chosen.

The last but not the least, writing a succinct report in a foreign language is also a challenge for me. Ms Merchant and I spent a large amount of time correcting grammar and tried to make the whole report compact and well arranged.

Table 8: Gantt Chart

	Start Date	***Planned End***	***Actual Start***	***Actual Finish Date***
Background Reading and Literature Reviewing	**23/Jun/13**	**27/Jun/13**		
Finding Relevant Literatures	23/Jun/13	24/Jun/13	23/Jun/13	23/Jun/13
Reading and Make Notes	25/Jun/13	26/Jun/13	24/Jun/13	26/Jun/13
Meet with Supervisor	27/Jun/13	27/Jun/13	27/Jun/13	27/Jun/13
Data Gathering	**28/Jun/13**	**16/Jul/13**		
Finding Data	28/Jun/13	28/Jun/13	28/Jun/13	01/Jul/13
Building Pie Charts to show Aid distribution for ten years	01/Jul/13	03/Jul/13	02/Jul/13	04/Jul/13
Plot graphs show aid trends for fifty years	04/Jul/13	08/Jul/13	05/Jul/13	05/Jul/13
Data analysis (statistical)	09/Jul/13	16/Jul/13	06/Jul/13	08/Jul/13
Meet with Supervisor				
Model Building	**17/Jul/13**	**26/Jul/13**		
Statistical model building	17/Jul/13	19/Jul/13	09/Jul/13	13/Jul/13
Test model	20/Jul/13	23/Jul/13	16/Jul/13	18/Jul/13
Compare results with previous findings	24/Jul/13	26/Jul/13	19/Jul/13	20/Jul/13
Writing Report (draft)	**01/Aug/13**	**15/Aug/13**	**20/Jul/13**	**05/Aug/13**
Meet with Supervisor	08/Aug/13	08/Aug/13		
Report Correction	**16/Aug/13**			

The Gantt chart was the key of research time management. It can be seen from the chart that I finished most parts of research earlier than expected. This gave me sufficient time to write and improve the report.

6.2 Data and Approach Shifting

As explained in early section, there has been found limitation of available data after the research began. After meeting with my LSE supervisor Ms Sue Merchant and agreed by my organisational supervisor Dr. Roger Martin, in order to keep the quality of research and to ensure the outcome is rich and varied, the research shifted to analyse how development aid affects poverty in the twenty highest fertility countries for past ten years. The approach adopted change to a fixed effect panel data model correspondingly.

The shifting of approach brings some strengths and weaknesses for the research. The main weakness of shortening the period from fifty years to ten years is that causes the trend of change during time becomes more vague and what happened during the former forty years was unknown. On the other hand, it also brings some strength:

- The research switch from one country to twenty countries can lead to more comparisons and interesting discussion about the differences of development aid effectiveness in different countries.

- The approach two-way fixed effect panel data model follows the nature of available data but regardless of differences between countries and years, which lead to a relatively accurate outcome.

- As mentioned in data section 3.3.3, there are quite a few missing values observations for some countries analysed. The adopt panel data model can directly increase the number of observations used in empirical research through increasing the number of countries to avoid inaccuracy of model results due to the quality of data.

6.3 Project Related with MSc Management Science Course

There are two main aspects directly related with the MSc Management Science course: the statistical model building and simulation. As mentioned in section 6.1, alternative approaches for two-way fixed effect model and causal loop diagram exists. Two alternative approaches to adopt an illustrative simulation in Simul8 or to build @Risk simulation model was considered by us at the beginning of the research. The software Simul8 and @Risk are taught in the course OR 426.2. After searching for the data and discussing the purpose of the project with Ms Sue Merchant, we agreed that although building the causal loop diagram is new to me, it can reflect more information on the reasons which caused high fertility rates. Therefore, the causal loop diagram was adopted. Although at the beginning of the research, fixed effect panel data model were not familiar to me, the course OR 426.1 taught by Dr. David Jarrett provided much useful advice and knowledge about how to build fixed effect panel data models to investigate development aid affecting fertility rates.

6.4 Outcomes

In my opinion, the overall outcome of the research is successful since all requirements written in terms of reference were achieved. The conclusion obtained by the research is consistent with the likely conclusion which was suspected by the client and the research provides sufficient quantitative support for the conclusion. Moreover, during the research, interaction and communication with supervisors provided great help with the completion of research, especially Ms Sue Merchant who was always constructive and patient. Although I have not met my external supervisor Dr. Roger Martin very often, we communicated smoothly via e-mail.

6.5 Important Lessons Learned and Possible Improvements

In general, it is been a great experience to work on this project and I learned a lot of knowledge about development aid – where aid comes from, how aid is distributed, whether aid works efficiently and any possible ways to improve the level of efficiency. Besides specialized knowledge about development aid, many other things which have given me a great chance to help my career in the future were also learned from doing the project:

- Time management is the key for a project, especially a quite large project. During the project, I realized there are always unknown and new challenges to be met. If I do not leave enough time at each stage, there is a good chance I might finish the project in a rush and would not have enough time to deal with details of report.

- Detail is very important. When doing the project, there were many terminologies, such as GDP per capita, total fertility rate, poverty headcount ratio and so on. Each data source has a different definition and calculation method for these terminologies. If I did not pay attention to the detail of differences, mistakes and misleading is easy to occur, especially when interpreting a complicated result.

- Regularly communicating with my supervisor was much more efficient than solving problems on my own. During the project, when I met a problem and tried to solve it by myself, I normally spent large amount of time thinking. However, when I frequently communicated my problem with my supervisor, even though the supervisor only gives me a hint, discussion was more efficient to solve the issue.

- Being creative is the solution of many problems. This can be reflected when I was trying to find appropriate method to analyse the topic given by the client. People are likely to feel fearful when they face an unknown problem, I found that being open minded and creative can provide many ideas about solving problems.

- The core of a problem should be analysed carefully at the beginning of project. Since the problem of research can be very complex and big, it is easy to get confused about the main problem we wish to solve. Setting bullet points about the main problems is a very helpful to guide the logic of researchers during the project.

- Due to the time limitation, it is regret that the reason behind the negative relationship between children under five mortality rates and total fertility rate has not been found. This might worth further investigation.

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Appendix A
Terms of Reference

Sponsoring Organisation:
Population Matters
135-137 Station Road, London E4 6AG, UK

Student:
78250

Client Supervisor:
Roger Martin, Chairman of Population Matters

LSE Supervisor:
Sue Merchant

Working Project Title:
How Aid Resources Are Distributed in Developing Countries and Their Impacts

Description of Problem Area:
Over the last fifty years, governments, Non-Governmental Organisations, World Bank, United Nations and many other organisations have devoted much effort on improving health, education, food production and many other aspects in developing countries. However the overall impact of these efforts, whilst they may have reduced the percentage of people living in poverty, may not have reduced the absolute numbers, which is likely to have placed increasing strain on resources.

Purpose of Project:
This research attempts to analyse the aid given to one or more countries over the last 50 years, in terms of its distribution by type (eg health, education, food aid etc) and in particular the percentage spent on aspects which may contribute to reducing fertility. The research should also try to assess how effective this has been in reducing the birth rate in those countries. The purpose of the research will be to try to clarify how expenditure between types of aid might be adjusted to achieve greater stabilisation of the population.

Proposed Method:
Statistical Analysis, Illustrative Simulation (Possibly)

Data Type and Sources:
Website, Journal

Hardware and Software Required and Available:
Minitab, @Risk (Possibly)

Deliverables:
Report

Agreed by:	Internal supervisor	Date
	LSE supervisor	Date
	Student	Date

Appendix B – Glossary of Technical Terms

Table 9: Definition of Terminology

Variable	*Definition*
Total Fertility Rate or Fertility Rate	The total number of children every women would have during her lifetime on average of the region
Life Expectancy	The average number of years a new born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. [20]
Size of Population	Population counts all residents regardless of legal status or citizenship who are generally considered part of the population of their country of origin. But not include refugees who not permanently settled in the country. [21]
Children Under 5 Mortality Rate	The probability of children under five years old will die among 1000 new born baby if subject to current age-specific mortality rate.
GDP per Capita	It is gross domestic product divided by the number of population in the current year. The gross domestic product is measure of aggregate production.
Poverty Line	The poverty line used in the report is $38 per month, which equivalent to $1.25 per day. People living below poverty line means people daily living standard less or equal than $1.25.
Poverty Headcount Ratio	Poverty headcount ratio measures the percentage of people living below the poverty line ($1.25 per day). The higher poverty headcount ratio indicates there are more people living below the poverty line in the region. [22]
OECD	Abbreviation of the Organisation for Economic Co-operation and Development. It focus on promote policies that will improve the economic and social well-being of people all over the world. [27]
DAC	Abbreviation of the Development Assistance Committee. It is a group of developed countries selected from OECD members discuss and deciding issues about development aids and poverty reduction in developing countries. [12]
Total Development Aid Disbursement	It is the total amount of actual international transfer of financial resources at every year. [15]
Development Aid on Education	Total amount of development aid spent on education. Education includes unspecified level, basic education, secondary education and post-secondary education.
Development Aid on Health	Total amount of development aid spent on health. It includes general health and basic health.
Development Aid on Reproductive Health	Total amount of development aid spent on reproductive health care.
Development Aid on Family Planning	Total amount of development aid spent on family planning.
Development Aid on STD control	Total amount of development aid spent on STD control including HIV/AIDS.
Development Aid on Economic Infrastructure	Total amount of development aid spent on economic infrastructure. It includes transport, storage, communication, energy, banking & financial service and business & other services.

P or P Value	P value measures a hypothetical repetition of the study. It tests the significance of the variable in regression model. If the p value of the variable less than 0.05, then the variable is significant at 5% level.
t Value	t value measures the significance of the variable in regression model. It corresponds with p value. If a variable has very small p value and it is significant, then the t value of this variable is large and significant in the model.

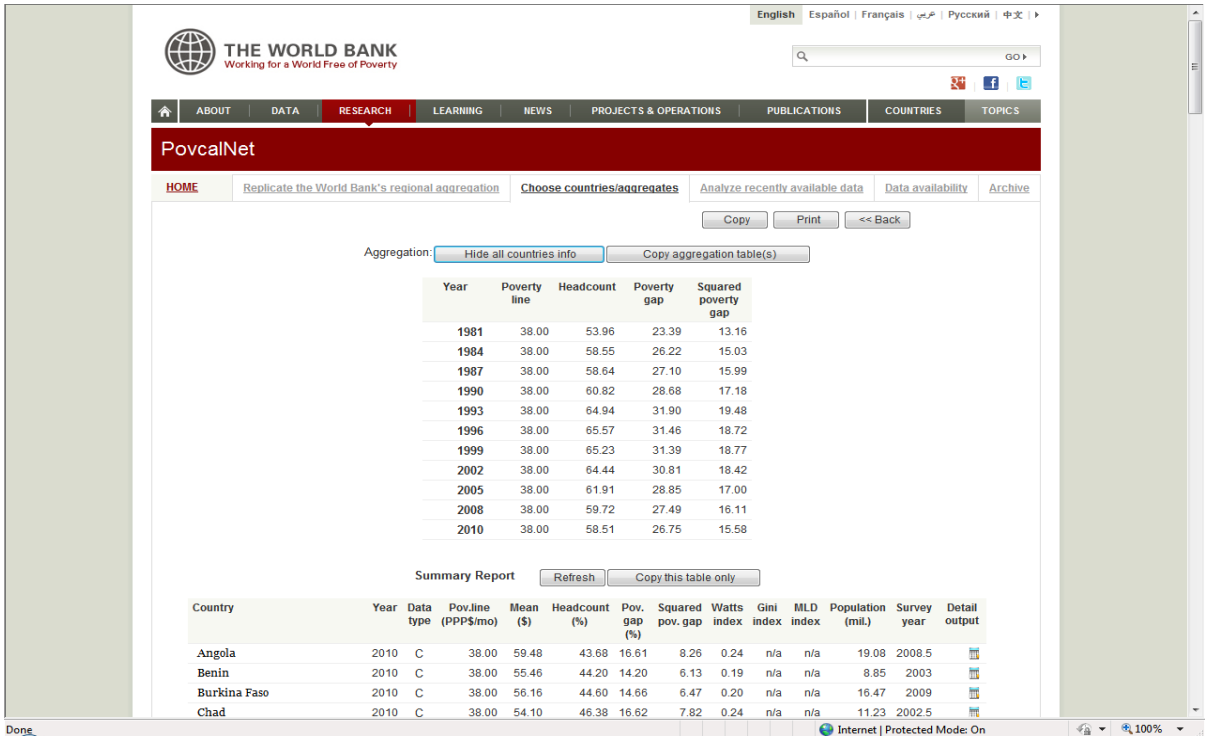
Appendix C. Data Sources

Table 10: Data Sources	
Data	***Source***
Table Data:	
Table 1: 2011 world fertility rate	The World Bank
Source and Distribution of Development Aid Data:	
Total Development Aid Disbursement from 1961 to 2011 Total Aid from DAC Countries from 1961 to 2011 Total Aid from G7 Countries from 1961 to 2011 Total Aid for Multilateral Agencies from 1961 to 2011 Aid Distribution on Social Infrastructure, Economic Infrastructure, Production, Multi-sector, Commodity Aid, Action Relating to Debt, Humanitarian Aid and Others from 2002 to 2011 Aid Distribution on Education, Health, Reproductive Health, Family Planning, STD Control and Others from 2002 to 2011	Organisation for Economic Co-Operation and Development (OECD) – Query Wizard for International Development Statistics (QWIDS)
Poverty Data	
Aggregate Value of Poverty Headcount Ratio for the Twenty Highest Fertility Rate Countries from 1981 to 2010 Aggregate Value of Poverty Headcount Ratio for Sub-Saharan African Region from 1981 to 2010 Aggregate Value of Poverty Headcount Ratio for Worldwide from 1981 to 2010 Aggregate Value of Poverty Headcount Ratio for China from 1981 to 2010	The World Bank – PovcalNet an Online Poverty Analysis Tool
Empirical Research Data:	
Total Fertility Rate Life Expectancy Size of Population	United Nation Data, sourced from the World Bank
Children Under 5 Mortality Rate GDP per Capita	United Nation Data, sourced from United Nations Statistic Division
Development Aid on Education Development Aid on Health Development Aid on Reproductive Health Development Aid on Family Planning Development Aid on STD Control Development Aid on Economic Infrastructure	Organisation for Economic Co-Operation and Development (OECD) – Query Wizard for International Development Statistics (QWIDS)

Appendix D – Model Building and Test for Panel Data Model

1) Aggregate Value of Poverty Headcount Ratio in the Twenty Highest Fertility Countries

The Twenty Highest Fertility Rate Countries



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Aggregation: Hide all countries info | Copy aggregation table(s)

Year	Poverty line	Headcount	Poverty gap	Squared poverty gap
1981	38.00	53.96	23.39	13.16
1984	38.00	58.55	26.22	15.03
1987	38.00	58.64	27.10	15.99
1990	38.00	60.82	28.68	17.18
1993	38.00	64.94	31.90	19.48
1996	38.00	65.57	31.46	18.72
1999	38.00	65.23	31.39	18.77
2002	38.00	64.44	30.81	18.42
2005	38.00	61.91	28.85	17.00
2008	38.00	59.72	27.49	16.11
2010	38.00	58.51	26.75	15.58

Summary Report | Refresh | Copy this table only

Country	Year	Data type	Pov.line (PPP$/mo)	Mean ($)	Headcount (%)	Pov. gap (%)	Squared pov. gap	Watts index	Gini index	MLD index	Population (mil.)	Survey year	Detail output
Angola	2010	C	38.00	59.48	43.68	16.61	8.26	0.24	n/a	n/a	19.08	2008.5	
Benin	2010	C	38.00	55.46	44.20	14.20	6.13	0.19	n/a	n/a	8.85	2003	
Burkina Faso	2010	C	38.00	56.16	44.60	14.66	6.47	0.20	n/a	n/a	16.47	2009	
Chad	2010	C	38.00	54.10	46.38	16.62	7.82	0.24	n/a	n/a	11.23	2002.5	

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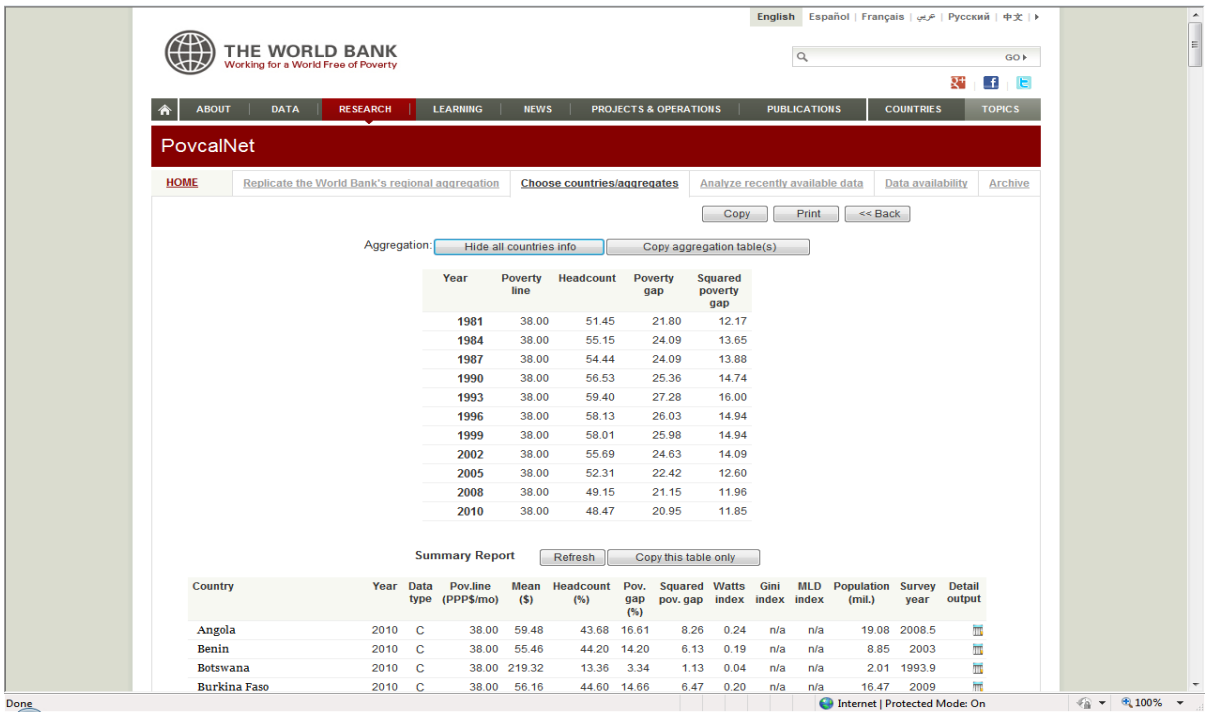
The Sub-Saharan Region



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Aggregation: Hide all countries info | Copy aggregation table(s)

Year	Poverty line	Headcount	Poverty gap	Squared poverty gap
1981	38.00	51.45	21.80	12.17
1984	38.00	55.15	24.09	13.65
1987	38.00	54.44	24.09	13.88
1990	38.00	56.53	25.36	14.74
1993	38.00	59.40	27.28	16.00
1996	38.00	58.13	26.03	14.94
1999	38.00	58.01	25.98	14.94
2002	38.00	55.69	24.63	14.09
2005	38.00	52.31	22.42	12.60
2008	38.00	49.15	21.15	11.96
2010	38.00	48.47	20.95	11.85

Summary Report | Refresh | Copy this table only

Country	Year	Data type	Pov.line (PPP$/mo)	Mean ($)	Headcount (%)	Pov. gap (%)	Squared pov. gap	Watts index	Gini index	MLD index	Population (mil.)	Survey year	Detail output
Angola	2010	C	38.00	59.48	43.68	16.61	8.26	0.24	n/a	n/a	19.08	2008.5	
Benin	2010	C	38.00	55.46	44.20	14.20	6.13	0.19	n/a	n/a	8.85	2003	
Botswana	2010	C	38.00	219.32	13.36	3.34	1.13	0.04	n/a	n/a	2.01	1993.9	
Burkina Faso	2010	C	38.00	56.16	44.60	14.66	6.47	0.20	n/a	n/a	16.47	2009	

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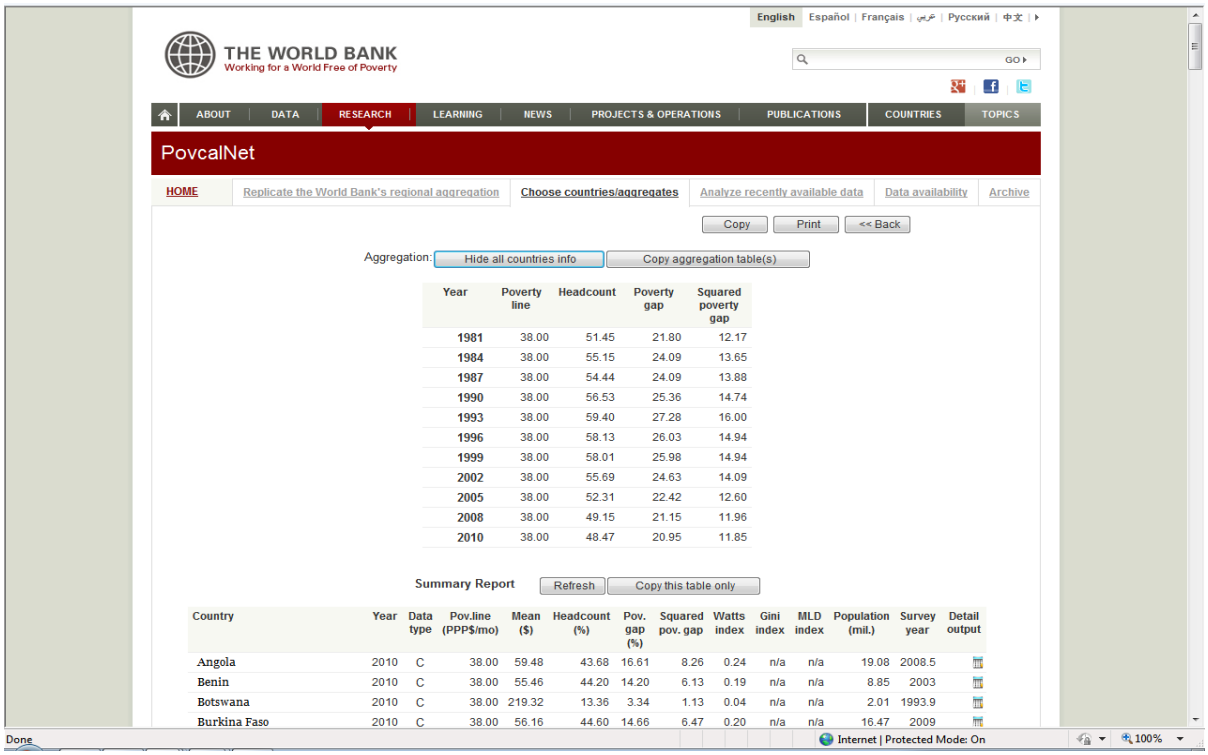
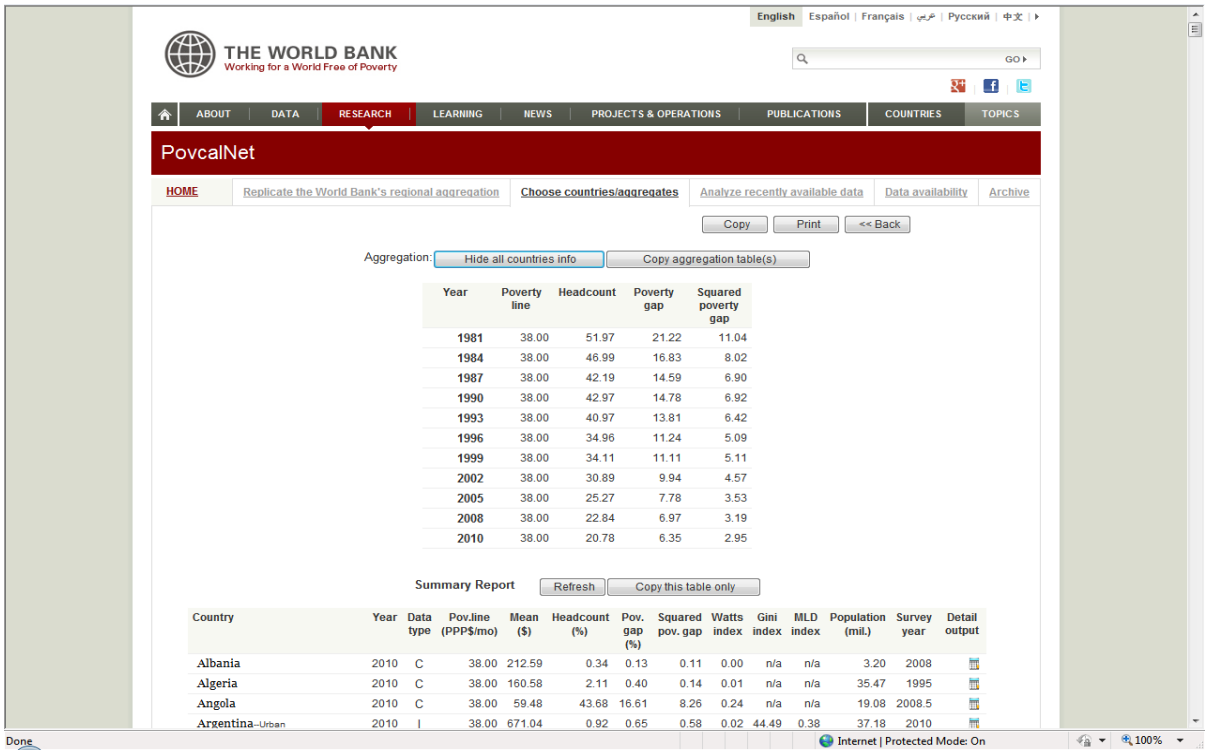
China

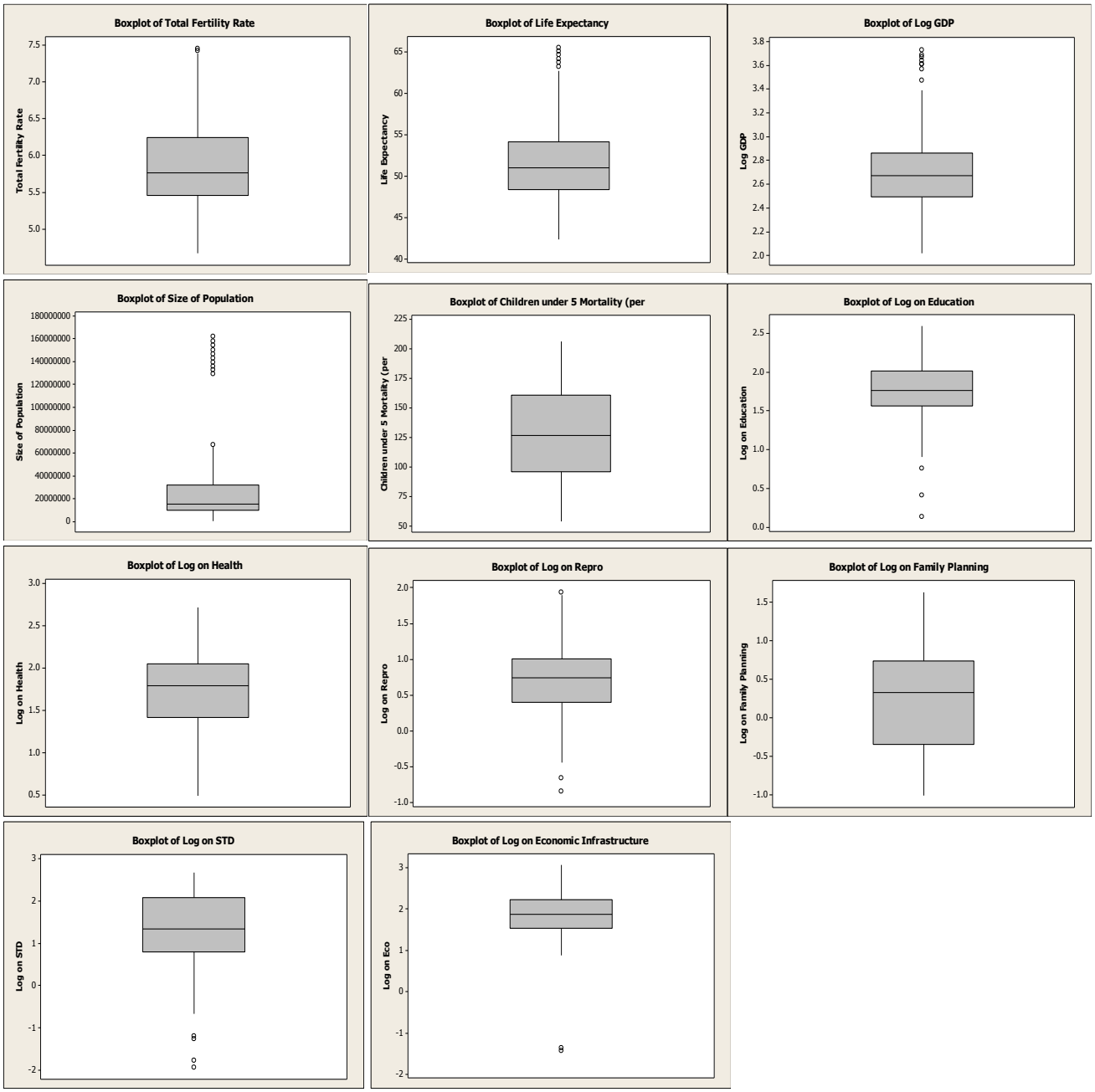


Worldwide



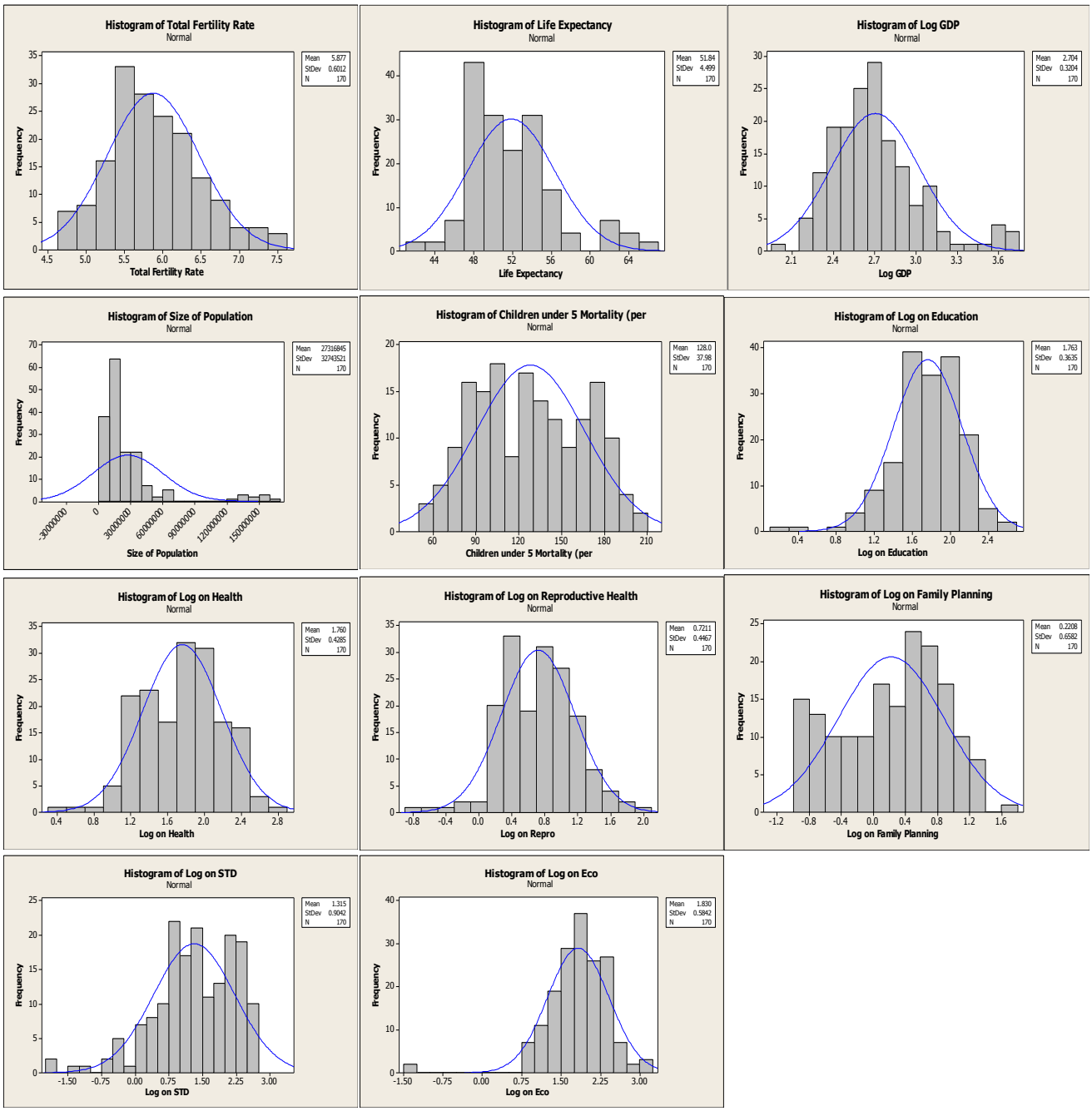
2) Boxplot

Below boxplots show any outlier of variables in empirical model dataset. It can be seen that variable life expectancy, log GDP per capita, size of population, log aid on education, log aid on reproductive health, log aid on STD control and economic infrastructure has a few outliers. After investigate these outlier observations, none of them are error and removing them would lead data bias. Therefore, keep these outlier observations in the model building dataset.



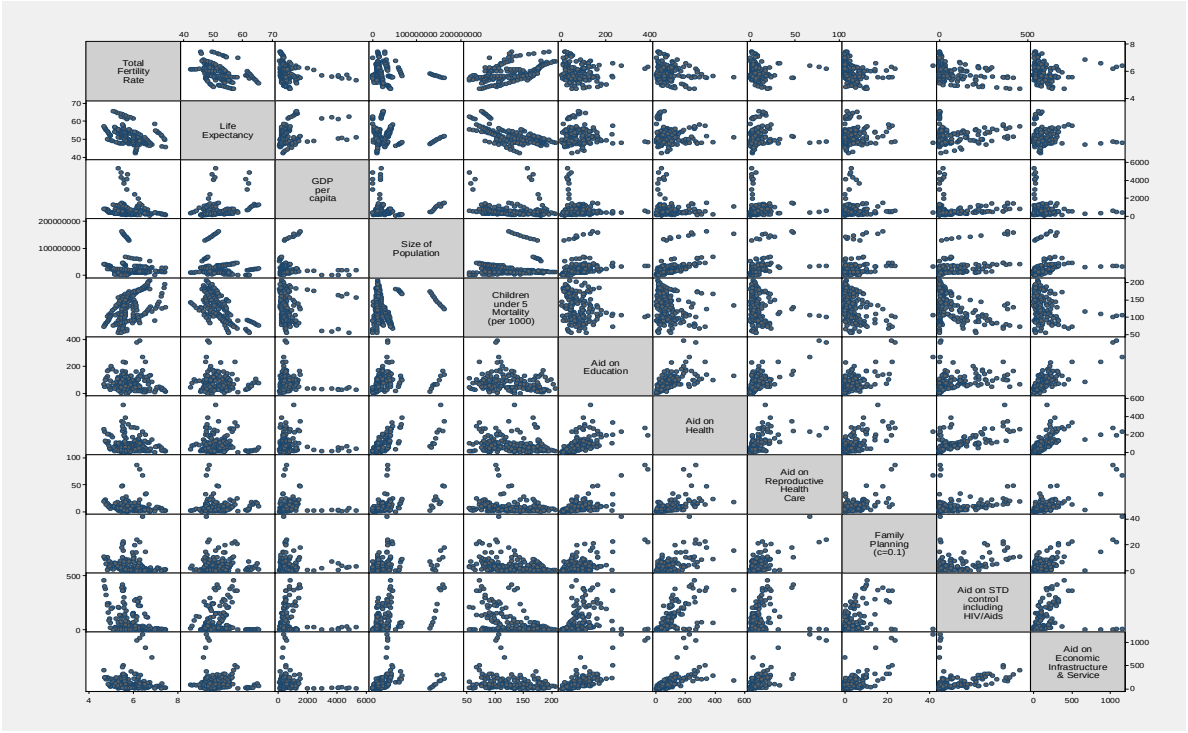
3) Histogram

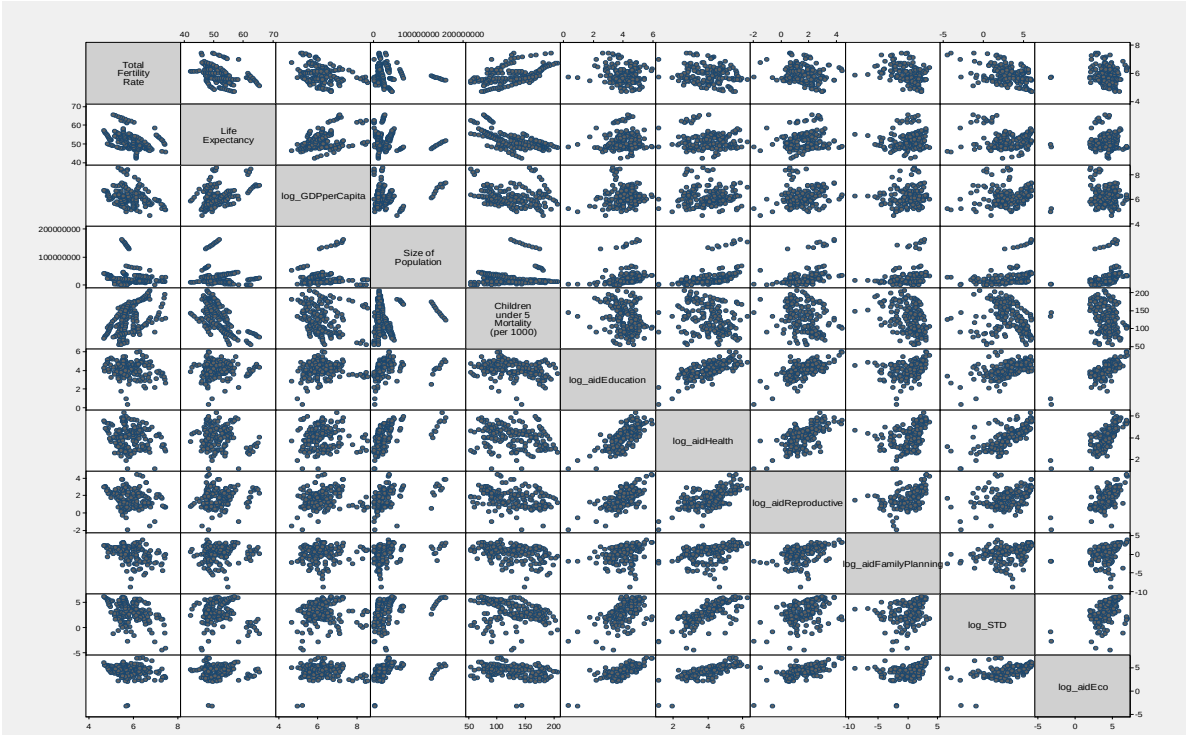
Histogram displays data structure of each variable. The vertical axis displays the frequencies of the observations appear in the range which indicated by horizontal axis. It can be seen from the size of population plot that there are some extreme values in variable size of population. Some observations have very large size of population, exceed 150 million. These observations are from Nigeria, which is the seventh largest populous country in the world.



4) Matrix Plot

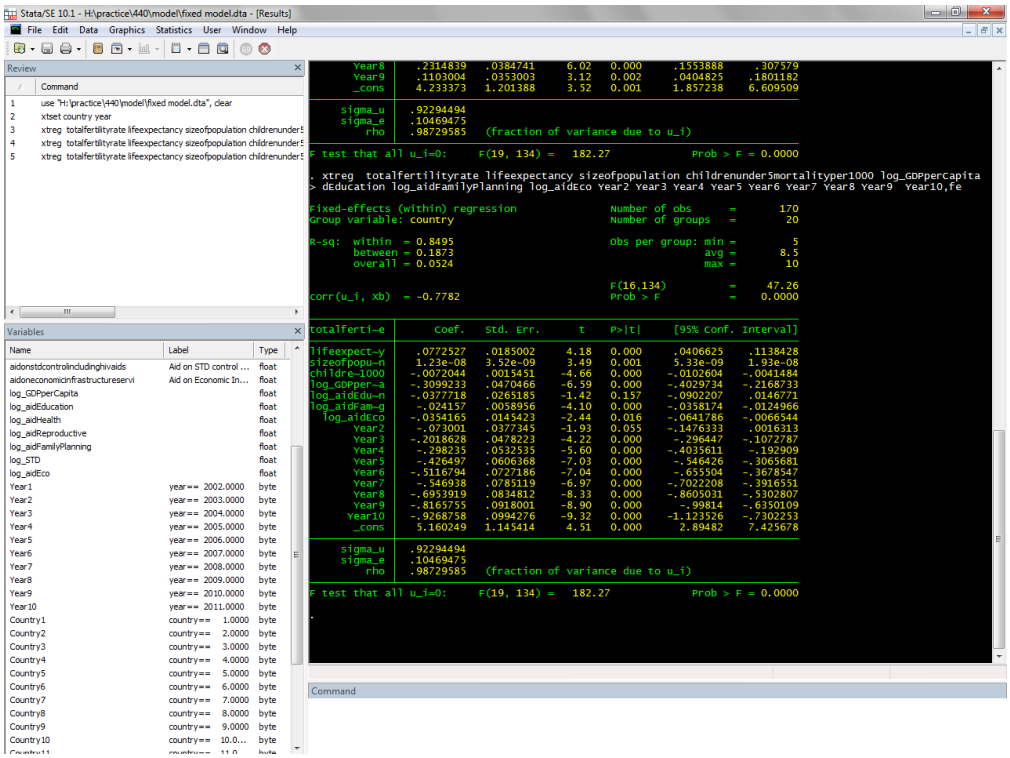
The above matrix shows observation scatter of each variable before logarithmic transformation. It is clear that observations of variable GDP per capita, development aid on education, health, reproductive health, family planning, STD control and economic infrastructure are concentrated at left hand side of their plot. After logarithmic transformation, observations of these variables are more scattered from the below matrix.



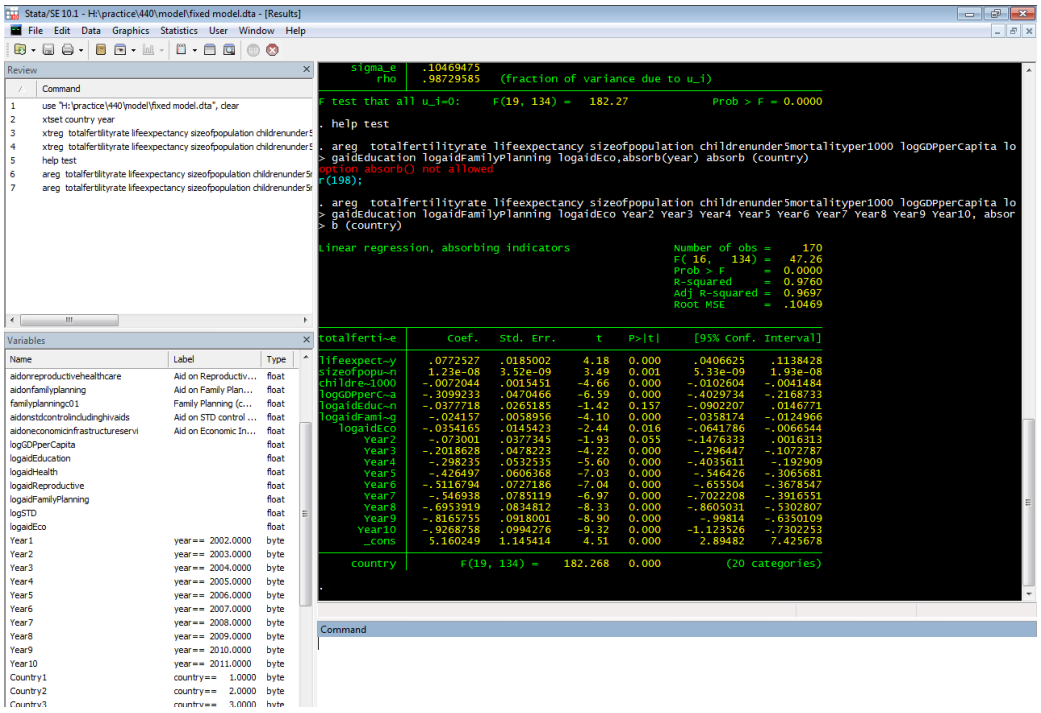


5) Two-Way Fixed Effect Panel Data Model

The Stata Results of two-way fixed effect panel data model (Table 6): results when using xtreg,fe command



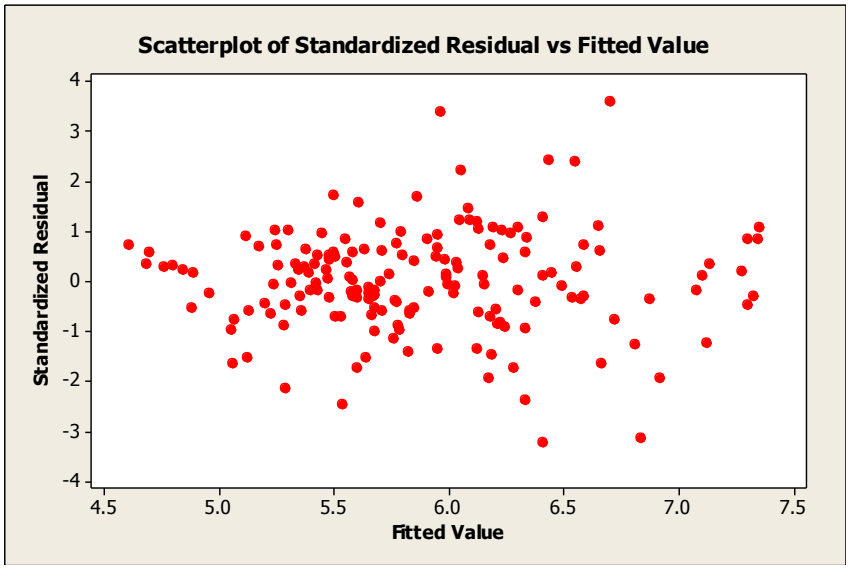
The Stata Results of two-way fixed effect panel data model (Table 6): results when using areg command. R-square of the model gets from below



6) Residual plot

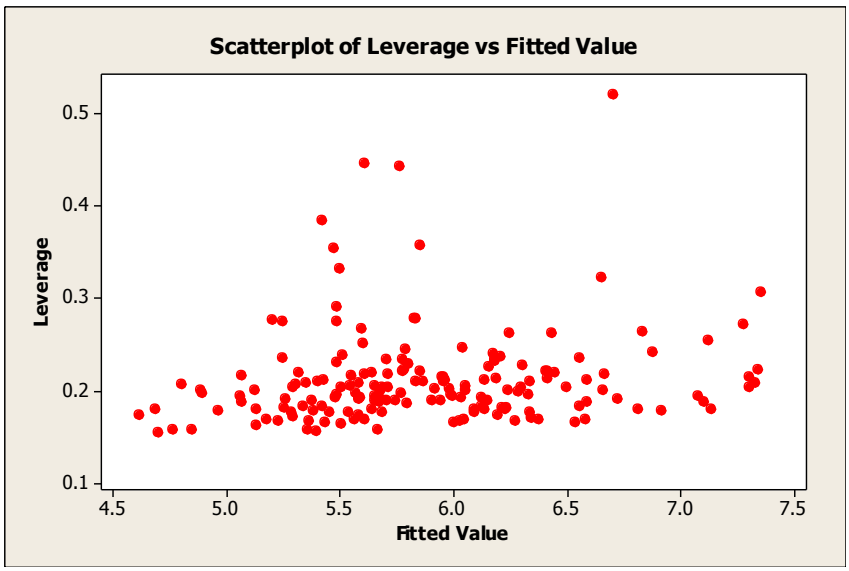
Standardized Residual vs. Fitted Value

There are only two observations which have standardized residuals larger than 3 which indicate that no unusually large standardized residual in the empirical model.



Leverage vs. Fitted Value

There is only one observation has leverage higher than 0.5, which has no reason to believe that it is an error. Thus, keep in model building dataset.



7) Causal Loop Diagram