UNIVERSITY OF BIRMINGHAM

Essays on co-residing decision, public education expenditure, income inequality, and education policies

by

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ABSTRACT

The determinants of residing arrangements of senior citizens to explain household formation behaviour, the role of public education expenditure to change income distribution, and the success of educational policies to increase school attendance in Bangladesh are the research objectives of this thesis which consists of four independent essays. Theoretical models and empirical analysis have been conducted both in the first and second essays to find appropriate determinants of residing arrangements of senior citizens in developing and developed countries respectively. The results suggest that economic growth and religion determine co-residence arrangements in developing countries while life-cycle pensionable wealth and cultural factors determine solitary residing patterns in developed countries. The third essay investigates, theoretically and empirically, the impact of public education expenditure on income inequality. The findings show that public education expenditure reduces income inequality for developed OECD countries but increases for developing countries. Finally, the success issues of two education policies in Bangladesh - the "(Obligation to) Primary Education Act 1990" (PEA 1990) and the "Female Secondary School Stipend Program 1994" (FSSSP 1994), are theoretically and empirically evaluated. The results highlight that the PEA 1990 policy is not fully successful but the PEA 1990 and the FSSSP 1994 policies jointly make remarkable success in school attendance and literacy rates in the country.

Key words: Co-residing arrangements, solitary residing attitudes, senior citizens, public education expenditure, income inequality, educational policies of Bangladesh.

DEDICATION

Dedicated to

- My mother, A.R.Hamida Akhter, who has sacrificed her whole life for her children
- My wife, Layla Akhter and sons, who had to go through a great deal of hardships during the last two years because of my absence
- My eldest brother, Md. Muzahidur Rahman and other siblings, who have always prayed for my degree

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ACRONYMS

AAE	Africa, Asia, Central and East European countries
ADF	Augmented Dickey-Fuller
ADL	Autoregressive Distributed Lag
BBS	Bangladesh Bureau of Statistics
B.C	Before the Birth of Christ
BLUE	Best Linear Unbiased Estimator
CPS	Current Population Survey
CPI	Consumer Price Index
DAAE	Developing Africa, Asia and European countries
DHS	Demographic and Health Surveys
DPE	Directorate of Primary Education
FE	Fixed Effects
FSP	Female Stipend Programme
FSSS	Female Secondary School Stipend
FYP	Five Year Plan
GA	General Assembly
GoB	Government of Bangladesh
GDP	Gross Domestic Product
GHBS	Greek Household Budget Surveys
GNP	Gross National Product
HDI	Human Development Index
HDRO	Human Development Report Office
IMF	International Monetary Fund
IIS	Impulse Indicator Saturation
LAA	Least Developed African and Asian countries
LAAM	Latin America and the Caribbean countries
LDS	Less Developed Countries

MDG	Millennium Development Goals
MLE	Maximum Likelihood Estimator
NSS	National Sample Survey
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
PEA	(Obligation to) Primary Education Act 1990
PISD	Panel Study of Income Dynamics
PPP	Purchasing Power Parity
RE	Random Effects
SABE	Health, Well-being and Ageing Survey
SHIW	Survey of Households‘ Income and Wealth
SSC	Secondary School Certificate
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Education Sciences and Cultural Organisation
US	United States
WIDER	World Institute for Development Economics Research

CHAPTER ONE

Introduction

1.1 Core Issues

This thesis is concerned with some core multi-faceted issues in development economics ranging from the residence behaviour of the elderly (subsequently cited as –senior citizens") within the family, to the impact of public education expenditure on the young and its consequential impact on income inequality. When analysing co-residency, we also undertake a comparative analysis between developing and developed countries so that the differences (or similarities) may be examined. In addition, we analyse the impact of public policy (in terms of the legal stipulation to primary education) on school attendance and literacy – often considered as a sine qua non for development. This issue is analysed for a poor developing country, Bangladesh, and the case study allows us insight into education policy issues in development. Although the topics are different conceptually and methodologically, they allow an insight into the economic decision-making behaviour of a member in an –extended family" (a family consisting of older and younger generations) in terms of residence, education and policy. We know members of an extended family make decisions based on economic perspectives. In an extended family, making residing arrangement decision is an important issue for the old and that investing human capital development via education is vital for the young. In addition, in both cases, the role of government has significant consequences on these decision processes. We have attempted to analyse all these issues in this thesis.

Residing behaviour of senior citizens, the impact of public education expenditure on income inequality and the consequences of education policies in Bangladesh are the three individual topics of the thesis. **Chapters Three** and **Four** cover the essays titled –Altruism

and residing arrangements of senior citizens in developing countries" and "Solitary residing senior citizens in European countries" respectively; and **Chapters Five** and **Six** present the other two essays titled "Impact of public education expenditure on income inequality" and "Effects of two education policies on educational development in Bangladesh" respectively.

As ageing baby-boomers approach retirement age, their economic behaviour and corresponding socio-economic impact have become an important research agenda. Population ageing is becoming a big challenge for the policymakers in all societies as it involves several socio-economic consequences especially in the pension and health care systems, family composition, and the residing arrangement of generations. Although many studies (Ermisch, 2003; Becker,1991; Samuelson, 1958) have stressed the necessity of the family composition decision of the younger generation, a concentrated research focus on the residing arrangement of senior citizens is a relatively new theme. It is driven by concerns raised around the world that the residing arrangements of senior citizens matter both in developing and developed countries: however, the natures of concern of these arrangements are different in developing and developed countries.

Thorough out the thesis, we consider people aged 60 years and above as senior citizens. Table - 1.1 shows that 73 percent of the senior citizens in North America and 69 percent of the senior citizens in Europe live alone or in the couple typed family structure, while in Asia and Africa it is only 23 percent and 17 percent respectively. The statistics infer that residing arrangement of senior citizens in North America and Europe follows the nuclear family type while in developing Africa and Asia, the residing arrangement of senior citizens is the extended family type. The population Census - 2001 of Bangladesh reports that there has been a decreasing trend in the proportion of households with seven members and above since 1981 and that the percentage of households of five members or less has shown increasing

trend: 33.7 percent, 37.8 percent and 50.6 percent respectively in 1981, 1991 and 2001. These statistics indicate that family size in developing countries is gradually turning from the extended family to the nuclear family. These phenomena have raised the question regarding the determinants of the residing arrangements of senior citizens both in developing and developed countries around the world.

Table 1.1: Residing Arrangement of Senior Citizens (aged 60 and above) by Selected Regions and Sub-regions of the World

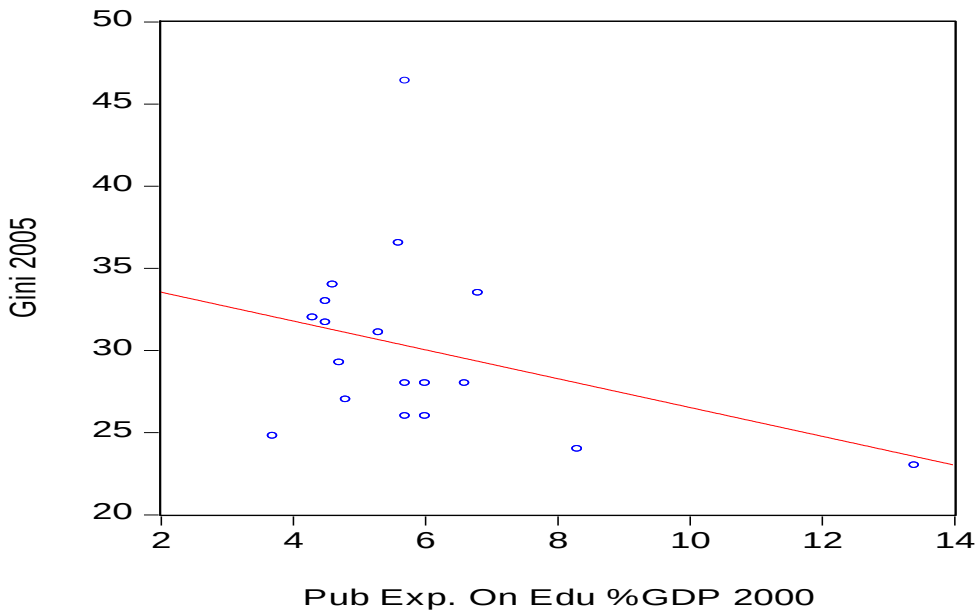
Living Arrangement Region/Sub-region	Alone	Couple only	Alone or Couple only	With children or grand children	With other relatives or non relatives	Total
Asia	7	16	23	74	4	100
(East	9	20	29	70	1	100
▪Southeast	6	13	19	73	9	100
South-central)	4	9	13	83	-	100
Africa	8	9	17	74	8	
Europe	26	43	69	26	4	100
(South)	19	39	58	38	4	100
Latin America & Caribbean	9	16	25	62	14	100
North America	26	47	73	19	8	100

Source: UN 2005, Table II.5, p 36

Turning now to education conception in an extended family, investing in human capital accumulation is a significant decision making issue of the young generation. Human capital, at present, is considered as an essential factor of production which needs to be developed for achieving rapid economic growth. Education and training are the basic input of acquiring human capital. Human capital accumulation, whether it is private or public education, is a major conduit through persistent or cross-dynastic income change in reducing

inequality. Studies (Glomm and Ravikumar, 2003; Barro, 1999) have claimed that the public education system ensures the equality of opportunity and equal access to the inputs of learning technology across all pupils; as a result, incomes converge and income inequality declines in the society. An alternative viewpoint in the education and income inequality literature shows that the role of expanding public education provision by increasing public education expenditure creates more unequal income distribution in a society. The finding of Gould et. al. (2001) states that in many developing countries public education provision has expanded; as a result, the marginal product of labour has increased during the last few decades but wage inequality or income inequality has widened significantly.

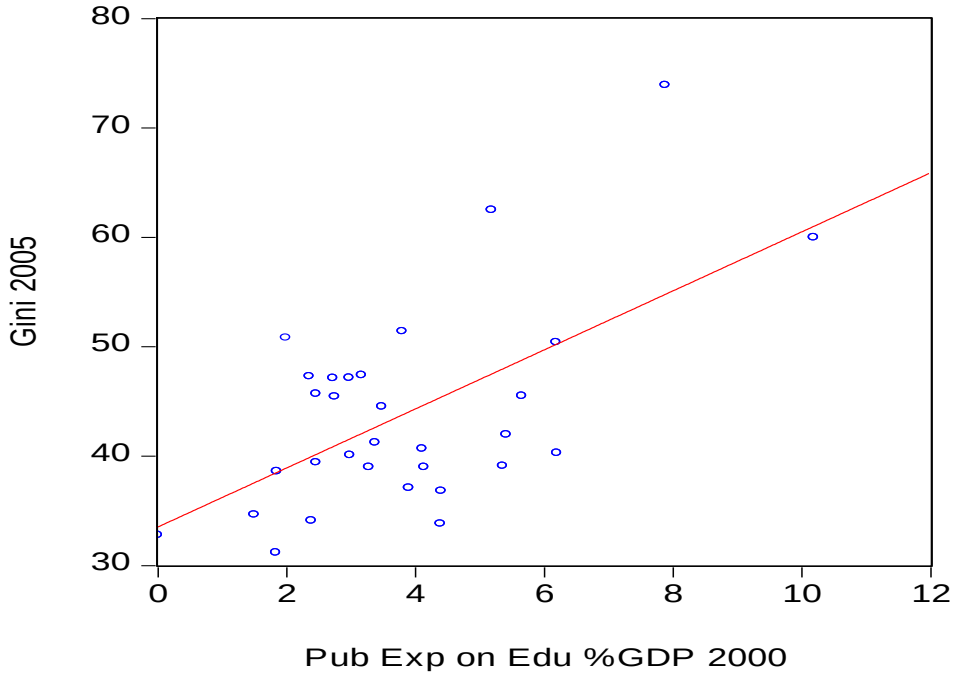
Figure 1.1: OECD countries: Income Inequality 2005 and Public education expenditure 2000



Empirically we can say that ―Gini coefficient" and public education expenditure as a percentage of Gross Domestic Product (GDP) are two widely used indices respectively for measuring income inequality of a country and the contribution of government to human capital development via education. It might be reasonable to assume that the change in public education expenditure affects the income distribution of a country at least 5 years later. In

Figure 1.1, we have plotted Gini coefficient of 2005 and public education expenditure of 2000 of 18 Organizations of Economic Cooperation and Development (OECD) countries[1]. The estimated relationship between income inequality and public education expenditure is negatively sloped. It implies that an increase in 5-year earlier public education expenditure reduces income inequality of current year and vice versa if other things remain constant.

Figure1.2: Poor countries: Income Inequality 2005 and Public education expenditure 2000



In Figure 1.2, we have plotted Gini coefficient of 2005 and public education expenditure of 2000 of 31 African, Asian, Latin American and the Caribbean poor countries[2]. From the Figure 1.2, we see that the relationship between 5-year earlier public education expenditure and income inequality is positive. The contradictory impact of public education expenditure on income inequality of a country needs to be investigated meticulously.

[1] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom and United States

[2]Bangladesh, Gambia, Ghana, Guinea, India, Indonesia, Jamaica, Kenya, Lao, Latvia, Lesotho, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mongolia, Mozambique, Namibia, Nepal, Pakistan, Philippines, Rwanda, Senegal, Swaziland, Thailand, Togo, Trinidad and Tobago, Uganda and Zambia.

Like many other countries, the Government of Bangladesh (GoB) invests nearly 4 percent of her gross domestic product (GDP) on education every year. Several policies have been adopted to increase the returns to those investments. Among those, two are directly related to improve school attendance. One is the ―(Obligation to) Primary Education Act (PEA) 1990" aiming to eradicate illiteracy from primary school aged (6 years to 10 years) children throughout the country enrolling all of them into schools and to ensure universal primary education for all children in the country. Another one is the ―Female Secondary School Stipend (FSSS) program 1994" which has been implemented all over the country to increase female attendance at existing schools in secondary level aiming to reduce the gap between male and female school attendance. The Female Stipend Program (FSP) was created as a pilot project in 1982 in Bangladesh and was implemented initially in six villages only to increase the enrolment and retention of girls in secondary schools. The pilot FSP yielded positive results: girls' secondary enrolments increased from an average of 7.9 percent to 14 percent in some project areas and dropout rates fell from 14.7 percent to 3.5 percent (Haq & Haq, 1998, p. 93). Therefore, the GoB extended the program nationwide in 1994 and it was called the ―Female Secondary School Stipend (FSSS)" program.

On an average, one third of the total education budget has been allocated for primary education during the last fifteen years but still in reality, primary education in Bangladesh is very vulnerable. According to the report of Directorate of Primary Education (DPE), 2008, we see that there are at least four different types of primary educational institutions: out of 82218 total primary educational institutions - 37672 are Government Primary Schools, 20083 are Registered Non-Government Primary Schools, 966 are Non-Registered Non-Government Primary Schools and 23497 are Other Primary level Institutions (Basically Religious unorganised institutes). Similarly, out of 365925 primary school teachers - 182899 are in Government Primary Schools, 76875 are in Registered Non-Government Primary Schools,

2460 are in Non-Registered Non-Government Primary Schools, and 103691 are in Other Primary level Institutions. The academic curriculum for different types of primary institutions is also significantly different. That means the pupils of primary level have not got uniform and universal primary education yet. On the other hand, the government‘s contribution in secondary level of education is significantly declining. There are 317 Government managed secondary schools and 18,453 private High Schools, which receive teachers‘ salary from the Government (Bangladesh Country Report, 2009). Statistics show that the primary education expenditure as percentage of GDP is increasing but public secondary education expenditure is decreasing dramatically. As a result, the enrolment rate between primary and secondary level falls more than 50 percent. The demand for secondary level of education is continuously becoming a privately financed good and going beyond the reach of poor rural household. In almost all the developed countries in the world, primary and secondary levels of education together are considered as basic education for their citizens. The impacts of these two important government education policies of Bangladesh on overall school attendance needs to be evaluated rigorously.

1.1.1 Chapter Three

We now consider preliminary discussion of each chapter separately. In developing countries, historically, households represent the main institution that distributes goods and services between generations (Becker 1991; Kuznets 1978; Thornton, Chang and Sun 1984). It can be noticed that due to altruistic attitude towards parents, children transfer money to their parents and/or grandparents in their old age because the senior citizens in developing countries hardly have any consistent flow of income which they could consider as their permanent income (Ghuman and Ofstedal 2004; Martin 1988, 1989; Mason 1992). Moreover, senior citizens (such as elderly parents) in that age do not want the financial support only but some logistical supports also which cannot be met by the direct transfer payments from

children. Nevertheless, co-residence of senior citizens with young citizens (for instance, parents with their children) can satisfy both the financial and logistical need of the senior people in developing countries. Policymakers in developing countries greatly value this family tie and like this tradition to be carried on rather than introducing governmental safety-nets programs (Knodel, Chayovan and Siriboon 1992). Unfortunately, in the era of globalisation when the ―traditional values of familism and filial piety are being supplanted by the Western values of individualism" (Martin 1989; p. 627), the residing arrangement of senior citizens in the developing countries is a great concern for the policymakers because neither there is any developed public or private residing institution established yet nor there are hardly any socio-economic safety-nets by the governments (Bongaarts and Zimmer 2001; Mason 1992) for the senior citizens. We, therefore, investigate the research question that what are the factors determining co-residing pattern of senior citizens in developing countries. We have developed a theoretical framework which explains the residing arrangement of senior citizens with their altruistic children. Using panel data of 16 African and 6 Asian countries around the world, we have also empirically examined the significant factors which determine the co-residence pattern between two successive generations in developing countries. Estimated results suggest that the economic growth leads to a significant fall in the co-residence arrangements of senior citizens with their children. Life expectancy and cultural issues are also found to be significant phenomena of residing pattern of senior citizens. This research question is answered in detail in Chapter Three. Let us now move into Chapter Four.

1.1.2 Chapter Four

On the other hand, in developed countries, the solitary residing arrangement of senior citizens concerns the policymakers. Studies (Pendry, Barrett and Victor 1999; Breeze, Sloggett and Fletcher 1999) show that solitary residing senior citizens are more likely to enter

an institution than those living with at least one other person. Even where institutionalisation does not take place because of cultural or social norms and values, solitary residing senior citizens are more likely to require special care either from the state or from relatives or neighbours, in the form of home helps and other social services, than those who live with others. Moreover, solitary residing senior citizens are more vulnerable than co-residing senior citizens. They need outside assistance in the case of illness or disability and are at greater risk of social isolation even though the systems of social security of developed countries are well organised. Studies (Hermalin, et. al., 2002; Gierveld, Jenny and Tilburg, Theo 2010; Casey, and Yamada, 2002) show that compared to those senior citizens co-residing either with a partner or in a multi-generation household, solitary residing senior citizens are more likely to be lonely and depressed, to have a small social network and to have infrequent contact with children. We, therefore, want to research on the question- what are the determinants of solitary residing behaviour of senior citizens in European countries.

At present, Europe is the largest area with the highest proportions of senior citizens and is projected to remain so until 2050. In Europe, 22 percent of the population is aged 60 years or over in the year 2009 and is projected to be 35 percent in the year 2050 which is the highest in any other regions in the world (United Nations, 2009). Approximately, 24 percent of total senior citizens reside alone in the more developed regions (Europe and North America), compared to 8 percent in the less developed regions (Africa, and Asia). Within Europe, the different regions show markedly different proportions of solitary residing senior citizens, ranging from 19 percent in Southern Europe to 34 percent in Northern Europe (United Nations, 2009) which is currently the highest in the World. We, therefore, have chosen 16 European countries to investigate the research question. We have developed a theoretical framework for co-residing and solitary residing decision of parent and child in a

household assuming that co-residing and solitary residing are mutually exclusive events for both of them. Using macro-level and gender-specific aggregate unbalanced panel data sets of 16 European countries, we have empirically investigated the most relevant factors of solitary residing. The empirical results forecast that growth in life-cycle pensionable wealth, life expectancy after retirement, and religious culture of senior citizens reduce solitary residing attitude of senior citizens. Chapter Four covers the details of the essay.

1.1.3 Chapter Five

Continuing with Chapter Five, Becker and Kevin (1988) discuss both the altruistic intergenerational transfer of co-residing family and the investment in children‘s education decision. They argue that parents must trade-off between own consumption and investment in human capital of children. They show that poor parents or parents in poor economy behave like altruistic but there is a shortage in leaving bequest for the investment of children‘s education as the marginal utility of parents‘ old aged consumption is higher than the marginal utility of children‘s consumption in the future. Therefore, investment in human capital is less than the efficient amount without government intervention or social norms in a poor family or a poor country. Thus state intervention in the provision of education and other human capital could raise investments in children to the efficient levels and such intervention would also reduce the inequality because the opportunities of investing children‘s human capital for the poor family are possible. The findings of Sylwester (2002) say that the public education expenditure reduces income inequality of a country. The author mentions that ―the results appear to be stronger in the OECD countries although there is some evidence, albeit weaker, that public education expenditures slowly lessen income inequality in less developed countries" (Sylwester, 2002 p.49) but the author does not take any measure to show the effects separately for the OECD countries and the less developed countries. We have

attempted to investigate the impact of public education expenditure on income inequality of a country by forming a theoretical model for developing and developed countries, along with analysing empirically for the OECD region, for Latin America and the Caribbean (LAAM) region, developing Africa, Asia and East Europe (DAAE) region, and the least developed Africa and Asia (LAA) region. We have found that the impact of public education expenditure on income inequality depends on the development status of a country. The detailed answer of the question - what is the impact of public education expenditure on income inequality of a country, is covered in Chapter Five of the thesis.

1.1.4 Chapter Six

Finally with Chapter Six, the ―Universal Declaration of Human Rights" makes education a basic need for an individual. At present, it is no more an elitist need in any society. So, every government should be responsible to ensure meeting up this need for its citizens. Considering the importance of education, all developed countries around the world have made education up to a certain level free and compulsory for all of their residents at a very early stage of their development; for example Japan, the most developed country in Asia, had high levels of education before they advanced towards industrial development (Sen, 1999). There are many developing countries that are far behind to introduce free and compulsory education up to a basic level. The Government of Bangladesh (GoB) has introduced compulsory, universal primary education by ―(Obligation to) The Primary Education Act, 1990" (The Bangladesh Gazette, Act No. 27 of 1990) - cited as PEA 1990 here after, which was piloted partially in 1992 and has been implemented fully since 1993**.** But still the country is struggling to achieve universal primary education for all of her primary school aged children. In part one of this chapter, we have studied the question - why the government of Bangladesh is struggling to implement universal primary education successfully for all of

its primary school aged children after nineteen years of the policy inception. We have framed a theoretical model of the demand for compulsory education. The theory states that not essentially any rule imposed by the government determines equilibrium demand for schooling decision but the opportunity cost of education, preference for education, parent's income and the maximum years of compulsory education jointly resolves the demand for education. Using time series annual data from 1980 to 2005, we have considered both demand and supply sides factors of school attendance. Using "Autoregressive Distributed Lag (ADL)" estimation model, we have operated "Impulse Indicator Saturation (IIS)" technique to evaluate the success of the PEA 1990 policy measure. The estimated result illustrates that the PEA 1990 policy has not achieved the target yet.

In part two of the chapter, we are concerned about two major education related policy measures that have been introduced since 1991. These are: (i) "(Obligation to) Primary Education Act (PEA), 1990" and (ii) "the Female Secondary School Stipend (FSSS) Programme, 1994".[3] Moreover, the GoB has taken two national education policies since 1990. Not the impact of any specific policy are we going to evaluate in this section, but we are attempting to investigate the combined impact of both of these educational policies on overall school attendance of population aged between 5 and 24 years, and on literacy rates of population aged 5 years and over of the country. Part two wraps up the combined impact of two educational policies – the PEA 1990 and the "Female Secondary School Stipend -1994 (FSSS 1994)", on school attendance of population aged between 5 year and 24 year and on the literacy rate of the population aged 5 years and above. Using district level panel data of 62 districts (out of 64 districts in Bangladesh) for two time periods 1991 and 2001, we have conducted fixed effects estimation method on the two indicators (number of school attendance

[3]Brief discussions about these policies are given in appendix of chapter six.

and literacy rate) of educational development. The estimated results demonstrate that the combined policies have an enormous effect on both indicators with some other development factors for instance family size, annual growth rate, possession of agricultural land etc.

1.2 Structure of the Study

Chapter Two presents the very important background literature of the whole thesis. We have covered theoretical literature related to co-residing behaviour, altruistic family behaviour, impact of public education expenditure and income inequality and the demand for education. We have also studied empirical literature regarding co-residing behaviour, public education expenditure and income inequality as well as educational policies in Bangladesh. Chapter Three provides the determinants of co-residing behaviour of senior citizens in developing countries. Chapter Four discusses the determinants of solitary residing behaviour of senior citizens in the developed European countries. Chapter Five highlights theoretically and empirically the impact of public education expenditure on income inequality around the world. Chapter Six covers the success of the PEA policy and combined impacts of the PEA and the FSSS policies on school attendance and literacy rates in Bangladesh. Finally, Chapter Seven presents the summary of the thesis and concludes with some policy implications. It also notes the limitations of the study.

1.3 Contributions to Knowledge

The study aims at contributing further to the theoretical and empirical literature on the co-residing behaviour of senior citizens in developing and developed countries, the impact of public education expenditure on income distribution and the success of different educational policies in Bangladesh.

We have studied four independent topics - theoretically and empirically: all these essays are novel contributions to relevant economic literature. The sets of data, the percentage of senior citizens residing with children in developing countries and the percentage of solitary residing senior citizens in developed countries are used in the empirical section of Chapters Three and Four respectively, which are the first ever used in economic literature to investigate residing arrangements of senior citizens around the world. Moreover, macro-level panel data are used throughout the thesis to empirically analyse co-residing behaviour of senior citizens in developing countries and solitary residing attitudes of senior citizens in developed countries, which is another significant contribution to the family formation literature.

To theorise the effects of public education expenditure on income inequality, macro based theoretical models for developing and developed countries have been framed in Chapter Five. The theory provides an important result that public education expenditure is a Pareto improvement for any country under some conditions which gives new insight in education literature.

The final contribution has been made in Chapter Six where educational policies of the GoB are evaluated. There are no theoretical and econometric works in this topic for Bangladesh. We conduct the first econometric analysis of evaluating the success of "(Obligation to) Primary Education Act 1990" in Bangladesh. Similarly, using district level panel data set and econometric estimation technique for assessing the success of educational policies on overall school attendance and literacy rate has never been done before for Bangladesh.

1.4 Concluding Remarks

Around the world, the residing arrangement of senior citizens has become immensely important, which needs to be studied rigorously because of new challenges related to population aging. The residing structure of senior citizens is changing; as a result, a certain amount of the responsibility of consumption choice, choice of education and saving choice of a family is shifting from family to government. The governments of almost all the developed countries have already taken huge family responsibilities on their own shoulders. Due to enormous public responsibilities along with population ageing among these developed countries, governments are struggling to maintain the existing status of a welfare state; while, developing countries are trying to increase public responsibilities to improve their development status although they have shortage of necessary resources. The governments of these developing countries are also fighting to improve the existing status of their welfare. That is why the determinants of residing behaviour of senior citizens need to be studied seriously. At the same time, choice of education, expenditure on education, as well as educational policies has great impacts on income distribution, tax structure and pension provision of a country which are, at present, essential research agendas to be focused by researchers. We have endeavoured to highlight all these vital topics in the thesis.

CHAPTER TWO

Background Literature

2.1 Introduction

Since the thesis covers two different issues – co-residing decision of senior citizens and impacts of public education expenditure, we have reviewed literature related to each issue separately. The co-residing decision of senior citizens in developing and developed countries has different dimensions in theoretical and empirical literature and we have focused on the living arrangement of older people with younger one. Theoretical literature regarding the co-residing decision has mostly developed as an individualistic motive of two agents (usually a parent and child) and there are some literature focusing on altruistic intergenerational transfer of family behaviour where two agents (parent and child) are co-residing. On the contrary, we have framed a model for the developing countries where one agent (child) is altruistic, and the other agent (parent) is individualistic; and another for the developed countries where both agents are individualistic. We, therefore, review a few but very important literature about altruistic intergenerational transfer model also. The empirical literature about the determinants of the co-residing decision of senior citizens in the developing countries and determinants of solitary residing senior citizens in the developed European countries are mainly reviewed separately.

Similarly, as literature related to the impact of public education expenditure on income inequality and the impact of public education policies on school attendance in Bangladesh are quite different in nature; we have reviewed the most relevant theoretical and empirical literature of the impact of public education expenditure on income inequality. We also have highlighted the empirical literature about different public education policies in Bangladesh.

2.2 Theoretical literature about co-residing decision

Ermisch (2003) develops a model of co-residing decision of a selfish (individualistic) child with a selfish parent. Assuming that housing service is a pure public good, the basic objectives of the author are to analyse theoretically when and why a child co-resides with a parent, how much benefit the parent and child get individually from housing service and when the child prefers not to co-reside with the parent. In Ermisch (2003), both parent and child have own utility function and income. Individualistic parent is head of the family and charges a rental transfer from the co-residing child. The individualistic child makes co-residing decision as long as the total utility from residing alone does not exceed the total utility from co-residing. From the model, the author derives that as parent income increases, the total demand for housing and rental transfer from child to parent increases in case of co-residing. How much transfer payment a parent can charge from the child depends on the child‘s taste of independence or privacy but the author does not include any parameter or variable for measuring the taste of independence in his model. Housing is a pure public good for co-residing parent and child which is a strong assumption intuitively because co-residing creates loss of privacy and congestion problem. The author mentions that changing this assumption does not change the results significantly. We have frameworked our co-residing decision model of senior citizens based on Ermisch (2003) but included negative externality of co-residing (such as congestion) in both parent and child‘s utility functions. We have assumed that housing is a semi-public good rather than pure public good. Including this negative externality effect in co-residing decision, we have got significantly different results from that of Ermisch (2003). For instance, an increase of parent or child income cannot definitely predict the direction (increase or decrease) of the effect on demand for housing when they are co-residing whereas Ermisch‘s (2003) result does.

Chiappori (1992) develops a model about the collective labour supply decision of a household based on individual preference and shows that the outcomes are Pareto efficient. The author explains that in the early stage of life an agent behaves altruistically because he shares non-labour income with other family members and the agent behaves individualistically about his labour supply decision in later stages of life. In Chiappori (1992), the author is aggregating individual utility maximisation process by imposing some weight of each individual decision which he calls- collective utility maximisation decision. We have used this collective utility maximisation concept for the analysis of our co-residing behaviour of senior citizens where the working citizen is the head of the family and follows the collective utility maximisation concept of co-residing senior citizens by assigning specific weight on the equilibrium maximum utility of solitary residing senior citizens.

Altonji, Hayashi and Kotlikoff (1997) develop a two-period overlapping generation model where parents are altruistic to their children but children may or may not be altruistic to the parents. They argue theoretically that the altruistic transfer would be one to one that means a dollar increase (decrease) in the permanent income of an altruistic parent, who makes a transfer to her child, increases (decreases) the same amount of altruistic transfer towards children. They empirically test the hypothesis using the 1988 wave of ~~–th~~e 1968–89 Panel Study of Income Dynamics (PSID) data set" of the United States of America. Their finding shows that a reduction in parents' income by one dollar reduces their transfer by only five cents and a one-dollar increase in the child's income reduces the transfer he receives by less than eight cents. Thus, the hypothesis of the dollar-to-dollar altruistic relation is rejected by the empirics and it significantly rejects pure altruism hypothesis between generations for the developed countries like the United States of America. However, we have developed a model

on co-residing behaviour of elderly parent and young child for the developing countries where we assume that the young child is altruistic towards the elderly parent. We are not going to test the degree of altruism in the co-residing behaviour.

Becker and Kevin (1988) cover both the altruistic intergenerational transfer of co-residing family and the investment in children‘s education decision. They show that under some conditions, an altruistic parent and selfish child maximise family resources better than the state intervention. They argue that parents must trade-off between own consumption and investment in human capital of children. The equilibrium criterion of investing human capital for altruistic parents is the marginal rate of return on human capital that equals the rate on assets. Parents are better off with efficient investments because they can trade between bequests and investments. Poor parents or parents in poor economy behave like altruistic but there is a shortage in leaving bequest for the investment of children‘s education because the marginal utility of parents‘ old aged consumption is higher than the marginal utility of children‘s consumption in the future. They would like to raise their own consumption at the expense of their children‘s, but they cannot do without leaving debts to children. They argue that both parents and children could be better off by a contract that parents invest in human capital of children up to an efficient level if children would repay their elderly parent not less than their invested amount. That means - although poor parents are altruistic, their attitude about investment in human capital is based on exchange motive. They also say that younger children cannot agree to make such contracts; therefore, investment in human capital is less than the efficient amount without government intervention, social norms or guilt by parents and children in a poor family or a poor country. Thus, state intervention in the provision of education and other human capital could raise investments in children to the efficient levels and such intervention would also reduce the inequality because the opportunities of investing

in children's human capital in the poorer family are possible. They argue that state interventions in the market for schooling, the provision of old-age pensions are necessary for the poor country. In our analysis of co-residing behaviour, we use the opposite direction of altruism – child altruistic towards parent in the developing countries but elderly parent is individualistic. We also utilise the concept that state intervention in human capital accumulation reduces income inequality in the second part of the thesis.

Andreoni (1989) modifies pure altruistic natured models for gift and intergenerational transfer by introducing "warm glow" concept. Using the "warm glow" concept, he gives the theory of intergenerational transfer a new foundation, i.e., the altruistic intergenerational transfer does not necessarily be a pure altruistic motive always; hence, does not need to follow "Ricardian equivalence" condition perfectly. He states that individuals contribute to a public good for two reasons – people demand more public good and people get some benefit like benefit from private goods from their gift which he calls as a warm glow. Because of selfish motive, pure altruism is rare except "impure altruism". Contrary to the previous literature, this model generates identifiable comparative statics results. We also use the concept of impure altruism in forming the model of co-residing behaviour in developing countries but do not estimate the degree of impure altruism.

2.3 Empirical literature of co-residing behaviour in the developing countries

The existing empirical literature mainly investigate the significant determinants of co-residing arrangements of senior citizens where the results are more or less contradictory. A group of literature explains some of the determinants as significant determinants whereas some other literature explain them as insignificant determinants for residing arrangement.

Martin (1989) tries to find out the socio-economic, cultural and demographic determinants of the living arrangements of the senior citizens in four developing countries (Fiji, the Republic of Korea, Malaysia and the Philippines) in north-south region of the Pacific Ocean. In her analysis, ~~"d~~data from a 1984 round of surveys of persons aged 60 and over, sponsored by the World Health Organization (WHO) Regional Office for the Western Pacific, are used to analyse the living arrangements of the elderly in Fiji, the Republic of Korea, Malaysia, and the Philippine"[4] (p 628). At the first stage, the author has taken observations of the elderly who has at least one living child so the sample size is 695 for Korea, 953 for Malaysia, 656 for the Philippines and 636 for Fiji. In the second stage, the author restricts it to the elderly who has spouse and uses 743 observations for Korea, 982 observations for Malaysia, 689 observations for the Philippines and 664 observations for Fiji. Both simple Logit and multinomial Logit estimation methods are respectively used for the first and the second stage of analysis; where in the first stage, there is a contrast of two types of responses in the dependent variable (living with children or not living with children) and in the second stage, there are four types of responses (alone, with spouse, with children and others).The author has hypothesised that the modernisation variables, such as- year of education, living in urban area, year at a current address; the economic variables, such as- self-supporting, home

[4]see detail data collection method in Martin (1989)

ownership, health status; the demographic variables, such as- gender, age, spouse alive, children alive and the cultural variables, such as- religion, ethnicity are considered as the determinants of co-residence of the senior citizens in these areas. Results show that the hypothesis of modernisation theory is mostly not significantly justified and the hypothesis of economic ability to buy privacy regarding the co-residence decision of the elderly people in these countries is weakly justified. The author has found that there is negative relationship between self-support and home ownership variable and co-residence with children for Korea and Malaysia but these variables are positively related when it is a co-residing situation with spouse and the other two outcomes. The result implicitly suggests that living spouse or availability of children with whom an elderly can live might be a determining factor of explaining co-residency of the elderly. The results say that sex and age have significant influence on co-residency of the elderly as well as other demographic variable as divorce and remarriage behaviour significantly determine the co-residence pattern in Malaysia only. We have used macro-level data and included a combination of economic, demographic and cultural determinants of co-residing of elderly population in developing countries.

The United Nations Population Divisions (2005) have produced a report which covers the data on the living arrangement of older persons, trends in living arrangement, some determinants of living arrangement such as- age, marital status, gender, head of households, educational level, availability of kin etc; assembled to get a complete picture of the current older people‘s living arrangement around the world. The report consists of five chapters including an introduction and conclusion. In chapter two, it discusses the patterns and trends of living arrangement. In chapter three, it covers the economic and social factors of older persons‘ living arrangement and chapter four highlights the informal supports and transfers between generations. Some of the data are collected from original secondary sources that

include published articles and books, reports of the United Nations and other organizations, and special databases. However most of the ―micro-level" data are collected at the individual level from primary sources such as population censuses and surveys including the Demographic and Health Surveys (DHS), the United States Current Population Survey (CPS) and the Health, Well-being and Ageing Survey (SABE). Mostly all analyses are descriptive in nature using percentage of different factors and describe the results. The report also uses ―Odd–value' for most of the determinants of living arrangement of older persons. It is found in the report that gender determines living arrangements of older persons. Females are more likely to live alone than their male counterparts especially where the overall population of elderly people is high. Only in 25, out of 127 countries' proportion of the elderly men living alone is higher than that of the elderly women. Contrary to the results by gender, more unmarried older men are living alone than the unmarried women. The percentage of solitary living is the lowest in Southeastern and South central Asia, Eastern and Western Asia and all regions within Africa; the Latin America and the Caribbean have middle positions; and the Europe, Northern America and Oceania have the highest percentage of solitary living arrangement of older persons. Age differential also determines the living pattern of older people. In societies with less availability of institutional supports, the oldest old, who are more likely to need assistance in their daily life, are more prone to co-reside with children or other relatives. In Latin America and the Caribbean, Asia and Africa, living with a child or grandchild is the most common for older persons; in Europe and the United States of America, the most common arrangement is the couple-only household, followed by individuals' living alone. The findings of the report also suggest that there is a global trend towards independent living such as alone or with spouse only among older persons; as a result, co-residence with children or grandchildren or other relatives is declining. As in many developing countries, the amount and pace of this decreasing trend are small; so, the

difference between developed and developing countries will continue for many years. The report also predicts that the living arrangements of older persons differ greatly within countries according to demographic characteristics like age, gender and marital status; and also due to socio-economic characteristics like place of residence, education and material well-being (p.107). We have collected our data from this source but our estimation methods and results are different from the report.

Bongaarts and Zimmer (2002) work on the living arrangements of senior citizens of forty three (43) developing countries around the world. Their study emphasises on the comparisons of living patterns of older people according to gender, geographical region and socio-economic development of these sample countries. Their study is based on justifying the ~~–e~~onvergence theory" i.e., after the industrial revolution extended family is becoming nuclear family. Using original data of 43 developing countries of Africa, Asia and Latin America from the Demographic and Health Survey (DHS) done between the period 1990 and 1998, they examine several indicators of the living arrangement of older people like household size, percentage of living alone, the headship of households and co-residence with kin and others. Bongaarts and Zimmer (2002) have considered each country as a unit of analysis and calculate the average (mean) of each indicator for all these three regions without putting any weight of a country's sample size. They also analyse the role of socio-economic factors in living arrangement by estimating OLS regressions of the country average for these indicators on levels of education, GNP per capita, and percentage of urban population controlling the effect of region and gender. The results of the study indicate that household size is significantly different among these three regions; more senior citizens live with smaller household size than that of the average, only a very small percentage of the population live alone, and the average proportion of living alone across all countries is twice as high for

women as for men. In the Asian region, living alone is very uncommon for older men. The diversity of living arrangement pattern is the greatest in Africa and the least in Latin America. The study also mentions that the co-residence pattern of senior citizens among these regions varies significantly. Co-residence with adult child for both male and female elderly is the highest in the Asian region and the lowest in the Latin American region. Bongaarts and Zimmer (2002) argue that co-residence of senior citizens differs significantly according to the gender of older people. They estimate that 76.7 percent older males live with their spouse while only 27.8 percent older females do, and 58.9 percent older females live with at least one adult child while 52.5 percent older males do. The average proportion of females in Africa living with any adult (78.4 percent) is lower than that of the other regions. Their estimated results show that levels of schooling significantly determine the living arrangement of older people except the proportion of senior citizens living with a spouse. Schooling positively correlates with the percentage of living alone and percentage of the elderly who is the head of household; and negatively correlates with household size, percentage of older people living with adult children and the percentage of people living with another adult. GNP per capita and percentage of older people living in rural area do not have any correlation with living arrangement. Life expectancy has positive association with living with an adult child. We have used the findings of Bongaarts and Zimmer (2002) as an empirical basis about choosing the determinant of co-residence of senior citizens in developing countries but our estimation methods and data set are different from their work.

Ghuman and Ofstedal (2004) examine the nature of economic and social supports that children and siblings are making for the elderly people in Bangladesh. They pay attention on co-residence, exchange of money, goods or services, child care and social visits. They also examine the role of gender as a support recipient and a support provider in the patterns of exchange. Using the Matlab Health and Socioeconomic Survey conducted in Matlab,

Bangladesh in 1996, they calculate percentage distributions of different choice variables and test whether there are significant differences between the senior men and women. Their results suggest that strong family tie and strong intergenerational co-residence exist in Bangladesh. More than 82 percent of older parents are living with one or more child. Between one half of married and two-thirds of unmarried elderly live with a married son. Since married children often have children of their own, living with married children typically implies a three-generation household. The study finds that less than 50 percent senior citizens receive money, goods or other services from family members outside the household; and most elderly parents who do not live with children, either have a child who lives nearby or receive money or other assistance from a non-coresident child. Children or other relatives keep frequent (weekly or daily) contact with their elderly parents or grandparents who are living alone. It also suggests that married sons are considerably more likely to co-reside with parents than married daughters and sons are more likely to coreside or live within a close distance, provide money, goods or services, and be in frequent contact with their parents than that of the daughters.But the daughters are actively involved in exchanges with their parents, particularly their mothers. Nearly one fifth of older women, married or unmarried, receive money, goods or services from a non-coresident married daughter. They mention that Bangladesh is about a half to two-thirds as likely to receive monetary or material aid from non-coresident children compared to the Philippines or Thailand. There is no consistent evidence that women are at a disadvantage when it comes to receiving support from children or siblings. Older women are more likely to receive aid from a non-coresident sibling than men irrespective of marital status. Although we are not estimating economic and social support from children to elder parents, the study of Ghuman and Ofstedal (2004) helps us to construct the theoretical framework of coresidence pattern for the senior citizens in developing countries by assuming the working generation (children) to be altruistic towards the elderly generation.

Chuks (2005) investigates the demographic determinants of living arrangement of older South African population using 10 percent observations of a micro-level data of the "1996 Population Census of South Africa". In this paper, percentage distribution and "odds ratio' (odds=proportion/(1–proportion) p. 24) of several demographic variables like age, gender, marital status and race are calculated in determining the residing pattern of the older people of South Africa. The results of this study state that gender and race significantly determine living areas of the older population in South Africa. For example, older women (gender) and African (race) are more likely to live in rural areas than their male counterparts and White, Coloured and Asian counterparts. More than 48.9 percent among all African non-White aged 60 and above and 56 percent aged 80 and above reside in the extended family. The majority of African, Asian and Coloured older people(58 percent, 53 percent, and 57 percent respectively) live in extended households, while only a minority (17.2 percent) of White older people do. Similarly, African and Coloured older people (16 percent) are much more likely to live in augmented households than Whites (9 percent) do. Conversely, the majority of White older South Africans lives in nuclear households (55 percent) while only about (20–25 percent) of the other racial groups do. Similarly, almost 1 in 5 White older people live alone – compared to only 6 percent, 5 percent and 4 percent among Africans, Coloureds and Asians respectively. Although we study cross-country analysis of the co-residence pattern of elderly people; unlike Chuks (2005) where only South Africa is studied, we have realised that race and gender have an important role in determining co-residing behaviour of the senior citizens. We, therefore, include gender as a determining factor in our empirical analysis.

Pal (2007) argues that co-residence decision is a joint decision of both agents - children and parents, and depends upon the comparison of each agent's utility level when they live alone or co-reside. Using the data of the 52nd round National Sample Survey (NSS) of Indian rural sectors, the author constructs some indicators combining different benefits (financial and non-financial) both for the adult and elderly to evaluate their utility gains from co-residing. The finding of the study is that the probability of co-residence is generally lower among the better off the elderly; the likelihood is also lower for the older and female elderly without a spouse and also those with poor health, thus necessitating social protection for these disadvantaged elderly. Our work focuses on cross-country analysis and therefore, estimation method and data sets are different from Pal's (2007).

Hamoudi and Thomas (2006) wanted to find out empirically the preferences of different motives of altruistic transfers (pure altruistic, altruistic exchange or altruistic belief/inter-temporal preference) between generations. Using the "Mexican Family Life Survey and the Mexican Family Survey Preferences Pilot of the year 2002 and 2005", they found very preliminary evidence on the relationship between intergenerational transfers and three dimensions of preferences of adults. They found little evidence of altruistic motive but relatively more support went to risk and inter-temporal preferences. So, they concluded that the evidence of altruism is not exactly pure but it is mixed with pure, inter-temporal and exchange motives. They did not highlight the factors of co-residing decision.

2.4 Empirical literature on solitary residing behaviour of senior citizens in developed countries

Pampel (1992) discusses the prevalence and change in solitary residing senior citizens in European nations from 1975 to 1989 and examines the influence of individual factors on the solitary residing arrangement of senior citizens in the region. Using the twice-yearly "Eurobarometer Survey" of nations in the European Community data of 1975 - which is the first survey and that of 1989 - which is the last survey, the author considers 13 European countries being in the European Community at the time of the first survey. Pampel (1992) uses a logistic regression method with micro data sets of cross-national study. Results show that the effects of variables proxies for income are in the expected direction, but they are trivial in magnitudes. Pampel (1992) also finds that all Catholic countries (Italy, Ireland and Northern Irelands) have the lowest solitary residing elderly people and comments that in all European countries "the effect of religion, and its implications for these country patterns subsequently" (p. 106) but the estimated results predict that "none of the religious variables has significant effects for both types of models" (p. 110) regarding the solitary residing decision of senior citizens. He has also found that the trend over time in living alone across all nations is upward. Age, education, sex, marital status, and occupation are positively related to the solitary residing pattern of the European region. We use this study as the baseline study of the determinants of solitary residing senior citizens and develop our empirical model for this study but our chosen countries, data set and estimation techniques are different from Pampel (1992).

Hotz, McGarry and Emily (2010) discuss the living arrangement of elderly women and their adult children over the life cycle of an elderly woman, where special attention has

been given to find out the relationship between the evolution of living arrangements over time and the socioeconomic status of elderly women and their adult children.They use the –Panel Study of Income Dynamics (PSID)" data of the United States of America. In the data set, each respondent has life time family behaviour (nearly 40 years); thus, the authors are able to analyse the life cycle behaviours of a respondent and her children. Initially they try to find out the variables that are correlated to the living arrangements of the elderly women, after that they use multinomial Logit estimation methods assuming that living arrangement is a function of elderly women's age, schooling, income, race, number of children and health status along with her children's mean age, income, disability status and unemployment. Their findings suggest that elderly mothers are motivated to retain their wealth as they age. They have tried to find the simultaneous correlation between living arrangement and current or lagged income but the relationship between living arrangements and financial resources at older ages is present far earlier in life long before resources are likely to be altered because of living arrangements. We are studying the factors of the solitary residing decision of senior citizens in the developed European countries and our estimation method and data sets are different from them.

Manacorda and Moretti (2002) discuss why Italian young boys (aged 18-30 years) prefer to co-reside with their parent. They argue that Italian young men are co-residing with their parents because parents prefer to do so. They investigate the role of parental preference by estimating the effect of exogenous changes in parental income on the rates of cohabitation in Italy using the –Survey of Households' Income and Wealth (SHIW)" micro data from 1989 to 2000 (1989, 1991, 1993, 1995, 1998 and 2000). To find the endogeneity of parental income, they use change in father retirement age as an instrumental variable. Their results suggest that 10 percent increase in annual parental income results in approximately 10 percent

rise in the proportion of boys living with their parents. The main shortcoming in their paper is that they assume co-residing behaviour depends on parental preference of income change. In their paper, financial gain of co-residing that children have enjoyed is not focused. They use micro data of Italy and instrumental variable estimation technique, which might not be fit for all countries over the world. So, we have used macro pooled data of 16 developed European countries.

The fundamental objective of Gaymu et. al.(2006)'s article is to find the determinants of different types of living arrangement of senior citizens in nine European countries. Using micro-level data and "logistic estimation method" for finding the determinants of living alone for these countries, they show that health status, age, gender, region and number of child are important determinants of solitary residing senior citizens. In our study, we use macro-level data and "panel estimation method" for finding the factors of solitary residing.

Karagiannaki (2005) focuses on the determinant of trends of living arrangement of senior citizens in Greece. Using five cross-sections of the Greek Household Budget Surveys (GHBS) and "probit estimation method", the author tries to find determining factors of trends in residing arrangement. In our study, we cover 16 European countries and "panel estimation method" using macro-level data set.

Gaymu and Springer (2010) focus on finding life satisfaction of the senior European living alone from gender and cross-country perspective. Their estimation results say that health has always been the strongest determinant of life satisfaction, whichever the subpopulation analysed. However, we are focusing on the residing arrangement of senior citizens, not on their life satisfaction.

We can summarise from the above literature of co-residing behaviour of senior citizens in both developed and developing countries that (i) theoretically both parent and child want to maximise own utility from housing service; (ii) either parent or child or both can behave altruistically regarding co-residing decision; (iii) co-residing in a house and solitary residing are considered as mutually exclusive event, and co-residing in a house creates some negative externality; (iv) empirically income, age, education, gender, culture and regional factors are the most significant in determining co-residing or solitary residing behaviour of both elderly parents and younger children.

2.5 Literature on impacts of public education expenditure on income inequality

The second part of the thesis consists of two chapters of which one covers the impact of public education expenditure on changing income inequality of an economy and another investigates the impacts of education policies on school attendance in Bangladesh. Now we briefly discuss the most relevant literature related to these topics.

Sylwester (2002) empirically examines the relationship between ‗Gini' value and public education expenditure using a cross section of 50 countries around the world. The change in income inequality value from 1970 to 1990 is the dependent variable which is regressed on the average of ratio of public education expenditure to GDP from 1960 to 1969. The other explanatory variables used in this regression equation are - the natural log of GDP per capita in 1970, the average number of years of schooling within the adult population in 1970, a dummy for whether or not a country was a member of the OECD in 1970, and regional dummy variables for East Asia, Latin American, and Africa. Using the Ordinary Least Square (OLS) estimation technique, Sylwester (2002) predicts that public education expenditure reduces income inequality of a country. He also mentions that ―the results appear

to be stronger in the OECD countries although there is some evidence, albeit weaker, that public education expenditures slowly lessen income inequality in less developed countries" (Sylwester, 2002 p.49) but he does not take any measure to show the effects separately for the OECD countries and the less developed countries. Since Sylwester (2002) includes 4 dummies as additive form, not as a multiplicative form with any of the explanatory variable, the above results do not actually reflect the effect of public education expenditure on income inequality of different regions. We have replicated Sylwester's (2002) method with the data sets of 64 countries starting from 1980 to 2005. We then extend our analysis to find a specific model by sequentially eliminating the most insignificant variable from the general model. We have also conducted panel analysis for all the sample countries and separately for different groups of countries, such as- the Organisation of Economic Cooperation and Development (OECD) countries, Latin America and the Caribbean countries etc.

Glomm, G. and Ravikumar, B. (2003) have constructed an overlapping generation model where each individual's human capital investment depends on the quality of schools. They have shown that the income gap between the rich and the poor may widen when the quality of public education is the same for all individuals. This implies that public education expenditure does not have any impact on changing the income distribution. Moreover, they have found that the tax effect on income inequality is also ambiguous. We have developed a static macro model for both developed and developing countries. Results of our model explain that public education expenditure reduces income inequality for developed countries and increases income inequality for developing countries.

Biggs and Dutta (1999) work on the distributional effects of education expenditure to evaluate the change in long run income distribution through reductions in public education

expenditure of the United Kingdom. In a dual education system, where public and private education systems coexist, they have derived a dynamic model of the earnings distribution which is determined by an individual‘s quality of education and ability. Using the simulation technique, they have shown that an increase in public education expenditure increases the income of future generations and the dispersion of income falls; and in the other direction, a decrease in public expenditure reduces the participation rate which leads to the higher earning differential. They have also argued that the participation response in public education in a dual education system can induce a U-shaped relation between education and average income. A dual education system may generate substantially higher inequality than a fully private education system. As demonstrated later, this chapter differs from their paper regarding the data set, estimation methods as well as results.

Fraja (2002) discusses optimal education policies in altruistic framework. The author constructs a model with a continuum of households consisting of two generations. During the lifetime of an individual- one receives education, possibly a bequest, works, has a child and spends for own consumption and possibly leaves bequest for children. The findings of the paper are that the level of optimal education depends on parental income for less able child and the children from better off families receive a more optimal level of education. The high ability child of better off family enjoys the benefit of government provision of education but the cost of providing this education is borne by the low ability child of a poor family. We have developed a macro level model for public education expenditure and income inequality in developing countries as well as developed countries and we have also conducted empirical analysis.

Hendel, Shapiro, and Willen (2005) analyse educational opportunity and income inequality. They construct static and dynamic multigenerational model of wage determination

where education is a signalling factor and ability is a skill factor. Generations leave bequest for the payment of educational cost of the next generation. They show that making education more affordable means- as more and more high-ability workers become educated, the wages of unskilled workers fall; therefore, wage and income inequality between skilled and unskilled workers increase. They also argue that reducing financial constraints for post secondary education reduces the average ability of the uneducated pool and therefore increases the wage gap. Our model and empirical analysis are different from them and will be discussed in detail in the relevant chapters of the thesis.

Galor and Moav (2006) prove that compulsory public education demises the class structure in the economy that means wealth differential gradually turns to zero level. They consider a closed overlapping-generations economy in a process of development. In every period - a generation, which consists of a continuum of individual, is born. Each individual, within as well as across generations, is identical in their preferences and innate abilities. Individuals allocate the resulting wage income, along with their interest income, between consumption and transfers to their children. They also assume that the economy endogenously evolves through two fundamental regimes: Regime-I is the early stage of development, which is characterized by a stable class structure. Regime-II is the later stage of development and is characterized by the onset of the gradual demise of the Capitalists-Workers class structure. They argue that capital accumulation in the process of industrialization gradually intensifies the relative scarcity of skilled labour and generates an incentive for human capital accumulation. Due to the complementary nature between physical and human capital in production, the capitalists are among the prime beneficiaries of the accumulation of human capital by the masses. They, therefore, have the incentive to support the provision of public education that improves their economic well-being, contributing significantly to the demise of

the existing class structure. Since we developed a macro level model of public education expenditure and income inequality, we have not considered individual ability to receive education. We also empirically evaluate our model and propositions.

Saha and Sensarma (2011) empirically estimate returns to different levels of academic specialisation of Indian corporate sector workers. They modify earning function of Mincer (1974) by incorporating several dummy variables for different types of higher education (arts, science, commerce, etc.) and diplomas to compare the earning differences from these different types of academic specialisation in the corporate workers of India. Using data on the annual reports of six large Indian private sector firms for the financial year April 1986 to March 1987, they estimate the modified earning function by Maximum Likelihood Estimation (MLE) techniques. Their results show that returns to college education is significantly higher than that of school education, and that the earning returns of management and engineering specialists are considerably larger than that of the science, arts and commerce specialists. They also find that short-course diplomas are also providing additional returns. This study highlights the importance of higher and specialised education in changing income distribution of developing countries.

Fernandez and Rogerson (1995) agree that public education provision implicitly transfers resources from high-income individuals to low-income individuals that mean we can say that public education provision reduces income inequality, but they show reverse causation between income inequality and public education expenditure. Fernandez and Rogerson (1995) develop a model in which education is only partially publicly provided and individuals vote over the extent to which it is subsidized. They show that (i) the majority voting equilibrium consists of a positive subsidy to education but with only the rich and

middle class obtaining an education while the poor is subsidising the education; (ii) the efficiency consequences of subsidisation with excludability (relative to an equal-subsidy system) may be positive for a poor economy, but never for a wealthy economy; (iii) economies with more unequal income distributions are more likely to perpetuate this inequality over time; and (iv) finally there are instances in which wealthier individuals would profit from making education more costly since this affects their ability to exclude others and extract resources from them. The most distinct finding of Fernandez and Rogerson (1995) is that economies with more unequal income distributions are more likely to perpetuate this inequality over time that leads to an unequal distribution of public education expenditure. One can therefore say that income inequality determines the public education expenditure over time while most literatures argue the reverse causation. We have considered this reverse causality issue in our public education expenditure and income inequality chapter; therefore, have done endogenity test.

2.6 Literature about impacts of public education policies on school attendance in Bangladesh

Mincer (1974) theoretically develops schooling model of an individual whose working life is fixed. During the working life, an individual can either go to work or school. If the individual goes to school, he postpones earnings for the time spent in school and reduces the span of his working life which is called time cost. The total investment in schooling is the summation of these time costs and direct money outlays for schooling. Individual's internal rate of return from schooling is defined as "the present value of real earnings streams with and without investment" (p.7). Mincer (1974) concludes theoretically that (i) the ratio of annual earnings of two different years of schooling is larger than unity that means having more schooling commands higher income; (ii) the ratio is a positive function of internal rate of

return, in detail we can say that people with more schooling get higher annual pay; the difference between earnings of individuals due to a constant difference in years of schooling is higher as the rate of return on schooling is higher; and (iii) a negative function of entire working life implies the difference is larger that occurs when the general span of working life is shorter. Mincer (1974) also shows that ~~th~~e larger the dispersion of schooling, the larger a negative function of entire working life implies the difference is larger that occurs when the general span of working life the relative dispersion and skewness in the distribution of earning" (p.25) and ~~th~~e higher the rate of return from schooling, the higher the income inequality and skewness" (p.25). The empirical analysis of schooling model is not very satisfactory but in Mincer's (1974) words ~~th~~e disappointing performance of the schooling model need not cast doubt on the relevance or importance of human capital analysis"(p.44). We have used direct cost and opportunity cost of schooling while developing the theoretical model of demand for compulsory primary level of education. We have also conducted an empirical analysis using education related data of Bangladesh.

Becker (1975) develops a theoretical model of investment in different aspects of human capital development such as school education, on job training, health, morality etc. Assuming that an individual or family has a certain amount of time that can be allocated between consumption and investment in human capital, the equilibrium condition of human capital investment is that the present value of the marginal cost of investing in human capital equals the present value of future returns. Becker (1975) shows that the amount of time spent investing in human capital would tend to decline with age because the remaining lifetime and the present value of future return would decline with age as well as the cost of investment would tend to rise with age because foregone earnings would be higher. Another important result of Becker's (1975) is that hours of work would be lower at younger ages and rise more

rapidly than if there were no investments in human capital. We have used the concept of foregone cost of time as the opportunity cost of schooling for developing our theoretical model of demand for education. Moreover, we also pursue empirical analysis using education related time series and panel data of Bangladesh.

Saha and Sarkar (1999) analyse the significance of schooling, formal and informal job experiences on the earnings of corporate workers in India. They empirically estimate the earnings function of 3196 male workers of six big firms in India using the cross-section data of these firms in 1987. To framework the estimation model of the study, they modify the earnings function of Mincer (1974) by tenure and non-tenure job experiences instead of work experience in the Mincer's (1974) equation. They also introduce various levels of educations (called as "linear splines") to capture the possible existence of differential rates of earnings due to different levels of schooling. Using the annual reports of six large companies in 1987 of India, they estimate the model with the MLE method. Their results show that the rate of return to schooling is low up to the junior level, increases significantly up to the undergraduate levels and sharply declines at the master level. Both seniority and tenure (firm specific) job experiences are significant determinants of earnings of a worker. When years of unemployment and informal experience are incorporated, earnings of low-educated workers appear to be driven entirely by formal-sector experience.The paper shows the significance of schooling in the developing countries, like India and Bangladesh.

Hendry, Johansen, and Santos (2006) discuss an econometric process of selecting a regression model when there are more variables than the number of observations. They call the variables impulse dummies (or indicators) and consider one of the impulse dummies for every observation. The selection process is called general-to-specific model specification and is known as automatic general-to-specific model selection procedures when a model is

saturated with a complete set of impulse indicators. The method helps us to find those regressors that genuinely matter from those that are in fact irrelevant but unknown to investigators. We have used automatic "impulse indicator saturation" method via "OxMetrics" software to evaluate the impact of "Obligation to Primary Education Act -1990" considering the year 1993 is one of the impulse indicators.

Samarrai (2007) discusses education finance trends for Bangladesh. Using 1990 to 2006 data, the author has argued that Bangladesh government has made a substantial increase in primary education financing but it is still low compared to the other countries in the region and countries at similar levels of development. The author also says that the impact on education outcome at primary level is still insignificant compared to the increase in government funding. Our analysis significantly differs both theoretically and empirically from Samarrai (2007).

Ahmed and Ninno (2002) evaluate food for education programme in Bangladesh. Using primary data collected in school, household, community, and food grain dealer surveys; they show that the introduction of this program has increased primary school enrolment, promoted attendance, and reduced dropout rates despite the fact that the quality of education, however, remains a problem. They have also found that the increase in enrolment is greater for girls than for boys. It is because the opportunity cost of a girl in rural area is lower than the boys, which is not mentioned in their discussion. Their finding is an empirical support for our theoretical model of Bangladesh chapter that the opportunity cost of education plays an important role in establishing compulsory basic education in a developing country like Bangladesh.

Ardt, Kalene, et. al. (2005) reports on the challenges and success of primary education in Bangladesh. They identify two fundamental issues: equity and access issues and quality

issues. In equity and access issues, gender inequity is the most serious problem of a primary education system in Bangladesh. They mention that 1.5 million primary school age girls are un-enrolled in primary education although the government has given emphasis on girls' enrolment. Referring to studies they say that girls' attendance rates are considerably lower than the rates for boys because girls are often kept at home to work and take care of younger siblings. Urban poverty and child labour, and quality of primary education are identified as the other significant problems of achieving compulsory primary education in Bangladesh. They address that the following reform measures are necessary to implement compulsory primary education successfully in Bangladesh.

–The reforms are:

• To increase the absolute number of teachers in Bangladesh until class sizes can be limited to approximately 30 students, rather than 60 or even 100 students as is seen today.

• To change the form of the educational system to one that is more enjoyable for students and that can be tailored to the needs of different communities. The fact that many parents are uneducated, as well as a relative lack of teacher-student interaction, should be taken into account when deciding the type and amount of homework expected from students.

• To improve school facilities and to provide incentives for families to educate their sons and daughters: most importantly free food, the elimination of all school fees, and stipends for working children" (p.19). We have done rigorous investigations theoretically and empirically on the impact of obligatory primary education in Bangladesh.

Asadullah and Chaudhury (2009) discuss the experience of incentive-based reforms in the secondary Islamic education sector in Bangladesh. The main issues of the reform are changes in curriculum and policy regarding admission of female students. Using a cross-sectional census data-set on formal secondary schools and Islamic schools, they point

out that a significant fraction of the existing post-primary registered religious schools comprises of formerly all-male registered and unregistered religious schools that previously offered traditional, religious education. Furthermore, these religious schools have embraced female students in recent years because the government introduced cash incentives for female secondary level education. They show that modernized religious education helps to achieve gender parity in secondary enrolment during 1999–2003, holding the number of secular secondary schools constant. This finding highlights the previously undocumented role played by religious schools in removing gender disparity in rural Bangladesh. We have focused both obligation to primary education act 1990 and female secondary school stipend programme, not religious education only. We have conducted theoretical and empirical analysis which has not yet been done in any study for Bangladesh.

Literature on public education expenditure and income inequality show contradictory findings. Some literature show that public education expenditure reduces income inequality. There are some studies that predict public education expenditure increases income inequality and a very few literature theoretically say that income inequality changes the public education expenditure of a country. Theoretically ability plays an important role in determining wage and income of an individual, as a result, the income distribution of the society also changes. Demand for education is a function of direct education cost, opportunity cost of attending education and time cost of schooling as well as family income, taste and supply of educational instruments. There are a few empirical literature regarding education system, government policies and achievements in Bangladesh. Moreover, most of them have not conducted both theoretical and empirical analysis.

CHAPTER THREE

Altruism and residing arrangements of senior citizens in developing countries

Abstract

Unlike developed countries, there is no formal ‗social safety-nets' arrangements for retired senior citizens in developing countries. Consequently in most of the developing countries, elderly parents have been co-residing with their working children (working citizens) which ensure their social and economic safety. However, the structure of co-residing has been changing rapidly. This study develops a theoretical framework which explains the residing arrangement of senior citizens with their altruistic working citizens. The study also empirically examines the significant factors which determine the co-residence pattern between two successive generations in developing countries. Estimated results suggest that economic growth leads to a significant fall in co-residence arrangements of elderly parents with their children. Life expectancy and cultural issues are also found to be significant phenomena of residing pattern of senior citizens.

3.1 Introduction

Existing literature (see, for example, Ghuman and Ofstedal 2004; Martin 1988, 1989; Mason 1992) suggest that senior citizens in less developed countries (LDCs) have hardly any consistent flow of income which they could consider as their permanent income. As a result, they depend on public or private transfer payments. Although occasionally governments of developing countries[5] introduce some transfer payment programs for senior citizens, those are often temporary in nature and not enough for surviving smoothly. Consequently, unlike developed countries, in LDCs, almost all transfer payments for senior citizens come from their working children and relatives, not from the government.

Due to increase in the average life expectancy rate, the percentage of senior citizens is increasing around the world. The proportion of the world's population aged 60 years or over is projected to increase from about 10 percent in 2000 to 13 percent by 2020. By 2050, it is

[5] The government of Bangladesh has implemented old age pension system since 1997 but the amount of pension is very nominal Taka 100/- per month per person and the number of older people receiving the pension is a few but the number is increasing gradually.

likely to be over 20 percent (United Nations 2003). In most of the developed countries, there are social safety-nets (Bongaarts and Zimmer 2001) by the governments which assure the senior citizens some sort of social security after their retirements. However, there are hardly any socioeconomic safety-nets by the governments of developing countries (Bongaarts and Zimmer 2001; Mason 1992) for their senior citizens. Consequently, how the senior citizens can maintain their lives after retirement (for example, in respect of their residing arrangements, health status, pension provisions and overall safety-nets) is an issue of great concern in developing countries.

Historically, households around the developing world represent the main institution that distributes goods and services between generations (Becker 1991; Kuznets 1978; Thornton, Chang and Sun 1984). It has been noticed that due to altruistic attitude towards parents, working children transfer money to their parents and/or grandparents in their old age. However, parents at that age do not want the financial support only but some logistic supports also which cannot be met by the direct transfer payments only. Thus, co-residence of parents with their children can satisfy both the financial and logistic needs of elderly parents. Hence, usually working children take responsibilities of their elderly parents‘ livelihood especially in developing countries. Martin (1988, 1989) and Mason (1992) find that in the United States only about 15 percent of the senior citizens live with their working children, where as more than three-quarters of Asian senior citizens reside with their offspring.

It is a cultural norm in Asia and the Pacific region that the younger generation of a family takes care for its older generations (Martin 1989; Nydegger 1983). In China, there is even written law (Wu 1994) for this. Policymakers in developing countries greatly value this family tie and like this tradition to be carried on rather than introducing governmental safety-nets programs (Knodel, Chayovan and Siriboon 1992). Although the United Nations (UN) has forecast a substantial change in living arrangement around the world over time, however,

during the last two decades there was no study on the change of residing patterns of the senior citizens in developing countries. Besides, in the era of globalization when the ~~tr~~aditional values of familism and filial piety are being supplanted by the Western values of individualism" (Martin 1989; p. 627), studies on the change in the living arrangements in developing countries are going to be extremely useful.

As mentioned earlier that in the US only about 15 percent of senior citizens live with their working children, while more than three-quarters of Asian senior citizens reside with their offspring; which implies that the pattern of residing arrangements for senior citizens are extremely diverse between the developed and developing countries. Although there is quite a large number of literature which estimate the residing arrangements of senior citizens in the developed countries (see, for example, Burch and Matthews 1987; Chiappori 1992; Gaymu et.al. 2006), there is hardly any literature on the residing arrangements of the senior citizens of the developing and the least developed countries. Although Bongaarts and Zimmer (2001), Hashimoto (1991), Martin (1989), Ofstedal, Knodel and Chayovan (1999), and Zimmer and Dayton (2003) investigate the determinants of residing pattern of the senior citizens in developing countries by using cross-sectional study, they have not looked into the changing pattern of residing arrangement due to the change in income levels of working citizens. Subsequently, studies on the determinants of residing arrangements as well as the change in the residing pattern of developing countries are equally important for policy implication. Whilst the existing literature (although there are only a few) attempts a static analysis of living arrangement of the senior citizens of the least developed countries, we examine both the significant determinants as well as the changing pattern of residing arrangements due to the growth and development in developing countries.

Historically, there is very little consensus about the factors that affect residing arrangements of family members with the evolution of societies and economies. Economists

(Ermisch 2003; Samuelson 1958; Pal 2007) theorise that trade-off between the utility from residing in an extended family and in a nuclear family determines the household formation behaviour. Sociologists (Pampel 1992, 1982; Wall 1990) generally hypothesise that industrialisation, urbanisation and technological advancement (also known as modernisation) change household structures from an extended family to a nuclear family. Hypotheses related to demography say (Bongaart 2001; Grundy 1992; Kobrin 1976) that rising life expectancy and declining fertility are the determinants of changing family structures. Studies (Grundy 1992; Pampel 1982, 1992; Martain 1989) those highlight psychological point of view of residing arrangements, say that changing social norms, culture and values determine the change in households' structures. Subsequently, there is an underlying economic interpretation of the above mentioned hypotheses that the declining economic benefits of co-residence in the extended family and increasing importance of privacy for both the young and the elderly may decide the residing arrangements of senior citizens both in the developed and the developing countries.

Nonetheless, this is not unusual that with the increase in income level of the working citizens (i.e. children of elderly people), their workloads and responsibilities increase in their workplaces. Increasing workload and preferring personal privacy would have to create externality of congestion for the working children if they co-reside with their parents and grandparents. Moreover, with changes in income, working generations are able to afford to pay transfer to their parents and thus co-residence may go down although they still maintain the same level of altruistic attitude towards parents and grandparents. Subsequently, it is not unlikely that with the increase in income levels of working children the degree of co-residency falls. May be that is why people in developed country are less likely to reside in an extended family compared to their counterpart in the developing economy. This also suggests that the co-residing pattern in developing countries may have been changing with their

economic growth. Hence, this area is needed to be investigated for policy purpose. However, to the best of our knowledge, there is no literature which focuses on the change in residing pattern for senior citizens in developing countries due to changes in the income levels of working citizens.

Although the level of income may financially assist the families to co-reside, however, we hypothesise that *change in per capita income of working citizens negatively influence the co-residence of senior citizens.* This may happen due to negative externality for the working generation (it is worth noting that the working generation is usually the decision maker in developing countries) which emerges from congestion, preference for personal privacy, migration for better opportunity and increased workloads. Secondly, *housing price may also affect the pattern of co-residence.* Thirdly, *some cultural issues such as religion and geographical difference may affect the living arrangement.* Finally, *there are some other socio-economic variables such as literacy rate, life expectancy rate, labour force participation, urban migration which may affect the residing pattern of senior citizens in developing countries.* Consequently, it is important to investigate whether religion, geographical area, literacy and life expectancy rates along with income level and housing price influence the residing arrangement of senior citizens in developing countries.

3.2 The Model

We solve utility maximization problem for an altruistic child and his/her individualistic elderly parent. We assume that the elderly parent does not have any income and consequently, the child takes care of the elderly parent (traditionally, son takes the responsibility of elderly parents in developing countries; hence, we use ‗he' from now on). Hence, the utility function of altruistic child is:

$$U^{C,j} = U\left(X^{C,j}, h^{C,j}, U^{P,j}\left(X^{P,j}, h^{P,j}\right)\right) \quad (3.1)$$

where, U^C and U^P are utility function of altruistic child and elderly parent respectively; X^C, h^C stand for consumption of material goods and housing for the child respectively and X^P, h^P denote consumption of material goods and housing for the elderly parent according to order. The superscript, $j = a, r$ where "a" represents the child and parent are residing apart and "r" represents they are co-residing. The utility of the child depends on his own consumption of material goods, housing, and the total utility of an elderly parent. Since the total utility of the elderly parent is an argument of the child's utility function, the child is considered as altruistic. Elderly parent does not have any income and his consumption of material goods and housing depends on the amount of transfers made by the child. Thus, the utility function of a child is directly depends on his own consumption, parent's utility, while indirectly depends on own consumption and the amount of transfer he makes for the elderly parent. In this way, the child gets a "warm-glow" (Andreoni 1990) from the utility of the elderly parent.

The altruistic child makes a lump-sum transfer to his parent and lives apart from the parent - we call this case as "Situation A". The transfer works as "warm-glow" (Andreoni, 1990) in the total utility of the child. However, when the child and the parent co-reside and the child takes utility maximisation decision for both of them - we name this case as "Situation B". In "Situation B", the child does not make any cash transfer to his parent. Instead of transfer, he gives a certain weight on parent's total indirect utilityderived from"Situation A". How much weight the child has assigned toa parent's total indirect utility depends on the child's degree of altruism toward the parent.

Situation A:Working child and elderly parent are residing apart

Housing is a pure private good for both the altruistic working child and individualistic elderly parent. Since the elderly parent does not have any income flow, the child makes a lump-sum transfer, T, to his parent. As the child and the elderly parent reside separately, they take their own consumption decision. We generally assume that a utility function is continuous, concave and twice differentiable in all arguments. However, to get specific results, we are simplifying the assumption that the utility function is log-linear for both the parent and the child.

Utility maximisation problem for separately living adult child is :

$$Max_{X^{C,a},h^{C,a},T} \ln U^{C,a} = \alpha \ln X^{C,a} + \beta \ln h^{C,a} + \tau \ln V^{P,a}(T) \quad (3.2)$$

Subject to the budget constaint is:

$$Y^C = P_x X^{C,a} + P_h h^{C,a} + T \quad (3.3)$$

where, $\ln U^{C,a}$ is the utility function of adult child residing apart, α and β are individual utility share in total utility derived from the consumption of material goods and housing respectively and τ is the degree of altruism towards elderly parent. The argument $ln\, V^{P,a}(T)$ is the indirect utility function of the elderly parent, which is:

$$ln\, V^{P,a}(T) \Rightarrow Max_{X^{P,a},h^{P,a}} \ln U^{P,a} = \gamma \ln X^{P,a} + \delta \ln h^{P,a} \quad (3.4)$$

Subject to the budget constaint is:

$$T = P_x X^{P,a} + P_h h^{P,a} \quad (3.5)$$

where, γ and δ are utility share in total utility derived from the consumption of material goods and housing respectively. T is the amount of transfer received from the altruistic child, P_x and P_h are price of material goods and rent of housing respectively.

Solving the parent's problem for any given transfer T, one gets the demand function for material goods and housing of the parent as follows.

Parent's demand for material goods is:

$$X^{P,a*} = \frac{\gamma T}{(\gamma+\delta)P_x} \tag{3.6}$$

Parent's demand for housing is:

$$h^{P,a*} = \frac{\delta T}{(\gamma+\delta)P_h} \tag{3.7}$$

Substituting parent's demand for material goods and housing in his utility function, one gets the indirect utility function of the parent as follows.

$$\ln V^{P,a}(T) = \gamma \ln \gamma + \delta \ln \delta + (\gamma+\delta)\ln T - (\gamma+\delta)\ln(\gamma+\delta) - \gamma \ln P_x - \delta \ln P_h \tag{3.8}$$

Now, carrying out the adult child's optimisation problem after substituting parent's indirect utility function in equation (3.2) and solving it subject to budget constraint given in equation (3.3), one gets,

Demand for material goods for separately residing adult child is:

$$X^{C,a*} = \frac{\alpha Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_x} \tag{3.9}$$

Demand for housing for separately residing adult child is:

$$h^{C,a*} = \frac{\beta Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h} \tag{3.10}$$

The demand for housing of the child is a function of child's income, rent of the housing, degree of altruism, and preference parameters of both the child and elderly parent. The demand for housing is directly related to income and inversely related to rent. A unit increase in the degree of altruism towards parent decreases child demand for housing $\left[\frac{\beta(\gamma+\delta)Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}^2 P_h}\right]$ amount and vice versa if other things remain constant, which is called *altruistic effect*. The intuition behind this outcome is that an increase in child's degree of altruism indicates that child's relative preference switches from the consumption of housing to altruistic transfer and other material goods. Therefore, demand for housing decreases.

Equilibrium amount of transfer that the altruistic child is making to his elderly parent is:

$$T^* = \frac{\tau(\gamma+\delta)Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}} \tag{3.11}$$

The equilibrium amount of transfer is a function child's income, degree of altruism and preference parameters of both the child and the elderly parent.

After substituting the equilibrium amount of transfer in equation (3.7), we get optimal demand for housing of the separately residing parent is:

$$h^{P,a*} = \frac{\tau\delta Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h} = \frac{\tau\delta}{\beta} h^{C,a} \tag{3.12}$$

The demand for housing for the elderly parent residing apart from the child is a function of child's income, rent of housing, degree of altruism, and preference parameters of both the child and elderly parent. The demand function follows all general properties of law of demand such as positive income effect and negative substitution effect. A unit increase in the degree of altruism increases parent's equilibrium demand for housing $\left[\frac{\delta(\alpha+\beta)Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}^2 P_h}\right]$

amount and vice versa if other things remain constant which we like to call as *altruistic effect*. The intuition behind this result is that an increase in child's degree of altruism toward parent indicates that parent receives more transfer from his child so that parent can spend more on the consumption of housing and on other goods. Thus, the demand for housing increases of the parent.

Substituting the equilibrium amount of transfer that maximises the total utility of the altruistic child in the indirect utility function of parent, we get the following indirect utility function for the parent.

$$\begin{aligned}\ln V^{P,a}(Y^C) = {} & \gamma \ln \gamma + \delta \ln \delta + (\gamma + \delta) \ln \tau + (\gamma + \delta) \ln Y^C \\ & - (\gamma + \delta) \ln\{(\alpha + \beta) + \tau(\gamma + \delta)\} - \gamma \ln P_x \\ & - \delta \ln P_h \end{aligned} \tag{3.13}$$

The equilibrium total utility of parent residing apart is a function of child's income, degree of altruism, price of material goods, rent of housing, and preference parameters of both the elderly parent and the altruistic child.

The indirect utility function of altruistic child who resides in a separate house is as follows.

$$\begin{aligned}\ln V^{C,a}(Y^C) = {} & \alpha \ln \alpha + \beta \ln \beta + \tau\gamma \ln \gamma + \tau\delta \ln \delta + \tau(\gamma + \delta) \ln \tau \\ & + \{\alpha + \beta + \tau(\gamma + \delta)\} \ln Y^C - \{\alpha + \beta + \tau(\gamma + \delta)\} \ln\{(\alpha + \beta) + \tau(\gamma + \delta)\} \\ & - \alpha \ln P_x - \tau\gamma \ln P_x - \beta \ln P_h - \tau\delta \ln P_h \end{aligned} \tag{3.14}$$

The equilibrium total utility of altruistic child residing apart is a function of child's income, price of material goods, rent of housing and preference parameters of both parent and child.

Special case: Now assume that, preferences for material goods and housing for the child and the parent are equal to each other. That is, $\alpha = \gamma; \beta = \delta;\ \alpha + \beta = \gamma + \delta = 1$. With these simplifications, we can get, $h^{P,a} = \tau h^{C,a}$. That is, if $\tau < 1$ consumption of housing of the parent's will be less than that of the child and $\tau > 1$ consumption of housing of the parent's will be higher than that of the child.

Proposition 1: *The demand for housing of a separately residing parent directly changes with a change in child's income or a change in child's degree of altruism.While the change in demand for housing of a separately residing child with a change in his income is positive but the change in demand for housing of a separately residing child with a change in degree of altruism is negative.*

Proof: See mathematical appendix of Chapter Three.

Situation B: Child and parent are co-residing

Assume that altruistic child likes to co-reside with his elderly parent in a house and he takes care of all consumption expenditures of his elderly parent. So the child now does not make any direct transfer. Ermisch (2003) assume that housing is a public good that means residing more people in a house does not reduce residential utility of each individual in the family. We assume that housing is a semi-public good. Co-residing in a house might create a negative externality for the altruistic child and the elderly parent. Examples of some negative externality of co-residing are congestion problem, loss of privacy etc. for both the child and parent. Housing is therefore, considered as a semi-public good not a pure public one (Ermisch 2003) for both the child and parent due to negative externality of co-residing.

It might be possible that co-residing creates economies of scale in the housing. But we assume that the housing market is perfectly competitive and rent is not affected by the amount of the demand for housing.

Let us assume that the externality parameter for the child and parent are θ^C and θ^P respectively. To internalise this externality, let us assume that the partial utility of housing for every agent is the difference between the utility generated by residing in a private house and the effect of externality due to co-residing. Thus, we assume the log-linear utility function of the elderly parent co-residing with the child becomes as follows.

$$\ln U^{P,r} = \gamma \ln X^{P,r} + (\delta - \theta^P) \ln h^{C,r} \; ; \; 0 < \gamma, \delta < 1 \; and \; \theta^P < \delta \qquad (3.15)$$

where, γ and δ are the utility share of consumption of goods and housing respectively; which are similar as that of residing apart. Since parent and child co-reside in a house which is rented by the child, partial utility of housing for the parent is generated from the $h^{C,r}$ argument. $\theta^P < \delta$ this restriction on externality parameter indicates that the magnitude of externality effect cannot exceed the utility share of private housing for the parent. Although the elderly parent has a specific utility function when co-residing, the altruistic child takes utility maximising decision for both parent and himself. Therefore, the parent does not have any budget constraint.

The log-linear utility function of a co-residing altruistic child becomes as follows.

$$\ln U^{C,r} = \alpha \ln X^{C,r} + (\beta - \theta^C) \ln h^{C,r} + \tau \ln U^{P,r} \; ;$$

$$0 < \alpha, \beta < 1; \tau > 0 \; and \; \theta^C < \beta \qquad (3.16)$$

where, the argument $ln \, U^{P,r}$ is the direct utility function of the elderly parent, which is inserted in the utility function because the child is altruistic and he is maximising co-residing

parent's wellbeing. α and β are utility share in total utility derived from the consumption of material goods and housing respectively, which are the same as that of residing apart. $\theta^C < \beta$ this restriction on the externality effect parameter indicates that the magnitude of externality effect cannot exceed the utility share of private housing for the child.$\tau$is the degree of altruism towards elderly parent and also altruistic utility share in the total utility of the child. The budget constraint of the child is as follows.

$$Y^C = P_x(X^{C,r} + X^{P,r}) + P_h h^{C,r} \tag{3.17}$$

where, Y^C is the income of working child, $h^{C,r}$ is the amount of housing consumed by both the child and parent. The utility maximisation problem for the altruistic child becomes as follows.

$$\begin{aligned} Max_{X^{C,r}, X^{P,a}, h^{C,r}, \lambda} L \\ &= \alpha \ln X^{C,r} + (\beta - \theta^C) \ln h^{C,r} + \tau \ln U^{P,r} \\ &+ \lambda[Y^C - P_x(X^{C,r} + X^{P,r}) + P_h h^{C,r}] \end{aligned} \tag{3.18}$$

The demand for housing of co-residing child and elderly parent is as follows.

$$h^{C,r*} = \frac{\{(\beta - \theta^C) + \tau(\delta - \theta^P)\} Y^C}{[(\alpha + \tau\gamma) + \{(\beta - \theta^C) + \tau(\delta - \theta^P)\}] P_h} \tag{3.19}$$

The demand of housing for co-residing child and elderly parent is a function of the child's income, rent of housing, degree of altruism, externality parameters and preference parameters of both the child and elderly parent. The *altruistic effect* of demand for housing is $\frac{Y^C\{\alpha(\delta - \theta^P) - \gamma(\beta - \theta^C)\}}{[(\alpha + \tau\gamma) + \{(\beta - \theta^C) + \tau(\delta - \theta^P)\}]^2 P_h}$ which is ambiguous in sign.

Lemma 1: *The rate of change in demand of housing for co-residing child and parent due to changes in the child's degree of altruism depends on the relative magnitudes of the ratio of*

elasticity of material goods to the elasticity of housing of the altruistic child $\left(\varepsilon_{X^{,r}}/\varepsilon_{h^{C,r}}\right)$*and that of the elderly parent* $\left(\varepsilon_{X^{P,r}}/\varepsilon_{h^{C,r}}\right)$*. The demand for co-residing housing increases due to a unit rise in the degree of altruism if the* $\left(\varepsilon_{X^{,r}}/\varepsilon_{h^{C,r}}\right) > \left(\varepsilon_{X^{C,r}}/\varepsilon_{h^{C,r}}\right)$ *and vice versa.*

Proof: See mathematical appendix of Chapter Three.

The rate of change in demand for housing of the co-residing child and elderly parent with respect to own externality parameter is considered as *externality effects in housing demand*. A unit increase in externality of co-residing of the child decreases the demand for housing $\frac{(\alpha+\tau\gamma)Y^C}{\{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]\}^2 P_h}$ amount and vice versa if other things remain constant. Similarly, a unit increase in externality of co-residing of the parent decreases the demand for housing $\frac{\tau(\alpha+\tau\gamma)Y^C}{\{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]\}^2 P_h}$ and vice versa if other things remain constant.

Proposition 2: *(a) A change in child's income directly changes demand for housing when child and parent are co-residing.*

(b) When co-residing, the effect of demand for housing on the change in child's degree of altruism is ambiguous.

(c) The effect of demand for housing on degree of externality of either the child's or the parent's is negative in co-residing situation.

Proof: See mathematical appendix.

An increase in child's income increases demand for housing for co-residing parent and child and vice versa if other things remain constant.The effect of child's degree of altruism on demand for housing of co-residing child and parent is ambiguous. An increase in child's degree of altruism increases demand for housing if and only if $\alpha(\delta-\theta^P) > \gamma(\beta-\theta^C)$ while

decreases demand for housing if and only if $\alpha(\delta - \theta^P) < \gamma(\beta - \theta^C)$ when other things hold constant. The effect of either child's or parent's externality of co-residing on demand for housing in co-residing situation is always negative if other things being constant. As we expact that an increase of child's income increases both degree of altruism and externality of co-residing to the child, the overall effect of child's income increase on the demand for housing in co-residing situation is ambiguous. We therefore, like to investigate empirically the income effect on co-residing decision of senior citizens (parents).

The equilibrium total utility can be found from the indirect utility function for the elderly parent co-residing with the child, which is as follows.

$$\begin{aligned}\ln V^{P,r} = {} & \gamma \ln \tau + \gamma \ln \gamma + (\delta - \theta^P) \ln\{(\beta - \theta^C) + \tau(\delta - \theta^P)\} + \{\gamma + (\delta - \theta^P)\} \ln Y^C \\ & - \{\gamma + (\delta - \theta^P)\} \ln[(\alpha + \tau\gamma) + \{(\beta - \theta^C) + \tau(\delta - \theta^P)] - \gamma \ln P_x \\ & - (\delta - \theta^P) \ln P_h \end{aligned} \tag{3.20}$$

The equilibrium total utility of co-residing elderly parent is a function of the amount of income, price of material goods and services, rent of housing and preference parameters of both the altruistic child and elderly parent. The elasticity of total utility with respect to income, ($\varepsilon_{Y^C}^{V^{P,r}} = \frac{\partial \ln V^{P,r}}{\partial \ln Y^C}$), is $\{\gamma + (\delta - \theta^P)\}$ which is constant and depends on preference parameters of the elderly parent.

The equilibrium total utility is the indirect utility function of the altruistic child co-residing with elderly parent, which is as follows.

$$\ln V^{C,r} = \alpha \ln \alpha + \{(\beta - \theta^C) + \tau(\delta - \theta^C)\} \ln\{(\beta - \theta^C) + \tau(\delta - \theta^C)\} + \tau\gamma \ln \tau + \tau\gamma \ln \gamma$$
$$+ [\{\alpha + (\beta - \theta^C)\} + \tau\{\gamma + (\delta - \theta^P)\}] \ln Y^C$$
$$- [\{\alpha + (\beta - \theta^C)\}$$
$$+ \tau\{\gamma + (\delta - \theta^P)\}] \ln[\{\alpha + (\beta - \theta^C)\} + \tau\{\gamma + (\delta - \theta^P)\}] - (\alpha + \tau\gamma) \ln P_x$$
$$- \{(\beta - \theta^C) + \tau(\delta - \theta^C)\} \ln P_h \qquad (3.21)$$

The equilibrium total utility of co-residing altruistic child is a function of the amount of income, price of material goods and services, rent of housing and preference parameters of both the altruistic child and elderly parent. The elasticity of total utility with respect to income, $(\varepsilon_{Y^C}^{V^{C,r}} = \frac{\partial \ln V^{C,r}}{\partial \ln Y^C})$, is $[\{\alpha + (\beta - \theta^C)\} + \tau\{\gamma + (\delta - \theta^P)\}]$ which is constant and depends on preference parameters of both the child and elderly parent.

Proposition 3: *Total indirect utility is less elastic with respect to child's income when co-residing than when residing apart for both the parent and the child.*

Proof: See mathematical appendix of chapter three.

Proposition 4: *Child will be indifferent between co-residing and residing apart when his income is* $\boldsymbol{Y^C} = \left[\frac{[\{(\alpha+\beta)+\tau(\gamma+\delta)\}]^{\{(\alpha+\beta)+\tau(\gamma+\delta)\}}[\{(\beta-\theta^C)+\tau(\delta-\theta^C)\}]^{\{(\beta-\theta^C)+\tau(\delta-\theta^C)\}}}{[\{\alpha+(\beta-\theta^C)\}+\tau\{\gamma+(\delta-\theta^P)\}]^{[\{\alpha+(\beta-\theta^C)\}+\tau\{\gamma+(\delta-\theta^P)\}]}\beta^{\beta}\delta^{\tau\delta}\tau^{\tau\delta}}\right]^{\frac{1}{(\theta^C+\tau\theta^P)}}$. *If income is higher than the threshold level, the child decides to reside apart and vice versa. Similarly, elderly parent will be indifferent between co-residing and residing apart when child income is* $\boldsymbol{Y^C} = \left[\frac{[\{(\alpha+\beta)+\tau(\gamma+\delta)\}]^{(\gamma+\delta)}[\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]^{(\delta-\theta^P)}(P_h)^{\theta^P}}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]^{\{\gamma+(\delta-\theta^P)\}}\delta^{\delta}\tau^{\delta}}\right]^{\frac{1}{\theta^P}}$. *If child income is higher than the threshold level elderly parent prefers to reside apart and vice versa.*

Proof: See mathematical appendix of the chapter.

The elasticity of total utility in co-residing with respect to child's income is lower compared to that of the residing apart for both the child and elderly parent. That means, the

percentage change in total utility of co-residing situation due to a unit increase in child‘s income is lower than the percentage change in total utility of separately residing situation due to a unit increase in child‘s income for both the child and elderly parent. This outcome infers that as the child‘s income increases both the child and elderly parent are more willing to reside separately than to co-reside when other things are constant because the percentage increase in total utility is greater when residing apart.

The theoretical analysis suggests that co-residing decision for the elderly parent depends on the income of the child, degree of altruism, the degree of externality of co-residing, and rent of housing service. The discussion of proposition 2 and proposition 3 result that as income of the child increases, co-residing decreases and vice versa. The intuition behind this negative correlation between child‘s income and co-residency of parent with child is that an increase in individual income increases solitary residing attitude because privacy/independence is considered as a purchasable good, and therefore, co-residing attitude of an individual decreases (Pampel 1992).

We, therefore, hypothesise from the model that (i) increase in income of working citizens decreases the co-residency of senior citizens and (ii) increase in the price of housing also decreases the demand for housing of a senior citizen.

These two hypotheses are going to be empirically tested with the other relevant explanatory factors in the next sections of the chapter.

3.3 The Empirical Model, Methodology and Data

3.3.1 The Empirical Model

According to the theory developed in this chapter, co-residency decision of senior citizens depends on income of working citizens and rent of housing. We use per capita

income of an employed person *(GDP*[6]*)* as a proxy of income of working citizen and inflation *(CPI)* as a proxy of the rent of housing. Although inflation is not considered as a good proxy of rental price variable, we have used it because in most of the developing countries, rental markets are not developed and organised. Moreover, the majority of the people in developing countries lives in rural areas where the rental housing market does not exist at all. Consequently, data on the housing price index is unavailable in existing data sources in the sample countries. Along with these two explanatory variables, we have considered some other determinants that have been found to be important factors on explaining co-residency behaviour of senior citizens.Chuks (2005) and Ghuman and Ofstedal (2004) find that age of senior citizens is an important determinant of their residing arrangement. We, therefore, use the life expectancy at birth *(LIEF)* as one of the explanatory variables in this study. In developed countries, the level of education of the senior citizens plays an important role in determining the residing pattern of them. Gaymu et.al. (2006), Kathleen and Schoeni (2000), and Kinsella (1990) find that having higher levels of education of the senior citizens indicates less likelihood of co-residing with an adult child. We use the literacy rate of the adult population *(LITE)* in our study. The level of human development may affect the residing arrangement of senior citizens. Gaymu et. al. (2006), Kinsella (1990) find that a less number of senior citizens co-reside with their children in developed countries and a large number of senior citizens co-reside with adult child in developing countries. The United Nations Development Programme (UNDP) introduces the ―Human Development Index (HDI)" in 1990. It is a hybrid measure of three development indicators namely: life expectancy, literacy rate and GDP of a country. In this paper, we use *HDI* as a substitute of three independent variables *(GDP, LIFE and LITE).* Martin (1989) indicates that a larger proportion of urban migration might be a reason for weakening ties of children with their elderly parents. We,

[6] Italicised words in parathesis indicate the symbol used for the variable in this chapter.

therefore, include the ratio of urban to rural population *(RUR)* as an explanatory variable. The ratio is a measure of the relative number of population living in an urban area to a rural area within a country. Kinsella (1990) and the United Nations (2005) find that the higher the female labour force participation, the higher the possibility of co-residing with senior citizens. Consequently we include the labour force participation rate *(LFP)* of both male and female in our study. Gaymu et. al., (2006) and Pampel (1983, 1992) suggest that culture may be an important determinant of the residing arrangement. Region and religion could be good proxies for culture variable. We use the percentage of the population who are either Muslim or Christian or Hindu, Buddhist and others.

We use the percentage of senior citizens living with their child *(PEPCH)* to the total number of senior citizens of a country in a year as our dependent variable[7]. People who are 60 years of age or above are considered as senior citizens and the people aged 25 to 59 years are considered as working citizens. Male *(MPEPCH)* and female *(FPEPCH)* are also used in the estimation to examine whether they are significantly different if we separately estimate co-residing arrangements.

Although the *PEPCH* and labor force participation rate *(LFP)* are separate variables for male and female; all other explanatory variables, such as, per capita income of employed people *(GDP)*, life expectancy at birth *(LIFE)*, adult literacy rate *(LITE)*, consumer price index *(CPI)*, ratio of urban to rural population *(RUR)*, human development index *(HDI)*, percentage of Muslim people *(MUS)*, percentage of Christian people *(CHR)*, percentage of Hindu, Buddhist and Others *(HBO)* are common for both male and female. We also use a combined (male and female) *PEPCH* variable in our estimation.

[7]The household composition of older persons is classified into mutually exclusive categories which include living alone, living with spouse only, living with children/children-in-law, living with grandchild (without children), living with other relatives and living with non-relatives'(United Nations 2005, p.133).

Usually economic theory does not provide a very precise guideline about specifying linear versus log-linear functional form for regression analysis (Godfrey and Wickens, 1981). However, the choice of functional form has important implications for statistical tests, for forecast and for policy analysis (Hall, 1978). In this chapter, we have used Sargan (1964)[8] criterion because of computational simplicity, for getting clear cut decision and also (Godfrey and Wickens, 1981) for choosing one functional form. Sargan's (1964) criterion suggests that the log-linear model is appropriate for this estimation rather than a simple linear model. Subsequently, we employ the following model for estimation:

$$\ln PEPCH_{it} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln CPI_{it} + \beta_3 \ln LIFE_{it} + \beta_4 \ln LITE_{it} + \beta_5 \ln LFP_{it} + \beta_6 \ln RUR_{it} + \beta_7 lnMUS_{00i} + \beta_8 lnCHR_{00i} + \beta_9 lnHBO_{00i} + \beta_{10} SEX_{it} + \beta_{11} AFR_i + \vartheta_i \quad (3.22)$$

$$\ln MPEPCH_{it} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln CPI_{it} + \beta_3 \ln LIFE_{it} + \beta_4 \ln LITE_{it} + \beta_5 \ln LFP_{it} + \beta_6 \ln RUR_{it} + \beta_7 lnMUS_{00i} + \beta_8 lnCHR_{00i} + \beta_9 lnHBO_{00i} + \beta_{10} AFR_i + \vartheta_i \quad (3.23)$$

$$\ln FPEPCH_{it} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln CPI_{it} + \beta_3 \ln LIFE_{it} + \beta_4 \ln LITE_{it} + \beta_5 \ln LFP_{it} + \beta_6 \ln RUR_{it} + \beta_7 lnMUS_{00i} + \beta_8 lnCHR_{00i} + \beta_9 lnHBO_{00i} + \beta_{10} AFR_i + \vartheta_i \quad (3.24)$$

where, $PEPCH$, $MPEPCH$ and $FPEPCH$ are percentage of senior citizens living with their children, the percentage of senior male living with their child and percentage of senior female living with their child respectively. GDP is per capita income of employed people, CPI is consumer price index, $LIFE$ is life expectancy at birth, $LITE$ is literacy rate, LFP is labour force participation rate, RUR is ratio of urban to rural population, HDI is human

[8] See empirical appendix of chapter three for Sargan (1964) method and empirical result.

development index (which is not shown in any equation (3.22), (3.23) or (3.24); however, we employ this cumulative variable instead of GDP, $LIFE$ and $LITE$ variables), MUS is the percentage of Muslim population, CHR is the percentage of Christian population, HBO is the percentage of Hindu, Buddhist and other people, SEX is a gender dummy and AFR is a regional dummy. $\vartheta \sim N(0, \sigma^2)$ is the disturbance term assumed to be distributed normally with zero mean and constant variance across the countries.

3.3.2 Estimation Method

A large number of studies use multinomial Logit model for estimating the causal relationship between residing arrangement and the explanatory variables which is an appropriate measure when the dependent variable is dichotomous variable. In this study dependent variable is the percentage of senior citizens living with children which is not a dichotomous variable; that is why, ordinary least square (OLS) estimation method is more appropriate than the any other method. There are a lot of studies using the OLS estimation method for finding a causal relationship (Bongaarts and Zimmer, 2002; Department of Economic and Social Affairs, Population Division, United Nations, 2005) between residing arrangements of senior citizens and the factors that determine this relationship.

Although, the panel analysis we have conducted here is included two waves of time due to unavailability of data, the study definitely enriches knowledge of residing arrangements literature. Because neither we found any literature using panel data analysis technique to find the determinants of residing arrangements of the senior people for developing countries, nor there is any trend analysis been conducted yet regarding the residing arrangements of the senior citizens in these two regions.

There are several attractive features of panel analysis if one has the panel data set. Firstly, panel data analysis is very helpful to deal with the heterogeneity in the micro unit, in our case it is individual country. The heterogeneity means that all these countries are different from one another in a fundamental unmeasured way. Therefore, using cross-section analysis, one cannot include all the relevant variables which are appropriate for each country. As a result, cross-section analysis might produce biased results, while panel data analysis helps to correct this problem. Secondly, panel analysis uses more variability by combining variation across the country and over time which helps to alleviate the multicollinearity problem. Thirdly, panel analysis can address the turnover question because the data track a common sample of country over different years. Finally, panel data analysis helps to get a dynamic adjustment while cross-section data analysis cannot. This study employs the unbalanced panel estimation technique using twenty two cross-sectional and two time series observations. We deliberately ignore developed country data to avoid prospective heterogeneity problem. Time gap for each country is at least five years up to ten years. Overall the time period includes between 1990 and 2002.

We use the fixed effects and random effects models[9] for (i) overall co-residence (senior citizens living with working citizens) pattern as well as for co-residence of (ii) senior male and (iii) senior female separately. The study uses unbalanced panel data of twenty two Asian and African countries.

The study uses the Hausman (1978) test[10] criterion for model selection between random effects and fixed effects. Estimated results suggest that random effects are appropriate for separate male and female model but the fixed effects model is preferable for combined model.

[9] Brief explanation of fixed effects and random effects model is given in empirical appendix of chapter three.
[10] Briefly explain Hausman (1978) test procedure in appendix of chapter three.

We employ the _general-to-specific' modelling technique by sequentially eliminating the most insignificant variables from the general model.

3.3.3 Data

The sample consists of 22 countries in the African and Asian regions. Among these 22 countries, 16 are taken from the African region, and 6 are chosen from Asian regions; which are specifically known as _South and South East Asia'. According to the definitions provided by the United Nations, 9 countries among these 16 African countries are from West Africa: Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Ghana, Mali, Niger, Nigeria and Senegal; 5 countries are from East Africa and Horn of Africa: Kenya, Malawi, United Republic of Tanzania (Tanzania), Zambia and Zimbabwe; and 2 countries are taken from Central and Southern Africa: Madagascar, and Rwanda. 6 South and South East Asian countries are: Bangladesh, India, Nepal, China, Indonesia and the Philippines. Senegal, Burkina Faso, Ghana, Benin, Cote d'Ivoire, Mali, Niger, Nigeria and Cameroon are neighbouring countries in the West Africa; and Kenya, Tanzania, Malawi, Zambia, Zimbabwe, Rwanda and Madagascar are neighbouring countries in the Eastern and Southern region of Africa. These countries are socially, economically and culturally not very much different from each other. Bangladesh, India and Nepal are the neighbouring countries in South Asia having social, economic and cultural similarity. China is adjacent to India and a little far from Indonesia and the Philippines, which are two neighbouring countries in South East Asia; but has a great socio-economic and cultural similarity with these countries. Almost all these countries are the least developed countries in the world though South and South East Asian countries are growing relatively faster than the African countries.

In this study, observations of dependent variables are directly related to the senior citizens residing with working child and the observations of independent variables are related

to the working citizens because the aggregate data on explanatory variables at a particular time are representing existing situation that means existing working citizens of the economy at that time. Reasons of using this specific nature of data in this study are: (i) the theoretical model and also many studies (Martin 1988, 1989; Mason 1992; Ghuman and Ofstedal 2004) have found that senior citizens in the least developed countries hardly have any consistent flow of income which they can consider as permanent income. As a result, they have to depend on the transfer from mainly working children and other relatives for maintaining their livelihood, (ii) the senior citizens are defined as age 60 and above at the time of collecting data, so the aggregate variables at that specific year are actually representing both the senior citizens and working citizens.

The theoretical model in this chapter is based on micro behaviour of elderly parent and working child. In this situation, household survey panel data sets should be ideal for conducting empirical analysis. But it is nearly impossible to gather household survey panel data sets for 22 developing countries around the world because most sample countries do not have such type of data sets specifically in English version and also the time cost of collecting such data sets is huge. Due to this limitation, we have used macro-level (aggregate) data sets for all sample countries. One may raise the question - how does the micro model link with macro-data set or empirical analysis? We know macro variables are the aggregation of micro variables in most of the cases, for example- income approach is one way of measuring gross domestic product (GDP) where all factors‘ income are added up, and wage income contributes more than 50 percent of GDP in any country. Similarly, the consumer price index (CPI) is the percentage change in the weighted average of all consumer goods in a households consumption bundle between the base year and current years. The weight is given according to the amount of spending on consumption good in the consumption bundle. So each product‘s price matters for calculating consumer price index. Therefore, we can say macro

data is the reflection of micro-data and vice versa. Moreover, there are many studies (Bongaarts and Zimmer 2001; Department of Economic and Social Affairs, Population Division, United Nations 2005) where macro-level data have been used instead of micro-level datafor empirically investigating the living arrangement behaviour of senior citizens in case of cross-country analysis.

The detail description of all variables and sources of gathering data is presented in Data appendix of Chapter three.

Throughout the text, we have omitted the subscripts of all variables for ease of reading.

3.4 Empirical Results

Overall the time period includes between 1990 and 2002. Descriptive statistics of the variables are given in Table 3.1. The statistics indicate that co-residing pattern of senior people with working children is more likely in the Asian region than that of African region. On average 65.23 percent senior citizens of the research areas, among which 61.72 percent African and 74.58 percent Asian senior citizens co-reside with their children. If we consider the gender issue, we find that on average 70.34 percent male *(MPEPCH)* and 59.83 percent female *(FPEPCH)* senior citizens co-reside with at least one working child. If we consider the regional difference we find that 68.43 percent male and 54.58 percent female of Africa and 75.44 percent male and 73.84 percent female of Asia co-reside with their children. In the first wave, 70.86 percent male and 60.17 percent female senior citizens co-reside with their children.

Table 3.1: Descriptive Statistics

Variable			Obs.	Mean	Std. Dev.	Min	Max
pepch	Panel		44	65.23	10.55	45.7	88.1
	1st wave	Total	22	65.74	10.29	45.7	88.0
		Africa	16	62.01	8.13	45.7	75.6
		Asia	6	75.68	9.12	64.5	88.0
	2nd wave	Total	22	64.72	11.02	46.5	88.1
		Africa	16	61.44	9.53	46.5	80.1
		Asia	6	73.47	10.52	62.8	88.1
mpepch	Panel		44	70.34	9.22	52.3	89.7
	1st wave	Total	22	70.86	8.76	54.8	88.5
		Africa	16	68.68	8.05	54.8	83.5
		Asia	6	76.68	8.49	68.2	88.5
	2nd wave	Total	22	69.81	9.84	52.3	89.7
		Africa	16	68.17	9.06	52.3	85.0
		Asia	6	74.2	11.35	60.1	89.7
fpepch	Panel		44	59.83	12.51	35.6	87.3
	1st wave	Total	22	60.17	12.60	35.6	87.3
		Africa	16	54.68	8.40	35.6	67.6
		Asia	6	74.82	10.04	61.0	87.3
	2nd wave	Total	22	59.49	12.71	41.4	86.1
		Africa	16	54.48	9.75	41.4	75.2
		Asia	6	72.87	9.91	60.4	86.1
gdp			44	2617.64	1757.84	527.0	8688
cpi			44	52.99	29.20	0.05	93.61
rur			44	45.86	27.50	7.53	138.10
lfp			44	60.34	17.05	29.0	87.0
hdi			44	0.42	0.15	0.078	0.74
mus			44	29.27	30.29	0.3	90.7
chr			44	39.33	31.72	0.1	102
hbo			44	33.98	26.09	0.9	96.5
life			44	53.19	8.22	32.7	70.5
lite			44	56.43	22.33	14.7	94.8

Among them 68.68 percent male and 54.68 percent female of Africa and 76.68 percent male and 74.82 percent female of Asia co-reside with their children. While, in the second wave, 69.81 percent male and 59.49 percent female co-reside with their children. Among them, 68.17 percent male and 54.48 percent female of Africa and 74.2 percent male and 72.87 percent female of Asia co-reside with their children. When compared between these two waves, we observe that co-residence arrangements for senior male have fallen in the second wave by 5.87 percent in China and 5.23 percent in Rwanda; the maximum fall in two regions,

Asia and Africa, respectively. However, co-residence arrangements for senior female have fallen in the second wave by 3.82 percent in China and 5.17 percent in Kenya; the maximum fall in Asia and Africa, respectively. Surprisingly, co-residence arrangements have increased in the 2nd wave by 5.37 percent in Senegal. Overall, the rate of change in co-residing arrangements is higher in Asia compared to Africa.

We employ the ‗general-to-specific' modelling technique by sequentially eliminating the most insignificant variables. The result of specific model[11] is presented in Table 3.2. Estimated results suggest that the income of working child has a negative and significant impact on co-residence. Specifically, a one percent increase in the income of employed child leads to about 0.10 percent fall in co-residence. The magnitude of the coefficient of income varies from -0.097 (senior female co-residence) to -0.111 (all seniors' co-residence). As we have mentioned in the theoretical model that if the income of the child increases, co-residing becomes very costly for child (due to highly negative externality); it would have a negative impact on co-residence and therefore, a direct transfer payments to parents and residing in separate houses may be preferable to co-residence for the child in that case.

More specifically, an increase in the income of aworking child may increase the demand for privacy; which influences him to reside in a separate house. This also might be because employed adults may require moving to different cities or different countries when he gets promoted in his job. It may also be the case that a new job offers more salary to the working child requiring them to move to a new place. Both of the above mentioned cases are not unlikely in developing countries. Subsequently, a good job offer or a promotion may cause a reduction in co-residence.

[11] The results of general model is given in empirical appendix of chapter three

Table 3.2: Regression results for overall co-residing senior citizens as well as for co-residing male and female separately

	Combined		**Male**		**Female**	
	Random Effects	Fixed Effects	Random Effects	Fixed Effects	Random Effects	Fixed Effects
LGDP	-0.105*** (0.037)	-0.111* (0.062)	-0.101*** (0.034)	-0.153** (0.054)	-0.097** (0.046)	-0.147* (0.788)
LLIFE	0.342*** (0.105)	0.522*** (0.112)	0.229** (0.107)	0.334** (0.132)	0.327** (0.141)	0.500** (0.177)
LLITE		0.141*** (0.043)				
LRUR		-0.103** (0.046)				
LLFP		0.343** (0.161)				
LMUS	0.045*** (0.016)	0.065** (0.030)	0.044*** (0.017)	0.052 (0.036)	0.049** (0.019)	0.106** (0.050)
AFR	-0.186*** (0.070)	Omitted[ɔ]	-0.121* (0.065)	Omitted[ɔ]	-0.303*** (0.083)	Omitted[ɔ]
Const.	3.634*** (0.483)	1.208 (0.997)	4.107*** (0.482)	3.966*** (0.601)	3.609*** (0.628)	2.937*** (0.869)
Obs.	44	44	44	44	44	44
Cross-section	22	22	22	22	22	22
Wald, χ^2	27.79***	F= 6.26***	20.23***	F=3.44**	29.61***	F=3.33**
Hausman		Supported[š]	Supported[š]		Supported[š]	

*Note: standard errors in parenthesis *, ** and *** indicate the significance level at 10%, 5% and 1% respectively. ɔ is omitted because of collinearly. šHausman test supports respective Fixed or Random effects model.*

Rent is not found to be a significant variable for co-residence. It may suggest that income, altruism and externality are such important phenomena that rentof housing becomes immaterial for co-residence. This may also be because of using a weak proxy *(CPI)* for rent in our study. However, since there is no rental index available for developing countries; we do not have any better alternative proxy for this variable.

Life expectancy *(LIFE)* has a positive and significant impact on co-residence. Estimated result indicates that a one percent increase in life expectancy at birth increases the co-residence by 0.23-0.52 percent. With an increase in the life expectancy rate, the female

senior citizens are more likely to co-reside (+0.23) with their children compared to the male senior citizens. Since the existing co-residents are likely to continue co-residing and some new retired elderly parents start co-residing with their children as well, the number of co-resident increases with the increase of life expectancy rate.

The literacy rate *(LITE)* of the adult population has a positive impact on co-residence. This variable has been found to be significant only in overall senior citizens‘ co-residence. However, the ratio of urban to rural population *(RUR)* has a negative and significant effect on co-residence of overall senior citizens. Consequently, if the number of urban working migrants increases (which reduces the number of rural working children), the rate of (overall) co-residence falls. The labour force participation rate *(LFP)* has a positive and significant impact on (overall) co-residence. It can be noted that none among the literacy rate, ratio of urban to rural population, labour force participation rates has been found to be significant determinants of male or female co-residence separately. Culture (religion and region) is found to be a significant determinant for co-residence. Muslim senior citizens are more likely (and significantly) to be co-residing with their children compared to their Christian, Hindu, Buddhist and other religious counterparts. This variable is found to be positive and significant in all cases (i.e., male, female and overall senior citizens‘ co-residence). The coefficients of Muslim variable suggest that a 1 percent increase in Muslim population (to total population) increases co-residence for male, female and overall senior citizens by 0.044, 0.049 and 0.065 percent respectively. Regional dummy *(ARF)* is found to be negative and significant for co-residence, which suggests that African people are less likely to co-reside compared to Asian people.

Health expenditure might play an important role in determining residing behaviour of senior citizens in developing countries because health expenditure is privately managed by the household in all countries in our data set. We therefore consider health expenditure as

percentage of GDP *(HEALTH)* as an independent variable with all other independent variables to check the robustness of our estimated results. We have estimated general models for male and female senior citizens separately and conducted Hausman (1987) test between Fixed effects and Random effects models[12]. Estimated results show that Random effects model is preferred for both male and female senior citizens. The log value of health expenciture as percentage of GDP *(LHEALTH)* is found statistically insignificant in all models without affecting the significance of other variables that have found significant in our primary estimations.

In development literature, it is usual that economic growth has positive impact on life expectancy, educational development, health status, urbanisation, labour force participation rates and overall human development of all citizens in a country. In our data set, there might be correlation among the variables *LGDP,LLIFE, LLITE, LHEALTH, LHDI, LRUR,*and *LLFP* variables. To check correlation among these independent variables, we have estimated correlation matrix[13] of independent variables. We have found that the variable, *LGDP* is significantly correlated with *LLIFE, LLITE, LHEALTH, LHDI, LRUR, LLFP* and *LHBO* variables. But we believe that our estimated results of both general model and specific models do not suffer multicolinearity problem because the variable *LLIFE* and *LLITE* variables are highly significant with t-value is more than two. This is one of the remedial measures of multicolinearity problem.

3.5 Conclusions

The study develops a theoretical model which captures the altruism, congestion problem and negative externality concepts which can emerge from co-residence of the senior citizens with their working children. We also empirically estimate the significant determinants

[12]The estimated result is given in Empirical Appendix of Chapter Three in Table 3.5
[13] The estimated correlation matrix is given in Empirical Appendix of Chapter Three in Table 3.6

of co-residence pattern of senior citizens in developing countries, specifically, in Asia and Africa. Changing pattern in co-residence due to changes in the determinants over time is also investigated. Our theoretical model indicates that although housing price negatively affects the co-residence pattern; income, however, affects the co-residence pattern depending on the relative effectiveness of altruism and negative externality emerged from co-residence.

Empirically, we examine whether per capita income of employed people, housing price, the life expectancy rate, literacy rate, migration from rural to urban area and culture (religion and region) can influence the co-residence pattern of the senior citizens in developing countries. We use the data of senior citizens (collectively), senior male and senior female who are co-residing with their working children and subsequently employ the fixed effects and random effects models for estimation. Sargan‘s (1964) criterion suggests that the log-linear model rather than a simple linear model is appropriate for this estimation. We, therefore, estimate log-linear multiple regression models in the light of our theoretical model. However, in the empirical models, we include some additional explanatory variables which were suggested by the existing literature. Our theoretical model suggests that co-residence of the senior citizens may fall with the increase in children‘s income level which is found to be appropriate empirically. The estimated results suggest that income has a negative and significant effect on co-residence of the senior citizens with their working children which is slightly higher for male senior citizens compared to their female counterpart. The life expectancy rate has a positive and significant effect on co-residence which is higher for female than that of male senior citizens. One percent increase in the life expectancy rate increases about 0.5 percent of overall co-residence. Religious culture and regional culture significantly influence the co-residence pattern of the senior citizens. Muslim religion and Asian culture have a positive impact on co-residence of the senior citizens.

Since per capita income in developing countries is increasing over time, following our empirical findings, we conclude that co-residence will fall in developing Africa and Asia over time. Moreover, due to intensive family planning policy in developing countries, there are one or two working children in a family nowadays. Consequently, a growing number of senior citizens who are mainly dependent on their working children will have to maintain more vulnerable livelihood in near future. Besides, in this era of globalization, growing job opportunities are relocating the working generation and subsequently breaking the extended family into nuclear families. Hence, governments of developing countries need to be more concerned about residing arrangements for senior citizens and they require planning for a good alternative of co-residence for the senior citizens.

Appendices: Chapter Three

Mathematical Appendix

Proposition 1:

Proof: $\frac{\partial h^{P,a}}{\partial Y^C} = \frac{\partial}{\partial Y^C}\left[\frac{\tau\delta Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h}\right] = \frac{\tau\delta}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h} > 0$

$$\frac{\partial h^{P,a}}{\partial \tau} = \frac{\partial}{\partial \tau}\left[\frac{\tau\delta Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h}\right] = \frac{(\alpha+\beta)\delta Y^C}{[\{(\alpha+\beta)+\tau(\gamma+\delta)\}]^2 P_h} > 0$$

$$\frac{\partial h^{C,a}}{\partial Y^C} = \frac{\partial}{\partial Y^C}\left[\frac{\beta Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h}\right] = \frac{\beta}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h} > 0$$

$$\frac{\partial h^{C,a}}{\partial \tau} = \frac{\partial}{\partial \tau}\left[\frac{\beta Y^C}{\{(\alpha+\beta)+\tau(\gamma+\delta)\}P_h}\right] = \frac{-\beta(\gamma+\delta)Y^C}{[\{(\alpha+\beta)+\tau(\gamma+\delta)\}]^2 P_h} < 0$$

$$since, \alpha, \beta, \gamma, \delta, \tau, P_h > o \; and \; for \; a \; positive \; child^{'}s \; income \; \blacksquare$$

Lemma 1:

Proof: The rate of change in the demand of housing for co-residing child and elderly parent with respect to the child‘s degree of altruism is as follows.

$$\frac{\partial h^{C,r}}{\partial \tau} = \frac{Y^C\{\alpha(\delta-\theta^P)-\gamma(\beta-\theta^C)\}}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]^2 P_h}$$

$\frac{\partial h^{C,r}}{\partial \tau} > 0 \; if \; \frac{\alpha}{(\beta-\theta^C)} > \frac{\gamma}{(\delta-\theta^P)}$ and $\frac{\partial h^{C,r}}{\partial \tau} < 0 \; if \; \frac{\alpha}{(\beta-\theta^C)} < \frac{\gamma}{(\delta-\theta^P)}$

where, $\left(\varepsilon_{X^{C,r}}/\varepsilon_{h^{C,r}}\right) = \frac{\alpha}{(\beta-\theta^C)}$ and $\left(\varepsilon_{X^{P,r}}/\varepsilon_{h^{C,r}}\right) = \frac{\gamma}{(\delta-\theta^P)}$ ■

Proposition 2:

Proof: (a) $\frac{\partial h^{C,r}}{\partial Y^C} = \frac{\partial}{\partial Y^C}\left[\frac{\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}Y^C}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]P_h}\right] = \frac{\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]P_h} > 0$

$$iff, \alpha, \beta, \gamma, \delta, P_h > 0 \; and \; \beta > \theta^C \; and \; \delta > \theta^P \blacksquare$$

(b) $\frac{\partial h^{C,r}}{\partial \tau} = \frac{\partial}{\partial \tau}\left[\frac{\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}Y^C}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]P_h}\right] = \frac{Y^C\{\alpha(\delta-\theta^P)-\gamma(\beta-\theta^C)\}}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]^2 P_h}$

$$\frac{\partial h^{C,r}}{\partial \tau} > 0 \; iff \; \alpha(\delta-\theta^P) > \gamma(\beta-\theta^C)$$

$$\frac{\partial h^{C,r}}{\partial \tau} < 0 \; iff \; \alpha(\delta-\theta^P) < \gamma(\beta-\theta^C)$$

$$iff, \alpha, \beta, \gamma, \delta, P_h > 0 \; and \; \beta > \theta^C \; and \; \delta > \theta^P \blacksquare$$

(C) $\frac{\partial h^{C,r}}{\partial \theta^C} = \frac{\partial}{\partial \theta^C}\left[\frac{\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}Y^C}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]P_h}\right] = -\frac{(\alpha+\tau\gamma)Y^C}{\{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]\}^2 P_h} < 0$

$$\frac{\partial h^{C,r}}{\partial \theta^P} = \frac{\partial}{\partial \theta^P}\left[\frac{\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}Y^C}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]P_h}\right]$$

$$= -\frac{\tau(\alpha+\tau\gamma)Y^C}{\{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]\}^2 P_h} < 0$$

$$iff, \alpha, \beta, \gamma, \delta, P_h > 0 \; and \; \beta > \theta^C \; and \; \delta > \theta^P \blacksquare$$

Proposition 3:

Proof: The elasticity of total utility with respect to child‘s income for the child residing apart is as follows.

$$\varepsilon_{Y^C}^{V^{C,a}} = \{(\alpha+\beta)+\tau(\gamma+\delta)\}$$

The elasticity of total utility with respect to child‘s income for co-residing child is as follows.

$\varepsilon_{Y^C}^{V^{C,r}} = \{\alpha + (\beta - \theta^C)\} + \tau\{\gamma + (\delta - \theta^P)\}.$

The difference of elasticity of total utility between residing apart and co-residing for the child is

$$\varepsilon_{Y^C}^{V^{C,a}} - \varepsilon_{Y^C}^{V^{C,r}} = \theta^C + \tau\theta^P > 0 \; since \; 0 < \theta^C < \beta < 1, and \; 0 < \theta^P < \delta < 1$$

Similarly, difference of elasticity of total utility between residing apart and co-residing for an elderly parent is

$$\varepsilon_{Y^C}^{V^{P,a}} - \varepsilon_{Y^C}^{V^{P,r}} = (\gamma + \delta) - \{\gamma + (\delta - \theta^P) = \theta^P > 0 \blacksquare$$

Proof: Proposition 4:

Threshold income by making co-residing decision for the child:

Comparison of indirect total utility of children residing apart and co-residing is

$$\begin{aligned}
&\ln V^{C,a} - \ln V^{C,r} \\
&\quad = \alpha \ln \alpha + \beta \ln \beta + \tau\gamma \ln \gamma + \tau\delta \ln \delta + \tau(\gamma + \delta) \ln \tau \\
&\quad + \{\alpha + \beta + \tau(\gamma + \delta)\} \ln Y^C - \{\alpha + \beta + \tau(\gamma + \delta)\} \ln\{(\alpha + \beta) + \tau(\gamma + \delta)\} \\
&\quad - \alpha \ln P_x - \tau\gamma \ln P_x - \beta \ln P_h - \tau\delta \ln P_h - [\, \alpha \ln \alpha \\
&\quad + \{(\beta - \theta^C) + \tau(\delta - \theta^C)\} \ln\{(\beta - \theta^C) + \tau(\delta - \theta^C)\} + \tau\gamma \ln \tau + \tau\gamma \ln \gamma \\
&\quad + [\{\alpha + (\beta - \theta^C)\} + \tau\{\gamma + (\delta - \theta^P)\}] \ln Y^C \\
&\quad - [\{\alpha + (\beta - \theta^C)\} \\
&\quad + \tau\{\gamma + (\delta - \theta^P)\}] \ln[\{\alpha + (\beta - \theta^C)\} + \tau\{\gamma + (\delta - \theta^P)\}] - (\alpha + \tau\gamma) \ln P_x \\
&\quad - \{(\beta - \theta^C) + \tau(\delta - \theta^C)\} \ln P_h]
\end{aligned}$$

If indirect total utility between residing apart and co-residing remain same for the child, then $\ln V^{C,a} - \ln V^{C,r} = 0$ so that,

$$\beta \ln \beta + \tau\delta \ln \delta + \tau\delta \ln \tau + [\theta^C + \tau\theta^P] \ln Y^C - \{\alpha + \beta + \tau(\gamma + \delta)\} \ln\{(\alpha + \beta) + \tau(\gamma + \delta)\}$$
$$- [\theta^C + \tau\theta^C] \ln P_h - \{(\beta - \theta^C) + \tau(\delta - \theta^C)\} \ln\{(\beta - \theta^C) + \tau(\delta - \theta^C)\}$$
$$+ [\{\alpha + (\beta - \theta^C)\}$$
$$+ \tau\{\gamma + (\delta - \theta^P)\}] \ln[\{\alpha + (\beta - \theta^C)\} + \tau\{\gamma + (\delta - \theta^P)\}] = 0$$

$$\boldsymbol{Y^C = \left[\frac{[\{(\alpha+\beta)+\tau(\gamma+\delta)\}]^{\{(\alpha+\beta)+\tau(\gamma+\delta)\}}[\{(\beta-\theta^C)+\tau(\delta-\theta^C)\}]^{\{(\beta-\theta^C)+\tau(\delta-\theta^C)\}}(P_h)^{(\theta^C+\tau\theta^C)}}{[\{\alpha+(\beta-\theta^C)\}+\tau\{\gamma+(\delta-\theta^P)\}]^{[\{\alpha+(\beta-\theta^C)\}+\tau\{\gamma+(\delta-\theta^P)\}]}\beta^\beta\delta^{\tau\delta}\tau^{\tau\delta}}\right]^{\frac{1}{(\theta^C+\tau\theta^P)}}}$$

Threshold income by making co-residing decision for the elderly parent:

Comparison of indirect total utility of parent residing apart and co-residing is

$$\ln V^{P,a} - \ln V^{P,r}$$
$$= \gamma \ln \gamma + \delta \ln \delta + (\gamma + \delta) \ln \tau + (\gamma + \delta) \ln Y^C$$
$$- (\gamma + \delta) \ln\{(\alpha + \beta) + \tau(\gamma + \delta)\} - \gamma \ln P_x - \delta \ln P_h$$
$$- \gamma \ln \tau$$
$$- \gamma \ln \gamma - (\delta - \theta^P) \ln\{(\beta - \theta^C) + \tau(\delta - \theta^P)\} - \{\gamma + (\delta - \theta^P)\} \ln Y^C$$
$$+ \{\gamma + (\delta - \theta^P)\} \ln[(\alpha + \tau\gamma) + \{(\beta - \theta^C) + \tau(\delta - \theta^P)] + \gamma \ln P_x$$
$$+ (\delta - \theta^P) \ln P_h$$

If indirect total utility between residing apart and co-residing remain same for the parent, then $\ln V^{P,a} - \ln V^{P,r} = 0$ so that,

$$\delta \ln \delta + \delta \ln \tau + \theta^P \ln Y^C - (\gamma + \delta) \ln\{(\alpha + \beta) + \tau(\gamma + \delta)\}$$
$$- (\delta - \theta^P) \ln\{(\beta - \theta^C) + \tau(\delta - \theta^P)\}$$
$$+ \{\gamma + (\delta - \theta^P)\} \ln[(\alpha + \tau\gamma) + \{(\beta - \theta^C) + \tau(\delta - \theta^P)] - \theta^P \ln P_h = 0$$

$$\boldsymbol{Y^C = \left[\frac{[\{(\alpha+\beta)+\tau(\gamma+\delta)\}]^{(\gamma+\delta)}[\{(\beta-\theta^C)+\tau(\delta-\theta^P)\}]^{(\delta-\theta^P)}(P_h)^{\theta^P}}{[(\alpha+\tau\gamma)+\{(\beta-\theta^C)+\tau(\delta-\theta^P)]^{\{\gamma+(\delta-\theta^P)\}}\delta^\delta\tau^\delta}\right]^{\frac{1}{\theta^P}}}$$

Empirical Appendix

Sargan (1964) method for Testing Linear versus Log-Linear Functional Form

Assume that we are going to choose one model between linear regression model (M_1)in equation and log-linear regression model (M_2)in equation.

$$M_1: MPSPCH_{it} = \alpha_0 + \alpha_1 GDP_{it} + \alpha_2 LIFE_{it} + \alpha_3 LITE_{it} + \alpha_4 CPI_{it} + \alpha_5 RUR_{it} + \alpha_6 LFP_{it} + \alpha_7 MUS00_i + \alpha_8 CHR00_i + \alpha_9 HBO00_i + \alpha_{10} SEX_i + \alpha_{11} AFR_i + \varepsilon_i$$

and

$$M_2: \log PSPCH_{it} = \log \beta_0 + \beta_1 \log GDP_{it} + \beta_2 \log LIFE_{it} + \beta_3 \log LITE_{it} + \beta_4 \log CPI_{it} + \beta_5 \log LFP_{it} + \beta_6 \log RUR_{it} + \beta_7 \log MUS00_i + \beta_8 \log CHR00_i + \beta_9 HBO00_i + \beta_{10} SEX_i + \beta_{11} AFR_i + \vartheta_i [i = 1,..44, t = 1st, 2nd]$$

According to Sargan (1964) mentioned by Godfrey and Wickens (1981), choosing one between these two models is based upon the ratio of the maximized likelihoods for the case in which ε and ϑ are both independently distributed normal variables with zero means and standard deviations σ_ε and σ_ϑ respectively (p.488). Assuming the ordinary least squares (OLS) estimators of linear model and log-linear model are denoted by tildes and hats respectively, we can write estimated variance-covariance matrices of linear model and log-linear model in matrix notation respectively as follows.

For linear model:

$$\tilde{\sigma}_\varepsilon{}^2 = n^{-1} \varepsilon' \varepsilon$$

$$= n^{-1} \left[PSPCH - \widetilde{PSPCH} \right]' \left[PSPCH - \widetilde{PSPCH} \right]$$

For log-linear model:

$$\hat{\sigma}_{\vartheta}{}^{2} = n^{-1}\vartheta'\vartheta =$$

$$n^{-1}\left[logPSPCH - \widehat{logPSPCH}\right]'\left[logPSPCH - \widehat{logPSPCH}\right]$$

Where, $\tilde{\sigma}_{\varepsilon}{}^{2}$ and $\hat{\sigma}_{\vartheta}{}^{2}$ are sum of squares residuals from linear model and log-linear model respectively.

Sargar's (1964) criterion is

$$S = \left(\frac{\tilde{\sigma}_{\varepsilon}}{g\hat{\sigma}_{\vartheta}}\right)^{T}$$

Where, g is the geometric mean of the vector of dependent variable $PSPCH' = [PSPCH_{11}, \ldots..PSPCH_{n1}]$.

The decision rule is that if $S < 1$, linear model is supported by the data set and if $S > 1$, log-linear model is supported by the data set.

Empirical results of linear versus log linear functional form

Using Sargan's (1964) criterion of testing linear versus log linear model, I have found that both the 1st wave and the 2nd wave of data sets support log linear model instead of the linear model. The result is given in the following Table 3.3

Table 3.3: Empirical results of linear versus log linear functional form

	1st Wave Data Set	2nd Wave Data Set
Square root of Residual Sum Square (RSS) for Linear Regression model	907.91	1056.69
Square root of Residual Sum Square (RSS) for Log Linear Regression model	0.2974	0.3061
Geometric Mean (g)	70.23	63.45
Sargan's criterion value $\boldsymbol{S = \left(\frac{\tilde{\sigma}_{\varepsilon}}{g\hat{\sigma}_{\vartheta}}\right)^{T}}$	$(43.48)^{44} > 1$ Log linear model is preferred	$(54.41)^{44} > 1$ Log linear model is preferred

The fixed effects model

The linear functional form of male senior people is considered and assumed that an observation of the $i-th$ country in the $t-th$ waves of the data set is as follows.

$$MPSPCH_{it} = \alpha_0 + \alpha_1 GDP_{it} + \alpha_2 LIFE_{it} + \alpha_3 LITE_{it} + \alpha_4 CPI_{it} + \alpha_5 RUR_{it} + \alpha_6 LFP_{it} + \alpha_7 MUS00_i + \alpha_8 CHR00_i + \alpha_9 HBO00_i + \alpha_{10} SEX_i + \alpha_{11} AFR_i + \varepsilon_i$$

$$[i = 1,..44\ t = 1st\ 2nd]$$

Average of the $i-th$ country in the $t-th$ waves can be written as

$$\overline{PSPCH_i} = \alpha_i + \alpha_1 \overline{GDP_i} + \alpha_2 \overline{LIFE_i} + \alpha_3 \overline{LITE_i} + \alpha_4 \overline{CPI_i} + \alpha_5 \overline{RUR_i} + \alpha_6 \overline{LFP_i} + \alpha_7 \overline{MUS_i} + \alpha_8 \overline{CHR_i} + \alpha_9 \overline{HBO_i} + \alpha_{10} \overline{SEX_i} + \alpha_{11} \overline{AFR_i} + \varepsilon_i$$

By subtracting

$$PSPCH_{it} - \overline{PSPCH_i} = \alpha_1 (GDP_{it} - \overline{GDP_i}) + \alpha_2 (LIFE_{it} - \overline{LIFE_i}) + \alpha_3 (LITE_{it} - \overline{LITE_i}) + \alpha_4 (CPI - \overline{CPI_i}) + \alpha_5 (RUR_{it} - \overline{RUR_i}) + \alpha_6 (LFP_{it} - \overline{LFP_i}) + \alpha_7 (MUS_{it} - \overline{MUS_i}) + \alpha_8 (CHR_{it} - \overline{CHR_i}) + \alpha_9 (HBO_i - \overline{HBO_i}) + \alpha_{10} (SEX_i - \overline{SEX_i}) + \alpha_{11} (AFR_i - \overline{AFR_i}) + \varepsilon_i$$

The OLS estimation gives us the fixed effect estimator. The similar process needs to be used for estimating fixed effect estimator for log linear model.

The random effects model

Instead of treating,α_i as a fixed constant, this specification assumes that α_i is drawn from an identically and independently distributed (iid) distribution, $\alpha_i \sim N(0, {\sigma_\mu}^2)$ and is uncorrelated both with the $\varepsilon_i$and with the X_{it} . The specification then becomes as follows.

$$MPSPCH_{it} = \alpha_0 + \alpha_1 GDP_{it} + \alpha_2 LIFE_{it} + \alpha_3 LITE_{it} + \alpha_4 CPI_{it} + \alpha_5 RUR_{it} + \alpha_6 LFP_{it} + \alpha_7 MUS00_i + \alpha_8 CHR00_i + \alpha_9 HBO00_i + \alpha_{10} SEX_i + \alpha_{11} AFR_i + \mu_i + \varepsilon_i$$

Where, α is the mean of the random intercepts $\alpha_i = \alpha + \mu_i$ and the errors $\mu_i$and ε_i in the composite error term with variances ${\sigma_\mu}^2$ and ${\sigma_\varepsilon}^2$respectively. So the expected value of $E(\mu) = 0$ and homoscadastic variance is $V(\mu) = {\sigma_\mu}^2 + {\sigma_\varepsilon}^2$ and an equi-correlated block-diagonal covariance matrix exhibits serial correlation over time only between the disturbances of the same individual.

$$cov(\mu_{it}, \mu_{js}) = {\sigma_\mu}^2 + {\sigma_\varepsilon}^2 \; for i = j, t = s$$

$$= {\sigma_\mu}^2 for i = j, t \neq s$$

And it is zero otherwise. This also means that the correlation coefficient between μ_{it} and μ_{js} is

$$\rho = correl(\mu_{it}, \mu_{js}) = 1 \quad for i = j, t = s$$

$$= \frac{{\sigma_\mu}^2}{({\sigma_\mu}^2 + {\sigma_\varepsilon}^2)} for i = j, t \neq s$$

Here, the appropriate estimator is the generalized least squares (GLS) which is known as random effect estimator.

Hausman (1978) test: Fixed Effects vs. Random Effects Model

To test which model is the correct specification, Hausman (1978) assumes the following hypotheses.

$H_0: plim\hat{q} = 0 \quad against H_a : plim\hat{q} \neq 0$Where, $\hat{q} = \alpha^{GLS} - \alpha^{OLS}$ is the difference between consistent and efficient estimator (in matrix notation).

Hausman test statistic is

$m = \hat{q}'[V(\hat{q})]^{-1}\hat{q}$

Here, variance of$\hat{q}$, is $V(\hat{q}) = V(\alpha^{GLS}) - V(\alpha^{OLS})$. The test statistic is asymptotically distributed under H_0 as ${\chi_K}^2$ where K denotes the dimension of slope vector, α. In order to make this test operational, the variance covariance matrix is replaced by estimated variance covariance matrix and GLS is replaced by corresponding feasible generalised least square(FGLS) estimator.The decision rule is that rejecting the null hypothesis means the random effect model is the preferred specification, otherwise the fixed effect model is the one.

Table 3.4: Estimated Results of General Models

		Combined **(PEPCH)**		Male **(MPEPCH)**		Female **(FPEPCH)**	
		Random Effects	Fixed Effects	Random Effects	Fixed Effects	Random Effects	Fixed Effects
LGDP		-0.075	-0.096	-0.081	-0.098	-0.060	-0.116
(S.E)		(0.057)	(0.071)	(0.052)	(0.070)	(0.074)	(0.108)
LLIFE		0.380***	0.583***	0.288***	0.451***	0.376**	0.714***
(S.E)		(0.127)	(0.131)	(0.117)	(0.129)	(0.172)	(0.199)
LLITE		0.028	0.134***	0.010	0.108**	0.023	0.171**
(S.E)		(0.048)	(0.048)	(0.044)	(0.047)	(0.066)	(0.072)
LCPI		0.0004	0.003	0.001	0.007	0.003	0.001
(S.E)		(0.012)	(0.012)	(0.011)	(0.012)	(0.016)	(0.018)
LRUR		-0.038	-0.099	-0.031	-0.108*	-0.028	-0.060
(S.E)		(0.049)	(0.059)	(0.044)	(0.059)	(0.064)	(0.091)
LHDI							
(S.E)							
LLFP		-0.032	0.337*	-0.069	0.273	0.008	0.386
(S.E)		(0.095)	(0.192)	(0.085)	(0.188)	(0.119)	(0.290)
LMUS		0.040*	0.069*	0.031	0.037	0.041	0.126*
(S.E)		(0.023)	(0.040)	(0.021)	(0.040)	(0.029)	(0.061)
LCHR		-0.018	-0.014	-0.011	-0.003	-0.025	-0.031
(S.E)		(0.014)	(0.016)	(0.013)	(0.016)	(0.019)	(0.024)
LHBO		-0.011	-0.013	-0.013	-0.013	-0.015	-0.017
(S.E)		(0.016)	(0.017)	(0.015)	(0.016)	(0.022)	(0.025)
AFR		-0.113	omitted	-0.052	omitted	-0.214*	omitted
(S.E)		(0.090)		(0.081)		(0.113)	
Const.		3.452***	0.947	4.104***	1.998*	3.176***	-0.079
(S.E)		(0.787)	(1.126)	(0.712)	(1.106)	(1.018)	(1.706)
Obs.		44	44	44	44	44	44
R^2	within	0.57	0.737	0.488	0.676	0.428	0.622
	between	0.43	0.005	0.355	0.006	0.547	0.064
	overall	0.43	0.009	0.357	0.002	0.540	0.071
		Wald-χ^2 =30.52***	F = 4.05***	Wald-χ^2 =22.77***	F = 3.02**	Wald-χ^2 =29.38***	F = 2.38*
Hausman Test	χ^2(d.f)	$\chi^2(9)$= 15.98		$\chi^2(9)$= 14.34		$\chi^2(9)$= 14.10	
	Prob>χ^2(d.f)	Prob>$\chi^2(9)$= 0.067		Prob>$\chi^2(9)$= 0.111		Prob>$\chi^2(9)$= 0.119	
Hausman Test Result		Supported		Supported		Supported	

*Note: standard errors in parenthesis *, ** and *** indicate the significance level at 10%, 5% and 1% respectively. ɔ is omitted because of collinearly. šHausman test supports respective Fixed or Random effects model.*

Table 3.5: Estimated Results of General Models for Male and Female senior citizens including LHEALTH variable

		Male **(MPEPCH)**		Female **(FPEPCH)**	
		Random Effects	Fixed Effects	Random Effects	Fixed Effects
LGDP		-0.088*	-0.097	-0.078	-0.14
(S.E)		(0.053)	(0.077)	(0.076)	(0.109)
LLIFE		0.332***	0.489***	0.456**	0.755***
(S.E)		(0.133)	(0.162)	(0.193)	(0.23)
LLITE		-0.002	0.11*	0.013	0.216**
(S.E)		(0.048)	(0.056)	(0.069)	(0.079)
LHEALTH		-0.039	-0.012	0.004	0.105
(S.E)		(0.069)	(0.08)	(0.099)	(0.114)
LCPI		0.009	0.007	0.014	-0.013
(S.E)		(0.013)	(0.015)	(0.019)	(0.021)
LRUR		-0.032	-0.106	-0.035	-0.056
(S.E)		(0.045)	(0.063)	(0.065)	(0.09)
LHDI					
(S.E)					
LLFP		-0.088	0.297	-0.014	0.484
(S.E)		(0.089)	(0.209)	(0.122)	(0.298)
LMUS		0.029	0.047	0.046	0.165**
(S.E)		(0.023)	(0.048)	(0.031)	(0.068)
LCHR		-0.01	-0.004	-0.023	-0.035
(S.E)		(0.013)	(0.016)	(0.019)	(0.024)
LHBO		-0.014	-0.014	-0.018	-0.019
(S.E)		(0.015)	(0.018)	(0.022)	(0.025)
AFR		-0.041	omitted	-0.223*	omitted
(S.E)		(0.087)		(0.119)	
Const.		4.13***	1.73	3.089***	-0.85
(S.E)		(0.758)	(1.31)	(1.06)	(1.865)
Obs.¬		42	42	42	42
R^2	within	0.46	0.66	0.40	0.67
	between	0.38	0.01	0.60	0.017
	overall	0.38	0.005	0.59	0.02
		Wald-χ^2 =20.85**	F = 2.16	Wald-χ^2 =30.35***	F = 2.19*
Hausman Test	χ^2(d.f)	$\chi^2(10)$= 13.03		$\chi^2(10)$= 15.05	
	Prob>χ^2(d.f)	Prob>$\chi^2(10)$= 0.22		Prob>$\chi^2(10)$= 0.13	
Hausman Test Result		Supported		Supported	

*Note: standard errors in parenthesis *, ** and *** indicate the significance level at 10%, 5% and 1% respectively. ɔ is omitted because of collinearly. šHausman test supports respective Fixed or Random effects model. ¬ number of observation become 42 because data of health expenditure for Zimbabwe are not available.*

Table 3.6: Correlation matrix of log variables

r $Prob.$	LGDP	LCPI	LLIFE	LLITE	LHEALTH	LHDI	LRUR	LLFP	LMUS	LCHR	LHBO	LMPEPCH	LFPEPCH
LGDP $Prob.$	1.00 ---												
LCPI $Prob.$	0.01 0.97	1.00 ---											
LLIFE $Prob.$	0.57 0.00	0.08 0.56	1.00 ---										
LLITE $Prob.$	0.36 0.02	-0.29 0.06	0.30 0.05	1.00 ---									
LHEALTH $Prob.$	-0.33 0.03	-0.05 0.77	-0.38 0.01	-0.21 0.18	1.00 ---								
LHDI $Prob.$	0.54 0.00	0.24 0.12	0.57 0.00	0.53 0.00	-0.08 0.59	1.00 ---							
LRUR $Prob.$	0.70 0.00	0.01 0.93	0.36 0.02	0.39 0.01	-0.02 0.88	0.53 0.00	1.00 ---						
LLFP $Prob.$	-0.37 0.02	-0.15 0.35	-0.14 0.38	0.24 0.13	0.04 0.80	0.11 0.48	-0.29 0.06	1.00 ---					
LMUS $Prob.$	0.14 0.39	0.27 0.08	-0.09 0.57	0.52 0.00	-0.16 0.32	-0.28 0.07	-0.01 0.96	-0.37 0.02	1.00 ---				
LCHR $Prob.$	0.08 0.61	-0.31 0.04	-0.20 0.20	-0.51 0.00	0.16 0.30	0.18 0.25	0.25 0.11	0.48 0.00	-0.32 0.04	1.00 ---			
LHBO $Prob.$	-0.38 0.01	0.02 0.91	-0.07 0.66	-0.34 0.26	0.27 0.08	-0.15 0.35	-0.39 0.09	0.05 0.74	-0.17 0.27	-0.19 0.21	1.00 ---		
LMPEPCH $Prob.$	-0.02 0.89	0.37 0.02	0.14 0.39	-0.53 0.00	-0.20 0.21	-0.13 0.39	-0.11 0.49	-0.38 0.01	0.36 0.02	-0.60 0.00	-0.21 0.90	1.00 ---	
LFPEPCH $Prob.$	0.17 0.28	0.42 0.00	0.45 0.00	-0.33 0.03	-0.38 0.01	0.09 0.57	-0.08 0.61	-0.32 0.04	0.21 0.19	-0.63 0.00	0.03 0.84	0.84 0.00	1.00 ---

Note: r represents coefficient of correlation and $prob.$ represents corresponding probability value.

Data Appendix

Percentage of senior citizens (PEP)

The United Nations Departments of Economics and Social Affairs/Population Division has classified the data on living arrangement of older people into six mutually exclusive categories[14] and calculates the percentage of each category to total senior population. That means the percentage of senior citizens for each category is defined as the number of senior citizens of a category divided by the total number of senior citizens of a country in a year. In the data set, people aged 60 years and above are considered as senior citizens and the child aged 25 years and above is considered as working citizens. Data on this variable are available on different points of time for different countries, for example- observations on Nigeria and China are in the year 1990; on Cameroon and Indonesia are in the year 1991; on Madagascar, Malawi, Niger, Rwanda, Tanzania and Zambia are in the year 1992; on Burkina Faso, Ghana, Kenya, Senegal, India and the Philippines are in the year 1993; on Cote d'Ivoire, Zimbabwe and Bangladesh are in the year 1994 and on Benin, Mali and Nepal are in the year 1996. That means the observations of different countries are scattered from the year 1990 to the year 1996, which we have called as the 1st wave of data. In the 2nd wave of data, the observations are scattered from the year 1997 to the year 2002 like the 1st one. In case of the 2nd wave of data, the observations on Madagascar, Senegal, and Indonesia are in the year 1997; on Cameroon, Ghana, Kenya, Niger, and the Philippines are in the year 1998; on Burkina Faso, Cote d'Ivoire, Nigeria, Tanzania, Zimbabwe, and India are in the year 1999; on Malawi, Rwanda, Bangladesh and China are in the year 2000; on Benin, Mali, and Nepal are in the year 2001 and the observation on Zambia is in the year 2002. The

[14] The household composition of older persons in the present publication is classified into mutually exclusive categories, including living alone, living with spouse only, living with children/children-in-law, living with grandchild (without children), living with other relatives and living with non-relatives'(p.133). See detail in United Nations Department of Economic and Social Affairs/Population Division *Living Arrangements of Older Persons Around the World, Annex3.*

source of these two waves of data set comes from the United Nations Department of Economic and Social Affairs/Population Division *Living Arrangements of Older Persons Around the World,* Annex IV, Table A.IV.9.pp.192-198.

We have compiled separate observations on the percentage of male senior citizens residing with at least one working child *(MPEPCH)* and the percentage of female senior citizens living with at least one workingchild *(FPEPCH)*. Let us symbolise *(MPEPCH)* and *(FPEPCH)* variables as $MPEPCH\_it$ and $FPEPCH\_it$ where $i[= 1\ to\ 22]$ indicates number of countries and $t[= 1st, 2nd]$ indicates number of waves.In this study family consists of at least two adult generations, considered as extended family and both $MPEPCH\_it$ and $FPEPCH\_it$ variables are representing an extended family where either male or female or both senior citizens are co-residing with at least one working child. Either of these two variables is used as dependent variables in the study for finding the determinants and trends of co-residing arrangements of either male or female or both senior citizens. Although we have separate data for the percentage of male senior citizens *(MPEPCH)* and the percentage of female senior citizens *(FPEPCH)* residing with at least one working child; all explanatory variables, for example- per capita income of employed person *(GDP)*, life expectancy at birth *(LIFE)*, adult literacy rate*(LITE)*, consumer price index *(CPI)*, ratio of urban to rural population *(RUR)*, human development index *(HDI)*, percentage of people belonging to Muslim religion *(MUS)*, percentage of people belonging to Christian religion *(CHR)*, percentage of people belonging to Hindu, Buddhist and Other religions *(HBO)*) are in macro measures so that they are applicable for both male and female observations of dependent variable; except labour force participation rate *(LFP)*, which has separate observation for each male and female. We, therefore, have merged the male and female observations to construct a combined dependent variable, which we have called combined percentage of senior citizens

(PEPCH), and have created a corresponding explanatory dummy variable which we have called sex variable *(SEX)* to distinguish male observation from female observation. This merging process helps us to increase the total number of observation from 22 to 44 by adding only an explanatory variable *(SEX)* that is a way of removing multicolinearity problem in the estimated process. Let us symbolise *(PEPCH)* variable as$PEPCH_it$ where $[i = 1\ to\ 44]$ indicates 22 countries and 2 observations for each country and $t[= 1st, 2nd]$ indicates two waves of data sets.

The difference between the 1st wave of data and the 2nd wave of data is at least 5 years for all sample countries except Senegal, which has 4 years‘ of time difference; and at most 10 years‘ of time difference happening in the case of China.

Gross Domestic Product (GDP) per employed person

The model suggests that the income of an adult child is an important determinant of making residing decision of the senior citizens. We use the GDP per employed person as an independent variable and symbolise as GDP_it where $i[= 1\ to\ 22]$ indicates country and $t[= 1st, 2nd]$ indicates wave. The source of data is the World Bank, data bank (indicators).

Consumer price index (CPI)

The model suggests that housing price or rent of a house is another important determinant of residing decision for working children as well as senior citizens. Data on the rent of a house are hardly available for the sample countries and these are too sporadic for different points of time for every country used in this study. We use inflation as a proxy of price of housing service in our analysis. The variable is an independent variable and symbolised as CPI_it where $i[= 1\ to\ 22]$ indicates country and $t[= 1st, 2nd]$ indicates wave.

Life expectancy at birth (LIFE)

Bongaarts and Zimmer (2002) and other researchers have found that there is a strong positive correlation between life expectancy and residing arrangement of senior citizens of a country. Many researchers have found that age of senior citizens is an important determinant of their residing arrangement (Bongaarts and Zimmer 2002; Ghuman and Ofstedal 2004; and Chuks 2005). We, therefore, have used life expectancy at birth in a country as an independent variable in this study. The variable is symbolised by $LIFE\_it$. The observations of this variable are collected from the several reports of the Human Development Report Office (HDRO) – an independent wing of the United Nations Development Programme.

Literacy rate (LITE)

In developed countries, the level of education of the senior citizens plays an important role in determining the resident pattern of them. Gaymu et.al. (2006), Kathleen and Schoeni (2000), and Kinsella (1990) find that having higher levels of education of the senior citizens indicates less likelihood of co-residing with working children. We have used the literacy rate of the adult population aged 15 years and above of a country as an independent variable in this study. The variable is symbolised by $LITE\_it$. The observations of this variable are collected from the several reports of the Human Development Report Office (HDRO) – an independent wing of the United Nations Development Programme.

Human development index (HDI)

The level of development might affect the living arrangement of senior citizens because Gaymuet. al. (2006), Kinsella (1990) find that thesenior citizens residing with their children are small in number in developed countries, while a large number of senior citizens reside with working children in developing countries. Human development index (HDI),

introduced by the United Nations Development Programme (since 1990), is an indicator of a country's status of development. It is a hybrid measure of three development indicators (Life expectancy, Literacy rate and GDP) of a country. We have used the variable *HDI* as an independent variable and as a substitute of three independent variables *(GDP, LIFE and LITE)*. Human development index is symbolised by HDI_it. The observations of this variable are collected from the several reports of the Human Development Report Office (HDRO) – an independent wing of the United Nations Development Programme.

Ratio of urban to rural population (RUR)

Martin (1989) indicates that a larger proportion of urban migration might be a reason for weakening ties of children with their elderly parents. Similarly, the modernisation theory believes that urbanisation, the more percentage of population living in urban area might be a reason of weakening ties between senior citizens and their children that leads to determine the residing arrangements of senior citizens. We have included the ratio of urban to rural population as an independent variable. The ratio is a measure of the relative number of population living in an urban area to a rural area of a country. The difference of ratios between two points of times measures the urban-rural migration pattern of a country. The variable is symbolised as RUR_it. The data source is the World Bank, data bank (indicators).

Labour force participation rate (LFP)

Kinsella (1990) and the United Nations (2005) find that the higher the female labour force participation, the higher the possibility of co-residing with senior citizens. That is why, we have included the labour force participation rate both for male and female as an independent variable and symbolised as LFP_it. The data are collected from the World Bank, data bank (indicators).

Religion (Muslim, Christian and Hindu plus Buddhist plus Others)

Gaymu et.al. (2006) and Pampel (1983, 1992) suggest that culture may be an important determinant of the residing arrangement. Region and religion could be good proxies for culture variable. We, therefore, have used the percentage of the population belonging to one of these three different religious cultures- Muslim, Christian, and Hindu plus Buddhist plus others. These variables are used to capture the effect of religious culture (if any) on residing decision. These variables are symbolised as $MUS70$, $CHR70$, and $HBO70$ respectively for the percentage of Muslim, Christian and Hindu plus Buddhist plus other population of a country in the year 1970. $MUS00$, $CHR00$, and $HBO00$ are respectively the percentage of Muslim, Christian and Hindu plus Buddhist plus other population of a country in the year 2000. Since the observations of both the 1st wave and the 2nd wave of data sets cover the time period 1990 to 2002, we have used the observations of the year 2000 of these three variables for cross-country analysis of both waves of data sets. The data on religion are collected from the web site of Robert Barro and Rachel McCleary, who have compiled a cross-country dataset on the share of religious people in the population. ‗Adherence fractions of population are shown for 10 religion groups and non-religion (incl. atheists) in 1970, 2000, and 1900 (from Barrett).'

Region (Africa and Asia)

There is a vast difference between the cultures of these two sample regions. We, therefore, have utilised dummy variable to cover the cultural difference created due to geographical difference. One regional dummy variable is created to investigate the regional effect in this study that is symbolised as AFR. The variable takes the value 1 (one) if the country is in African region and value 0 (zero) when the country falls in Asian region. Therefore, regional differences are assessed with respect to the values for Africa.

Sex (Male and Female)

Sex is a dummy independent variable used to find the effect of gender on co-residing decision for combined dependent variable. It is symbolised as SEX_it. $SEX$is an independent variable for estimating $PEPCH$, the dependent variable only. The variable takes 0 (zero) value for male and takes 1 (one) value for female. In the 1st and 2nd wave of data sets, observations are different for male and female in the percentage of senior citizens living with children or alone or couple only and labour force participation rate. The variable is used as an independent variable in the estimation process when we merge both data sets of male and female.

The natural logarithmic value of each observation is used in the analysis. All logarithmic variables are symbolised by adding a prefix of the letter _L' in the symbol of every variable, for an example - the logarithmic value of the symbol of per capita income of an employed person is symbolised as $LGDP_{it}$. Since we have 22 countries and 2 observations for each country, one is for male and the other is for female in each wave of data set. As a result, our total observations of each wave of data set become 44 for combined dependent variable. This aggregation helps us to increase the number of total observations in estimation process; as a result, the degree of freedom in estimation process has increased. Another important issue about the data set is that the observation on this variable for each country is collected according to the year of dependent variable both in the 1st and the 2nd wave of data sets. For example- in the 1st wave of data set, the observation on the dependent variable for the country, Benin is taken in the year 1996; so we use the GDP per employed person in the year 1996 for it. In the 2nd wave of data set, the observation of the dependent variable for the country, Benin is 2001; so we use the GDP per employed person in the year 2001 for it.

CHAPTER FOUR

Solitary residing senior citizens in European countries

Abstract

The percentage of solitary residing senior citizens in Europe is the highest in the world at present. The increasing nature of percentage of solitary residing senior citizens in Europe is a big issue for policymakers to find appropriate factors of explaining such behaviour. We have strived to find the factors that determine solitary residing behaviour of the senior citizens in Europe. We have developed a theoretical framework which includes negative externality of co-residing (such as privacy, congestion) and derived the criterion of choosing solitary residing decision by the senior citizens. Using macro-level and gender-specific unbalanced panel data sets of 16 European countries, we have empirically investigated the most relevant factors of solitary residing. The empirical results show that growth in life-cycle pensionable wealth, life expectancy after retirement and religious culture of senior citizens reduce their solitary residing attitude.

4.1 Introduction

Currently population ageing is one of the most concerning policy making issues in the world because post-war baby-boomers around the world approach older generation of a society in the early decades of the 21st century. It involves not one but several socio-economic consequences in an economy having an impact on economic growth, savings, investment, consumption, labour markets, pensions, taxation, intergenerational transfers, family composition, housing services, health care services and specially residing arrangements. That is why, population ageing and its consequences around the world has been focused on rigorously by the policymakers and researchers.

A concentrated research focused on the residing arrangement of senior citizens is a relatively new theme. It is driven by concerns raised around the world in general, and the developed countries in particular because residing arrangements matter a great deal over there. Studies (Pendry, Barrett and Victor, 1999; Breeze, Sloggett and Fletcher, 1999) show

that solitary residing senior citizens are more likely to enter an institution than those living with at least one other person. Even where institutionalisation does not take place because of cultural or social norms and values, solitary residing senior citizens are more likely to require special care either from the state or from relatives or neighbours, in the form of home helps and other social services, than those who live with others. In this study, attention has been paid to find the determinants of the residing arrangements of senior citizens and particular concentration is given on finding the factors affecting the solitary residing attitude of the senior citizens in 16 (sixteen) most developed European countries.

This topic is of interest for several reasons. A few of these reasons are: *Firstly,* there are a few rigorous socio-economic studies, both theoretical (Hoerger, Picone, and Sloan 1996; Ermisch, 1981) and empirical (Soldo, Wolf and Agree, 1990; Pampel, 1992). *Secondly,* Europe is currently the major area with the highest proportions of senior citizens and is projected to remain so until 2050. All these 16 countries fall in the 1st quartile of country ranking by the percentage of population aged 60 and over (United Nations, 2009). In Europe, 22 percent of the population was aged 60 years or over in the year 2009 and is projected to be 35 percent in the year 2050, which is the highest in any other regions in the world (United Nations, 2009). *Thirdly,* approximately 24 percent of total senior citizens reside alone in the more developed regions (Europe and North America), compared to 8 percent in the less developed regions (Africa, and Asia). Within Europe, the different regions show markedly different proportions of solitary residing senior citizens, ranging from 19 percent in Southern Europe to 34 percent in Northern Europe (United Nations, 2009) which is currently the highest in the World. *Finally*, solitary residing senior citizens are more vulnerable than co-residing senior citizens. They need outside assistance in the case of illness or disability and are at greater risk of social isolation even though the systems of social security of these countries are well developed. Studies (Hermalin, et. al., 2002; Gierveld, Jenny and Tilburg,

Theo 2010; Casey, and Yamada, 2002) show that compared to those senior citizens co-residing either with a partner or in a multi-generation households, solitary residing senior citizens are more likely to be lonely and depressed, to have a small social network and to have infrequent contact with children.

The significantly high solitary residing pattern of the senior citizens in these European countries has raised the question to find out the factors explaining this pattern. There are a few studies dealing with the factors determining residing arrangement of the senior citizens but our study is different from prior works in several ways. *Firstly,* we have developed a theoretical model for explaining co-residing decision (assuming that co-residing and solitary residing are mutually exclusive events) of senior citizens which has been rarely done in earlier studies except Manacorda, and Moretti, (2006). *Secondly*, a number of studies (Michael, Fuchs and Scott 1980; Macunovich, et. al. 1995; Glick, Bean, and Van Hook, 1997) use macro-data to explain changes in household structure over time. Another group (Wolf, and Soldo, 1988; Burr, and Mutchler 1992) uses cross-sectional micro-data to explain cross-sectional variations in living arrangements; and a third (smaller) group (Mutchler, and Burr, 1991) uses panel data to study the dynamics of changes in household structure at a micro level. In this chapter, we have used cross-country aggregate (macro-level) unbalanced panel data for 16 European countries which covers all the highly developed countries in this region. The advantage of macro-level data is that it exhibits overall information about a country not a specific cluster, region or group of citizens of a country. Therefore, cross-country analysis using macro-level data predicts reliable statistics about a country while cross-country micro-level data provides limited information. The predictions using micro-level data is accurate for the cluster, region or group of people surveyed, not for the whole country especially when the sample size is relatively small compared to the whole population. Thus cross-country comparison is more authentic using macro-level panel data sets. *Thirdly,* we have included a

number of new variables in empirical analysis, for example - life-cycle pensionable wealth of senior citizens and mean income of working citizens as proxy of the income of senior and working citizens respectively; and the percentage of citizens belonging to the Christian religion as a proxy of cultural norms and values which have not been introduced in any of the previous works. *Finally,* we have conducted panel analysis which provides, empirically, the dynamics of solitary residing arrangement of the senior citizens in this region.

4.2 The Model

Usually an elderly parent (generation of senior citizen) residing with a working child (generation of working citizen) in a house is considered as co-residing behaviour of the generations while either a member of the generation of senior citizens or the generation of working citizens residing in separate house is considered as solitary residing behaviour. We have assumed that solitary residing or co-residing behaviour for a citizen is a mutually exclusive event. That means a solitary residing citizen excludes co-residing arrangement from his (her) preference and vice versa. Here we have developed a model that helps to answer the question to when a senior citizen likes to take a solitary residing decision from co-residing arrangement.

Assume that the senior citizen and the working citizen consume only two goods – material goods and housing. Housing is considered as a purely private good for both of the types of citizens when they reside in separate house. We call this as "Solitary residing situation". According to Ermisch (2003) housing is considered as a purely public good for both the senior and working citizens when they are co-residing. Instead of Ermisch's (2003) assumption, we assume co-residing creates some kind of negative externality such as congestion and loss of privacy for both the senior and working citizens; thus, we consider

housing as a semi-public good when they are co-residing. We call this as ―Co-residing situation". In both of the situations, the working citizen has wage income and the senior citizen has pension income and they spend all their income for the consumption of these two goods.

Solitary residing situation:

Let us assume that both senior and working citizens have ―Cobb-Douglas" form of utility function such as $U^j\left(X^j, h^j\right) = (X^S)^\gamma (h^S)^\delta$ and $U^j\left(X^j, h^j\right) = (X^W)^\alpha (h^W)^\beta$ where $j = S, W$ with $'S'$ standing for the senior citizens and $'W'$ standing for the working citizens, $X^j \; and \; h^j$ are material goods and housing respectively, they are substitute to each other. The utility function is continuous, concave, non-negative, and twice differentiable for all arguments. For reaching specific results we assume that all utility functions are log-linear.

The log-linear form of the utility function of senior citizens is as follows.

$$\ln U^S = \gamma \ln X^S + \delta \ln h^S \; ; \; \gamma, \delta > 0 \qquad (4.1)$$

where, $\ln U^S$ is the total utility of senior citizen who consumes X^S amount of material goods and h^S amount of housing. The budget constraint of senior citizens is as follows.

$$Y^S = P_x X^S + P_h h^S \qquad (4.2)$$

where, Y^S is income of senior citizen, $P_x X^S$ is the amount of money senior citizen wants to spend for material goods, and $P_h h^S$ is the amount spent for the consumption of housing, P_x and P_h are price of material goods and rent of housing respectively.

The log-linear utility function of the working citizen is as follows.

$$\ln U^W = \alpha \ln X^W + \beta \ln h^W \; ; \; \alpha, \beta, > 0 \qquad (4.3)$$

where, $\ln U^W$ is the total utility of working citizen who consumes X^W amount of material goods and h^W amount of housing service. The budget constraint of working citizen is given in equation (4.4).

$$Y^W = P_x X^W + P_h h^W \tag{4.4}$$

where, Y^W is the income of working citizen, $P_x X^W$ is the amount of money working citizen wants to spend for material goods, $P_h h^W$ is the amount spent for the consumption of housing, P_x and P_h are price of material goods and rent of housing respectively.

The utility maximisation problem for senior citizen is given in equation (4.5).

$$Max_{X^S, h^S, \lambda} L = \gamma \ln X^S + \delta \ln h^S + \lambda[Y^S - P_x X^S - P_h h^S] \tag{4.5}$$

The utility maximisation problem for working citizen is given in equation (4.6).

$$Max_{X^W, h^W, \lambda} L = \alpha \ln X^W + \beta \ln h^W + \lambda[Y^W - P_x X^W - P_h h^W] \tag{4.6}$$

Demand for housing in solitary residing senior citizen is:

$$h^{S*} = \frac{\delta Y^S}{(\gamma+\delta)P_h} \tag{4.7}$$

Demand for housing in solitary residing working citizen is:

$$h^{W*} = \frac{\beta Y^W}{(\alpha+\beta)P_h} \tag{4.8}$$

Total demand for housing in solitary residing situation for both citizens is:

$$H^* = \frac{\delta(\alpha+\beta)Y^S + \beta(\gamma+\delta)Y^W}{(\alpha+\beta)(\gamma+\delta)P_h} \tag{4.9}$$

The indirect utility function in solitary residing senior citizens is given in equation (4.10).

$$\ln V^S = \gamma \ln \gamma + \delta \ln \delta + (\gamma + \delta) \ln Y^S - (\gamma + \delta) \ln(\gamma + \delta) - \gamma \ln P_x - \delta \ln P_h \qquad (4.10)$$

The indirect utility function in solitary residing working citizen is given in equation (4.11).

$$\ln V^W = \alpha \ln \alpha + \beta \ln \beta + (\alpha + \beta) \ln Y^W - (\alpha + \beta) \ln(\alpha + \beta) - \alpha \ln P_x - \beta \ln P_h \qquad (4.11)$$

When housing is a purely private good and both the senior citizen and the working citizen reside in separate houses, the demand for housing is a function of individual income, rent of housing and corresponding preference parameters only. This follows the standard properties of a Marshallian demand function, such as - income effect is positive, $\frac{\delta}{(\gamma+\delta)P_h}$ and $\frac{\beta}{(\alpha+\beta)P_h}$ respectively for the senior citizen and the working citizen; the price effect is negative $\frac{\delta Y^S}{(\gamma+\delta)(P_h)^2}$ and $\frac{\beta Y^W}{(\alpha+\beta)(P_h)^2}$ respectively for the senior citizen and the working citizen.

Co-residing situation

Assume that the senior citizen and the working citizen co-reside in a house and bear the cost of housing according to their marginal utility derived from housing. Housing, in this case, is not a purely private good because each agent can exclusively enjoy some parts of house but not all parts; for example - each agent might exclusively use some bedrooms but commonly use living room, kitchen and washroom. Along with that, both agents have to bear some amount of externality effect due to congestion in housing and might lose some amount of privacy due to residing together. The externality effect is negative for them because they loss privacy and feel congested. To compare the total utility from the solitary residing situation and co-residing situation, we have to internalise the externality effect.Assume that utility of housing in co-residing situation equals the difference between the partial utility of housing from the solitary residing situation and the disutility of externality effect from co-residing situation. It might be possible that the economy of scale in housing may exist for co-

residing situation but we assume that the housing market is perfectly competitive and rent is not affected by the amount of demand for housing.

Let the utility function for both citizens be similar to the solitary residing situation except externality parameters being inserted in both agents‘ utility share of housing. Assume that parameter θ^j indicates degree of externality effect for co-residing. Also assume that the working citizen is the decision maker, and therefore, he has got more bargaining power than the senior citizen.

Let us assume that the working citizen rents a house and invites the senior citizen to co-reside in that house. The working citizen is individualistic, he (she) wants to maximize his (her) total utility and the senior citizen is also individualistic and he (she) faces externality effect from co-residing if he (she) accepts the working citizen‘s offer. The senior citizen wants to maximise total utility from co-residing that would not less than the utility of solitary residing. The working citizen is the decision maker, he (she) maximizes following utility function subject to following two constraints.

The log-linear version of the utility functions of both senior citizen and working citizen are as follows.

$$Max_{X^W, X^S, H,} \ln U^W = \alpha \ln X^W + (\beta - \theta^W) \ln H + \gamma \ln X^S + (\delta - \theta^S) \ln H \qquad (4.12)$$

Where, the utility function of senior citizen is -

$$\ln U^S = \gamma \ln X^S + (\delta - \theta^S) \ln H \; ; \; \gamma, \delta > 0 \; and \; \delta > \theta^S \qquad (4.13)$$

where, $\ln U^S$ is the total utility of senior citizen who consumes X^S amount of material goods, θ^S is the degree of externality of co-residing for senior citizen and H is the amount of housing.

The utility function of working citizen is -

$$\ln U^W = \alpha \ln X^W + (\beta - \theta^W) \ln H \; ; \; \alpha, \beta > 0 \; and \; \beta > \theta^W \tag{4.14}$$

where, $\ln U^W$ is the total utility of working citizen who consumes X^W amount of material goods, θ^W is the degree of externality of co-residing for working and H is the amount of housing.

The constraints are: (i) budget constraint and (ii) co-residing constraint of senior citizen.

The Budget constraint is

$$Y^W + Y^S = P_x(X^W + X^S) + P_h H \tag{4.15}$$

where, Y^W and Y^S are respectively the income of working citizen and senior citizen, P_x and P_h are price of material goods and rent of housing respectively.

The co-residing constraint of the senior citizen is given as follows.

$$\gamma \ln X^S + (\delta - \theta^S) \ln H \geq \ln V^S \tag{4.16}$$

where, $\ln V^S$ is the indirect utility function of the senior citizen in solitary residing situation.The co-residing constraint indicates that the total utility of senior citizen from co-residing situation must be greater than or equal to that of the solitary residing situation.

The utility maximising problem of the working citizen is become as follows.

$$Max_{X^S, X^W, H, \lambda} \ln U^W$$
$$= \alpha \ln X^W + (\beta - \theta^W) \ln H + \gamma \ln X^S + (\delta - \theta^S) \ln H + \lambda [Y^W + Y^S$$
$$- P_x(X^W + X^S) - P_h H \tag{4.17}$$

The total demand for housing is:

$$H^* = \frac{\{(\beta-\theta^W)+(\delta-\theta^S)\}(Y^W+Y^S)}{[\{\alpha+(\beta-\theta^W)\}+\{\gamma+(\delta-\theta^S)\}]P_h} \quad (4.18)$$

While the housing is a public good, the demand for housing either for the senior citizen or for the working citizen is a function of joint income of the senior citizen and the working citizen, degree of the externality effect of both the senior and the working citizen, preference parameters of both citizens and the price of housing. Therefore, a unit increase in the income of either senior citizen or working citizen increases the demand for co-residing housing of the senior citizen $\frac{\{(\beta-\theta^W)+(\delta-\theta^S)\}}{[\{\alpha+(\beta-\theta^W)\}+\{\gamma+(\delta-\theta^S)\}]P_h}$ amount and vice versa if other things remain constant. We would like to call this as *income effect* of co-residing housing demand. On the other hand, a unit increase in the degree of the externality of either senior citizen or working citizen reduces the demand for housing $\frac{(\alpha+\gamma)(Y^W+Y^S)}{[\alpha+\gamma+(\beta-\theta^W)+(\delta-\theta^S)]^2 P_h}$ amount and vice versa if other things are held constant. We would like to call this as an *externality effect* of co-residing.

Proposition 1:*(a) The change in income of either working citizen or senior citizen directly (positively) changes demand for housing when other things hold constant.*

(b)The change in externality parameter of either working citizen or senior citizen indirectly (negatively) changes demand for housing when other things remain fixed.

Proof: see mathematical appendix of chapter four.

From proposition 1 we can conclude that co-residing decision of the senior citizen and working citizen is determined by the income effect and externality effect. Income effect increases co-residing demand for housing and externality effect decreases co-residing demand

for housing. Assuming that own externality parameter is positively correlated with own income. As a result, the overall sign of co-residing demand for housing with own income is ambiguous. The demand for housing is negatively related to price (rent) of housing in all cases.

The indirect utility function of co-residing senior citizen is:

$$\begin{aligned}\ln V^{S(CoR)*} = {} & \gamma \ln \gamma + (\delta - \theta^S) \ln\{(\beta - \theta^W) + (\delta - \theta^S)\} + \{\gamma + (\delta - \theta^S)\} \ln(Y^W + Y^S) \\ & - \{\gamma + (\delta - \theta^S)\} \ln[\{\alpha + \gamma + (\beta - \theta^W) + (\delta - \theta^S)\}] - \gamma \ln P_x \\ & - (\delta - \theta^S) \ln P_h \end{aligned} \tag{4.19}$$

The indirect utility function of co-residing working citizen is:

$$\begin{aligned}\ln V^{W(CoR)*} = {} & \alpha \ln \alpha + (\beta - \theta^W) \ln\{(\beta - \theta^W) + (\delta - \theta^S)\} + \{\alpha + (\beta - \theta^W)\} \ln(Y^W + Y^S) \\ & - \{\alpha + (\beta - \theta^W)\} \ln[\{\alpha + \gamma + (\beta - \theta^W) + (\delta - \theta^S)\}] - \alpha \ln P_x \\ & - (\beta - \theta^W) \ln P_h \end{aligned} \tag{4.20}$$

Proposition 2: (a) *At the equilibrium total utility, senior citizen will be indifferent between co-residing and solitary residing with a cut-off income, which is the function of utility parameters, externality parameters of both citizens and rental price of housing. The cut-off proportion of is*

$$\frac{Y^s}{Y^W} = \frac{\left(\beta + \delta - \theta^W - \theta^S\right)^{\frac{\left(\delta - \theta^S\right)}{\left(1 - \theta^S\right)}} (P_h)^{\frac{\theta^S}{\left(1 - \theta^S\right)}}}{\left(\delta^{\frac{\delta}{(1 - \theta^S)}}\right)\left(2 - \theta^W - \theta^S\right)\left(Y^S\right)^{\theta^S - 1} - \left(\beta + \delta - \theta^W - \theta^S\right)^{\frac{\left(\delta - \theta^S\right)}{\left(1 - \theta^S\right)}} (P_h)^{\frac{\theta^S}{\left(1 - \theta^S\right)}}} \tag{4.21}$$

(b) At the equilibrium total utility, working citizen will be indifferent between co-residing and solitary residing with a cut-off income, which is the function of utility parameters, externality parameters of both citizens and rental price of housing. The cut-off proportion of is

$$\frac{Y^W}{Y^S} = \frac{\left(\beta+\delta-\theta^W-\theta^S\right)^{\frac{\left(\beta-\theta^W\right)}{\left(1-\theta^W\right)}}(P_h)^{\frac{\theta^W}{\left(1-\theta^W\right)}}}{\beta^{\frac{\beta}{\left(1-\theta^W\right)}}\left(2-\theta^W-\theta^S\right)(Y^W)^{\theta^W-1}-\left(\beta+\delta-\theta^W-\theta^S\right)^{\frac{\left(\beta-\theta^W\right)}{\left(1-\theta^W\right)}}(P_h)^{\frac{\theta^W}{\left(1-\theta^W\right)}}} \quad (4.22)$$

Proof: see mathematical appendix of chapter four.

Although we cannot definitely say about the impact of an increase in the income of senior citizens on decision of co-residing housing demand.If we assume that $\alpha = \gamma, \beta = \delta \; and \; (\alpha+\beta) = (\gamma+\delta) = 1,$ then we can say an increase in income of senior citizen from the cut-off level income increases total utility form co-residing and vice versa. *We, therefore, investigate that an increase in the life- cycle pension income of senior citizen decreases solitary residing decision.* We are going to test this proposition empirically along with other relevant factors.

4.3 Empirical Analysis

4.3.1 The Empirical Model

The empirical findings of earlier literature provide ambiguous decisions about the determinants of solitary residing behaviour of senior citizens in the European countries and other parts of the world. Many studies have attempted to find the answer to this question using several hypotheses: studies using data for the United States (Michael, Fuchs and Scott, 1980; Wolf and Soldo, 1988; Soldo, Wolf and Agree, 1990; Wolf, 1990; Kotlikoff and Morris, 1990; Ruggles, 1994, 1988; Kramarow, 1995) find that the income of senior citizens,especially women have a strong positive correlation with the solitary residing pattern. While Pampel (1992) using 13 European cross-national data shows that the effects of variables that are utilised as proxies for income are in the expected direction, but they are trivial in magnitudes. However, Kramarow (1995) also finds that proxies for an income

account for a fraction of all changes during the twentieth century, although the income variable does not behave as expected. That means, although the income of senior citizens has an important role in determining their residing pattern, studies have not provided concrete support about the magnitude and sign of this hypothesis.

The model, we have developed, has found that solitary residing decision depends not only on the income of senior citizens but also on the income of working citizens. Moreover, privacy or congestion parameters and preference parameters are also significant factors. Since privacy, congestion and preference are subjective issues and we do not have data on these variables, we have assumed these are unobserved heterogeneity and fixed over time to time and country to country. We also know that the senior citizens are usually retired from works and maintain their livelihood from the pension income. We, therefore, have used life-cycle pensionable wealth *(LPWS)* of male and female senior citizens as a proxy of income of senior citizens which is not considered as proxy of income in earlier literature. We believe that life-cycle pensionable wealth is a more appropriate proxy of the income of senior citizen. Since the senior citizens are retired from work, they can accurately calculate their life-cycle pension allowance and life expectancy after retirement and be able to estimate the life-cycle wealth from the pension. We also assume that senior citizens spend all their wealth smoothly for everyday consumption till death and do not keep anything for the bequest. In such a situation, life-cycle pensionable wealth of senior citizens is the best proxy for measuring their income.

Since the income of working citizens is also an important factor, derived in the model, for making residing decision of the senior citizens, we have used mean realincome of working citizens *(MRIW)* as an explanatory variable in our empirical model.

The model shows that rent of housing is another important determinant of residing decision for the senior citizens. An increase in rent decreases housing demand if other things remain constant; as a result, the solitary residing tendency of the senior citizens decreases and

vice versa. The data on rent of a housing service are hardly available for the sample countries and these are too sporadic for different points of time for every country used in this study. We have used an inflation rate *(CPI)* as a proxy of housing price in our empirical model.

Some studies (Mutchler 1992; Ruggles, 1994) find that ‗older old' non-married people are significantly more likely to live alone than their ‗younger old' counterparts. The hypothesis is not uniquely appropriate for both male and female senior citizens[15]. Therefore, age or life expectancy after retirement of senior citizens *(LIFE)* is considered as another determining factor of solitary residing decision in the empirical model.

Gender differences between female and male (female minus male) plays a significant role. The ―Pearson correlation coefficient" between the percentage of solitary residing senior citizens and the size of the gender difference between female and male is 0.70 (United Nations, 2005). One of the reasons of the solitary residing female senior citizens being more in number is their longer widowhood compared to their male counterpart. This implies that the gender of senior citizens affects residing pattern. That is why we have estimated two separate models for male and female senior citizens.

In developed countries, the level of education of the senior people plays a significant position in determining the resident pattern. Pampel (1992) finds that having higher level of education among the senior citizens indicates less likelihood of co-residing with working citizen. We have used average years of schooling of the senior male *(MAYS)* and female *(FAYS)* citizens as an explanatory variable in this study.

Labour force participation of the working generation is considered as another important determinant of solitary residing behaviour of the senior citizen. Children typically move out of the parental home as they complete study, enter into the job market, and also find

[15] Female senior citizens are more likely to reside alone than their counterpart male.
See detail Gaymu J. et.al. (2006).

their partner leaving their parents alone (United Nations, 2005). We have included labour force participation rates of male and female working citizens *(LFP)* as an explanatory variable.

The proportions of solitary residing senior citizens are much higher in northern than in southern and eastern Europe. These differences are caused because of the survival of ancestral family systems in the southern European region characterised by strong family links (Gaymu and Springer, 2010; Reher, 1998). The typical culture of many developed countries is that woman in the family such as wives look after ailing or disabled husbands and adult daughter or in lesser extent daughter-in-law takes care of the widowed senior citizens (Shanas, 1979; Kulys, and Tobin, 1980). We believe that religious culture has a significant influence on overall culture (such as determining residing arrangement of family members, developing social norms and values of a person etc.) of a personin a society. The percentage of people belonging Christian religion is significantly different among sample countries. The average number of the percentage of Christian believers in sample countries is 87.80 percent with a standard deviation is 7.88 in 1970 and in 2000 the statistics are 79.64 percent and 11.03 respectively. In 1970 the number of the highest percentage of Christian believers is 97.7percent in Norway and the lowest number is 73.7 percent in Sweden.In 2000 the maximum number of percentage of population belonging Christian religion is 92.7 percent in Poland and the minimum number is 61.5 percent in the Netherland and the United Kingdom. These statistics indicate that there is significant difference in religious culture and also it is changing significantly over the time among sample countries. Since family tradition, norms and values of citizens also influence solitary residing behaviour and the majority of the population residing in the sample countries are belonging to a Christian religious belief, we have included the percentage of the population belonging to the Christian religion *(CHR)* in our empirical model as a proxy of culture, norms and values.

Usually economic theory does not provide a very precise guideline about specifying linear versus log linear functional form for regression analysis (Godfrey and Wickens, 1981). However, the choice of functional form has important implications for statistical tests, for forecast and for policy analysis (Hall, 1978). In this chapter, we have used Sargan[16] (1964) criterion because of computational simplicity and for getting clear cut decision (Godfrey and Wickens, 1981) and for choosing one functional form. Sargan (1964) criterion suggests that the linear model is appropriate rather than log-linear model for the data set. Subsequently, we employ the following linear models.

The empirical model for male senior citizens:

$$PMSRA_{it} = \alpha_0 + \alpha_1 LPWM_{it} + \alpha_2 MRIW_{it} + \alpha_3 CPI_{it} + \alpha_4 MLIFE_{it} + \alpha_5 MAYS_{it} + \alpha_6 MLFP_{it} + \alpha_7 CHR_{it} + \varepsilon_{it}[i = 1,..16 \; and \;\; t = 1st \; and \; 2nd] \quad (4.26)$$

The empirical model for female senior citizens:

$$PFSRA_{it} = \alpha_0 + \alpha_1 LPWF_{it} + \alpha_2 MRIW_{it} + \alpha_3 CPI_{it} + \alpha_4 FLIFE_{it} + \alpha_5 FAYS_{it} + \alpha_6 FLFP_{it} + \alpha_7 CHR_{it} + \varepsilon_{it}[i = 1,..16 \; and \;\; t = 1st \; and \; 2nd] \quad (4.27)$$

where, $PMSRA$ and $PFSRA$ are percentage of male and female senior citizens residing alone respectively. $LPWM$ and $LPWF$ are life cycle pensionable wealth of male and female senior citizens respectively. $MRIW$ is the meanreal income of working citizens, CPI is the inflation rate, $MLIFE$ and $FLIFE$ are life expectancy after retirement of male and female senior citizens respectively. $MAYS$ and $FAYS$ denote average years of schooling of male and female senior citizens according to order. $MLFP$ and $FLFP$ are respectively labour force

[16] Sargan (1964) criterion is discussed briefly in the empirical appendix of previous chapter. We have provided the estimated results with current data sets in Table 4.1 in the empirical appendix of this chapter.

participation rate of male and female working citizen, and CHR is the percentage of the Christian population. $\varepsilon \sim (0, \sigma^2)$ is a disturbance term assumed to be distributed normally with zero mean and constant variance across the countries.

4.3.2 Estimation method

Though the panel analysis conducted here has only two points of time in data sets, the study obviously gives insights into the area of residing arrangements literature. There are several attractive features of panel analysis if one has the panel data set. *Firstly,* panel data analysis is very helpful to deal with the heterogeneity in the micro unit, in our case it is individual country. The heterogeneity means that all these countries are different from one another in a fundamental unmeasured way. Therefore, using cross-section analysis, one cannot include all the relevant variables which are appropriate for each country. As a result, cross-section analysis might produce biased results. This is where panel data analysis helps to correct this problem. *Secondly*, it uses more variability by combining variation across the country and over time which helps to alleviate the multicollinearity problem. *Thirdly*, it can address the turnover question because the data track a common sample of country over different years. *Finally*, panel data analysis helps to get a dynamic adjustment which cross-section data analysis cannot do.

We have employed the ‗general-to-specific' modelling technique by sequentially eliminating the most insignificant variables from the general model.

We also have utilized the Hausman (1978) test[17] criterion for model selection between random effects and fixed effects models. Estimated results suggest that random effects are appropriate for the general model of male senior citizens and fixed effects model is preferable

[17]Since we briefly explain Hausman (1978) test procedure in empirical appendix of previous chapter, we just report Hausman test results.

for the general model of female senior citizens but only random effects models are appropriate for the specific models for both male and female senior citizens.

We use the fixed effects and random effects models for (i) male senior citizens and (ii) female senior citizens separately but report the appropriate one. The study uses unbalanced panel data of 16 European countries and 2 time periods. Thus our number of observations is 32.

4.3.3 Data

The sample consists of 16 European countries that are members of the Organisation of Economic Cooperation and Development (OECD). Among these 16 countries - Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom are the original signatory members of the OECD convention held in December 1960. Finland has joined in the year 1969 while Hungary and Poland have joined in the year 1996. In the year 2010, per capita GDP measured in US$ constant purchasing power parity (PPP) of these countries range between 16958 (Hungary) and 46908 (Norway); in the year 2007, life expectancy at birth of these countries lies between 73.3 years (Hungary) and 81.9 years (Switzerland); in the year 2009 fertility rate per woman aged 15 years to 49 years, lies between 1.3 (Hungary, Spain) and 2.0 (France, Norway); in the year 2009, the percentage of population aged 65 years and over lies between 13.5 (Poland) and 20.8 (Germany); in the year 2009, the population growth rate of these countries lies between -0.6 (United Kingdom) and 1.3 (Norway, Switzerland)[18]. All these countries are ranked ―very high human development" countries according to the Human Development Index (HDI) Report 2009 except Hungary and Poland which are ranked as ―high human development" countries. All of these countries have 70 percent and above of the

[18] See Table 4.2 in empirical appendix of chapter four

total population believing in Christian religion. We, therefore, can say that these countries are economically, demographically, socially, and culturally nearly similar.

In this study, the observations of dependent variable and independent variables are directly related to the senior citizens during the time periods and all these data sets are gender specific aggregate (macro-level) data except the income of working citizens, which is not gender specific though macro-level data. We include the income of working citizens in this study because the theoretical model developed in this study suggests that senior citizens may or may not co-reside with working citizens depending on the income of both the senior citizen and the working citizen and the price of housing services. In this study, we have developed a theoretical model based on the micro behavior of senior citizen and working citizen but the empirical analysis is based on macro level data sets. One might raise the question- how does the micro model link with aggregate (macro level) data set in empirical analysis? We know an aggregate observation is the summation of all individual observations, for example- income approach is one way of measuring gross domestic product (GDP) where all factors‘ income are added up, and wage income contributes more than 50 percent of GDP in any country. The consumer price index (CPI) is the percentage change in the weighted average of prices of all consumer goods in a household consumption bundle between the base year and current years. The weight is given according to the amount spent on consumption of goods in the consumption bundle. So each product‘s price matters in calculating consumer price index. Therefore, we can say macro level data is the reflection of micro-data and vice versa. Moreover, in case of cross-country analysis, there are many literatures where macro-level data are used instead of using micro-level data (Bongaarts and Zimmer 2001; Department of Economic and Social Affairs, Population Division, United Nations 2005).

The detail explanation of definition of each variable, source of data is provided in Data Appendix of the Chapter Four.

4.4 Results and Discussions

4.4.1 Descriptive analysis

Before we go to rigorous empirical results, we would like to start with descriptive analysis of both the waves of data sets for getting socio-economic status of this region during the two waves of time. Tables 4.3a, 4.3b, 4.3c and 4.3d (in empirical appendix), show that in the 1st wave of data set, on average 13.14 percent male and 35.76 percent female senior citizens are residing alone; while in the 2nd wave of data set, the percentages are respectively 15.26 percent and 38.95 percent. The statistics indicate that female seniors are more likely to reside alone than their male counterpart. The difference is remarkable because more than double female senior citizens are residing alone than the male in both the waves of data sets. Another important feature is that solitary residing trends are rising over the time for both male and female senior citizens. The growth rate of solitary residing senior citizens is 16.13 percentof the male and 8.92 percent for the female. Therefore, we can say that solitary residing male senior citizens are growing faster than that of their female counterparts.

We can infer that the average of life-cycle pension wealth of male and female senior citizens are respectively US$ 230678 and US$ 268333 in the 1st wave and US$ 197619 and US$ 228744.4 in the 2nd wave. Both the waves of data sets indicate that life-cycle pension wealth of male senior citizens is lower than that of the female. One of the reasons is that life expectancy after retirement for females is higher than that of the male resulting in life-cycle pension wealth being bigger in amount for female than for male. Another feature of the pension wealth is that it is declining both for the male and female senior citizens during the two waves. The reason for this type of negative growth in pension wealth might be due to the rise in the retirement age for both male and female citizens in most of these countries.

Statistics show that the real income of senior citizens declines during the time period. As a result, life-cycle pension wealth also declines for both the male and female senior citizens during this time period.

The average of mean real income of working citizens in these countries during the 1st wave and the 2nd wave of data sets are respectively US$ 55427 and US$ 24893.14. We can infer that the average income of working citizens is declining during these two waves. The negative growth rate of the mean real income of working citizens is more than 55 percent during this period and on an average 5.5 percent per year. Although this value of negative growth rate in real income of working citizens is not applicable equally to each individual country, we conclude that there is a huge downfall of average income of working citizens in this region during these two waves of the time period.

The mean values of inflation rates *(CPI)* in the 1st wave of data set and the 2nd wave of data set is respectively 45.18 and 68.41. We can say that the average rate of inflation during this time period (between the 1st wave and the 2nd wave) is 51.42 percent and on an average 5.14 percent per year. If we combine the average negative growth rate of the mean real income of senior citizens and the inflation rate, we can say that the real purchasing power of senior citizens has decreased during this time period.

The average values of the life expectancy after retirement for male and female senior citizens in the 1st wave of data set are 14.27 years and 20 years respectively, while in the 2nd wave of data set these values are respectively 15.66 years and 21.21 years. We can say that the growth rates of life expectancy after retirement are 9.74 percent and 6.05percent for both male and female senior citizens respectively. Since life expectancy after retirement increases and life-cycle pension wealth decreases, both male and female senior citizens become poorer during the time period.

The average years of schooling of male and female senior citizens in the 1st wave of data set are 7.168 years and 6.321 years respectively, while in the 2nd wave of data set these values are respectively 7.951 years and 6.86 years. On average the male senior citizens have higher educational qualifications than their counterpart and the average length of attending school has increased during the two waves for both male and female senior citizens.

The average values of the percentage of the population believing in the Christian religion in the 1st wave of data set (in the year 1970) and the 2nd wave of data set (in the year 2000) are respectively 87.80 percent and 79.64 percent. These indicate that believers are declining during the time period.

4.4.2 Results of Panel Estimations

The Hausman (1978) test suggests that the random effect model is preferred for male senior citizens and fixed effects model is preferred for female senior citizens in the general model(which includes all explanatory variables). We, therefore, report the estimated results of the general model. The estimation results of the general model are given in Table 4.4. From the Table 4.4, we see that for the male senior citizens, mean real income of working citizens *(MRIW)* is highly significant at less than 1 percent level with a negative sign of the estimated coefficient and the percentage of people belonging to the Christian religion *(CHR)* is significant at less than 5 percent level with a negative sign of the estimated coefficient. On the other hand, for the female senior citizens, life-cycle pensionable wealth (*LPWF),* life expectancy after retirement *(FLIFE)* and the percentage of people belonging to the Christian religion *(CHR)* are significant at less than 5 percent level with a negative sign of the estimated coefficients.

For the male senior citizens, solitary residing decision is affected significantly by the income of working citizens rather than his life-cycle pensionable wealth but for the female

senior citizens, the case is reversed. The sign of life-cycle pensionable wealth variable is negative for both male and female senior citizens. In case of the female senior citizens, it is significant although the magnitude is very trivial. The negative sign of the variable indicates that as life-cycle pensionable wealth of senior citizens increases, the percentage of solitary residing decreases which is contrary to the findings of Soldo, Wolf and Agree, 1990; Kotlikoff and Morris, 1990; Pamoel 1992 that the higher the income, the higher the percentage of solitary residing people. Despite the finding in our estimation opposes several earlier results, it is not irrational and unusual since Kramarow (1995) also found a negative relationship between income and solitary residing decision. One intuitive explanation of this relationship is that a wealthy female senior person can afford more easily to hire supporting people to co-reside with her than a less wealthy person. In this situation, the first choice of co-residing supporting person for the female senior citizens is the single working daughter or son or some relative and if senior citizens fail to get a relative to support them, the second choice is to hire support from the market. Another intuitive explanation of this negative relationship with solitary residing and life-cycle pension wealth is that senior citizens, who usually need assistance in maintaining their regular livelihood, have a strong preference for co-residency which mitigates their preference for buying privacy via residing alone. On the other hand, when a working person finds that his (her) wealthy parents are looking for helping people from the market, the working son (daughter) takes the opportunity to earn some financial benefit. Moreover, there are always some forms of altruistic exchange occurring between senior citizen and working citizen which is difficult to measure empirically (we are not trying to investigate this altruism in this chapter).

The coefficient of mean real income of the working citizen has got a negative sign for both male and female senior citizens although it is statistically significant in the case of males only. That means an increase in the mean income of working citizens lowers the percentage of

solitary residing senior citizens. We can give two types of interpretations of this result. One is that, as the income of working citizens‘ increases, they can afford more responsibility of senior citizens and co-reside with them. Another interpretation is that,when working citizens are spending more time for outside activities to earn more, they need some helping hands to look after their children and household activities. In any case, parents or relatives are the best option for co-residing.

The coefficient of life expectancy after retirement has been found to be significant with a negative signin the case of female senior citizens. The magnitude is 0.849 which implies that one year increase in life expectancy after retirement age of the female senior citizens lowers 0.849 percent probability of solitary residing. The finding is similar to the earlier studies that the ―older old" citizens are more likely to co-reside. For the male senior citizens, the life expectancy after retirement is found to be insignificant and has positive sign.

The coefficient of the percentage of people belonging to the Christian religion is found to be significant with negative sign for both male and female senior citizens. The negative sign indicates that with an increase in religious belief, the likelihood of solitary residing tendency decreases. This is an aggregate variable which is used as proxy of culture, social norms and values. The magnitudes of coefficients for the male and female senior citizens are respectively 0.143 and 0.321. These magnitudes imply that the probability of decreasing solitary residing attitude of female senior citizens is more than double than that of their male counterparts because of culture. The result is very much rational that female senior citizens of these countries are more influenced by religious belief in residing decision than their male counterpart.

Table 4.4: General Linear Random Effects model and corresponding Fixed Effects model for male and female

	Male Random Effects Model (PMSRA)	**Male Random Effects Model (PMSRA)**	**Female Fixed Effects Model (PFSRA)**	**Female Fixed Effects Model (PFSRA)**
LPWM	-5.9E-06	**-2.3E-06**		
(S.E)	(4.2E-06)	**(4.3E-06)**		
LPWF			-0.00016**	-4.9E-06
(S.E)			(7.2E-06)	(8.2E06)
MRIW	-0.0000143***	-0.000015***	-8.7E-06	-0.000011
(S.E)	(3.9E-06)	(4.66E-06)	(5.6E-06)	(7.4E06)
CPI	-0.019	0.024	-0.025	0.091
(S.E)	(0.031)	(0.027)	(0.071)	(0.078)
MLIFE	9.8E-06	4.6E-06		
(S.E)	(0.00005)	(0.000047)		
FLIFE			-0.849**	-0.71*
(S.E)			(0.284)	(0.37)
MAYS	0.436	0.649		
(S.E)	(0.46)	(0.516)		
FAYS			0.656	-0.052
(S.E)			(0.994)	(1.28)
MLFP	-0.122	-0.102		
(S.E)	(0.13)	(0.144)		
FLFP			0.123	0.128
(S.E)			(0.098)	(0.98)
CHR	-0.143**		-0.321**	
(S.E)	(0.071)		(0.109)	
Const.	36.41**	17.94	75.197***	40.57***
(S.E)	(14.66)	(14.43)	(14.11)	(10.25)
Obs.=	32	32	32	32
Grs.=	16	16	16	16
R-sq:				
w.	0.797	0.73	0.858	0.72
b.	0.11	0.09	0.468	0.39
o.	0.155	0.14	0.484	0.40
	Wald χ^2 (6) = 50.13***	Wald χ^2 (6) =32.04***	F-Stat. 7.77***	F-Stat. 4.33**
Hausman Test	χ^2 (5) = 7.92 $Prob > \chi^2$ =0.161 Random Effects Supported	χ^2 (4) = 4.19 $Prob > \chi^2$ =0.382 Random Effects Supported	χ^2 (5) = 18.79 $Prob > \chi^2$ =0.0019 Fixed Effects Supported	χ^2 (4) = 17.58 $Prob > \chi^2$ =0.0015 Fixed Effects Supported

(In the parentheses, standard error of the coefficient is given. * indicates that the variable is significant at 10percent error level or below. ** indicates that the variable is significant at 5 per cent error level or below and ***indicates that the variable is significant at below 1percent error level.)

To check the robustness of this variable, we have dropped the variable from boththe general models of male and female senior citizens and reported the results in Table 4.4. Incase of male senior citizens‘ model, when we have dropped the *CHR* variable, coefficient of mean real income of working citizens *(RMIW)* variable is remain significant but the overall R^2– value of the random effects model reduces 6 percent as well as the coefficient of intercept term becomes insignificant. Similarly, in case of female senior citizens‘ model, the dropping of *CHR* variable makes the coefficient of life-cycle pensionable weath *(LPWF)* variable insignificant and reduces the significance of the coefficient of life expectancy after retirement *(FLIFE)* variable. The overall R^2 – value of the estimated model is also reduced more than 8 percent after dropping the *CHR* variable. We therefore believe that religious culture has significant impact on solitary residing arrangement of senior citizens in developed European countries.

The inflation rate variable is found to be insignificant for both the male and female senior citizens but has expected negative sign. As rent increases, the solitary residing tendency decreases among senior citizens and vice versa which is supported by the theoretical model. The insignificant result of this variable might have issued from using a weak proxy of the rental price of housing services.

The variable, average year of schooling of senior citizens *(MAYS and FAYS)* is found to be insignificant for both male and female senior citizens with a positive sign. The sign is as expected and found in earlier research.

The variable, labour force participation rate *(MLFP and FLFP)* is found to be insignificant for both male and female cases but has a negative sign for male senior citizens and a positive sign for female senior citizens. With an increase in the labour market participation of the male working citizens, they might like to co-reside with senior citizens so that senior citizens can look after household activities. On the other hand, the positive sign of

the variable indicates that with an increase in the labour market participation of female working citizens, the solitary residing attitude of female senior citizens increases. There is a possibility that the working female citizens might develop an attitude to reside independently which may continue when they become older.

The Wald - χ^2 values for random effects model for male senior citizen is 50.13 which is highly significant and the overall R^2 value is 0.155. On the other hand, F-statistic for fixed effects model for female senior citizen is 7.77 which is highly significant and the overall R^2 value is 0.484.

Sequentially deleting the most insignificant variable from the general model, we have found the specific model for both male and female senior citizens. After choosing a specific random effects model for the male and a specific fixed effects model for the female, we have conducted the Hausman (1978) test again for the specific models. Now Hausman (1978) tests support only the random effects models for both the male and female senior citizens. Both specific models do not change the significance of variables remarkably except the life-cycle pensionable wealth of the male senior citizen being negatively significant at 10 percent level. This new finding enhances the importance of the variable in determining the solitary residing pattern of senior citizens in the European region. We can now more confidently say that the life-cycle pensionable wealth of senior citizens negatively affects solitary residing behaviour of senior citizens in this region. We report the results of specific models in Table 4.5 in the empirical appendix of chapter four.

4.5 Conclusions

The fundamental objective of this study is to find out the most reliable factors affecting solitary residing patterns of senior citizens of European countries. We develop a theoretical model including the congestion problem of co-residing that explains the co-residing behaviour of senior citizens and also determines when a senior citizen wants to reside alone. We have found from the theoretical model that a relative increase of senior citizen‘s income to working citizen‘s income encourages a senior citizen to co-reside with working citizen for gaining more consumer surplus from co-residing.

We have considered an empirical model including life-cycle pensionable wealth of senior citizens, mean real income of working citizens, inflation rates, life expectancy after retirement of senior citizens, average years of schooling of senior citizens, labour force participation rates of working citizens, and religious belief variables. Using gender specific, macro-level panel data set of two time periods, we have conducted random effects and fixed effects model estimation techniques.

From the estimated results, we have found that life-cycle pension wealth of senior citizens is significantly and negatively related tothe solitary residing decision of senior citizens although the magnitude is very minor. One intuitive explanation of this negative relationship between solitary residing attitude and life-cycle pension wealth is that the senior citizen who usually needs assistance in maintaining their regular livelihood, have a strong preference for co-residency, which mitigates their preference for buying privacy via residing alone. Another intuitive explanation of the negative relationship between solitary residing attitude and pensionable wealth is that a wealthy female senior person can afford more easily to hire supporting people to co-reside with her than a less wealthy person. Religious belief in Christianity is also significantly and negatively related tothe solitary residing pattern of senior

citizens which is complementary with prior studies of cultural traits. The mean real income of working citizens significantly and negatively affect solitary residing patterns of the male senior citizens although the magnitude of coefficient is very trivial. The intuition of this relation of the factor says that increasing working citizens‘ income leads an increase in the responsibility of working citizens towards senior citizens and therefore, solitary residing pattern of senior citizens decreases. Life expectancy after retirement is also a significant variable of female senior citizens in making solitary residing decision.

Having only two time points in our data set is the main limitation of the study but our empirical results are very much rational and logical that bear significant guideline for further research and policy makers.

Appendices: Chapter Four

Mathematical Appendix

Proposition 1: (a)

$$\frac{\partial H^*}{\partial Y^W} = \frac{\partial}{\partial Y^W}\left[\frac{\{(\beta - \theta^W) + (\delta - \theta^S)\}(Y^W + Y^S)}{[\{\alpha + (\beta - \theta^W)\} + \{\gamma + (\delta - \theta^S)\}]P_h}\right]$$

$$= \frac{\{(\beta - \theta^W) + (\delta - \theta^S)\}}{[\{\alpha + (\beta - \theta^W)\} + \{\gamma + (\delta - \theta^S)\}]P_h} = \frac{\partial H^*}{\partial Y^S} \blacksquare$$

(b)

$$\frac{\partial H^*}{\partial \theta^W} = \frac{\partial}{\partial \theta^W}\left[\frac{\{(\beta - \theta^W) + (\delta - \theta^S)\}(Y^W + Y^S)}{[\{\alpha + (\beta - \theta^W)\} + \{\gamma + (\delta - \theta^S)\}]P_h}\right]$$

$$= \frac{-(\alpha + \gamma)(Y^W + Y^S)}{[\{\alpha + (\beta - \theta^W)\} + \{\gamma + (\delta - \theta^S)\}]^2 P_h} \blacksquare$$

Proposition 2 (a):

Proof: When senior citizen is indifferent between co-residing and residing apart, then the difference between equilibrium total utility from co-residing and residing apart for senior citizen is equal to zero. Thus,

$$\ln V^{S(CoR)*} - \ln V^S = 0$$

$$\ln V^{S(CoR)*} - \ln V^S$$

$$= \gamma \ln \gamma + (\delta - \theta^S) \ln\{(\beta - \theta^W) + (\delta - \theta^S)\} + \{\gamma + (\delta - \theta^S)\} \ln(Y^W + Y^S)$$

$$- \{\gamma + (\delta - \theta^S)\} \ln[\{\alpha + \gamma + (\beta - \theta^W) + (\delta - \theta^S)\}] - \gamma \ln P_x$$

$$- (\delta - \theta^S) \ln P_h - \gamma \ln \gamma - \delta \ln \delta - (\gamma + \delta) \ln Y^S + \gamma \ln P_x + \delta \ln P_h + (\gamma$$

$$+ \delta) \ln (\gamma + \delta)$$

$$\Rightarrow \ln\left[\frac{Y^{S(cor)}}{Y^S}\right] = (\delta-\theta^S)\ln\{(\beta-\theta^W)+(\delta-\theta^S)\} - \delta\ln\delta + \{\gamma+(\delta-\theta^S)\}\ln(Y^W+Y^S) - (\gamma+\delta)\ln Y^S - \{\gamma+(\delta-\theta^S)\}\ln[\{\alpha+\gamma+(\beta-\theta^W)+(\delta-\theta^S)\}] + (\gamma+\delta)\ln\{\gamma+\delta - (\delta-\theta^S)\ln P_h + \delta\ln P_h$$

$$\Rightarrow (Y^S+Y^W)$$

$$= \left[\left(\frac{(\alpha+\gamma+\beta-\theta^W+\delta-\theta^S)^{(\gamma+\delta-\theta^S)}}{(\beta-\theta^W+\delta-\theta^S)^{(\delta-\theta^S)}}\right)\left(\frac{\delta^\delta}{(\gamma+\delta)^{(\gamma+\delta)}}\right)\left(\frac{(P_h)^{(\delta-\theta^S)}}{(P_h)^\delta}\right)\right]^{\frac{1}{(\gamma+\delta-\theta^S)}} (Y^S)^{\frac{(\gamma+\delta)}{\{\gamma+(\delta-\theta^S)\}}}$$

If we assume that $\alpha=\gamma;\ \beta=\delta;\ \alpha+\beta=\gamma+\delta=1;\ \beta>\theta^W\ and\ \delta>\theta^S$

$$\Rightarrow (Y^S+Y^W) = \left[\left(\frac{(2-\theta^W-\theta^S)^{(1-\theta^S)}}{(\beta+\delta-\theta^W-\theta^S)^{(\delta-\theta^S)}}\right)(\delta^\delta)\left(\frac{1}{(P_h)^{\theta^S}}\right)\right]^{\frac{1}{(1-\theta^S)}} (Y^S)^{\frac{1}{\{1-\theta^S\}}}$$

$$\Rightarrow \left[\left(\frac{(2-\theta^W-\theta^S)^{(1-\theta^S)}}{(\beta+\delta-\theta^W-\theta^S)^{(\delta-\theta^S)}}\right)(\delta^\delta)\left(\frac{1}{(P_h)^{\theta^S}}\right)\right]^{\frac{1}{(1-\theta^S)}} (Y^S)^{\theta^S} - Y^S = Y^W$$

$$\Rightarrow \left[\left(\frac{\left(\delta^{\frac{\delta}{(1-\theta^S)}}\right)(2-\theta^W-\theta^S)}{(\beta+\delta-\theta^W-\theta^S)^{\frac{(\delta-\theta^S)}{(1-\theta^S)}}}\right)\left(\frac{1}{(P_h)^{\frac{\theta^S}{(1-\theta^S)}}}\right)\left\{(Y^S)^{\theta^S-1}\right\}-1\right]Y^S = Y^W$$

$$\frac{Y^S}{Y^W} = \frac{(\beta+\delta-\theta^W-\theta^S)^{\frac{(\delta-\theta^S)}{(1-\theta^S)}}(P_h)^{\frac{\theta^S}{(1-\theta^S)}}}{\left(\delta^{\frac{\delta}{(1-\theta^S)}}\right)(2-\theta^W-\theta^S)(Y^S)^{\theta^S-1} - (\beta+\delta-\theta^W-\theta^S)^{\frac{(\delta-\theta^S)}{(1-\theta^S)}}(P_h)^{\frac{\theta^S}{(1-\theta^S)}}}$$

The ratio is positive iff

$$\left(\delta^{\frac{\delta}{(1-\theta^S)}}\right)(2-\theta^W-\theta^S)(Y^S)^{\theta^S-1} > (\beta+\delta-\theta^W-\theta^S)^{\frac{(\delta-\theta^S)}{(1-\theta^S)}}(P_h)^{\frac{\theta^S}{(1-\theta^S)}}\blacksquare$$

Proposition 2 (b):

When working citizen is indifferent between co-residing and residing apart, then the difference between equilibrium total utility from co-residing and residing apart for working citizen is equal to zero. Thus,

$$\ln V^{W(CoR)*} - \ln V^{W} = 0$$

$$\Rightarrow \ln V^{W(CoR)*} - \ln V^{W}$$

$$= \alpha \ln \alpha + \left(\beta - \theta^{W}\right) \ln\{\left(\beta - \theta^{W}\right) + \left(\delta - \theta^{S}\right)\} + \left\{\alpha + \left(\beta - \theta^{W}\right)\right\} \ln\left(Y^{W} + Y^{S}\right)$$

$$- \left\{\alpha + \left(\beta - \theta^{W}\right)\right\} \ln\left[\left\{\alpha + \gamma + \left(\beta - \theta^{W}\right) + \left(\delta - \theta^{S}\right)\right\}\right] - \alpha \ln P_x$$

$$- \left(\beta - \theta^{W}\right) \ln P_h - \alpha \ln \alpha - \beta \ln \beta - (\alpha + \beta) \ln Y^{W} + \alpha \ln P_x + \beta \ln P_h$$

$$+ (\alpha + \beta) \ln(\alpha + \beta)$$

$$\Rightarrow (Y^{S} + Y^{W})$$

$$= \left[\left(\frac{(\alpha + \gamma + \beta - \theta^{W} + \delta - \theta^{S})}{(\alpha + \beta)^{(\alpha+\beta)}}\right)^{(\alpha+\beta-\theta^{W})} \left(\frac{\beta^{\beta}}{(\beta - \theta^{W} + \delta - \theta^{S})^{(\beta-\theta^{W})}}\right) \left(\frac{1}{(P_h)^{\theta^{W}}}\right)\right]^{\frac{1}{(\alpha+\beta-\theta^{W})}} (Y^{W})^{\frac{(\alpha+\beta)}{(\alpha+\beta-\theta^{W})}}$$

If we assume that $\alpha = \gamma;\ \beta = \delta;\ \alpha + \beta = \gamma + \delta = 1;\ \beta > \theta^{W}\ and\ \delta > \theta^{S}$

$$\Rightarrow (Y^{S} + Y^{W}) = (2 - \theta^{W} - \theta^{S}) \left(\frac{\beta^{\beta}}{(\beta + \delta - \theta^{W} - \theta^{S})^{(\beta-\theta^{W})}}\right)^{\frac{1}{(1-\theta^{W})}} \left(\frac{1}{(P_h)^{\frac{\theta^{W}}{(1-\theta^{W})}}}\right) (Y^{W})^{\frac{1}{(1-\theta^{W})}}$$

$$\Rightarrow (2 - \theta^{W} - \theta^{S}) \left(\frac{\beta^{\beta}}{(\beta + \delta - \theta^{W} - \theta^{S})^{(\beta-\theta^{W})}}\right)^{\frac{1}{(1-\theta^{W})}} \left(\frac{1}{(P_h)^{\frac{\theta^{W}}{(1-\theta^{W})}}}\right) (Y^{W})^{\frac{1}{(1-\theta^{W})}} - Y^{W} = Y^{S}$$

$$\Rightarrow \left[\left(\frac{\beta^{\frac{\beta}{(1-\theta^{W})}} (2 - \theta^{W} - \theta^{S})}{(\beta + \delta - \theta^{W} - \theta^{S})^{\frac{(\beta-\theta^{W})}{(1-\theta^{W})}}}\right) \left(\frac{1}{(P_h)^{\frac{\theta^{W}}{(1-\theta^{W})}}}\right) (Y^{W})^{\theta^{W}-1} - 1\right] Y^{W} = Y^{S}$$

$$\frac{Y^W}{Y^S} = \frac{\left(\beta + \delta - \theta^W - \theta^S\right)^{\frac{\left(\beta-\theta^W\right)}{\left(1-\theta^W\right)}} (P_h)^{\frac{\theta^W}{\left(1-\theta^W\right)}}}{\beta^{\frac{\beta}{\left(1-\theta^W\right)}}\left(2 - \theta^W - \theta^S\right)(Y^W)^{\theta^W - 1} - \left(\beta + \delta - \theta^W - \theta^S\right)^{\frac{\left(\beta-\theta^W\right)}{\left(1-\theta^W\right)}} (P_h)^{\frac{\theta^W}{\left(1-\theta^W\right)}}}$$

The ratio is positive iff $\beta^{\frac{\beta}{\left(1-\theta^W\right)}}\left(2 - \theta^W - \theta^S\right)(Y^W)^{\theta^W - 1} > \left(\beta + \delta - \theta^W - \theta^S\right)^{\frac{\left(\beta-\theta^W\right)}{\left(1-\theta^W\right)}} (P_h)^{\frac{\theta^W}{\left(1-\theta^W\right)}}$ ■

Empirical Appendix

Table 4.1: Sargan's Linear vs. Log-linear Test Results

	1st Wave Data Set	2nd Wave Data Set
	$LPWS$ explanatory variable	$LPWS$ explanatory variable
Square root of (RSS) for Linear Regression model	24.0782	27.01
Square root of (RSS) for Log Linear Regression model	1.696	1.863
Geometric Mean (g)	20.284	22.626
Sargan's criterion value $\boldsymbol{S = \left(\frac{\tilde{\sigma}_{\varepsilon}}{g\hat{\sigma}_{\vartheta}}\right)^{n}}$	$(0.699)^{32} < 1$ Linear model is preferred	$(0.648)^{32} < 1$ Linear model is preferred

Table 4.2: Major indicators of the sample countries

Country	GDP/per head US $ (2010)	Public health spending percent of GDP (2007)	per cent change in house price over last year (2010)	Life expectancy at birth (2007)	Fertility rate (Children per woman 15 to 49 years (2009)	percent of Old age population (2009)	Population growth rate (2009)
Austria	35 389	6.8	n.a	80.1	1.4	17.5	0.3
Belgium	32 847	7.3	5.4	79.8	1.8	17.1	0.8
Denmark	32 241	6.5	2.8	78.4	1.8	16.1	0.6
Finland	31 730	6.1	8.7	79.5	1.9	16.9	0.5
France	29 661	7.5	5.2	81.0	2.0	16.7	0.5
Germany	33 423	7.8	2.3	80.0	1.4	20.8	-0.3
Hungary	16 958	5.7	n.a	73.3	1.3	16.5	-0.1
Italy	27 143	6.3	-2.0	81.4(2006)	1.4	19.9	0.7
Netherlands	37 005	6.0	-2.0	80.2	1.8	15.2	0.5
Norway	46 908	5.7	8.2	80.6	2.0	14.8	1.3
Poland	17 351	4.6	n.a	75.3	1.4	13.5	0.1
Portugal	21 661	6.6	n.a	79.1	1.3	17.8	0.1
Spain	26 940	6.1	-3.6	81.0	1.4	16.7	0.7
Sweden	33 771	6.6	7.8	80.8	1.9	17.9	0.9
Switzerland	37 775	5.6	4.7	81.9	1.5	16.7	1.3
United Kingdom	32 499	6.8	7.2	79.5	1.9	15.8	-0.6

n.a = not available

Source: Social Issues: Key table from OECD

Table 4.3a: Descriptive Statistics

		PMSRA		PFSRA		LPWM	
		1st wave	2nd wave	1st wave	2nd wave	1st wave	2nd wave
European Region (N=16)	Mean	13.14	15.26	35.76	38.95	230678	197619
	Std. Dev.	4.86	6.25	9.25	9.93	161993.1	87714.56
	J-B Val. (prob.)	0.945 (0.623)	0.421 (0.810)	2.509 (0.285)	1.906 (0.386)	41.116 (0.000)	3.865 (0.145)

Table 4.3b: Descriptive Statistics

		LPWF		MRIW		CPI	
		1st wave	2nd wave	1st wave	2nd wave	1st wave	2nd wave
European Region (N=16)	Mean	268333	228744.4	55427	24893.14	45.18	68.41
	Std. Dev.	203215.5	107079.3	103163.7	7136.282	22.65	24.62
	J-B Val. (prob.)	54.80 (0.000)	6.563 (0.038)	98.197 (0.000)	14.482 (0.000)	1.415 (0.493)	9.392 (0.009)

Table 4.3c: Descriptive Statistics

		MLIFE		FLIFE		CHR	
		1st wave	2nd wave	1st wave	2nd wave	CHR70	CHR00
European Region (N=16)	Mean	14.27	15.66	20.00	21.21	87.801	79.638
	Std. Dev.	1.439	2.921	2.666	3.357	7.884	11.029
	J-B Val. (prob.)	0.533 (0.766)	12.105 (0.002)	1.96 (0.375)	0.358 (0.836)	1.408 (0.495)	1.699 (0.428)

Table 4.3d: Descriptive Statistics

		MAYS		FAYS	
		1st wave	2nd wave	1st wave	2nd wave
European Region (N=16)	Mean	7.168	7.951	6.321	6.86
	Std. Dev.	1.666	1.514	1.687	1.606
	J-B Val. (prob.)	0.466 (0.792)	1.405 (0.495)	1.553 (0.46)	0.824 (0.662)

Table 4.5: Panel estimation results for specific models of male and female senior citizens

	Male		Female	
	Random Effects Model (PMSRA)	Fixed Effects Model (PMSRA)	Random Effects Model (PFSRA)	Fixed Effects Model (PFSRA)
LPWM	-5.9E-06	-5.1E-06		
(S.E)	(3.5E-06)*	(3.8E-06)		
LPWF			-0.000017	-0.000013
(S.E)			(3.6E-06)***	(4.02E-06)***
MRIW	-0.000013	-0.000014	-7.3E-06	-7.7E-06
(S.E)	(3.97E-06)***	(4.2E-06)***	(4.8E-06)	(5.2E-06)
CPI				
(S.E)				
MLIFE				
(S.E)				
FLIFE			-0.733	-0.734
(S.E)			(0.229)***	(0.261)**
MAYS				
(S.E)				
FAYS				
(S.E)				
MLFP				
(S.E)				
FLFP				
(S.E)				
CHR	-0.17	0.156	-0.391	-0.38
(S.E)	(0.041)***	(0.044)***	(0.06)***	(0.068)***
Const.	29.89	28.82	88.81	88.19
(S.E)	(3.79)***	(3.85)***	(9.21)***	(10.27)***
Obs.=	32	32	32	32
Grs.=	16	16	16	16
R-sq:				
w.	0.755	0.76	0.82	0.821
b.	0.126	0.11	0.30	0.301
o.	0.17	0.15	0.32	0.323
	Wald χ^2 (3) = 44.43***	F-Stat. 13.49***	Wald χ^2 (4) = 69.13***	F-Stat. 13.79***
Hausman Test	χ^2 (2) = 0.91 $Prob > \chi^2$ =0.63 Random Effects Supported		χ^2 (2) = 0.45 $Prob > \chi^2$ =0.80 Random Effects Supported	

(In the parentheses, standard error of the coefficient is given. * indicates that the variable is significant at 10per cent error level or below. ** indicates that the variable is significant at 5percent error level or below and ***indicates that the variable is significant at below 1percent level.)

Data Appendix

The percentage of senior citizens residing alone (PSRA)

The United Nations Department of Economics and Social Affairs/ Population Division has classified the data on living arrangement of older people into six mutually exclusive categories[19] and calculates the percentage of each category to total senior citizens. That means the percentage of elderly people (called as senior citizens) for each category is defined as the number of senior citizens of a category divided by the total number of senior citizens of a country in a year. In the data set, people aged 60 years and above[20] are considered as senior citizens and we have collected data on the percentage of senior citizens (both male and female) residing alone *(PSRA)*as the dependent variablein this study. The data on this variable are available at different points of time (given in parentheses) for different countries to indicate the reporting year of the observation. For example- Poland (1978), Portugal (1979), Hungary, Norway, Sweden and Switzerland (1980), Austria, Belgium, Italy, the Netherlands, Spain and the United Kingdom (1981), France (1982), Denmark (1986), Germany (1987), and Finland (1990). That means the observations of different countries are scattered from the year 1978 to the year 1990, which we have defined as the 1st wave of data set. In the 2nd wave of data set (as we have defined), the observations are scattered from the year 1988 to the year 2000 like the 1st wave of data set. For example- Poland (1988), the Netherlands (1989), Hungary, Italy, Norway, Sweden and Switzerland (1990), Denmark, Portugal (1991), Belgium, France, Germany, Spain and the United Kingdom (1994), Austria (1995), and Finland (2000). The discrete time difference of observation between these two waves of datasets for each country is at least 5 years (Denmark) and at most 14 years (Austria). The

[19] The household composition of older persons in the present publication is classified into mutually exclusive categories, including living alone, living with spouse only, living with children/children-in-law, living with grandchildren (without children), living with other relatives and living with non-relatives'(p.133). See detail in United Nations Department of Economic and Social Affairs/Population Division *Living Arrangements of Older Persons Around the World, Annex3.*

[20] In some countries age 65years and over is considered as senior citizens.

source of these two waves of data set comes from the United Nations Department of Economic and Social Affairs/Population Division *Living Arrangements of Older Persons Around the World,* Annex IV, Table A.IV.3 pp. 151-154.

We have complied separate observations on the percentage of male senior citizens residing alone *(PMSRA)* and the percentage of female senior citizens residing alone *(PFSRA)* and symbolised these two variables respectively as $PMSRA\_it$ and $PFSRA\_it$ where $[i = 1\ to\ 16]$ indicates number of countries and $[t = 1st, 2nd]$ indicates number of waves. Either of these two variables is used as the dependent variable in the study.

Since we have separate data for the percentage of solitary residing male and female senior citizens, all explanatory variables such as – life-cycle pensionable wealth of senior male *(LPWM)* and life-cycle pensionable wealth of senior female *(LPWF)*, life expectancy after retirement for senior male *(MLIFE)* and life expectancy after retirement for senior female *(FLIFE)*, average years of schooling of senior male *(MAYS)* and average years of schooling of senior female *(FAYS)*, and labour force participation rate of male working citizen *(MLFP)* and labour force participation rate of female working citizens *(FLFP)* are gender specific except mean real income of working citizen *(MRIW)*, inflation rates *(CPI)*, and the percentage of people belonging to Christian religion *(CHR)* which are in macro measures and are commonly used for both male and female cases during the estimation process.

Life-cycle pensionable wealth of senior citizens (LPWS)

We have used the life-cycle pensionable wealth of male and female senior citizens as a proxy of mean real income of senior citizens. This variable is symbolised as $LPWM\_it$ and $LPWF\_it$ for male and female respectively. The observations of this variable for each country are collected according to the year of the dependent variable. The source of data is OECD

(2011), *Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries*, OECD Publishing.The web address is: http://dx.doi.org/10.1787/pension_glance-2011-en

Mean real income of working citizens (MRIW)

We have used the mean real income of working citizens as an explanatory variable, symbolised as $MRIW\_it$. The observations of this variable for each country are collected according to the year of the dependent variable. The source of data is OECD (2011), *Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries*, OECD Publishing.The web address is: http://dx.doi.org/10.1787/pension_glance-2011-en

Inflation rate (CPI)

The data on rent of housing are hardly available for the sample countries and these are too sporadic for different points of time for every country used in this study. We have used inflation rates *(CPI)* as a proxy of rent of housing in our analysis although according to the international Monetary Fund (IMF), the calculation of inflation rate *(CPI)* does not include the rental expenditure in the household consumption bundle. The variable is symbolised as CPI_it.The data on this variable is collected from the International Monetary Fund (IMF).

Life expectancy after retirement (LIFE)

We have used life expectancy after retirement of male and female senior citizens as an explanatory variable in this study. The variable is symbolised by $MLIFE\_it$ and $FLIFE_it$respectively for male and female. The observations of this variable are collected from OECD (2011), *Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries*, OECD Publishing.The web address is:http://dx.doi.org/10.1787/pension_glance-2011-en pp. 29-30

Average years of schooling of senior citizens (AYS)

We have used the average years of schooling of the senior male and female citizens as an explanatory variable in this study. The variable is symbolised by $MAYS\_it$ and $FAYS\_it$ for male and female respectively. The observations of this variable are collected from the website of Baro and Lee educational attainment data sets.

Labour force participation rates of working aged citizens (LFP)

We have incorporated the variable called labour force participation rate of working aged male and female citizens and are symbolised as respectively $MLFP\_it$ and $FLFP\_it$. The data of this variable are collected from the OECD website for both male and female and also for different times. http://stats.oecd.org/Index.aspx?DataSetCode=LFS_SEXAGE_I_R.

Religion (CHR)

We believe that religion is a good proxy of culture, norms and values of a society. We, therefore, have used the percentage of the population belonging to the Christian religion because more than 70 percent of the total population belongs to the Christian religion in these countries. This variable is used to capture the effect of religious culture (if any) on residing decision and is symbolised by CHR_it. The data on religion are collected from the website of Robert Barro and Rachel McCleary who have compiled a cross-country data set on the share of religious people in the population. ‗Adherence fractions of population are shown for 10 religion groups and non-religion (incl. atheists) in 1970, 2000, and 1900 (from Barrett).‘ Throughout the text, we have omitted the subscripts of all variables for ease of reading.

CHAPTER FIVE

Impact of public education expenditure on income inequality

Abstract

Public education expenditure has an important role in human capital accumulation of a society but it can increase or reduce income inequality of the society. In this chapter, we are going to investigate the impact of public education expenditure on income inequality. We have developed models that can explain both situations - increasing public education expenditure can increase income inequality and can also reduce income inequality but in any case, it is a Pareto improvement under some conditions. We have also empirically examined the theoretical models. Using the panel data set of 62 countries started from 1980 to 1995 for explanatory variables and 1995 to 2005 for explained variable, we first replicate cross-country analysis according to Sylwester's (2002) estimation method and partially refute Sylwester's (2002) result that public education expenditure reduces income inequality. We have found that Sylwester's (2002) claim – public education expenditure reduces income inequality is true only for the Organisation of Economic Cooperation and Development (OECD) region but increasing public education expenditure increases income inequality for Latin America and the Caribbean (LAAM) region, developing Africa, Asia and east Europe (DAAE) region, and the least developed Africa and Asian (LAA) region. We have also conducted panel analysis and found the same conclusion that the development status of a country determines the positive or negative impact of increasing public education expenditure on income inequality. The gross domestic product (GDP), political stability, average year of schooling and corruption perception index- all these factors also have influence to determine income inequality of a country.

5.1 Introduction

Human capital, at present, is considered as an essential factor of production which needs to be developed for achieving rapid economic growth. Education and training are the basic input of acquiring human capital. Human capital accumulation, whether it is private or public education, is a major conduit through persistent or cross-dynastic income change that may be reduced inequality. Studies (Saha and Sensarma 2011; Saha and Sarkar 1999) show that schooling and job related training significantly increases earnings of industrial workers. But acquiring education is costly for a citizen that cannot be equally affordable by every

citizen of a country; as a result, inequality may be sharpened in the society. Access to education for all is therefore treated as aprimary condition of accruing human capital which helps to favourably change inequality of a society. Glomm and Ravikumar (2003 p.289) quotes the emphasis placed on access to education by the U.S. Supreme Court stating that ~~–in~~ these days, it is doubtful that any child may reasonably be expected to succeed in life if he is denied the opportunity of an education. Such an opportunity where the state has undertaken to provide, it is a right which must be made available to all on equal terms". Proper education of all citizens enhances socio-economic development of a nation. Education and training helps to change the income distribution of a society. In Stiglitz (1973) words, education is a process of involving the acquisition of skills which increases individual's productivity. Since income is related to productivity, the more education an individual has, the higher will be his income. Similarly, an individual having tertiary education is likely to receive a considerably higher income than the one who does not (Dutta et.al., 2001) and education or training plays signalling role into different jobs; the more highly educated individuals obtain the better jobs (Spence, 1973). As regards inequality, human capital (via education) may be considered as a substitute endowment for the rich, but as a complement of talent for the poor. Thus, higher education opportunities could potentially reduce inequality.

Studies (Glomm and Ravikumar, 2003; Barro, 1999) have claimed that the public education system ensures the equality of opportunity and equal access to the inputs of learning technology across all pupils; as a result, incomes converge that means income inequality declines in the society. The study (Chiu, 1998) argues that public education expenditure can improve economic growth while promoting equality. Schultz (1963) mentions that increasing human capital is one way to lower income inequality and increased support for public education might be one way to accomplish this. Glomm and Ravikumar (1992) develop a model where agents can choose between a private and public education

system and they show that income inequality unambiguously declines under a public education system. A continued support for public education lowers the level of income inequality over time (Saint-Paul and Verdier, 1992; Eckstein and Zilcha, 1994; and Zhang, 1996). The provision of universal public education was instrumental in the rapid formation of human capital and was therefore a catalyst, and possibly evens a necessary condition, for the demise of the class society (Galor and Moav 2006). All these studies support the notion that the higher the public education opportunity that implies increases in the public education expenditure, the lower the income inequality in an economy.

An alternative viewpoint in the education and income inequality literature shows that the role of expanding public education by increasing public education expenditure makes more unequal income distribution in a society. Galor and Moav (2000) states that if technological progress would increase the return to education without affecting the return to ability, wage inequality among educated would rise but wage inequality among the uneducated would decline. It infers that in a country with rapid technological progress, making education more affordable can lead to higher income inequality (Hendel et. al.,2005). The view is also supported by the finding of Gould et. al. (2001) that in many developing countries public education provision has expanded; as a result, marginal product of labour has increased during the last few decades but wage inequality or income inequality has widened significantly. This finding has also been observed in many advanced countries at the same time. One of the reasons for the positive relationship between income inequality and expanding public education is that households with higher income and brighter children contribute less in tuition fees towards the cost of the education system than households with lower income and less bright children (Fraja, 2002). Thus the educational system has been criticized as one of the major institutions by which inequality has been perpetuated, especially

in less developed countries (Stiglitz, 1973). All these studies are arguing that the increasing public education expenditure widens income inequality especially in the developing society.

Another school of thought views that expanding public education is not the cause of changing income distribution of a society rather income distribution of a society causes the change in public education expenditure. Although Fernandez and Rogerson (1995) agree with the most standard models predicted that public education provision reduces income inequality, they show income inequality determines the public education expenditure over time. They develop a model in which education is only partially publicly provided and individuals vote over the extent to which it is subsidized. Their model shows several results that are: the majority voting equilibrium consists of a positive subsidy to education but with only the rich and middle class obtaining an education while the poor subsidize the education; the efficiency consequences of subsidization with excludability may be positive for a poor economy, but never for a wealthy economy; economies with more unequal income distributions are more likely to perpetuate this inequality over time; and finally, there are instances in which wealthier individuals would profit from making education more costly since this affects their ability to exclude others and extract resources from them.The most distinct finding of Fernandez and Rogerson (1995) is that income inequality determines the public education expenditure over time while most of the literature argues reverse causation.We have considered this reverse causality issue in this chapter, therefore, have done endogenity test.

Although there are several points of view that suggest some causal relationship between income inequality and public education expenditure, studies discussed above seems to provide a reasonable flavour of the diversity in various views, and relatively ambiguous position regarding the direction of causal relationship between income inequality and public education expenditure. The ambiguity in predictions regarding such important policy issues of

public allocation of education expenditure and of income inequality need to be studied rigorously (Ram, 1989; Sylwester 2002). We would like to follow the view that public education expenditure causes to change income inequality in a society like Sylwester (2000, 2002), Jimenez (1986), Fields (1980) and others. In this chapter focus has been given to find the answers to the questions that *whether public education expenditure reduces income inequality that infers public education expenditure inversely affects income inequality of a society*. The same question has been studied by Sylwester (2002) and has found that public education expenditure reduces income inequality for some countries but not all sample countries in his study. *We, therefore, highlight on the second issue that whether the difference in the sign (directly or inversely)of this relationship depends on the level of development of a country or not.* To answer the first question, we replicate the Sylwester's (2002) estimation method using a different data set of 66 countries. The answer of the first question may help us to remove the ambiguity of Sylwester's (2002) findings. To answer the second question we have developed the theoretical model first and then empirical analysis using the same data set of 62 countries (4 countries are removed due to insufficient data). The answer of the second question sheds light both on the sign of (*i.e.* positively or negatively) the relationship that means income inequality is directly or inversely affected by the public education expenditure and other variables; and whether different countries have different signs because of their development status. The results may help us to take policy measures regarding public education expenditure and managing inequality of a society according to the level of development of the society.

Sylwester (2002) addresses a similar question. However, this chapter differs from Sylwester's (2002) at least in three points of view. *Firstly,* my study focuses on both theoretical and empirical analysis to answer these questions. *Secondly,* the data set we have

used in our study is different from that of Sylwester (2002). We took public education expenditure data from the year 1980 to 1995 while Sylwester (2002) took 1960 to 1969 and the difference in income inequality between 2005 and 1995 that in Sylwester (2002) was between 1990 and 1970. Why do we choose these specific points of time 1980 to 1995 for the average value of GDP and 1995 to 2005 for income inequality are discussed later in the empirical analysis section of the chapter. *Thirdly,* although this chapter begins with the replication of Sylwester's (2002) method using a different data set, we have extended empirical analysis of this chapter with panel estimation method. We therefore can say that the chapter is an extension of Sylwester (2002).

We have developed theoretical models: (i) for the countries where the total population is divided into skilled and unskilled categories and public education expenditure is spent on unskilled population to make them skilled. We call these countries as developed countries because unskilled population already have some level of education and additional public education expenditure is spent for making them as skilled labour force; (ii) for the countries where total population is divided into literate and illiterate categories and public education expenditure is spent for literate people because illiterate population do not enter into the public education system; hence illiterate population cannot enjoy the benefit of public education expenditure. We call these countries as developing countries because the majority of the population of these countries is out of the benefit of public education expenditure. An important result that emerges from these theoretical models is that increasing public education expenditure under conditions is Pareto-improving regardless of the development status of a country. In these regards, we believe that this chapter is a significant contribution to the existing literature.

5.2 Related Literature

The famous literature of Kuznets (1955) is considered as a foundation of the relationship between income inequality and economic growth. Literature shows that human resource development via education is affecting economic growth. Therefore, income distribution of a society has been change due to change in public education expenditure for changing human resource development. We therefore, like to review the work of Kuznets (1955) at first. Kuznets (1955) tries to empirically find the answers of two questions – ~~–~~does inequality in the distribution of income increase or decrease in the course of a country's economic growth? What factors determine the secular level and trends of income inequalities?" (p.1). Each country is considered as a unit in the sample countries and data for each unit is around 25 year national income and different percentiles of income distribution has been calculated. Due to data limitations, Kuznets (1955) uses the ratio of income share of the richest 20 percent of the population to that of the poorest 60 percent of the population as a measure of inequality. The comparison are carried out between a small set of developing countries and a small set of developed countries. Moreover, inequality in different sectors of production within a country is investigated. Author concludes that the trend in income inequality in two sectors of a country is determined on the per capita income differential or income distribution or both between the sectors. There is a direct relationship between inequality and sectoral growth. On the other hand, for cross-country comparison, Kuznets (1955) suggests a broad hypothesis of development that economic progress, defined as per capita income, is initially increases income inequality, but this disparity ultimately go away as the benifits of development permeate more widely. This hypothesis suggests inverted-U relationship when we plot per capita income in one axis and income inequality in other axis.

The empirical work regarding the relationship between income inequality and public education expenditure in this chapter is based on Sylwester (2002). In Sylwester (2002), the author empirically examines the relationship between ‗Gini' value and public education expenditure using a cross section of 50 countries around the world. The change in income inequality valuing from 1970 to 1990 is a dependent variable, which is regressed on the average of the ratio of public education expenditure to GDP from 1960 to 1969. The other explanatory variables used in this regression equation are - the natural log of GDP per capita in 1970, the average number of years of schooling within the adult population in 1970, a dummy for whether or not a country was a member of the OECD in 1970, and regional dummy variables for East Asia, Latin America, and Africa. Using the Ordinary Least Square (OLS) estimation technique, findings of the paper say that the public education expenditure reduces income inequality of a country. The author mentions that ―the results appear to be stronger in the OECD countries although there is some evidence, albeit weaker, that public education expenditures slowly lessen income inequality in less developed countries" (Sylwester, 2002 p.49) but the author does not take any measure to show the effects separately for the OECD countries and the less developed countries because of small sample size. Since Sylwester (2002) includes 4 dummies as additive form not as a multiplicative form with any of the explanatory variable, the above results do not actually reflect the rates of change in income inequality due to public education expenditure for different regions.In this chapter, we have replicated Sylwester's (2002) method with the data sets of 64 countries starting from 1980 to 2005. We then extend our analysis to find a specific model by sequentially eliminating the most insignificant variable from the general model – where both additive and multipricative forms of all regional dummies are considered. We also have conducted panel analysis for all the sample countries and separately for the groups of (i) Organisation of Economic Cooperation and Development (OECD) countries, (ii) Latin America and

Caribbean countries and (iii) Asia and African countries. We do believe that the chapter is significant extension of Sylwester (2002).

Biggs and Dutta (1999) have worked on the distributional effects of education expenditure to evaluate the change in long run income distribution by reductions in public education expenditure of the United Kingdom. In a dual education system, where public and private education systems coexist, they have derived a dynamic model of the earning distribution which is determined by an individual‘s quality of education and ability. Using the simulation technique, they have shown that an increase in public education expenditure increases the income of future generations and the dispersion of income falls; and in the other direction, a decrease in public expenditure reduces the participation rate which leads to higher earning differential. They have also argued that the participation response in public education in a dual education system can induce a U-shaped relation between education and average income. A dual education system may generate substantially higher inequality than a fully private education system. As demonstrated later, this chapter differs from their paper regarding the data set, estimation methods as well as results.

Glomm and Ravikumar (2003) have constructed an overlapping generation model where each individual‘s human capital investment depends on the quality of schools. They have shown that the income gap between the rich and the poor may widen when the quality of public education is the same for all individuals. This implies public education expenditure does not have any impact on changing the income distribution. Moreover they have found that the tax effect on income inequality is also ambiguous.

5.3 The Model

Mincer (1974) concludes theoretically that ―the percentage increments in earnings are strictly proportional to the absolute differences in the time spent at school, with the rate of return as the coefficient of proportionality” (p.11). We have developed our model on the basis

of the reduced form of Mincer (1974) equation that says that individual's earnings is directly proportional to the year of schooling. Also assume that education is supply driven only. We assume that there is a competitive market for the supply of education and thus the supply of education is elastic.

Education demand is a derived demand in the model. High level of education leads to high level of income for an individual. Thus the earning function of an individual is generated from the demand for education.

5.3.1 Case A: Developed countries

Consider a society with two types of people – one is called unskilled with a basic level of education, symbolised by R and the other one is called skilled with higher levels of education, symbolised by S. We call these countries developed countries because the unskilled population already has some basic level of education and additional public education expenditure is spent in making them as a skilled labor force. Suppose that the wage of unskilled people is

$$W_R = W(be) \tag{5.1}$$

This is a minimum wage but not constant, where, be is the quantity of basic education achieved. The wage of skilled people depends on the quantity of education they achieved which is written as follows.

$$W_S = W(he) \tag{5.2}$$

where, he is the quantity of higher education received. So it is obvious that the wage of skilled people is strictly greater than that of unskilled people.

$$he > be \Longrightarrow W_S > W_R \tag{5.3}$$

Now assume that there are λ, a fraction of the total population, who are skilled and $(1-\lambda)$ is unskilled and the total populationis N. All $(1-\lambda)$, and N are constant over time. Suppose public education expenditure for a unit of additional basic education for one person costs q; so, the total government spending on public education is

$$Q = q(be)(1-\lambda)N \tag{5.4}$$

where, Q is total public education expenditure, q is per unit cost of basic education, (be) is the number of units of basic education and $(1-\lambda)N$ is the fraction of the population achieving basic education.

Assumption I: The expenditure on enhancing education comes from foreign aid. Thus the expenditure does not have any impact on government‘s budget.

Assumption II: The expenditure on enhancing education comes from the tax revenue collected from the beneficiary of the additional education supplied by the government. Thus government has to optimise tax revenue that makes balanced budget for the government.

According to the assumption I: Now assume that the government receives Δ amount of foreign aid in the form of cash and incurs this expenditure on enhancing the basic education of unskilled workers.

Thus, in the new outcome

$$(be)^* = (be) + \frac{\Delta}{(1-\lambda)qN} \tag{5.5}$$

and wages for the skilled are $W_S = W(he)$, this remains unchanged because no amount of foreign aid is spent on higher education. Thus, the new wage for unskilled people is

$$W_R^* = W(be)^* > W_R = W(be) \tag{5.6}$$

Obviously this distribution Pareto dominates the initial distribution because $(1-\lambda)$ fraction of the population is strictly better off without worsening the λ fraction of the population. At the same time,

$$(W_S - W_R) = W(he) - W(be) > W_S - W_R^* = W(he) - W(be)^* \quad (5.7)$$

while the average income of unskilled people goes up without affecting the average income of skilled people. Hence, inequality must decrease because the variance of income distribution decreases. So, according to assumption I, increasing public expenditure on basic level of education decreases income inequality but it is a "Pareto improvement" for the society. We have considered that wage income is the measuring criterion of welfare of the population living in the society. The result shows that wage income of $(1-\lambda)$set of population is better-off without affecting the wage income of λ set of population of the economy. Thus a "Pareto improvement" has occurred due to change in public education expenditure.

We, therefore, have concluded that any increase in public education expenditure spent to raise productivity of a constant fraction of unskilled workers, the average wage rate of unskilled workers increases and the variance of income distribution decreases for the countries. It implies that public education expenditure decreases income equality inthe countries that use additional expenditure for developing the quantity of basic education by investing on the unskilled fraction of the population and it is Pareto-improvement under some conditions.

According to the assumption II: Now assume that public education expenditure is financed by the tax collected from the $(1-\lambda)$ proportion of the population who have enjoyed basic education facility, that means, an increase in Q is financed by taxing the higher wage rate W_R

of unskilled labour. The formal way of education financing is that the government initially borrows education expenditure and later pays back by taxing the benefitted population. For simplicity, assume that the interest rate of government borrowing is zero. Assume that the tax rate is τ which is imposed on unskilled population according to their wage premium due to improving the basic level of education. Thus, the tax-financing formula for total education expenditure is –

$$Q = \tau[W(be)^* - W(be)](1-\lambda)N \tag{5.8}$$

The take-home wage of unskilled population is

$$W_R = (1-\tau)[W(be)^* - W(be)](1-\lambda)N \tag{5.9}$$

The government balanced budget is

$$\tau[W(be)^* - W(be)](1-\lambda)N = Q = q(be)^*(1-\lambda)N \tag{5.10}$$

Assume the wage of unskilled population follows the following functional relation

$$W(be)^* = W(be) + (be^*)^\gamma \; where \; 0 < \gamma \tag{5.11}$$

Here, we assume that the marginal rate of return from education is greater than zero.

The equilibrium level of basic education is now -

$$\tau[W(be)^* - W(be)](1-\lambda)N = Q = q(be)^*(1-\lambda)N \tag{5.12}$$

$$(be)^* = \left(\frac{\tau}{q}\right)^{\frac{1}{(1-\gamma)}} \tag{5.13}$$

By varying tax, we can get the distributional implication of equilibrium education.

The wage of unskilled population becomes

$$W_R(\tau) = W(be) + \left(\frac{\tau}{q}\right)^{\frac{1}{(1-\gamma)}} \quad (5.14)$$

And the take- home wage of an unskilled worker is now

$$W_R(\tau) = \left[W(be) + (1-\tau)\left(\frac{\tau}{q}\right)^{\frac{1}{(1-\gamma)}}\right]$$

$$= \left[W(be) + \eta(q)(1-\tau)\tau^{\frac{\gamma}{(1-\gamma)}}\right] where\ \eta(q) = \frac{(1-\tau)}{\left(\frac{1}{q}\right)^{\frac{1}{(1-\gamma)}}} \quad (5.15)$$

The objective of the government is to optimise tax rate that makes balanced budget. The government imposes tax on wage earnings of unskilled workers according to the rate that optimises their take-home wage and balances government budget.Thus optimisation problem of the government becomes as follows:

$$Max_\tau \left[W(be) + \eta(q)(1-\tau)\tau^{\frac{\gamma}{(1-\gamma)}}\right] \quad (5.16)$$

The equilibrium tax rate imposed on unskilled population who enjoy additional basic education is

$$\tau^* = \gamma \quad (5.17)$$

The optimum condition of imposing tax is that the tax on unskilled people must be equal to the marginal rate of return from education. It is a Pareto-improving as long as the following condition holds.

$\gamma \geq \tau^*$ the unskilled fraction of the population is better-off without worsening the wage of the skilled fraction of population and income inequality would be reduced.

The following two conditions also affect income distribution of the economy although they are not Pareto improvement.

$\tau^* > \gamma$ the unskilled fraction of the population will be worse-off and income inequality would be widened.

$\tau^* < \gamma$ and additional education expenditure is financed by imposing additional taxes on a skilled fraction of the population, the unskilled fraction of the population will be better-off but the skilled fraction of the population would be worse-off although the distribution of income may be changed in favour of the unskilled fraction of the population but not a Pareto improvement.

Proposition-1: Increasing public education expenditure to increase the basic education of unskilled workers is a Pareto improvement if the tax rate imposed on unskilled workers for financing additional basic education expenditure follows some conditions.

Proof: see the derivation of 5.3.1.

5.3.2 Case B: Developing and less developed countries

Consider a society with two types of people – one is called illiterate and symbolised by L and the other one is called educated and symbolised by H. We call these countries as developing countries because the majority of the population of these countries is out of the benefit of public education expenditure. Suppose that the minimum wage of illiterate people is

$$W_L = \bar{W} \tag{5.18}$$

The wage of educated people depends on the quality of education they received which is written as

$$W_H = W(e) \tag{5.19}$$

where, e is the quality of education received. So it is obvious that $e > 0$ implies $W_H > W_L$.

Now assume that there are λ, a fraction of the total population, who are educated and $(1-\lambda)$ is illiterate and the total populationis N. Suppose that public education expenditure for a unit of education for one person costs q, so the government total spending on public education is

$$Q = qe\lambda N \tag{5.20}$$

According to the assumption I: Now assume that the government receives Δ amount of foreign aid in the form of cash and incurs this expenditure on enhancing educational quality. Thus, in the new outcome

$$e^* = e + \frac{\Delta}{\lambda q N} \tag{5.21}$$

For the illiterate population, wages remain$\overline{W}$ but for the educated population wage becomes as follows

$$W_H^* = W(e^*) > W_H = W(e) \tag{5.22}$$

Obviously this distribution Pareto dominates the initial distribution because λ fraction of the population is strictly better off without worsening the $(1-\lambda)$ fraction of the population. At the same time,

$$W_H^* > W_H \Longrightarrow W_H^* - \overline{W} > W_H - \overline{W} \tag{5.23}$$

So while the average income of educated people goes up without affecting the average income of illiterate people, inequality must increase because the variance of income distribution increases. So the core model shows that increasing public expenditure on education increases income inequality but it is a ‗Pareto-improvement' for the society.

According to the assumption II: Now assume that public education expenditure is financed by the tax collected from the λ proportion of the population who have enjoyed education facility that means an increase in Q is financed by taxing the higher wage rate W_H. For simplicity, assume that the interest rate of government borrowing is zero. Assume that the tax

rate is τ , which is imposed on an educated population according to their wage premium due to education. Thus the tax-financing formula of the government for total education expenditure is as follows.

$$Q = \tau[W(e) - \bar{W}]\lambda N \quad (5.24)$$

The take-home wage of an educated person is

$$W_H = [\bar{W} + (1 - \tau)W(e)] \quad (5.25)$$

The government balanced budget is

$$\tau[W(e) - \bar{W}]\lambda N = Q = qe\lambda N \quad (5.26)$$

Assume the wage of the educated population follows the following functional relation

$$W(e) = \bar{W} + e^{\gamma} where\ 0 < \gamma \quad (5.27)$$

That means, we assume that the marginal rate of return from education is greater than zero.

The equilibrium level of education is

$$\tau[W(e) - \bar{W}]\lambda N = Q = qe\lambda N \Rightarrow e = (\frac{\tau}{q})^{\frac{1}{(1-\gamma)}} \quad (5.28)$$

By varying tax, we can get the distributional implication of equilibrium education. The wage of an educated person is

$$W_H(\tau) = \bar{W} + (\frac{\tau}{q})^{\frac{1}{(1-\gamma)}} \quad (5.29)$$

And the take- home wage is

$$W_H(\tau) = \left[\bar{W} + (1 - \tau)\left(\frac{\tau}{q}\right)^{\frac{1}{(1-\gamma)}}\right]$$

$$= \left[\bar{W} + \eta(q)(1 - \tau)\tau^{\frac{\gamma}{(1-\gamma)}}\right] where\ \eta(q) = \frac{(1-\tau)}{(\frac{1}{q})^{\frac{1}{(1-\gamma)}}} \quad (5.30)$$

The objective of the government is to optimise tax rate that makes balanced budget. The government imposes tax on wage earnings of unskilled workers according to the rate that

optimises their take-home wage and balances government budget.Thus optimisation problem of the government becomes as follows:

$$Max_{\tau}\left[\bar{W}+\eta(q)(1-\tau)\tau^{\frac{\gamma}{(1-\gamma)}}\right] \tag{5.31}$$

The equilibrium tax rate is

$$\tau^{*}=\gamma \tag{5.32}$$

The tax on educated people must be equal to the marginal rate of return from education. It is a Pareto-improving as long asfollowing conditions hold.

$\gamma \geq \tau^{*}$ equilibrium tax rate is equal to the marginal benefit of education. It is a Pareto-improving because the educated fraction of the population is better-off without worsening the illiterate fraction of the population.

When the marginal rate of return of educated people is very much higher than the tax rate imposed on them to finance the additional cost of education, the situation is also a Pareto-improving but widens income inequality in the society.

$\gamma < \tau^{*}$ if the tax rate is lower than the marginal rate of return from education, educated population will be worse-off but income inequality may be reduced.

Proposition-2: Increasing public education expenditure of the educated population of a society widens income inequality but it is Pareto-improving under certain assumptions.

Proof: see the derivation and discussion of 5.3.2.

5.4 Methodology and Data

5.4.1 Estimation methods

5.4.1.1. Replication of Sylwester's (2002) estimation method

To answer the first research question of this chapter, we have replicated Sylwester's (2002) estimation method using our data sets. We discussed Sylwester (2002) estimation method briefly in background literature section; Sylwester (2002) conducts a cross-country analysis by regressing the difference in income inequality between 1990 and 1970 on the average value of the percentage of public education expenditure from 1960 to 1969, log of GDP, average years of schooling in 1970, log value of the population in 1970 and countries dummies through OLS estimation technique. We are going to replicate the same cross-country analysis using our data set using Sylwester's (2002) method of estimation. Doing this allows us to compare our results with Sylwester's and to make comments on the consistency of Sylwester's findings with a different set of data. Then, we pursue a model specification strategy by eliminating sequentially the most insignificant variable from the general model. Before going to the empirical model, we will explain the definitions and symbols of our dependent and independent variables.

The difference in income inequality between 2005 and 1995 ($\Delta INEQ$) is the dependent variable[21], regressed on the average value of public education expenditure as a percentage of GDP ($PEE95_i$) from 1980 to 1995. The first reason for choosing 15 years average value of public education expenditure is that a child needs at least 15 years of education (12 years in high school plus 3 years in a job-related specialisation) before entering the job market as a skilled worker. Thus, a child, who started school in 1980, and continued until 1995 means that he enjoyed the full benefit of public education expenditure before

[21] The italic letters in parenthesis indicates symbol that is used for representing the variable in the model.

coming to the job market. Therefore, we obtain a reflection of the impact of public expenditure on his income. However, the income of a person who entered into the job market 15 years earlier than the child then the income of the person reflects an income without the benefit of public education expenditure. We will establish a causal relationship on the difference in income distribution between a person enjoying the benefit of public education expenditure and a person who does not. Thus, we choose 15 years average values of public education expenditure as independent variable.

Another reason for choosing 1980 as the beginning year is the availability of public education expenditure data. The United Nations Education Science and Cultural Organisation (UNESCO) is the most reliable source of cross country and time series data on education (this is because the organisation mostly compiles data from the original census or survey of each country). The cross country and time series data on public education expenditure are reported from 1970 to 2010 on UNESCO‘s website. Unfortunately, no data are available for the most of our sample countries from 1970 to 1979 and from 2005 to 2010. We, therefore, choose the average of public education expenditure as the percentage of GDP during 1980 to 1995 in this chapter as per Sylwester‘s (2002) method.

Another advantage of taking 15 years‘ average is that some countries do not have all 15 observations of the corresponding 15 years, so we then take an average of the available observations. As a result, our empirical estimation does not miss any country‘s information and our total number of countries is 66 throughout the cross-country analysis.

We have taken the difference in income inequality between 2005 and 1995 while in Sylwester (2002), it was between 1990 and 1970. We wanted to take the difference in income inequality of 15 years from 1995 to 2010 so that we could evaluate the difference between the income distribution of a person enjoying the benefit of public expenditure and that of a person without it in order to consider the impact of public education expenditure on income

distribution. However, we could not due to the limitation of income inequality data. We have cross-country data on income inequality at best until 2006, which is collected from the World Institute for Development Economics Research (WIDER). We still believe that the difference of income inequality between 2005 and 1995 does not change our empirical results significantly. The average years of schooling of the adult population is $(AYS95_i)$, natural log of GDP is $(LGDP95_i)$, natural log of total population is $(LPOP_i)$; regional dummy for OECD countries is $(OECD_i)$, for Latin America and the Caribbean countries is $(LAAM_i)$, for Asia and east European countries is (AAE_i) and for African countries is (AFR_i). The regional dummy (AFR_i) is considered as base region in the cross-country regression analysis. The three dummies are included as an additive form only as Sylwester (2002) and the following specification of the model is estimated by the OLS technique after Sylwester (2002).

$$\Delta INEQ_i = \alpha_0 + \alpha_1 PEE95_i + \alpha_2 AYS95_i + \alpha_3 LGDP95_i + \alpha_4 LPOP95_i + \alpha_5 OECD_i + \alpha_6 LAAM_i + \alpha_7 AAE_i + \varepsilon_i \; ; i = 66 \quad (5.33)$$

After replicating Sylwester (2002), we specify the general model including all explanatory variables mentioned in equation (5.33) and dummy variables as well as public defence expenditure as a percentage of GDP $(PDE95_i)$ and political stability $(POLX95_i)$ for getting the most significant determinants of explaining income inequality of a country. All dummies are included both as additive and multiplicative form with all explanatory variables.

The general model is as follows.

$$\Delta INEQ_i = \beta_0 + \beta_1 PEE95_i + \beta_2 AYS95_i + \beta_3 LGDP95_i + \beta_4 LPOP95_i + \beta_5 PDE95_i + \beta_6 POLX95_i + \beta_7 OECD_i + \beta_8 LAAM_i + \beta_9 AAE_i + \beta_{10} PEEOECD_i + \beta_{11} PEELAAM_i + \beta_{12} PEEAAE_i + \beta_{13} AYSOECD_i + \beta_{14} AYSLAAM_i + \beta_{15} AYSAAE_i + \beta_{16} LGDPOECD_i + \beta_{17} LGDPLAAM_i + \beta_{18} LGDPAAE_i + \beta_{19} LPOPOECD_i + \beta_{20} LPOPLAAM_i + \beta_{21} LPOPAAE_i + \beta_{22} PDEOECD_i + \beta_{23} PDELAAM_i + \beta_{24} PDEAAE_i + \beta_{25} POLXOECD_i + \beta_{26} POLXLAAM_i + \beta_{27} POLXAAE_i + \vartheta_i \quad (5.34)$$

where, $PEEOECD_i$ is the average of public education expenditure multiplied by the dummy variable $OECD$.

$PEELAAM_i$ is the average of public education expenditure multiplied by the dummy variable $LAAM$.

$PEEAAE_i$ is the average of public education expenditure multiplied by the dummy variable AAE.

$AYSOECD_i$ is the average years of schooling multiplied by the dummy variable $OECD$.

$AYSLAAM_i$ is the average years of schooling multiplied by the dummy variable $LAAM$.

$AYSAAE_i$ is the average years of schooling multiplied by the dummy variable AAE.

$LGDPOECD_i$ is the log value of GDP multiplied by the dummy variable $OECD$.

$LGDPLAAM_i$ is the log value of GDP multiplied by the dummy variable $LAAM$.

$LGDPOAAE_i$ is the log value of GDP multiplied by the dummy variable AAE.

$LPOPOECD_i$ is the log value of population multiplied by the dummy variable $OECD$.

$LPOPLAAM_i$ is the log value of population multiplied by the dummy variable $LAAM$.

$LPOPAAE_i$ is the log value of population multiplied by the dummy variable AAE.

$PDEOECD_i$ is the public defence expenditure multiplied by the dummy variable $OECD$.

$PDELAAM_i$ is the public defence expenditure multiplied by the dummy variable $LAAM$.

$PDEAAE_i$ is the public defence expenditure multiplied by the dummy variable AAE.

$POLXOECD_i$ is the political stability multiplied by the dummy variable $OECD$.

$POLXLAAM_i$ is the political stability multiplied by the dummy variable $LAAM$.

$POLXAAE_i$ is the political stability multiplied by the dummy variable AAE.

AFR_i is considered as base region.

$\vartheta_i \sim N(0, \sigma_\vartheta^2)$is the disturbance term with zero mean and constant variance.

5.4.1.2 Estimation method of cross-country analysis

As Sylwester (2002) uses the OLS estimation method, we also have adopted the same technique for all the estimation process in the cross-country analysis. The OLS method is the best linear unbiased estimator (BLUE) since the specified functional form of general equation is both linear in parameters and variables. The OLS estimate is the best if it satisfies classical assumptions of normality, homoscadasticity and is without serial correlation of error distribution.

5.4.2 Endogeneity Test

The specified functional form might suffer endogeneity problem due to omitted variables, measurement errors or simultaneous system of equation. We, therefore, have performed endogeneity test before applying the OLS estimation technique. We have chosen four instrumental variables for the variable *PEE95* (public education expenditure as a percentage of GDP). The study (Fernandez and Roserson, 1995) argues income inequality causes change in public education expenditure; so, we choose two income inequality measures as instruments of public education expenditure. These two instrumental variables are: Gini coefficient of the year 1990 *(Gini 90)*and Gini coefficient of the year 1995 *(Gini 95)***.**

Another two instrumental variables are: natural log of value of the total number of student enrolment in 1995 *(laerm95)* and the gross enrolment ratio of a country in 1995 *(gerr95)*. These two instruments have been chosen because of the strong correlation (though not statistically significant at 5 percent level) of these two variables with public education expenditure but weak correlation with difference in income inequality between 2005 and 1995 ($\Delta INEQ$).

Table 5.3: Result of Hausman (1978) Endogeneity Test

Dependent Variable: (ΔINE)				
Method: Ordinary Least Square (OLS) regression				
Variable	Coefficients b(IV)	Coefficients B(OLS)	Differences	S. E. of Difference
PEE95	.0368696	.0031894	.0336802	.0228897
AYS95	-1.552104	-.6786428	-.8734611	1.868572
LGDP95	-11.02915	-6.636018	-4.39313	6.019791
PDE95	-1.745352	-.8356885	-.9096634	1.663456
POLX95	1.328829	.6029799	.7258489	.9186493
LPOP95	-.2416163	-1.522791	1.281175	2.378609
OECD	22.00184	12.45444	9.547399	15.01295
LAAM	9.749583	7.146572	2.603011	10.46078
AAE	-1.389285	7.042761	-8.432046	7.367
b = consistent under Ho and Ha; obtained from ivreg B = inconsistent under Ha, efficient under Ho; obtained from OLS regress				
Null Hypothesis, Ho: difference in coefficients not systematic				
chi2(9) = 2.17				
Prob>chi2 = 0.9886				

We are estimating the model given in equation (5.33) including public defence expenditure ($PDE95$) variable with instrumental variable (IV) and OLS estimation technique. Estimated results are given respectively in Table 5.1 and Table 5.2 in the appendix. We then test the difference of estimated coefficients between these two estimates. If the difference of estimated coefficients is not systematic, the model does not suffer endogeneity problem. This testing method is usually known as Hausman (1978) endogeneity test. The endogeneity test result is given in Table 5.3.The following estimated results show that the specified model does not suffer endogeneity problem anymore.

5.4.3 The panel analysis

In panel analysis, since we have huge missing observations in our dependent (Gini coefficient as a measure of income inequality) and independent variable (public education expenditure as percentage of GDP), we have taken three time points *(t=3)* of the dependent variable which is every five years point 1995, 2000 and 2005. If a country does not have an observation in any specific time point, we have considered the nearest one. The independent variable, public education expenditure as percentage of GDP is five years average value that means the average value of 1981 to 1985 is considered as the observation of 1985, average value of 1986 to 1990 is considered as the observation of 1990 and the average value of 1991 to 1995 is considered as the observation of 1995. The reason of taking only 3 (three) points of time in panel estimation is the unavailability of panel data for almost all the variables used in this study. Most of the countries in our sample do not have complete time series data of public education expenditure variable except some OECD countries. Although OECD countries also have some missing observations, other countries have more than 50 percent missing observation of this variable. That means out of 15 observations (1981 to 1995), we only have on average 6 to 7 observations for a country and they are scattered from 1981 to 1995. For example - Argentina has 2 observations from 1981 to1985, 3 observations from 1986 to 1990 and 3 observations from 1991 to 1995. Similarly, Brazil has only 3 observations- 1 observation in 1981, 1 observation in 1989 and 1 observation in 1994. We, therefore, have taken 3 values which are average of 1981 to1985, 1986 to 1990 and 1991 to 1995. As a result, we can manage at least 3 observations of this variable for each country in our panel estimation. Moreover, the variable, average years of schooling, has five years panel data in ~~t~~he Baro-Lee Educational Attainment Data set" which is another important explanatory variable in our panel analysis. Thus, we have taken 3 observations of all other independent

variables using the same procedure. Two exceptions are: for public defence expenditure *(PDE)* variable, which is considered at 1987, 1990 and 1995 points of time; and for corruption perception index *(CORP)* variable, which covers 1995, 2000 and 2005 points of time due to data limitations. The two advantages of taking lagged explanatory variables are- *firstly,* allow enough time to feel the complete effect of change in explanatory variables on the dependent variable. *Secondly,* it is less likely that estimated results suffer any reverse causality problem because it is very much likely in logical point of view that current values of all explanatory variables (public education expenditure, GDP per capita, years of schooling, defence expenditure, political stability) affect future values of income inequality but is unlikely that current values of all explanatory variables (public education expenditure, GDP per capita, years of schooling, defence expenditure, political stability) affect past values of income inequality. We, therefore, can say that our panel data set is not perfectly balanced.

There are several attractive features of panel analysis if one has the panel data set. *Firstly,* panel data analysis is very helpful to deal with the heterogeneity in the micro unit, in my case it is individual country. The heterogeneity means that all these countries are different from one another in a fundamental unmeasured way. Therefore, using cross-section analysis one cannot include all relevant variables which are appropriate for each country. As a result, cross-section analysis might produce biased results while panel data analysis helps to correct this problem. One might ask why we have conducted the cross-section analysis in this chapter before doing panel analysis. The reason for doing this is to answer the first research question which is the same as Sylwester (2002); thus, we think it would be better to replicate Sylwester‘s (2002) method using a different data set. *Secondly,* panel analysis uses more variability by combining variation across the country and over time which helps to alleviate the multicollinearity problem. We know the multicollinearity problem can be reduced by adding more observations. Since we are adding more information in panel analysis, such as-

time series data for each variable and each country, it helps to alleviate the multicollinearity problem. *Thirdly,* panel analysis can address the turnover question, that means one can repeat the same question to same unit every time in the data set because the data track a common sample of country over different years. *Finally,* it helps to get a dynamic adjustment which cross-section data analysis does not. There is hardly any work using panel estimation technique to find causal relationships between income inequality and public education expenditure. We, therefore, do believe that the study obviously gives some insights into the area of income inequality literature.

5.4.3.1 The fixed effects model

The general functional form of income inequality ($INEQ$) regressed on public education expenditure is *(PEE)*, average years of schooling is *(AYS)*, natural log of GDP is *(LGDP)*, natural log of population is *(LPOP)*, public defence expenditure is *(PDE)*, political stability is *(POLX)* and corruption perception index is *(CORP)*. No dummy variable is included in the specified general model because we have separated 62 countries into four regional groups- the *(OECD)* which covers 25 OECD member countries; the *(LAAM)* which covers 16 Latin American and the Caribbean countries (including Chile and Mexico two OECD member countries); the *(DAAE)* which includes 8 developing countries of Africa, Asia and East Europe and the *(LAA)* which includes 13 least developed African and Asian countries. We know, in the fixed effects estimation method, every individual entity has been assigned a dummy to separate from another entity. The specified general function is written as follows.

$$INEQ_{it} = \beta_0 + \beta_1 PEE95_{it} + \beta_2 AYS95_{it} + \beta_3 LGDP95_{it} + \beta_4 LPOP95_{it} + \beta_5 PDE95_{it} + \beta_6 POLX95_{it} + \beta_7 CORP_{it} + \vartheta_{it}[i = 1 \dots 62 \; and \; t = 1,2,3] \qquad (5.35)$$

where, $\vartheta_i \sim N(0, {\sigma_\vartheta}^2)$is an identically and independently distributed (iid) distribution, for each country.We are estimating the difference from the mean of the equation (35) by OLS method which gives us the fixed effects estimate.

5.4.3.2 The random effects model

Instead of treating β_i as a fixed constant, this specification assumes that β_i is drawn from an identically and independently distributed (iid) distribution, $\beta_i \sim N(0, {\sigma_\mu}^2)$ and is uncorrelated both with the $\vartheta_i$and with the independent variables. The specification then becomes as follows.

$$INEQ_{it} = \beta_0 + \beta_1 PEE95_{it} + \beta_2 AYS95_{it} + \beta_3 LGDP95_{it} + \beta_4 LPOP95_{it} + \beta_5 PDE95_{it} + \beta_6 POLX95_{it} + \beta_7 CORP_{it} + \mu_i + \vartheta_i \quad (5.36)$$

where, β is the mean of the random intercepts $\beta_i = \beta + \mu_i$ and the errors $\mu_i$and ϑ_i in the composite error term with variances ${\sigma_\mu}^2$ and ${\sigma_\vartheta}^2$respectively. Using the generalized least squares (GLS), equation (5.36) gives us the random effects estimate.

5.4.4 Specifications tests: Fixed Effects vs Random Effects methods

–Econometric analysis becomes much more than estimation and inference in the context of a given model" (Kennedy 1979, p. 71) and –specification tests form one of the most important areas for research in econometrics" (Hausman 1978, p.1251). That is why, econometric specification analysis plays an important role in finding the corresponding facts of a research work, thereby, defining a correctly specified model is the first task of conducting

an empirical research. We have used Hausman (1978)[22] test for choosing one specific estimation method between fixed effects and random effects.

Table 5.4: Empirical results of Hausman(1978) for Fixed vs Random Effects tests

	All countries	OECD countries	LAAM countries	DAAE countries	AAE countries
Hausman test statistic, χ^2_K	χ^2_7= 8.18	χ^2_7= 11.47	χ^2_7= 0.99	χ^2_7= 10.95	χ^2_7= 5.03
Probability value >χ^2_K	0.317	0.089	0.995	0.141	0.657
Decision rule	Cannot reject the null hypothesis	Cannot reject the null hypothesis	Cannot reject the null hypothesis	Cannot reject the null hypothesis	Cannot reject the null hypothesis
Preferred method	The random effects model is preferred	The random effects model is preferred	The random effects model is preferred	The random effects model is preferred	The random effects model is preferred

Note: K represents degree of freedom of χ^2- distribution.

We conduct Hausman (1978) test for all the countries first and then redo for all four groups of countries (the *(OECD)*, the *(LAAM)*, the *(DAAE)*, and the *(LAA)* countries) separately.

According to Hausman's (1978) test results, given in Table 5.4, we cannot reject the null hypothesis of ~~"n~~o systematic difference between the estimated coefficients between fixed effects and random effects". That means random effects method is preferred to fixed effects method. We, therefore, have conducted random effects estimation technique for all groups of countries.

5.4.5 Data

The study covers 64 countries[23] around the world in case of cross-country analysis. Among these countries, 27 are OECD member countries, 16 countries are from Latin America

[22] See detail about Hausman (1978) for testing process.

and the Caribbean *(LAAM)* except countries those are members of OECD (Chile, Mexico), 8 newly developing countries are from Africa, Asia and East Europe *(DAAE)* and 13 least developed countries are from Africa and Asia *(LAA)*except countries those are members of OECD (Japan, Israel, and Turkey).

In case of panel analysis, 62 countries are included. Four countries (Slovenia, Kyrgyz Republic, Latvia, and Lithuania) are excluded from it because of unavailability of observations on the dependent variable for these countries. Chile and Mexico are considered in both the *OECD* and the *LAAM* groups because these two countries‘ per capita GDP is far below than the other members of OECD, but they are very similar to the members of *LAAM*. We do not include Japan, Turkey and Israel in either of the *DAAE* group or the *LAA* group because of the enormous difference in per capita GDP with other members of these groups. These categorisations help us to compare the estimated results among the *OECD, LAAM, DAAE* and *LAA* groups of countries assuming that the OECD group is considered as highly developed countries, the *LAAM* group is considered as developing countries, the *DAAE* group is considered as newly developing countries and the *LAA* group is considered as the least developing countries around the world. Comparing the results among these groups will help us to answer the second research question of this chapter which is - whether the impact of education expenditure on income inequality varies according to the development status of a country or not.

Gini coefficients – an income inequality measure (INEQ)

We use Gini coefficients to measure the degree of income inequality as Sylwester (2002) does. The data of Gini value are taken from the WIDER (The World Institute for Development Economics Research). The advantage of using the Gini coefficient is the

[23] List of countries is given in appendix of chapter five

availability of panel data and the widespread use of the Gini coefficient as a measure of income inequality (Sylwester, 2002). In cross-section analysis, we take the difference of Gini values between 2005 and 1995 as dependent variable – the change in income inequality. The variable is symbolised as $\Delta INEQ_i$ where $'i'$ stands for country in cross-country analysis and is symbolised as $\Delta INEQ_{it}$ in panel analysis, where $'i'$ and $'t'$represent country and time respectively.

In panel analysis, we have taken every 5th year observation of Gini value for each country starting from the year 1995 to the year 2005. We, therefore, have taken 3 observations of Gini value for each country (Year 1995, 2000 and 2005). However, if a country does not have Gini value in the particular sample year, we have taken the observation of the nearest next year or the earlier year. Due to the unavailability of data, we are not able to take all the observations of 15 years; and about this the study (Sylwester, 2002 p. 45) asserts that ~~–it~~ is doubtful that the level of income inequality greatly changes over 1 or 2 years".

Public education expenditure as percentage of GDP (PEE)

The public education expenditure as a percentage of GDP is the fundamental explanatory variable used in this study. The data for this variable are taken from the UNESCO during the period 1980 to 1995. In cross-country analysis, we have taken the average of 15 years' public education expenditure as percentage of GDP. The variable is symbolised as $PEE95_i$.

In panel analysis, we have considered every 5 years' average of public education expenditure as a percentage of GDP at a time point. We have taken 3 time points for the variable at 1985 (average of 1981 to 1985), 1990 (average of 1986 to 1990) and 1995 (average of 1991 to 1995). We have chosen lagged public education expenditure because the

impact of these expenditures on income distribution takes years to be felt completely (Sylwester, 2002). The variable is symbolised as PEE_{it}.

If any country does have some missing observations during the 15 years, the average is calculated on the basis of available years of observations. If only one observation is available in any five year segment for a country, we have considered that observation as an average of those five years. Using the average of public education expenditure as percentage of GDP is a good instrument for comparison among countries as it reflects how much importance is given by the government on education sector relative to other sectors during the last 15 years, and also because the percentage is a non-scale measure.

Natural log of gross domestic product (LGDP)

The natural log of GDP per capita in the year 1995 is taken as an explanatory variable to capture an initial level of the development of a country and so does Sylwester (2002). It is assumed that ~~h~~higher income countries might be better equipped to narrow income inequality than are poorer nations" (Sylwester, 2002 p.45). The variable is symbolised as $LGDP95_i$ in cross-country analysis.

In panel analysis, we have taken data on the natural log of GDP per capita as an explanatory variable. The values of the natural log of GDP in the year 1985, 1990 and 1995 are considered as three time points of the panel data set. Per capita GDP is measured in current international dollar unit and the source is the IMF (International Monetary Fund, World Economic Outlook Database, October 2009).The variable is symbolised as $LGDP_{it}$.

Average years of schooling of adult population (AYS)

As a proxy measure of human capital, the average years of schooling of the adult populationare included in the study ~~to~~ control for existing human capital when trying to

ascertain any effects from additional expenditures" (Sylwester, 2002 p. 45). Fields (1980) points out a partial positive relationship between mean schooling level and earnings inequality and a positive relationship between schooling inequality and earning inequality, while the model predicts a reduction in earnings inequality if schooling inequality is reduced. The data for this variable is taken from the Barro and Lee (1994). In case of cross-country analysis, we have used the data on average years of schooling of the adult population in the year 1995. The variable is symbolised as $AYS95_i$.

For panel analysis, the data on this variable have been taken for the year 1985, 1990 and 1995; because in our panel data, we have considered those three time points for our other two independent variables. Five year panel data around the world are available in this data source and the variable is symbolised as AYS_{it}.

Although Sylwester (2002) uses the log of the total population, public defence expenditure, political stability, black market premium and a few other variables to cheque the robustness and the reverse causality of estimated initial regression of the change in income inequality on public education expenditure , log of GDP, average years of schooling and 4 (four) regional dummies (OECD, East Asia, Latin America and Africa); we have included these variables as explanatory variables in the general regression model. From this general model, we have sequentially eliminated the most insignificant variable to develop a specific model where most of the variables are significant and have good prediction power.

Natural log of total population (LPOP)

Sylwester (2002) uses the natural log of the total population of a country to control the size of the country and also to check the robustness of the baseline estimation. We have included this variable as an explanatory variable in the general model. Morley (1981) reports that population growth rate is directly related to the degree of income inequality. That means

the higher the total population, the higher the income inequality and vice versa if other things are controlled. The data on this variable are taken from Barro and Lee (1994). Here, the unit of measure of this variable is million and we have transferred this level form value into a natural log form. In cross-country analysis, the natural log of total population in the year 1995 is considered and the variable is symbolised as $LPOP95_i$.

In panel analysis, we have taken the data for the year 1985, 1990 and 1995 because of choosing three time points. The variable is symbolised as $LPOP_{it}$.

Political stability (POLX)

Alesina and Perotti (1996) say that political instability enhances income inequality that means countries having more income inequality are more likely to have prolonged political instability. We have taken democracy minus autocracy as proxy of the political stability of a country. Although democracy is considered as a good political system and autocracy is bad, in both cases the political movement can strongly affect the economic activity of a country. That is why we have chosen democracy minus autocracy as an indicator of the political stability of a country. Both democracy and autocracy are measured in 0-10 scale along with these three values -66, -77 and -88. These three values are defined as -66 for interruption, -77 for interregnum and -88 for transition. We have considered these 3 irregular codes as the highest level of autocracy and have assigned a value of 10 in autocracy index. Both the scales are ascending in order that means 0 is the lowest level of democracy or autocracy and 10 is the highest level. The data for this variable is compiled from the website of Paul Hensel‘s International Economic Data website. In cross-country analysis, we have used 15 years‘ (1980 to 1995) average of this variable and is symbolised as $POLX95_i$.

In panel analysis, we have chosen every 5 years' average of 3 time points (1985, 1990, and 1995). The variable is symbolised as $POLX_{it}$.

Public defence expenditure (PDE)

The empirical estimates of Abell (1994) reveal that military spending is associated with increasing income inequality, after controlling for macro-economic variables such as taxes, economic growth, interest rates, inflation and non-military spending. We, therefore, have included this as an independent variable in the specification of the general model. Military spending as percentage of GDP as we have called public defence expenditure ***(PDE)*** data are taken from the World Bank. The source covers the data from 1987 to 2007. We have taken the average of military spending as percentage of GDP from the year 1987 to 1995 in cross-country analysis and the variable is symbolised as $PDE95_i$.

In panel analysis, the observation of 1987 is considered as the observation of time point 1985, and the average of 1988 to 1990 is considered as time point 1990. The average of 1991 to 1995 is considered as the observation of 1995. The variable is symbolised as PDE_{it} .

Corruption perception index (CORP)

Gupta et. al. (1998) reports that high and rising corruption increases income inequality and poverty by reducing economic growth. We, therefore, have included corruption perception index ***(CORP)*** as an explanatory variable only in panel analysis. The corruption perception index developed by the Transparency International covers a wide range of corruption measures. Since the Transparency International has started preparing the CORP index since 1995 for developed countries and later on it covers nearly 139 countries around the world, the data are available from the year 1995 and later on. We, therefore, have used this variable in panel analysis only. We have chosen the observation of 1995 as the observation

for the time point 1985, the average of 1996 to 2000 as the observation for the time point 1990 and the average of 2001 to 2005 is considered as the observation for the time point 1995. Although all the other independent variables are lagged values, the data on *CORP* variable is at the same time points of dependent variable due to the unavailability of data earlier. The variable is symbolised as $CORP_{it}$.

5.5 Empirical Results

5.5.1 Descriptive Analysis

In this study, we have conducted cross-country estimation of 66 countries and a panel estimation of 62 countries. As mentioned earlier, we have dropped four countries in panel analysis due to the unavailability of data for all variables. In cross-country analysis, three regional dummies- the Organisation of Economic Cooperation and Development *(OECD)*, Latin America and the Caribbean *(LAAM)* and Asia and East Europe *(AAE)* are included; and Africa is considered as base region. All these dummies are included both as additive forms and multiplicative forms with each explanatory variable in the cross-country analysis. Including regional dummies helps us to evaluate the consequences of public education expenditure on income inequality in these regions and to distinguish the consequences among the regions. However, five separate panel estimations have been done deliberately; such as - for all countries (62 countries), for the highly developed *OECD* (25 countries), for the developing *LAAM* (16 countries), for the newly developing Africa, Asia and East European countries *(DAAE)* (8 countries) and for the least developed Africa and Asian countries *(LAA)* (13 countries); to avoid prospective heterogeneity problem and for distinguishing estimated results from all countries to four different regions. These separate estimation results facilitate us to answer the second research question of this chapter- whether

the development status of a country determines the impact of public education expenditure on income inequality.

The following descriptive statistics are based on the panel data sets for all four regions. Therefore, income inequality *(Gini)* variable covers time points 1995, 2000 and 2005; and independent variables- public education expenditure as percentage of GDP *(PEE)*, per capita gross domestic product *(GDP)*, average years of schooling of adult population *(AYS)* and political stability measure *(POLX)* wrap three lag time points 1985, 1990 and 1995; but the public defence expenditure *(PDE)* covers 1987, 1990 and 1995; and corruption perception index *(CORP)* covers 1995, 2000 and 2005 time points. Table 5.5 shows the descriptive statistics of all the variables.

The statistics indicate that on average income inequality is the highest in Latin America and the Caribbean *(LAAM)* region compared to the other three regions- the *OECD*, the *DAAE* and the *LAA*. The highly developed OECD countries have the lowest average income inequality followed by the *DAAE* and the *LAA*. The standard deviation of the income inequality distribution is the lowest in the *LAAM* region among these four regions which implies that the individual value is closer to the average value. We, therefore, infer that income inequality is more severe in the *LAAM* region than that of the other regions.

On average 4.7 percent public education expenditure as percentage of GDP is allocated in the *OECD* countries, which is the highest among these regions, followed by the *DAAE* and the *LAAM*; and the lowest allocation is in the *LAA* region. Naturally the average GDP per capita is the highest in the *OECD* region, which is; nearly double than the *DAAE* region, three times larger than the *LAAM* region and fifteen times bigger than the *LAA* region.

Table 5.5: Descriptive Statistics

Var.	OECD countries				
	Obs.	Mean	Std. Dev.	Min	Max
Gini	75	34.73	7.98	23.00	61.40
PEE	75	4.70	1.44	1.47	8.00
GDP	75	10872.34	4529.28	2756.20	24724.92
AYS	75	8.68	1.98	3.55	12.23
PDE	75	2.86	2.58	0.50	15.40
POLX	75	8.11	4.57	-7.00	10.00
POP	75	34.29	50.16	0.36	245.13
CORP	75	7.17	1.95	2.99	10.00
Var.	**LAAM countries**				
	Obs.	Mean	Std. Dev.	Min	Max
Gini	48	52.55	5.76	37.90	62.15
PEE	48	3.39	1.59	1.15	7.35
GDP	48	3384.54	1386.39	1638.64	6578.11
AYS	48	5.79	1.47	2.77	8.40
PDE	48	1.80	1.04	0.50	4.90
POLX	48	-2.06	22.45	-10.00	10.00
POP	48	20.65	33.65	1.96	141.26
CORP	48	3.67	1.43	2.10	7.55
Var.	**DAAE countries**				
	Obs.	Mean	Std. Dev.	Min	Max
Gini	24	39.75	11.27	23.10	59.00
PEE	24	4.35	1.11	2.45	6.72
GDP	24	5108.85	3073.13	1089.43	13275.17
AYS	24	7.12	1.94	4.40	10.81
PDE	24	2.94	1.34	0.20	4.60
POLX	24	3.13	6.05	-7.00	10.00
POP	24	16.36	16.01	0.97	54.70
CORP	24	4.99	1.78	2.79	9.40
Var.	**LAA countries**				
	Obs.	Mean	Std. Dev.	Min	Max
Gini	39	43.71	9.52	28.97	62.50
PEE	39	3.06	1.69	0.83	7.08
GDP	39	730.77	372.55	251.12	1532.88
AYS	39	4.09	2.05	0.62	8.92
PDE	39	2.36	1.61	0.40	7.00
POLX	39	-4.97	5.34	-10.00	8.00
POP	39	118.11	274.64	5.74	1109.74
CORP	39	2.63	0.61	1.70	4.10

Having a higher average of GDP and allocating higher percentage on education expenditure might help to keep a low level of income inequality. The mean value of the average years of schooling of the adult population is 8.68 years for the *OECD* region followed by the *DAAE* region (7.12 year), while the average year of education for the *LAAM* region is 5.79 years and for the *LAA* region is 4.09 years. The average allocation on public defence expenditure is the highest in the *DAAE* region (2.94 percent of GDP) followed by the *OECD*

(2.86 percent of GDP). The least developed *LAA* region has higher defence expenditure (2.36 percent of GDP) than that of the developing *LAAM* region (1.80 percent). However, the *LAA* region is politically the most instable among the other three regions. The *OECD* region is the most politically stable followed by the *DAAE* region. The average population is the highest in the *LAA* region (118.11 million) followed by the *OECD* (34.29 million), the *LAAM* region (20.65 million); and the poorest in the *AAE* region compared to the *OECD* region (34.29 million), the *LAAM* region (20.65 million) and the *DAAE* region (16.36 million). The *LAA* region is considered as the most corrupted region among all these regions.

5.5.2 Replication of Sylwester (2002) method using different sample countries and data set

The following result is found by using Sylwester's (2002) estimation method with 66 sample countries (different from Sylwester, 2002) and time series data set started from 1980 to 1995 for explanatory variables and from 1995 to 2005 for explained variable. The result helps us to verify the consistency of Sylwester's (2002) finding and for answering the first question of this chapter. We have replicated the following equation of Sylwester (2002, p.46).

$$\Delta INEQ_i = \beta_0 + \beta_1 PEE95_i + \beta_2 LGDP95_i + \beta_3 AYS95_i + \beta_4 OECD95_i + \beta_5 LAAM_i + \beta_6 AAE_i + \vartheta_i \quad (5.53)$$

The estimated results are shown in equation (5.54). Unlike Sylwester (2002), we have found the public education expenditure to be statistically strongly significant at less than 1% level with a positive sign of the coefficient and log of GDP is significant at less than 10% level with a negative sign. None of the regional dummies are statistically significant.

$$\Delta INEQ9505 = 33.25^{*} + 0.003\ PEE8095^{***} - 4.27 LGDP95^{*} + 0.077\ AYS95$$
$$(19.997) \quad (0.0008) \quad (2.369) \quad (0.728) \quad (5.54)$$
$$+ 7.85\ OECD95 + 6.56\ LAAM + 3.52\ AAE$$
$$(6.71) \quad (7.48) \quad (5.997)$$

where, Adjusted R^2 *= 0.015 and F-statistic = 1.169.*

The results imply that public education expenditure directly affects income inequality as the opposite of the Sylwester's (2002) result although the coefficient is very small in magnitude. Sylwester (2002) has found that the average years of schooling of adult population is highly significant with negative sign but we have found the opposite result in this case having a positive sign which is statistically insignificant. One reason of getting the opposite result might be the difference in sample country. We have not included 11 sample countries, those Sylwester (2002) has considered in his sample of 50 countries, but as we have a sample of 66 countries in total; so, we have 39 common countries and 27 different countries. Sylwester (2002) does not include a multiplicative form of dummy variables to check the difference in slope among these regions which may be another reason of getting opposite result. That is why we have included all multiplicative forms of dummy variables with each explanatory variable in our general cross-country model which is given in equation (5.34) and have reported the results in Table 5.6. The estimated coefficients of multiplicative forms of dummies reflect whether the slopes of explanatory variables differ due to dummies while the additive forms of dummies only show intercept difference. However, the important issue that is needed to be mentioned is that although the sample countries and time period of data set are different, notably opposite results indicate that public education expenditure cannot always reduce income inequality; moreover, it can increase income inequality of a country. We, therefore, need to research the relationship more meticulously that we have done in the next section by cross-country analysis as well as panel analysis.

5.5.3 Cross-country analysis

After getting an opposite conclusion replicating Sylwester (2002), we have chosen a general model given in equation (5.34) -which includes all explanatory variables except corruption perception index (CORP) and three regional dummy variables both as additive and multiplicative with all explanatory variables where African region is considered as base region inthe cross-country regression analysis. The specific model is derived after sequentially eliminating the insignificant variable from the general model with the help of t-score, R^2- value, Jarque-Bera normality test score. The results of the estimated general model and specific model are given in Table 5.6. The estimated model does not suffer normality problem and serial correlation problem of error term but does suffer heteroscadasticity problem.

The estimated results of the general model show that public education expenditure as percentage of GDP *(PEE95)*, average of the log value of per capita GDP of 1995 *(LGDP95)*, average political stability index *(POLX95)* and dummy variable of the OECD countries *(OECD* 95), Asia and East European countries *(AAE)* and the intercept term is statistically significant, that means the base region - African countries.

Among the multiplicative forms of dummies with all explanatory variables, such as public education expenditure *(PEE)* multiplied by the dummy *OECD*, called *PEEOECD,* so as *LGDPOECD, POLXOECD, PEEAAE, LGDPAAE* and *POLXAAE* are statistically significant. These estimated results imply that both the intercept and partial slope of the *OECD* region, the *AAE* region and the base region -African countries are statistically different for *PEE95, LGDP95* and *POLX95* variables. Similarly, public education expenditure *(PEE)* times the dummy *LAAM* is called *PEELAAM*. Although *PEELAAM* variable has been found to be statistically significant, the additive term of the *LAAM* variable is not significant. The

estimated partial slope coefficient of *PEE95* variable is positive (16.602) for base region - African countries. The cross product of this variable with OECD countries is (-15.216) and with the *AAE* region is (-16.601). We, therefore, can infer that the signs of partial slope for *PEE95* variable for the OECD region and the AAE countries are both positive and magnitudes are 1.39 and 0.001 respectively. We can predict that with a one percent increase in public education expenditure, 1.39 percent income inequality increases for the *OECD* region and 0.001 percent for the *AAE* region. The estimated partial slope coefficient of *LGDP95* variable is negative for both the *OECD* region and the *AAE* region although the magnitude is higher for the *OECD region* than that of the *AAE* region. The estimated partial slope coefficient of *POLX 95* variable is positive for the *OECD* region and negative for the *AAE* region although the magnitude is higher for the *OECD* region than that of the *AAE* region. Using the model specification methodology mentioned earlier, the specific model is chosen.

The estimated results given in Table 5.6 show that specific model does not suffer non-normality problem and serial correlation problem of error term but does suffer heteroscadasticity problem. We, therefore, have estimated the specific model with White-heteroscadasticity adjusted OLS estimation method. This technique does not change the values of estimated coefficient but adjust the standard error of the estimated coefficient. Therefore, prediction based on this technique is more reliable than the simple OLS in case of heteroscadasticity problem. Besides this, we also know that in presence heteroscadasticity problem in estimation, OLS estimates remain unbiased but lose precision of the estimated parameters. Thus, we at least can predict that our estimates are unbiased.

Table 5.6: Cross- country regression results for General and Specific models

	General Model		Specific Model	
	Coeff.	Std. Err.	**Coeff.**	**Std. Err.**
C	175.37***	50.51	**186.81*** **	**12.23**
PEE95	16.60***	5.13	**17.30*** **	**4.02**
LGDP95	-27.74***	9.68	**-29.92*** **	**2.94**
AYS95	-0.71	3.23		
PDE95	-7.67	5.66	**-7.55**	**5.29**
POLX95	3.23***	0.59	**3.31*** **	**0.67**
LPOP95	-9.09	7.31	**-10.10*** **	**3.80**
OECD95	-130.82**	64.60	**-142.50*** **	**39.62**
LAAM	-18.96	128.93	**-27.45**	**112.81**
AAE	-159.64***	57.75	**-163.14*** **	**24.07**
PEEOECD	-15.22***	5.29	**-16.00*** **	**4.18**
LGDPOECD	22.65**	10.69	**24.72*** **	**5.13**
AYSOECD	0.567	3.37		
PDEOECD	6.97	5.68	**6.86**	**5.31**
POLXOECD	-3.02***	0.71	**-3.08*** **	**0.77**
LPOPOECD	8.86	7.39	**9.93*** **	**3.91**
PEELAAM	-17.45***	6.02	**-18.24*** **	**5.11**
LGDPLAAM	9.07	18.82	**10.60**	**13.92**
AYSLAAM	0.39	5.98		
PDELAAM	9.54	7.18	**9.32**	**6.90**
POLXLAAM	-1.80	1.96	**-1.83**	**1.91**
LPOPLAAM	8.882	8.236	**10.101*** **	**4.090**
PEEAAE	-16.601***	5.130	**-17.297*** **	**4.022**
LGDPAAE	27.587***	10.051	**29.854*** **	**3.940**
AYSAAE	1.616	3.681		
PDEAAE	6.193	5.820	**5.772**	**5.400**
POLXAAE	-4.629***	0.878	**-4.654*** **	**0.921**
LPOPAAE	6.069	7.573	**6.569**	**4.074**
N	66		66	
Adjusted - R^2	0.21		0.29	
F-Sta.(Prob.)	1.60* (0.097)		2.05**(0.025)	
J-B Stat.(Prob.)	2.486 (0.288)		2.74 (0.254)	
White (Prob.)	3.375***(0.0005)		4.44***(0.00)	
LM Stat.(Prob.)	0.00008 (0.99)		0.0044 (0.947)	

(Std.Err. represents standard error of the coefficient is given. *, **, and *** indicate that the variable is significant at 10%, 5% and 1% level respectively. J-B Stat. indicates Jarque-Bera normality test statistic, White represents White heteroscadasticity test statistic and LM Stat. indicates Breusch-Godfrey serial correlation test statistics (Prob.) indicates probability of corresponding statistic)

The estimated results of the specific model show that the variables *(PEE95)*, *(LGDP95)*, *(POLX95)*, log of population at 1995 *(LPOP95),* dummy *(OECD* 95), dummy *(AAE)* and the intercept term are statistically significant. Among the multiplicative forms of dummies with all explanatory variables, *PEEOECD, LGDPOECD, POLXOECD,*

LPOPOECD, PEELAAM, LPOPLAAM, PEEAAE, LGDPAAE and *POLXAAE* are statistically significant. The estimated coefficient of the variable *(PEE95)* is positive and statistically significant at less than 1percent level with a magnitude of (17.30). It implies that for African region - withone percent increase in public education expenditure, 17.30 percent income inequality increases and vice versa if other things remain unchanged.The cross products of this *PEE95* variable with regional dummies *OECD95, LAAM* and *AAE* are respectively (-16.00), (-18.24) and (-17.30). We, therefore, can infer that the propensity to change in income inequality with respect to public education expenditure is positive for the African region, the *OECD* region and the *AAE* region but negative for the *LAAM* region. The magnitude of propensity to change in income inequality is not statistically different from African region to OECD region and the *LAAM* region but the *AAE* region (results are not reported). So we can infer that the propensity to change in income inequality due to changes in public education expenditure is positive with a magnitude of (0.001) for the *AAE* region but is (17.30) for the *OECD* and *LAAM*. The estimated coefficient of the variable *(LGDP95)* is negative and statistically significant at less than 1percent level with a magnitude of (-29.97). It implies that for African region, one percent increase in log value of per capita GDP lowers 29.97 percent income inequality and vice versa if other things remain unchanged. The cross products of this *LGDP95* variable with regional dummies *OECD95, LAAM* and *AAE* are respectively (24.72), (10.6) and (29.90) where the coefficient of the *LAAM* region is not statistically significant. We, therefore, can infer that the propensity to change in income inequality with respect to GDP per capita is negative for both the *OECD* region and the *AAE* region. That means changes in GDP per capita inversely changes income inequality if other things are held constant.

The estimated coefficient of the variable *(POLX95)* is positive and statistically significant at less than 1percent level with a magnitude of (3.305). It implies that in African region, one index point increase in political stability increases 3.31 point income inequality and vice versa if other things remain unchanged. The cross products of this (*POLX95)* variable with regional dummies *(OECD95)* and *(AAE)* are respectively (-3.08), and (-4.654). We, therefore, can infer that the propensity to change in income inequality with respect to political stability index is positive for both the *OECD* region and negative for the *AAE* region. That means the effect of political stability on change in income inequality has difference in sign and magnitude for these four regions. An improvement in political stability reduces income inequality in the *AAE* region while it increases in the *OECD* and the *AFR* regions.

The estimated coefficient of the variable *(LPOP95)* is positive and statistically significant at less than 1percent level with a magnitude of (-10.10). It implies that for the African region, with a unit increase in average log value of the total population, (10.10) point income inequality decreases and vice versa if other things remain unchanged. The cross products of this *(LPOP95)* variable with regional dummies the *OECD* and the *AAE* are respectively (9.93), and (6.57) which are not statistically significant. We, therefore, can infer that the propensity to change in income inequality with respect to the total population is negative for the *OECD* region. That means a unit increase in population, reduces income inequality in the *OECD* region and vice versa if other things remain constant.

Although public defence expenditure variable *(PDE95)* and its cross terms with dummies are not found as significant variables, we cannot accept the null hypothesis of this variable and its cross terms with dummies are as redundant variables jointly. That is why, we keep this insignificant variable in our specific model.

The adjusted-R^2 is 0.29 and the F-statistics is statistically significant. Moreover, both the specific model and the general model do not suffer either normality problem or auto correlation problem; we, therefore, can rely on our predictions. From cross-country analysis, we have concluded that increasing public education expenditure cannot always reduce income inequality of a country which is refuted by Sylwester's (2002) finding. Since we have found in cross-country analysis that slope coefficients of public education expenditure have got different values for different regions, we study this difference with more details in panel analysis which is given below.

5.5.4 Panel Analysis

The general model specified in equation (5.55) is estimated both by fixed effects model and random effects model and then have conducted Hausman (1978) test. Hausman (1978) supports conducting random effects model for all four regions *(OECD, LAAM, DAAE and LAA)* and that is why, we have utilised random effects estimation technique throughout for getting a specific model separately for all these regions. The estimation results are given in Table 5.7.

All these estimated equations fit very well because in every case Wald χ^2 value is statistically significant at below 1percent level and the overall R^2 values of each general model are 0.28, 0.49, 0.45, 0.88 and 0.49 respectively for the *All Countries*, the *OECD* region, the *LAAM* region, the *DAAE* region and the *LAA* region. The overall R^2 values for each specific model are not lower than that of the general model for any region. Here, we see that the overall R^2 values for regional estimated equations are also higher than that of the *All Countries* model. It implies that our regional estimated equations are better fitted than the *All Countries'* estimated equation. In all cases, random effects models are preferred estimation method to fixed effects method.

In case of estimated model for the *All Countries* model, public education expenditure as percentage of GDP *(PEE)* variable has got positive sign with a magnitude of 0.37 though not statistically significant. The positive sign of the estimated coefficient of this variable implies that one percent increase in public education expenditure increases 0.37 percent income inequality and vice versa when other things remain constant. The positive sign has been found in the *LAAM* region, the *DAAE* region and the *LAA* region with a magnitude of 0.30, 1.86 and 1.51 respectively. The estimated coefficient is significant at below 10 percent for the *DAAE* region only. In specific models, the estimated coefficients of the *PEE* variable of the *LAAM*, the *DAAE* and the *LAA* also have got positive sign. The estimated coefficient of this variable in specific model is statistically significant at below 10 percent level for the *LAA* region and 1 percent level for the *DAAE* region but insignificant for the *LAAM* region.

The magnitude of the estimated coefficient for the *DAAE* and the *LAA* regions are very large compared to that of the *LAAM* region and the *All Countries*. Since the specific models of all these three regions predict the positive sign for the coefficient of this variable; we, therefore, conclude that public education expenditure positively affects income inequality of the developing regions. The impact is strong for the least developed countries. However, the estimated coefficient for public education expenditure in the *OECD* region has got a negative sign with a magnitude of 0.31 and 0.12 respectively in general model and specific model though not statistically significant. The negative sign indicates that a unit increase in public education expenditure, reduces income inequality and vice versa if other things remain the same. We, therefore, predict that increasing public education expenditure can reduce income inequality of the highly developed *OECD* region.

Table 5.7: Results of panel estimations for countries categorised on Regions

	All Countries		Developed OECD Countries (OECD)		Developing countries in Latin America and Caribbean (LAAM)		Developing countries in Africa, Asia and East Europe (DAAE)		Least developed countries in Africa and Asia (LAA)	
	General	Specific	General	Specific	General	Specific	General	Specific	General	Specific
PEE	0.37	0.42	-0.31	-0.12	0.30	0.27	1.86*	2.23***	1.51	1.74*
(S.E)	(0.51)	(0.50)	(0.67)	(0.66)	(0.57)	(0.53)	(1.05)	(0.92)	(1.22)	(1.06)
LGDP	-0.43		-4.50**	-4.53**	-10.68***	-11.0***	8.48		2.17	
(S.E)	(1.52)		(1.98)	(1.94)	(3.66)	(3.13)	(6.65)		(3.99)	
PDE	-0.11		0.36		0.30		2.13	4.42***	-0.07	
(S.E)	(0.57)		(0.44)		(1.32)		(2.04)	(0.96)	(1.21)	
POLX	-0.09***	-0.09***	-0.22	-0.20	-0.07**	-0.07**	0.33	0.60***	-0.23***	-0.23***
(S.E)	(0.03)	(0.03)	(0.15)	(0.15)	(0.03)	(0.03)	(0.29)	(0.21)	(0.09)	(0.09)
AYS	-0.49	-0.64	1.16*	1.21*	1.13	1.07	-7.13***	-5.20***	1.08	1.45*
(S.E)	(0.62)	(0.48)	(0.68)	(0.68)	(0.95)	(0.77)	(1.72)	(0.50)	(1.21)	(0.85)
CORP	-1.31**	-1.29***	-0.93	-1.03*	-0.34		-1.56		3.99	3.27
(S.E)	(0.61)	(0.53)	(0.61)	(0.61)	(1.05)		(1.73)		(2.96)	(2.73)
LPOP	-0.76		1.30	1.31	3.21***	3.28***	1.13		-1.85	-1.94
(S.E)	(0.84)		(0.86)	(0.89)	(1.11)	(0.98)	(1.44)		(1.66)	(1.45)
Cons.	56.24***	51.2***	71.49***	71.83***	124.68***	126.9***	9.58	52.24***	15.1	28.89***
(S.E)	(9.91)	(3.23)	(15.74)	(15.39)	(25.37)	(21.86)	(33.31)	(5.73)	(26.7)	(11.55)
Obs.	186	186	75	75	48	48	24	24	39	39
Groups	62	62	25	25	16	16	8	8	13	13
R^2 -value										
w.	0.064	0.06	0.048	0.06	0.191	0.19	0.10	0.14	0.25	0.23
b.	0.304	0.30	0.533	0.49	0.579	0.57	0.96	0.96	0.62	0.63
o.	0.278	0.27	0.491	0.45	0.445	0.44	0.88	0.86	0.49	0.49
F-stas.										
Prob>F-stas										
Wald $\chi^2(k)$	31.20 (7)	31.12 (4)	23.74 (7)	21.55 (6)	20.38 (7)	22.41 (5)	118.3 (7)	121.2 (4)	18.01(7)	21.05 (5)
Prob>$\chi^2(k)$	0.0001	0.0000	0.001	0.001	0.0048	0.000	0.000	0.000	0.01	0.000
Hausman	8.18 (7)		11.47 (7)		0.99 (7)		10.95		5.03 (7)	
$\chi^2(k)$	0.31		0.089		0.99		0.14		0.66	
Prob>$\chi^2(k)$										
Decision	Random effects model supported		Random effects model supported		Random effects model supported		Random effects model supported		Random effects model supported	

(In the parenthesis standard error of the coefficient is given. *, **, and *** indicate that the variable is significant at 10%, 5% and 1% level respectively. w. b. and o. indicates R^2 -value within, between and overall respectively.(k)indicates degree of freedom of χ^2-statistic)

To check the robustness of this finding, we have grouped all these countries into three regions according to the GDP of each country in the year 2009 which is outside value of our data set. The highly developed region is defined as a country having GDP more than 20000 US Dollar. All OECD countries except Chile, Mexico and Turkey but Singapore are being the highly developed region. The developing region is defined as a country having GDP between 5000 and 20000 US Dollar. Most of Latin America and the Caribbean countries except Bolivia, Guatemala, Honduras and Nicaragua; some Asian countries China, Malaysia,

Thailand, Turkey; some East European countries- Bulgaria, Czech Republic and Hungary; and two African countries – South Africa and Mauritius are developing region. Finally, the least developed region is defined as a country having a GDP less than 5000 US Dollar. Mostly the African and Asian countries including Bolivia, Guatemala, Honduras and Nicaragua are in this region. We have estimated the same general and specific models with random effects method and have found that the sign of the coefficient of the public education expenditure variable is negative for the highly developed countries and the developing countries but positive for the least developed countries. The results are given in Table 5.8 in the Appendix. We, therefore, confirm that the development status of a country helps to determine the impact of public education expenditure on income inequality of a country. The impact is negative that means increasing public education expenditure reduces income inequality and vice versa for the highly developed countries only, but the opposite is true for the least developing countries and some developing countries also. Some other factors may also have an impact on income inequality which is discussed below.

The log value of GDP is found statistically significant for the *OECD* and the *LAAM* regions with negative sign but the variable is found to be insignificant in the estimated models for the *All Countries*, for the *DAAE* and the *LAA* regions. The sign of the coefficient is negative in estimated models for *All Countries* but is positive for the *DAAE* and the *LAA* regions. The magnitudes of the estimated coefficient for the *OECD* region and the *LAAM* region are respectively 4.5 and 10.68 in estimated general models. That means one percent increase in GDP reduces 4.5 percent income inequality in the *OECD* region and around 11 percent for the *LAAM* region and vice versa when other things remain constant. That means a country having a high GDP implies a low income inequality.

The variable, political stability index *(POLX)* is found statistically significant for all estimated models except the *OECD* region. The variable has got a negative sign for all regions except the *DAAE* region although the magnitudes are different for different regions. The negative sign of the estimated coefficient indicates that an improvement in the political stability index of a country reduces income inequality of the country and vice versa. The magnitude of the estimated coefficient of this variable is the biggest in the *LAA* region among the *OECD* region, the *LAAM* region and the *All Countries*. This result indicates that political stability is a more important factor in determining income inequality in the least developed region compared to the other three regions. This prediction follows the finding of Alesina and Perotti (1996) where they mention that political instability enhances income inequality. The positive sign of this variable for the *DAAE* region is not as we expect but the coefficient is not significant in the estimated general model but highly significant in specific model.

The average year of schooling *(AYS)* is highly and negatively significant for the *DAAE* region. That means an increase in average year of schooling reduces income inequality for this region. The estimated coefficient of this variable is positively and weakly significant for the *OECD* region both in general and specific models, while the variable is positively and weakly significant for the *LAA* region in specific model only. The positive sign indicates a direct relationship between average year of schooling and income inequality which is not unexpected. Because the model for developing countries results that the higher average year of schooling, the higher the income inequality- is not unlikely when only a specific fraction of the population has access to school. The result also supports the finding of Hendel et al., (2005) in where public education expenditure increases income inequality.

The variable corruption perception index *(CORP)* is found to be negatively and statistically significant both in the estimated general and specific models for the *All Countries,*

weakly significant for the *OECD* region in the estimated specific model and insignificant for the *LAAM* region and the *DAAE* region. Since, the higher value of corruption perception index *(CORP)* indicates less corruption, the negative sign implies that an improvement of this index reduces income inequality as we expected and support the finding of Gupta et. al.(1998). However, the coefficient of this variable has got a positive sign though not statistically significant for the *LAA* region. Our intuition behind this unexpected result is that corruption is so severe in this region that relatively less corrupted country in this region has also got more income inequality. That means, other factors are more important to determine the income inequality in this region.

The log value of total population *(LPOP)* is found to be positively and strongly significant determinant of income inequality in the *LAAM* region only. One percent increase in total population increases more than 3 percent income inequality in this region. This prediction supports the finding of Morley (1981). So, we can forecast that the higher the total population, the higher the income inequality in the *LAAM* region.

Public defence expenditure *(PDE)* is not found to be a significant variable in any estimated model except the specific model of the *DAAE* region with a positive sign. That means increase in public defence expenditure increases income inequality and vice versa if other things remain constant for the region. This prediction is also what we expected because Abell (1994) reveals that military spending is associated with increasing income inequality.

Finally, we want to emphasise the relationship between public education expenditure and income inequality according to the development status of countries to answer our second research question in this chapter. The public education expenditure as percentage of GDP *(PEE)* is found to have negative sign but is statistically insignificant for the *OECD* region. The variable *PEE* has a negative sign for the highly developed and the developing regions

during robustness check which is done by grouping these regions according to GDP. The consistency of sign between these two estimations indicates that public education expenditure reduces income inequality and vices versa if other things are held constant in the *OECD* region or high income countries only. This finding supports the conclusion of Sylwester (2002) as well as the theoretical derivation for the developed countries where additional public education expenditure is utilised for improving the quality of education system. On the other hand, the variable *PEE* has positive sign and is statistically significant for the *DAAE* region, the *LAA* region and is insignificant for the *LAAM* region. It is also found during the robustness check that the variable is positively and significantly related to the income inequality in the least developed region. The consistency of sign among these estimates indicates that an increase in public education expenditure increases income inequality and vices versa if other things are held constant for the *DAAE* and the *LAA* regions, in another way, the least developed countries. This finding refutes the conclusion of Sylwester (2002) but supports the theoretical model derived in this study for the developing countries, where additional public education expenditure is used for increasing the quantity of education. The results are therefore sufficient to answer the second question of this chapter that the development status of a country helps to determine the impact of public education expenditure on income inequality.

5.6 Conclusions

The fundamental objectives of this study are to solve the ambiguities that the public education expenditure affects income inequality, the sign or direction of this effect, the difference of this effect between the highly developed countries, the developing countries and the least developed countries. Keeping these objectives in mind, our theoretical model shows that public education expenditure reduces income inequality for the highly developed

countries where additional education expenditure is utilised for improving basic skill of workers in a society consisting of skilled and unskilled workers. On the other hand, public education expenditure increases income inequality for developing countries where additional education expenditure is utilised for improving the quantity of educated workers in a society consisting of literate and illiterate workers. Theory shows that in both types of society, additional public education expenditure is a*„Pareto improvement'* as long as the tax rates imposed on the beneficiary of education expenditure is less than or equal to the marginal rate of return from education. We, therefore, believe that the theoretical model solves these three ambiguities that public education expenditure affects income inequality and the direction of this effect is opposite for the highly developed countries and is direct for the developing or the least developed countries.

The empirical findings also support the theoretical findings that public educational expenditure causes changing income inequality through the endogeneity test of empirical model. Public education expenditure reduces income inequality of the highly developed *OECD* region and increases income inequality of the developing *LAAM,* the *DAAE* and the least developed *LAA* regions.

Not only public education expenditure but also per capita GDP, corruption perception index, political stability affect income inequality of the highly developed *OECD* countries; and per capita GDP, average years of schooling of adult population, total population of and country and political stability affect income inequality of the developing *LAAM*, the *DAAE* and the least developed *LAA* regions.

Appendix : Chapter Five

Table 5.1: Result of Instrumental Variable (IV) estimation method

Dependent Variable: ineq				
Method: Instrumental variables (2SLS) regression				
No. of observation (adjusted): 61				
Instrumented: pee8095 Instruments: ays95 lgdp95 pde8795 polx8095 lpop95 oecd95 laam AAE gini95 gini90 laerm95 gerr95				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
pee8095	.0368696	.0230319	1.60	0.116
ays95	-1.552104	2.101835	-0.74	0.464
lgdp95	-11.02915	6.661237	-1.66	0.104
pde8795	-1.745352	1.863363	-0.94	0.353
polx8095	1.328829	1.011581	1.31	0.195
lpop95	-.2416163	2.665692	-0.09	0.928
oecd95	22.00184	16.72519	1.32	0.194
laam	9.749583	11.86083	0.82	0.415
AAE	-1.389285	12.89705	-0.11	0.915
_cons	94.10015	48.23741	1.95	0.057
R-squared		MS square of Regression		-2035.81
Adjusted R-squared		MS square of Residuals		501.31
F(9, 51)	0.56			
Prob> F	0.8191			

Table 5.2: Result of Ordinary Least Square (OLS) estimation method

Dependent Variable: ineq				
Method: Ordinary Least Square (OLS) regression				
No. of observation (adjusted): 61				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
pee8095	.0031894	.0025556	1.25	0.218
ays95	-.6786428	.9623665	-0.71	0.484
lgdp95	-6.636018	2.852051	-2.33	0.024
pde8795	-.8356885	.8396653	-1.00	0.324
polx8095	.6029799	.4235318	1.42	0.161
lpop95	-1.522791	1.203384	-1.27	0.211
oecd95	12.45444	7.371794	1.69	0.097
laam	7.146572	5.590297	1.28	0.207
AAE	7.042761	5.533284	1.27	0.209
_cons	59.59762	20.21502	2.95	0.005
R-squared	0.1990	MS square of Regression		160.17
Adjusted R-squared	0.0576	MS square of Residuals		113.78
F(9, 51)	1.41			
Prob> F	0.2097			

Table 5.8: Results of panel estimations for countries categorised on GDP

	All Countries		Highly Developed Countries		Medium Developed Countries		Least Developed Countries	
	General	Specific	General	Specific	General	Specific	General	Specific
PEE	0.36	0.36	-0.25	-0.46	-0.62	-0.59	0.64	0.72
(S.E)	(0.53)	(0.51)	(0.70)	(0.64)	(0.79)	(0.76)	(1.00)	(0.87)
LGDP	-0.23		-1.98	-2.66	3.48	3.47	1.27	
(S.E)	(1.52)		(1.91)	(1.75)	(2.80)	(2.71)	(2.79)	
PDE	-0.10		0.68*	0.71**	0.12		0.07	
(S.E)	(0.56)		(0.37)	(0.36)	(1.67)		(1.01)	
POLX	-0.08***	-0.08***	-0.16		0.08	0.08	-0.10**	-0.11***
(S.E)	(0.03)	(0.03)	(0.21)		(0.12)	(0.12)	(0.05)	(0.04)
AYS	-0.52	-0.59	0.56	0.47	-3.47***	-3.43***	1.28	1.45**
(S.E)	(0.62)	(0.48)	(0.60)	(0.60)	(1.09)	(1.03)	(0.95)	(0.66)
CORP	-1.46***	-1.51***	-0.41		0.77	0.91	0.02	
(S.E)	(0.61)	(0.55)	(0.56)		(1.54)	(1.39)	(3.35)	
LPOP	-0.91	-0.93	0.57	0.73	-0.47		-4.28**	-4.36***
(S.E)	(0.82)	(0.80)	(0.72)	(0.69)	(1.31)		(2.00)	(1.31)
Cons.	55.51***	54.12***	48.78***	52.08***	40.42**	38.53**	41.02	49.05***
(S.E)	(9.81)	(4.08)	(15.61)	(15.02)	(20.27)	(18.81)	(25.98)	(6.57)
Obs.	180	180	69	69	63	63	48	48
Groups	60	60	23	23	21	21	16	16
R^2 -value								
w.	0.06	0.06	0.10	0.002	0.05	0.05	0.15	0.15
b.	0.34	0.35	0.33	0.33	0.40	0.39	0.71	0.70
o.	0.31	0.31	0.28	0.28	0.36	0.35	0.54	0.54
Wald $\chi^2(k)$	33.38 (7)	34.23 (7)	9.37 (7)	8.04 (5)	11.13 (7)	11.55 (5)	27.56	33.12
Prob>$\chi^2(k)$	0.000	0.000	0.23	0.15	0.13	0.04	0.000	0.000
Hausman$\chi^2(k)$	7.52 (7)		13.05 (7)		5.47 (7)		6.77 (7)	
Prob>$\chi^2(k)$	0.38		0.07		0.60		0.45	
Decision	Random Effects model supported		Random Effects model supported		Random Effects model supported		Random Effects model supported	

(In the parenthesis standard error of the coefficient is given. *, **, and *** indicate that the variable is significant at 10%, 5% and 1% level respectively. w. b. and o. indicates R^2 -value within, between and overall respectively.(k)indicates degree of freedom of χ^2-statistic)

Table 5.9: List of sample countries

The OECD countries	The LAAM countries	The DAAE countries	The LAA countries
Australia	Argentina	Bulgaria	Bangladesh
Austria	Bolivia	Czech Republic	China
Belgium	Brazil	Latvia	Cote d'Ivoire
Canada	Chile	Lithuania	Ghana
Chile	Colombia	Hungary	Indonesia
Finland	Costa Rica	Malaysia	Kenya
France	Dominican Republic	Mauritius	Kyrgyz Republic
Greece	Guatemala	Singapore	Malawi
Ireland	Honduras	South Africa	Mali
Israel	Jamaica	Thailand	Pakistan
Italy	Mexico		Philippines
Japan	Nicaragua		Sri Lanka
Luxembourg	Panama		Uganda
Mexico	Paraguay		Zambia
Netherlands	Uruguay		
New Zealand	Venezuela		
Norway			
Poland			
Portugal			
Spain			
Sweden			
Switzerland			
Turkey			
United Kingdom			
United States			

Chapter Six

Effects of two Education Policies on Educational Development in Bangladesh

Abstract

This chapter consists of two parts. Part one deals with evaluating the success of the "(Obligation to) Primary Education Act – 1990" (PEA 1990) – a significant education policy introduced by the Government of Bangladesh (GoB) in 1993. We have developed a theoretical model of the demand for compulsory education for both parts of the chapter. The theory shows that equilibrium demand for schooling decision depends on the opportunity cost of education, preference for education, and parent's income. Using annual time series data from 1980 to 2005 (the PEA 1990 has been implemented in 1993) we have analysed both demand and supply sides factors of school attendance. Using "Autoregressive Distributed Lag (ADL)" estimation model, we have used "Impulse Indicator Saturation (IIS)" technique to evaluate the success of the PEA 1990 policy measure. The estimated result illustrates that the PEA 1990 policy has not achieved to target. Part two analyses the combined impact of two educational policies – the PEA 1990 and the "Female Secondary School Stipend -1994 (FSSS 1994)", on school attendance of population aged between 5 year and 24 year and on the literacy rate of the population aged 5 years and above. Using district level panel data of 62 districts (out of 64 districts in Bangladesh) for two time points 1991 and 2001, we have conducted fixed effects estimation method on the two indicators (number of school attendance and literacy rate) of educational development. The estimated results demonstrate that combined policies have an enormous effect on both the indicators as do some other development factors, for instance- family size, annual growth rate, possession of agricultural land of the district.

PART ONE

An analysis of the "(Obligation to) Primary Education Act – 1990" in Bangladesh: theory and empirics

6.1.1 Introduction

Education has several significant impacts on the development of a society. Studies (Schultz 1963; Becker 1993) view that education builds human capital that directly enhances productivity. They mention that investing human capital via education yields a return like investing in physical capital and the role of education is considered as an engine of growth. Adelman and Morris (1967) and Putnam (1993) focus that education creates social capital by instilling patriotic values, developing a sense of community, inhibiting criminal and other antisocial behaviour, providing a common language and cultural norms that improve the efficiency of communication and economic transaction. Considering the significance education the "Universal Declaration of Human Rights" makes education a basic need for an individual. At present, it is no more an elitist need in any society. Considering the importance of education, all developed countries around the world have made up to a certain level of education free and compulsory for all of their residents at a very early stage of their development such as Japan, the most developed country in Asia, had high levels of education before they advanced towards industrial development (Sen. 1999). There are many developing countries that are far behind to introduce free and compulsory education up to a basic level. The Government of Bangladesh (GoB) has introduced compulsory, universal primary education by "(Obligation to) The Primary Education Act, 1990" (The Bangladesh Gazette, Act No. 27 of 1990) (the PEA 1990 hereafter)which was piloted partially in 1992 and has been implemented fully from 1993**.** But still the country is struggling to achieve universal primary education for all of her primary school going age children. In part one of this chapter, we

would like to study the question- *why the government of Bangladesh is struggling to implement universal primary education successfully for all of its primary school aged children after nineteen years of the policy inception.*

6.1.2 A brief scenario of primary and secondary education in Bangladesh

Bangladesh has achieved independence in 1971 after nine months of liberation war. The Bangladesh Constitution, Part II dealing with ―Fundamental Principles of State Policy" requires the State to secure to its citizens the provision of basic necessities of life including food, clothing, shelter, education and medical care (Article 15) and Article 17 as quoted in paragraph eight above speaks of ―establishing universal system of education and extending free and compulsory education to all children ... and removing illiteracy." The two Articles of the Constitution are taken to recognise education as a basic right of every citizen**.** In the year 1990, the parliament of the country has passed the PEA 1990 and the Act has been implemented since 1993. So, the country has observed more than 18 years of compulsory primary education regime. From Table 6.8 (in appendix) we see that the first, second and third five year plans of the BoG, targeting universal primary education and reducing dropout rate are two vital targets but none is achieved in any plan.

Figure 6.1 shows the enrolment in primary and secondary levels as a percentage of total corresponding school- aged children during the1973-74 to 2003-04 time periods. From the figure, we see that in the year 1999-00 and after, the percentage of enrolment at the primary level is more than 100 percent.These data imply that the government reports on the enrolment data are over estimated. Study (Ardt, K. et.al. 2005) shows that net enrolment in primary level education in Bangladesh during the time is nearly 80 percent of total school- aged children. The overestimated statistics onenrolment might be considered as measurement error. The reasons for this kind of measurement error might be that children may enrol in different

schools in an academic year or may migrate from rural to urban areas without cancelling their registration in the school in rural areas. Another important fact to be mentioned is that the percentage of enrolment in secondary level of education every year is less than 60 percent. From these empirics, we can infer that after completing primary education, the majority of children are not going to secondary school. That means the drop-out rate from primary to secondary level is nearly 50 percent. We also can predict that children enrolled in the first grade of primary level do not complete full five years of primary education. The overall increasing trend of enrolment in both primary and secondary levels indicates that overall attendance in school has improved during the last thirty years.

Figure 6.1: Enrolment as percentage of corresponding level school aged children

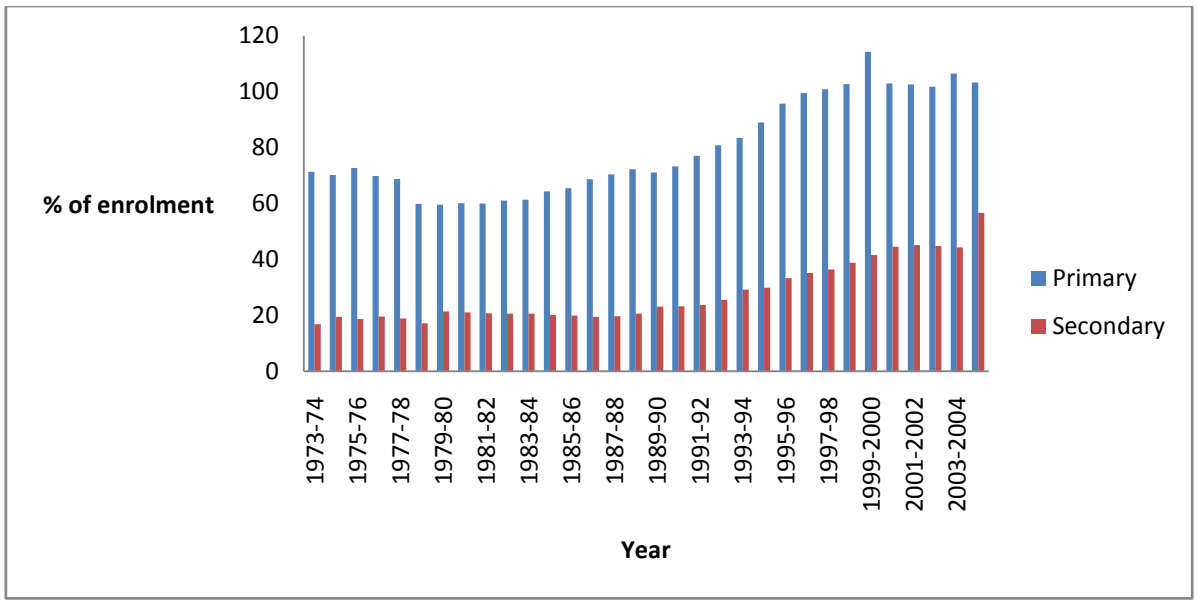


Figure 6.2 shows the teacher-student ratio in primary and secondary levels of education. It is assumed that the standard teacher-student ratio is 1:35 that means one teacher teaches thirty five students to maintain quality of education at the basic level (primary and secondary) of education. In primary school, teacher-student ratio is always higher than that of the standard measurement during the last 30 years. So, we can infer that there is a student

congestion problem in the primary level of education. In secondary school, the teacher-student ratio is the highest in the year 2000-01 where one teacher guides approximately forty students. Thus the congestion in primary school might reduce the quality of primary education in Bangladesh.

Figure 6.2: Student-teacher ratio in primary and secondary Level

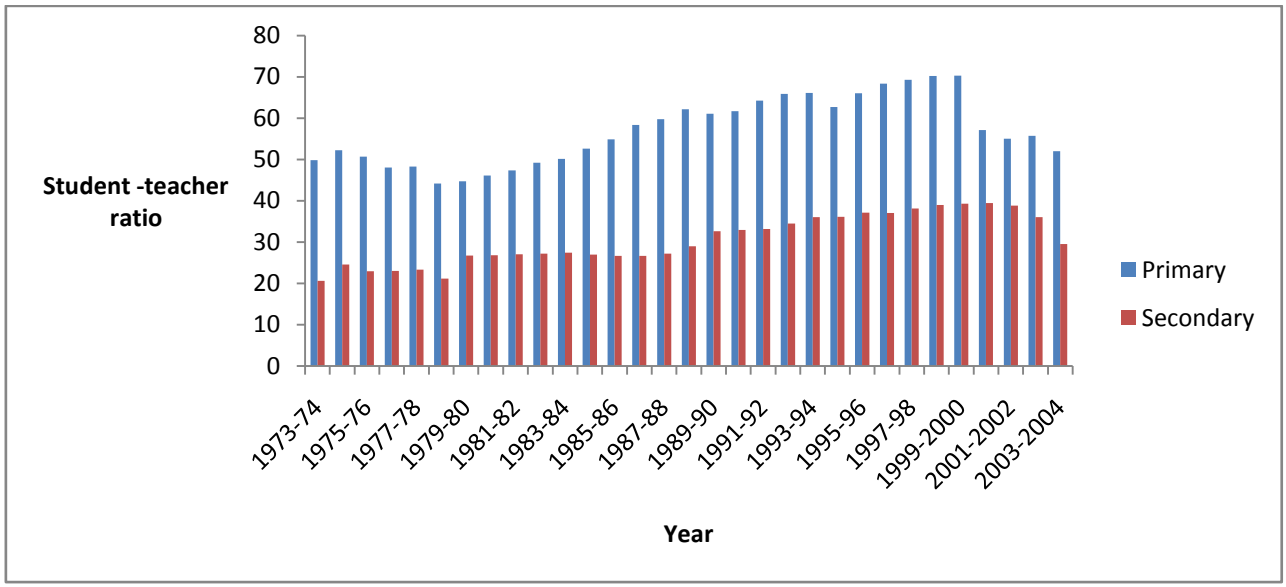


Figure 6.3 shows the average number of students in a primary and a secondary school. In the years 1973-74, both primary and secondary school have nearly 200 students per school on average. During this 30 years‘ time period, the number of students in secondary school becomes double; but in primary school, the average number is nearly stable. The stability in the number of students in primary school is observed during the period because every government puts emphasis on primary and mass education and establishes new primary schools (although not enough if we consider teacher-student ratio) over the period but does not establish enough secondary schools.

Figure 6.3: Average number of students per School in primary and secondary level

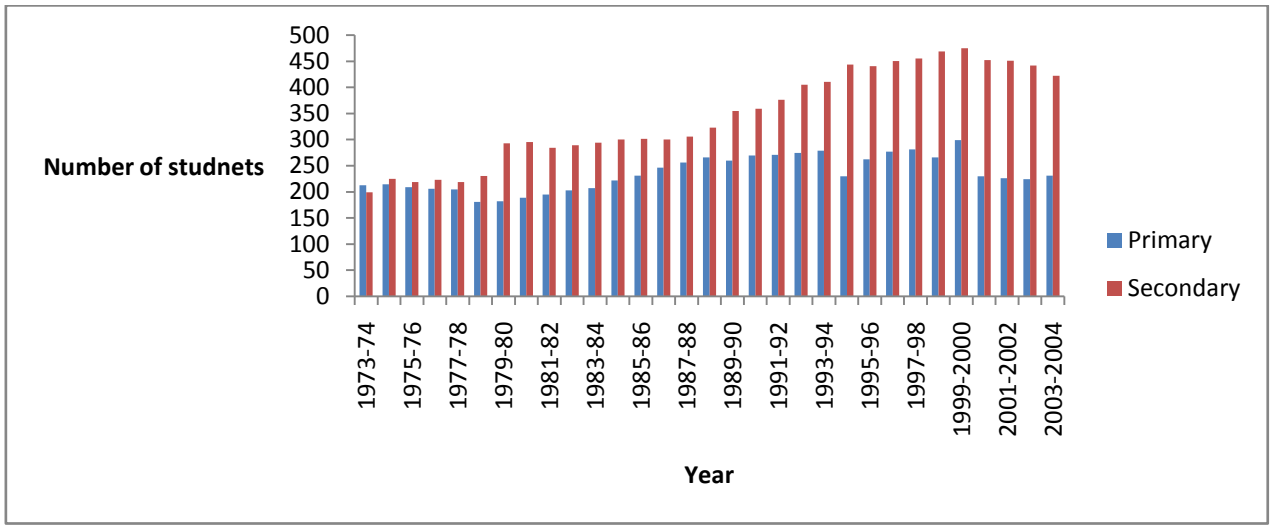


Figure 6.4 shows primary and secondary education expenditure per student. In the years 1973-74, public education expenditure per student both in primary and secondary levels of education was Taka 50 (US$ 0.60 in July 2006 conversion rate) and Taka 57 respectively. In the years 1994-95, one year after implementing the compulsory primary education act, public expenditure per student becomes Taka 560 in primary level and Taka 134 in secondary level. These empirical findings indicate that the government is putting maximum effort for ensuring compulsory and universal primary education but is assigning minimum effort for secondary education.The following two figures also help to draw nearly the similar conclusion.

Figure 6.4: Public expenditure per student in primary and secondary level

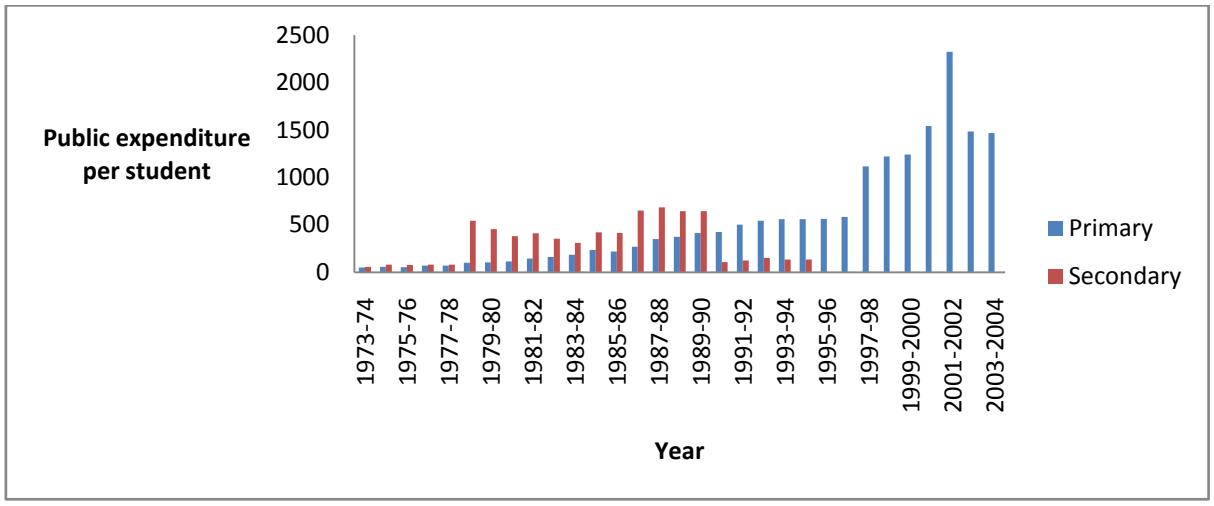


Figure 6.5 shows the public educational expenditure at primary and secondary levels as percentage of GDP. In the years 1973-74, primary education expenditure was around 0.62 per cent of GDP while secondary education expenditure was 0.14 percent of GDP. Only in the year 1978-79 and the year 1979-80, government allocated more resource in secondary level than primary level and for the remaining years, government's allocation for secondary education was continuously declining; while it was rising for primary and mass education. These empirical findings indicate that the government is putting maximum effort for ensuring compulsory and universal primary education but is assigning minimum effort for secondary education.

Figure 6.5: Public education expenditure as percentage of GDP

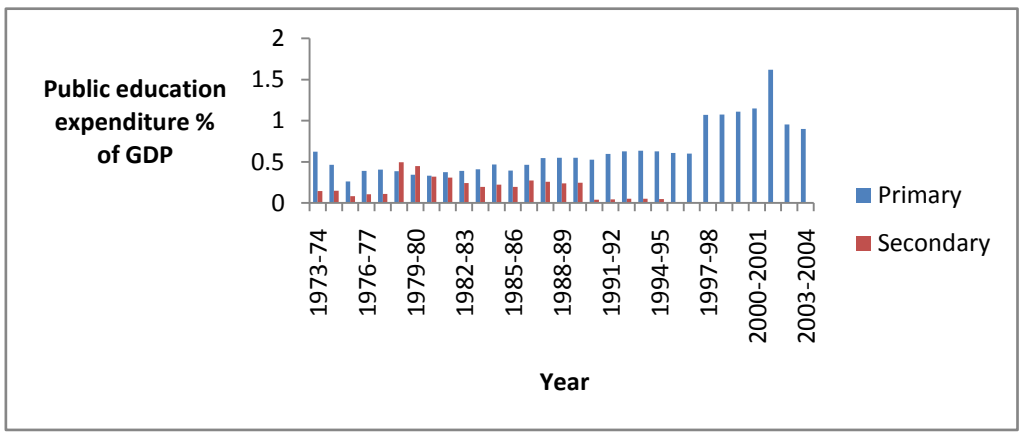
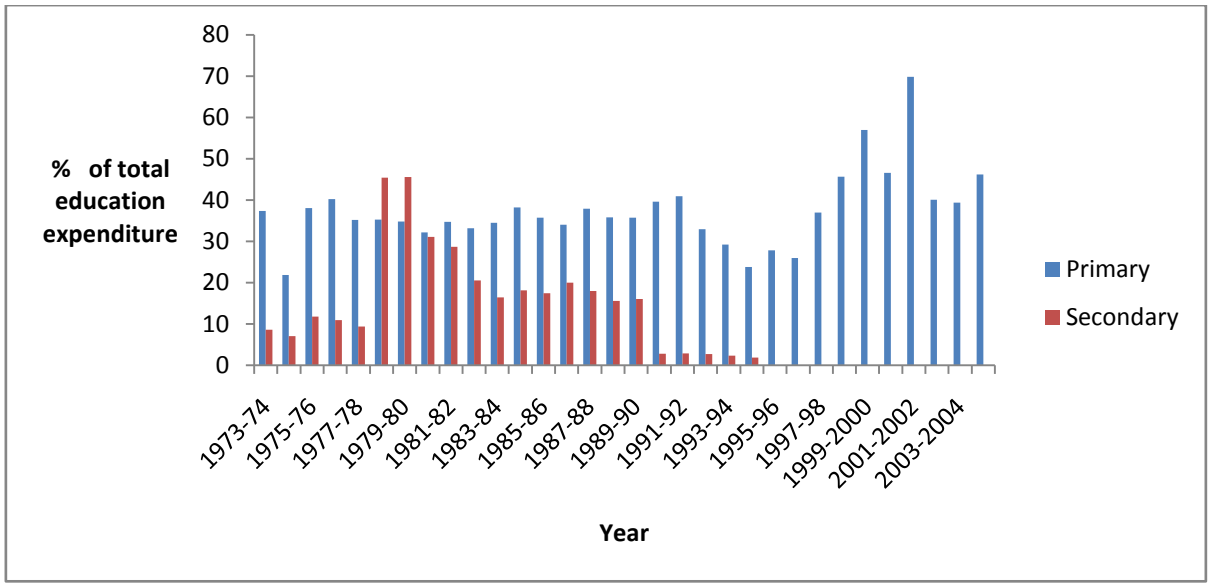


Figure 6.6 shows the public expenditure at primary and secondary levels as percentage of total public education expenditure. These data imply that the budget allocation for primary level is more or less stable during the sample period but it is declining very rapidly for secondary level. We see that allocation for the secondary level of education was only 1.82 percent of total public education expenditure while for primary sector it was 23.80 percent in the year 1994-95.

Figure 6.6: Public education expenditure as percentage of total education expenditure



Summarising all empirical and graphical results, we see thatfirstly, the GoB has considered primary education as the basic element of human right and therefore, introduced compulsory and universal primary education for all population of the age group of 6-10 years by law.

Secondly, on an average, one third of the total education budget has been allocated for primary education during the last fifteen years to implement the PEA 1990.

Thirdly, the student-teacher ratio is too high compared to what educationists considered to be ideal.Thus ~~a~~academicians and researchers think that to reach universal

primary education target, the government will have to recruit 700000 (seven hundred thousand) new teachers - preferably trained - and build 30,000 (thirty thousands) new schools and 60,000 (sixty thousands) new classrooms in existing schools within the next two years" (The Daily Star, 2009).

Fourthly, the cohort dropout rates seem to persist at around 50 percent. It was 47.2 percent in 2005, 50.5 percent in 2007 and has come down somewhat to 49.3 percent in 2008. To reduce drop-out rate, the government has introduced Primary School Stipend Programme which covers 4.8 million or 40 percent of the enrolled children of rural poor families to enable them to enrol and maintain attendance in school (Dhaka, Bangladesh Country Report, 2009). That means 60 percent of rural primary students is still out of stipend coverage. Thus, the opportunity cost of attending school for this 60 percent rural student induces them to drop-out from the compulsory primary level of education.

Finally, the government's contribution in secondary level of education is significantly declining. There are 317 Government managed secondary schools and 18,453 private High Schools, which receive teachers' salary from the Government (Bangladesh Country Report, 2009). From Figure 5, we see that the primary education expenditure as percentage of GDP is increasing but public secondary education expenditure is decreasing dramatically. As a result, the enrolment rate between primary and secondary level falls more than 50 percent. The demand for secondary level of education is continuously becoming a privately financed good and going beyond the reach of poor rural household. Since, almost all pupils in secondary level are taught by different private schools, the quality of secondary education differs significantly among the pupils. The GoB has therefore implemented the "Female Secondary School Stipend (FSSS) program 1994" all over the country in 1994 to encourage attendance of female pupils in secondary level of education.

6.1.3 The Model: demand for attending school

Assume that the state provides universal basic education up to T years without any tuition fees by a law but every family decides to send its children into education system according to its preference function. There is no pecuniary punishment in the family for noncompliance of the state law. Also assume that a family consists of a parent and a child. Both parent and child can go to work for income. Thus, family income is the sum of parent‘s income and a child‘s income. Alternatively, the parent goes to work and child goes to school. In this case, the child loses income, which is called opportunity cost of attending school and is symbolised as, Q_O per year. A family derives utility from the consumption of material goods and services, C and attending the school of child, E. The utility from education arises because it creases future income stream and therefore future consumption. The utility function of a family is _Cobb-Douglas‘ form. The utility function is continuous, twice differentiable and concave in both these two arguments and the family is maximising the total utility in both of these two arguments. The log-linear utility function for the family is as follows.

$$\ln U = (1-\theta) lnC + \theta \ln E \,; 0 < \theta < 1 \qquad (6.1)$$

Although the state has introduced compulsory basic education act (without punishment of noncompliance) for every child T years, it is assumed that every family decides whether or not to send its child for basic education for the maximum of T years depending on family‘s income and preference. Since income consists of parent‘s wage earning and child‘s wage earning, and every child in the economy has to enrol into a school at least at the first year of the maximum, Tyears by the state law; thus, every family loses child‘s income for the period when the child is attending school.The income of a family is, therefore, the sum of wage earning of the parent W plus child‘s opportunity cost of attending school Q_O.

Since a child can attend a maximum of T years of time in basic education and the opportunity cost of per year of attending school is Q_O, the family income Y can be written as follows.

$$Y = W + (T - E)Q_O \tag{6.2}$$

The equation (6.2) says that if the child attends maximum T years in school, family loses child's income for all these T years and the family income contains only parent's income, W; while if the child attend school E years of the maximum T years, the family income consists of both the parent's income, W and child's income, $(T - E)Q_O$.

The budget constraint for the family is

$$W + (T - E)Q_O = P_C C \tag{6.3}$$

where, P_C is the price of material goods and services. Since there is no tuition fees for attending school, no direct cost for attending school of the child is inserted into the budget equation.

Demand for basic Education: Every family maximises utility function subject to a budget constraint. The demand for attending school for the child of a family is as follows.

$$E^* = \frac{\theta W}{Q_O} + \theta T \tag{6.4}$$

The demand for attending school by the child of a family is a function of parent's income W, family's preference of child's education θ, maximum years of schooling T and the opportunity cost of attending school Q_O. An increase in the opportunity cost of education decreases $\left[\frac{\theta W}{(Q_O)^2}\right]$ years of a child's education and vice versa if other things remain constant. A unit increase in a parent's income increases $\left[\frac{\theta}{Q_O}\right]$ years of education and vice versa if other

things remain constant. A unit increase in family‘s preference for child‘s education increases $\left[T + \frac{W}{Q_O}\right]$ years of a child‘s education and vice versa if other things remain constant. A rise in maximum years of education by state law increases only θ amount of demand for attending school by the child of a family and vice versa holding other things in control.

The demand for attending school after introducing a compulsory education act is less than the maximum years of education, T. This result implies that introducing ―Compulsory Education Act”without any pecuniary penalty for noncompliance of the law,does not ensure that every child completes the maximum T years of education. The opportunity cost of attending school is a basic factor that determines equilibrium years of education along with the family preference for education and family income.

Demand for basic Education (with punishment): Now assume that the government has imposed a certain amount of pecuniary punishment, "P"per year for a family which is not sending a child into school.Thus the new budget equation of the family becomes as follows.

$$W + (T - E)(Q_O - P) = P_C C \tag{6.5}$$

where, P_C is the price of material goods and services.Since there is no tuition fees for attending school, no direct cost for attending school of the child is inserted into the budget equation. $(Q_O - P)$ is the net opportunity cost of attending school per year for a child. $(T - E)$ is the number of years a child is absent from the basic school attendance law. W is parent‘s income. Assuming utility function, government law except punishment clause, and preference parameters remain same, the equilibrium demand for education is as follows.

$$E^* = \frac{\theta W}{(\theta_0 - P)} + \theta T \tag{6.6}$$

In the presence of pecuniary punishment in basic education law, the equilibrium year of basic schooling demand for a child is positively depends on the parent‘s income, maximum year of basic education by law, relative preference for education, and pecuniary punishment for noncompliance of the government law while negatively depends on the opportunity cost of attending school. An increase in the opportunity cost of education decreases $\left[\frac{\theta W}{(Q_O - P)^2}\right]$ years of a child‘s education and vice versa if other things remain constant but a unit increase in pecuniary punishment imposed by the government increases $\left[\frac{\theta W}{(Q_O - P)^2}\right]$ years of education and vice versa if other things remain constant. Therefore, we can say the rate of change in demand for school attendance is the same either for opportunity cost or for punishment but in the opposite direction.

The maximum years of basic education will be attended by every child if, pecuniary punishment is as follows.

$$P = Q_O + \frac{\theta W}{(1-\theta)T} \tag{6.7}$$

Since the term $\frac{\theta W}{(1-\theta)T}$ is positive definite, government needs to impose pecuniary punishment higher than the opportunity cost of attending school. Otherwise, no obligatory education act will ensure maximum years of school attendance by every child.

We, therefore, hypothesise that (i)attending school directly depends on the parent's income, and (ii) inversely depends on the opportunity cost of attending school.

These hypotheses are going to be tested empirically along with some relevant explanatory variables in the following sections of the chapter. The part one of the empirical section deals with *an analysisof the "(Obligation to) Primary Education – 1990" in Bangladesh* and the part two covers *impact of education policies on overall educational*

development in Bangladesh. In part one- we consider country level annual time series data for investigating the functional relationship between the number of student enrolment in primary level as dependent variable and per capita GDP, the percentage of primary education expenditure in GDP, number of primary schools, number of primary school teacher, and the PEA 1990 dummy variable as independent variables. In Part two- we use district level panel data for 1991 and 2001 to evaluate the combined impact of the PEA 1990 and the FSSS 1994 policies separately on number of school attendance and literacy rate as dependent variables; and geographical area, total population, family size, annual growth rate, tap-water, sanitary-toilet, electricity, agricultural land and religion of a district as independent variables.

6.1.4 Empirical analysis for part one

6.1.4.1 Estimation method

Theoretically, we have found that demand for education depends on parent‘s income and opportunity cost of education. We therefore have hypothesised that the total number of students‘ enrolment as a proxy of demand for education depends on the per capita GDP as a proxy of parent‘s income, public education expenditure for primary education as a proxy of the opportunity cost, total number of school aged children, number of primary schools, number of teachers in primary school and the PEA 1990is also considered as a proxy of the opportunity cost of education.

***Total number of students enrolled in primary level of education (ERMT)*:** The total number of students enrolled for primary level of education in a year is considered as the dependent variable. In the model, we have found that the demand for schooling depends on parent‘s income and opportunity cost of attending school. We, therefore, believe that the total number of enrolment in the primary level of education is the best proxy variable for the

demand for schooling. We have collected annual data for this variable from the year 1980 to the year 2005. We, therefore, have 26 observations in total. The data are collected from several issues of the ‗Statistical Year Book of Bangladesh' (1980, 1984, 1990, 1995, 2000, 2005 and 2008 publications). The unit of measurement is thousand students and we have taken the natural log of each number. The variable is symbolised as $LERMT_t; t = 1980 \ldots 2005$ where, t is the year.

Per capita gross domestic product (GDP): Per capita domestic product is one of the independent variables used in empirical analysis. Since theory suggests that parent's income directly determines the demand for attending school of the child, we have included per capita GDP as a proxy measure of parent's income. The data on per capita GDP at current price is measured in local currency and are collected from the World Data Bank country indicators. The unit of measurement is thousand Taka (Taka is name of local currency) and we have taken the natural log of each number. The variable is symbolised as $LGDP_t$.

Total government primary education expenditure (PEE): Total government primary education expenditure is another independent variable used in empirical estimation. It is considered as supply-side variable of attending school. As government primary education expenditure increases by introducing stipend, free educational materials and free food for attending school can be considered as reducing opportunity cost of attending school.Since the opportunity cost of attending school reduces demand for school attendance increases and vice versa when other things remain constant. We have used annual data for this variable from the year 1980 to the year 2005. The data are collected from several issues of the ‗Statistical Year Book of Bangladesh' (1980, 1984, 1990, 1995, 2000, 2005 and 2008 publications). In the Statistical Year Book of 2000 and after, public education expenditure for primary, secondary or tertiary levels of education are not reported separately; we, therefore, have collected public

education expenditure data for primary level from the working paper of Rahman, et.al. (2005). The unit of measurement of this variable is thousand Taka and we have taken the natural log of each number. The variable is symbolised as $LPEE_t$.

Total number of school aged children (SAC): Total number of primary school aged children is another explanatory variable used in empirical estimation. It is considered as demand-side variable of attending school. As the number of school aged children increases, the demand for attending primary school increases and vice versa if other things remain constant. The data about age specific population are collected from Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects. The unit of measurement is thousand persons and the natural log of each number is considered. The variable is symbolised as $LSAC_t$.

Total number of primary school (NSC): Total number of primary school is another independent variable. It is considered as supply-side variable of attending school. As number of primary school increases, facilities of primary level education increases; as a result, indirect cost of attending school such as travelling cost reduces, thus the demand for attending school increases and vice versa if other things remain constant. We have collected annual data for this variable from the year 1980 to the year 2005 from several issues of the ‗Statistical Year Book of Bangladesh'. The unit of measurement is thousand schools and we have taken the natural log of each number. The variable is symbolised as $LNSC_t$.

Total number of primary school teacher (NPT): Total number of primary school teacher is another independent variable. It is considered as supply-side variable of attending school. We expect that as the number of primary school teacher increases, the supply of primary level education increases; therefore, demand for attending primary school increases and vice versa if other things remain constant. Annual data are collected from several issues

of the ‗Statistical Year Book of Bangladesh'. The unit of measurement is thousand persons and the natural log of each number has been taken. The variable is symbolised as $LNPT_t$.

The compulsory primary education act (PEA): The government of Bangladesh has implemented compulsory primary education act in the year 1993 (completely) and introduced limited amount of stipend (in cash and kinds) for attending primary school for the very poor family in the country. We think that introducing stipend is a proxy of the opportunity cost of attending school. We, therefore, have constructed a dummy variable before and after introducing the act. The variable is symbolised as PEA_t. The variable takes zero value from the year 1980 to 1992 and one value from the year 1993 to 2005.

6.1.4.2 Descriptive analysis

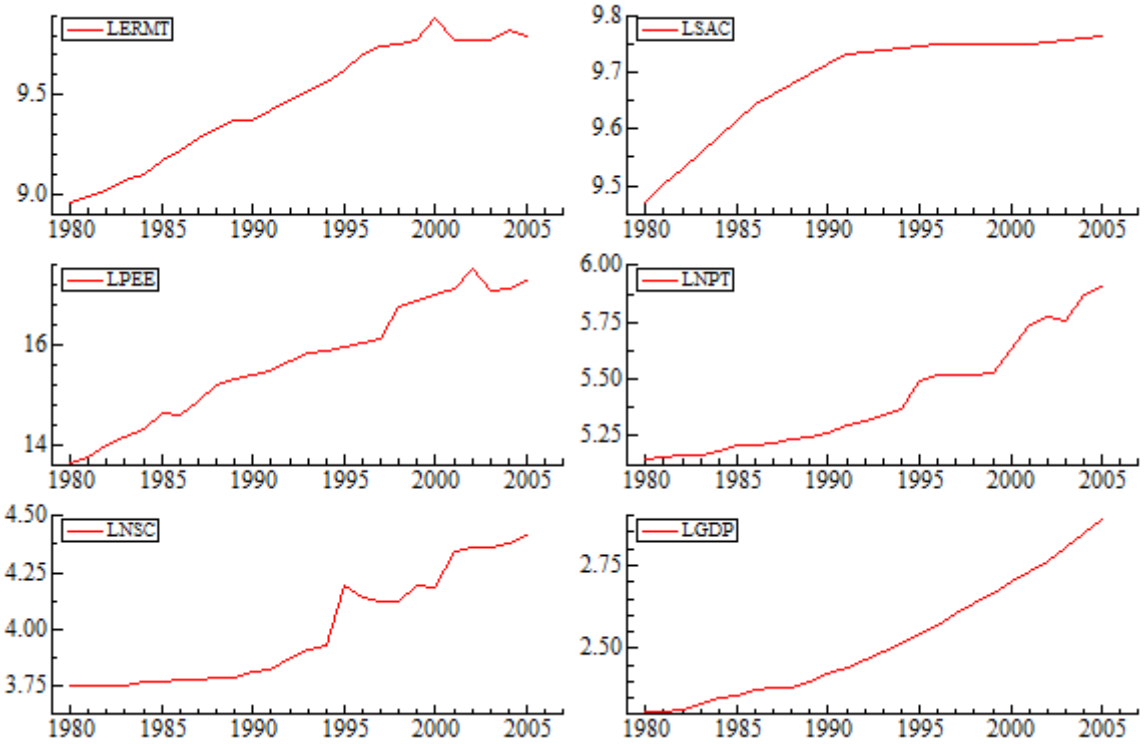
In the data set, all series of variables are measured in thousand units; for example- the number of students enrolled in primary level is measured in thousand students, per capita GDP is measured in thousand Taka in current year local currency, the government education expenditure at primary level is measured in thousand Taka in local currency, number of primary school teacher is measured in thousand teachers and the total number of primary schools is measured in thousand schools. There are 26 observations for each variable and the time period covers from the year 1980 to 2005.

Table 6.1: Descriptive statistics of variables

Variables	Mean	Std. Dev.	Min. value	Max. value	No. of Observations
$ERMT_t$	13566.77	3848.16	7733.00	19612	26
GDP_t	12.67	2.41	10.03	18.01	26
PEE_t	11584838	11651735	811400	41040000	26
SAC_t	16183.88	1367.64	12988	17386	26
NPT_t	231.20	59.59	172.78	367.57	26
NSC_t	55.86	14.28	42.44	82.87	26

Note: ―Std.Dev." represents standard deviation. ―Min. Value" and ―Max. Value" represent minimum and maximum value of each data series respectively.

Figure 6.7: Line graphs of all data series



The average number of enrolment in the primary level of education is approximately 13567 thousand students. The maximum number of students enrolled in the year 2000 and the minimum number of students enrolled in the year 1980. The number of enrolment of students has positive time trend. The average per capita GDP of population during the time period is approximately Taka 12.67 thousand per year. The highest nominal per capita GDP is in the year 2005 and the lowest is in the year 1980. The data indicate positive trend in nominal value. On average, the government education expenditure at primary level every year is approximately Taka 11. 58 billion (current year‘s nominal value). During the time period, the highest spending is allocated in 2002 and the lowest is in 1980. The data indicate positive trend in nominal value.

The average number of primary level school aged children is approximately 16184 thousand students. The maximum number of children is found in the year 2005 and the minimum in the year 1980. The average enrolment is lower than that of the average school aged children during the time period. So, we can say on average all children are not enrolled into school during the period. The average number of primary school teacher is 231 thousand and the maximum number of teachers is working in the year 2005 and the minimum number in the year 1980. The average number of primary schools is approximately 55.86 thousand. The maximum number of primary schools is found in the year 2005 and the minimum number in the year 1980. The total number of primary school also has positive time trend. We can conclude from the descriptive statistics that all series of data have a positive trend during the period.

From the Figure 6.7, we see that all series of variables have positive trend. The variable $LGDP_t$ has clear positive trend. The reason is the current value of per capita GDP measured in local currency, so over the time value is rising because of the rising price level. The variable $LERMT_t$ also has rising trend, although in the year 1998, the number of enrolment jumps for a year but falls again in the year 2001. But still the value of enrolment in the year 2001 is higher than that of the year 1998. So, we can say that the series has a trend and after the year 2001, the variable does not have trend but the values are still higher in the following year. The variable $LSAC_t$ has clear exponential trend which is natural for population data. Variables $LPEE_t, LNPT_t$ and $LNSC_t$ are all rising throughout the time period with ups and downs in different years but follow some kind of trend. We, therefore, are convinced that the data of all variables follow some trend with an intercept.

6.1.4.3 Unit root tests

At the beginning of empirical analysis, we have chosen the ordinary least square (OLS) estimation technique. The OLS estimation technique gives the best linear unbiased estimation of parameters under some classical regression assumptions, for instance- error distributions are normally distributed (normality assumption), every error distribution has constant variance (homoscadastic assumption), no serial correlation between error terms (no autocorrelation assumption) and functional form is correct etc. In case of time series data analysis ―non-stationary" is considered as another important estimation problem. Although earlier econometricians assume that ―non-stationary" time series economic data does not affect empirical analysis, but now they realise that ―running regression on non-stationary time series data can give rise to spurious values of R^2, Durbin-Watson statistic, and t-statistic, causing economists erroneously to conclude that a meaningful relationship among the regression varies" (Kennedy, 1979; p.296). From the statement we can infer that checking the stationary of time series data sets becomes an essential part of empirical estimation for removing spurious result. From the descriptive statistics and the figure 6.7, we have seen that each variable in our data set has a trend and therefore may suffer non-stationary problem. We have therefore conducted the *Augmented Dickey-Fuller (ADF)* test which is ―seems to be the most popular unit root test (for stationary of a data series) because of its simplicity and perform well" (Kennedy, 1979; p.324) to check ―non-stationary" issue of data series. We, therefore, conduct the ADF test for the level form of each series including both intercept (c) and trend (tr) for all series. The ADF test results are given in Table 6.2. The ADF results show that the natural log values of all variables suffer non-stationary problem.

Table 6.2: Results of ADF tests for six data series

ADF Test	**H_0: Has Unit Root (Non-Stationary)**					
Dependent Variable,	$LERMT$	$LGDP$	$LPEE$	$LSAC$	$LNPT$	$LSAC$
t-ADF statistic	-0.35 (c, tr)	-0.074 (c, tr)	-2.62 (c, tr)	-3.23 (c, tr)	-1.26 (c, tr)	-2.43 (c, tr)
Prob. Value	5%= -3.60 1%= -4.40	5%= -3.60 1%= -4.40	5%= -3.60 1%= -4.40	5%= -3.60 1%= -4.40	5%= -3.60 1%= -4.40	5%= -3.60 1%= -4.40
Decision	***Accept H_0 Series is non-stationary***	***Accept H_0 Series is non-stationary***	***Accept H_0 Series is non-stationary***	***Accept H_0 Series is non-stationary***	***Reject H_0 Series is non-stationary***	***Accept H_0 Series is non-stationary***

6.1.4.4 Cointegration analysis

The remedial measure of dealing with non-stationary data series is to check whether or not the series is cointegrated.

Table 6.3: Results of Cointegration test

Dependent variable: $\boldsymbol{LERMT_t}$					
Method of estimation: Least square Sample: 1980-2005					
	Co-eff.	St. Error	t-value		t-Prob.
Conts.	-3.29006	3.002	-1.10		0.2867
$\boldsymbol{LGDP_t}$	0.260876	0.5611	0.465		0.6473
$\boldsymbol{LPEE_t}$	0.0963316	0.05194	1.85		0.0792
$\boldsymbol{LSAC_t}$	1.13870	0.3336	3.41		0.0029
$\boldsymbol{LNPT_t}$	-0.235643	0.4603	-0.512		0.6146
$\boldsymbol{LNSC_t}$	0.195191	0.2869	0.680		0.5045
$\boldsymbol{PEA_t}$	0.119152	0.04513	2.64		0.0161
Estimated Residuals	$LEMRT_t - \widehat{LEMRT}_t$				
ADF test for estimated residuals	H_0: Has unit root (Non-stationary)				
Dependent variable, max. lag =4	Estimated Residuals				
$\boldsymbol{t}$-ADF statistic	D-lag 0	D-lag 1	D-lag 2	D-lag 3	D-lag 4
	-3.39	-3.28	-2.19	-1.93	-2.78
Probability Value	5%= -3.01 and 1%= -3.79				
Decision	Reject null hypothesis with no lag and one lag. The estimated residuals are stationary. Thus all series are cointegrated.				

Formally, the term cointegration is defined as if two series (there could be more series than just two); where, suppose $X_t$and Y_t are non-stationary; then if their linear combination is stationary, X_t and Y_t are said to be cointegrated. We, therefore, have conducted the cointegration analysis for all series of variables in our data set and found that the estimated

residuals are stationary. The result of cointegration analysis has been given in the Table 6.3. The test results show that the non-stationary variables are cointegrated.

6.1.4.5 Autoregressive distributed lags (ADL) estimation model

Since the variables are cointegrated, we have considered an *"Autoregressive distributed lags (ADL)"* model with two periods of lag of each variable as our general form of empirical model. We have taken two lags of each series because ~~"e~~conomic variables are seldom integrated of order greater than two" (Kennedy, 1979; p.302) so that our chosen model covers the full effect of each variable in the long run. Using the ~~"g~~*eneral-to-specific*" model specification technique of Hendry (1987) with the help of *"OxMetrics Software"*, we have tried to find a functional relationship between the number of enrolment in the primary level of education and the independent variables during the time period.

The general model which we have chosen covers the lag effects of every variable which is more frequent in time series data set. In the general model, a dummy variable is also included for covering the impact of introducing the PEA 1990 in Bangladesh. The general ADL model with two-period lags is given in the following equation. We have assigned different Greek letters- "α"are for the coefficients of autoregressive dependent variables and "β" are for the coefficients of the independent variables.

$$\begin{aligned} LERMT_t = {} & \alpha_0 + \alpha_1 LERMT_{t-1} + \alpha_2 LERMT_{t-2} + \beta_1 LGDP_t + \beta_2 LGDP_{t-1} + \beta_3 LGDP_{t-2} + \beta_4 LPEE_t \\ & + \beta_5 LPEE_{t-1} + \beta_6 LPEE_{t-2} + \beta_7 LSAC_t + \beta_8 LSAC_{t-1} + \beta_9 LSAC_{t-2} \\ & + \beta_{10} LNPT_t + \beta_{11} LNPT_{t-1} + \beta_{12} LNPT_{t-2} \\ & + \beta_{13} LNSC_t + \beta_{14} LNSC_{t-1} + \beta_{15} LNSC_{t-2} + \beta_{17} PEA_t \\ & + \varepsilon_t \end{aligned} \tag{6.8}$$

where, $LERMT_t$ is the natural log of the total number of students enrolled in the primary level of education in the year, t and $LERMT_{t-1}$ and $LERMT_{t-2}$ are respectively the 1st lag and 2nd lag of this variable.

$LGDP_t$ is the natural log of the total per capita gross domestic product (GDP) in the year, t and $LGDP_{t-1}$and $LGDP_{t-2}$ are respectively the 1st lag and 2nd lag of this variable.

$LPEE_t$ is the natural log of the total primary education expenditure in the year, t and $LPEE_{t-1}$ and $LPEE_{t-2}$ are respectively the 1st and 2nd lags.

$LSAC_t$ is the natural log of the total number of primary school aged population in the year, t. $LSAC_{t-1}$ and $LSAC_{t-2}$ are respectively the 1st and 2nd lags.

$LNPT_t$ is the natural log of the total number of primary school teachers in the year, t.$LNPT_{t-1}$ and $LNPT_{t-2}$ are respective lags.

$LNSC_t$ is the natural log of the total number of primary schools in the year, t. $LNSC_{t-1}$ and $LNSC_{t-2}$ are respective lags.

PEA_t is the dummy variable for covering the impact of the PEA 1990. PEA_thas zero value from 1980 to 1992 and one value from 1993 to 2005.

With the help of ―Autometric" program of model specification (fixing the dummy variable) which is developed in the ―OxMetrics Software", we have got the following specific model[24].

[24]See detail methodology in the OxMetrics software. All estimation results have been given in the results and discussion section.

$$LERMT_t = \alpha_0 + \beta_3 LGDP_{t-2} + \beta_4 LPEE_t + \beta_6 LPEE_{t-2} + \beta_8 LSAC_{t-1} + \beta_{11} LNPT_{t-1} + \beta_{12} LNPT_{t-2} + \beta_{13} LNSC_t + \beta_{14} LNSC_{t-1} + \beta_{15} LNSC_{t-2} + \beta_{17} PEA_t + \hat{\varepsilon}_t \quad (6.9)$$

From this specific ADL model with two periods of lag, we have solved the static long run equilibrium correction factor for the number of enrolment in the primary level of education in Bangladesh.

6.1.4.6 Impulse Indicator Saturation (IIS) or Dummy saturation estimation method

Since the estimated results of the specific model show that the dummy variable has an insignificant positive effect on the number of enrolments, we have conducted "dummy saturation" method of estimation for checking the robustness of the result related to the dummy variable. The estimated results[25] of "Impulse Indicator Saturation (IIS)" or the "dummy saturation" method identify the following years 1984, 1985, 1990, 1992, 1993, 1996, 2000, 2001, 2002, and 2005 to be significantly different from the other years.

From the unit root test, we have found that all data series are stationary at first except the number of the school aged population. To check the robustness of the results of my specific model with the one from two-period lags ADL model, we have chosen an ADL model with one period lag of each variable as another general model which is given in the following equation.

$$LERMT_t = \alpha_0 + \alpha_1 LERMT_{t-1} + \beta_1 LGDP_t + \beta_2 LGDP_{t-1} + \beta_3 LPEE_t + \beta_4 LPEE_{t-1} + \beta_5 LSAC_t + \beta_6 LSAC_{t-1} + \beta_7 LNPT_t + \beta_8 LNPT_{t-1} + \beta_9 LNSC_t + \beta_{10} LNSC_{t-1} + \varepsilon_t \quad (6.10)$$

[25]The results have been given in results and discussion section.

We do not include the dummy variable (compulsory primary education act 1990) PEA_t because we have estimated the above general model with "dummy saturation" method and have found the following specific model (specified year dummies are not included).

$$LERMT_t = \alpha_0 + \alpha_1 LERMT_{t-1} + \beta_1 LGDP_t + \beta_3 LPEE_t + \beta_6 LSAC_{t-1} + \beta_7 LNPT_t + \hat{\varepsilon}_t \quad (6.11)$$

The specific ADL model with one period lag does produce nearly similar significant variables of the specific ADL model with two period lags.

6.1.4.7 Data

The data used in this study cover the period from 1980 to 2005. Most of the education related data such as the number of student enrolment in the primary level, the number of teachers at primary level, the number of primary schools, and the expenditure on different levels of education are collected from the Statistical Year Book of Bangladesh 1980, 1984, 1990, 1995, 2000, 2005 and 2008 publications. The data about age specific population are collected from the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects.The data for GDP in local currency are collected from the World Data Bank. The information about educational objectives and achievement is collected from the different Five Year Plans by the Government of People's Republic of Bangladesh, such as 1st Five Year Plan – Chapter XIV, 2nd Five Year Plan – Chapter XVI, 3rd Five Year Plan – Chapter XIV, 4th Five Year Plan – Chapter XV and 5th Five Year Plan – Chapter XX.

6.1.5 Results and discussions

The estimation results of the general and specific ADL model with two-period lags, and general and specific ADL model with a one-period lag are given in Table 6.4.The

estimated general ADL model with two-period lags of each variable shows that the number of primary school teacher and the number of primary school of last year (one period lag) are significant at 1 percent level with negative and positive sign respectively. The adjusted R^2 is 0.995 but the estimated model suffers from serial correlation problem. The estimated specific ADL with two-period lags, which is preferred estimated model in this study, shows that $LGDP_{t-2}$, $LPEE_t$, $LPEE_{t-2}$, $LSAC_{t-1}$, $LNPT_{t-1}$, $LNPT_{t-2}$, $LNSC_{t-1}$ and $LNSC_{t-2}$ are statistically significant at 1 percent level. The adjusted R^2 is 0.997 which implies that more than 99 percent of variation in dependent variable is explained by the explanatory variables. The estimated model does not suffer from any problem of non-normality, heteroscadasticity and autocorrelation. If we look at the ―actual-fitted-residual" graph in Figure 6.8 of the estimated model, the fitted line nearly perfectly represents the actual line and none of residual exceeds the absolute value of 1.2. That means there is no data outlier for the estimated model. We, therefore, confidently make comments on estimated parameters.

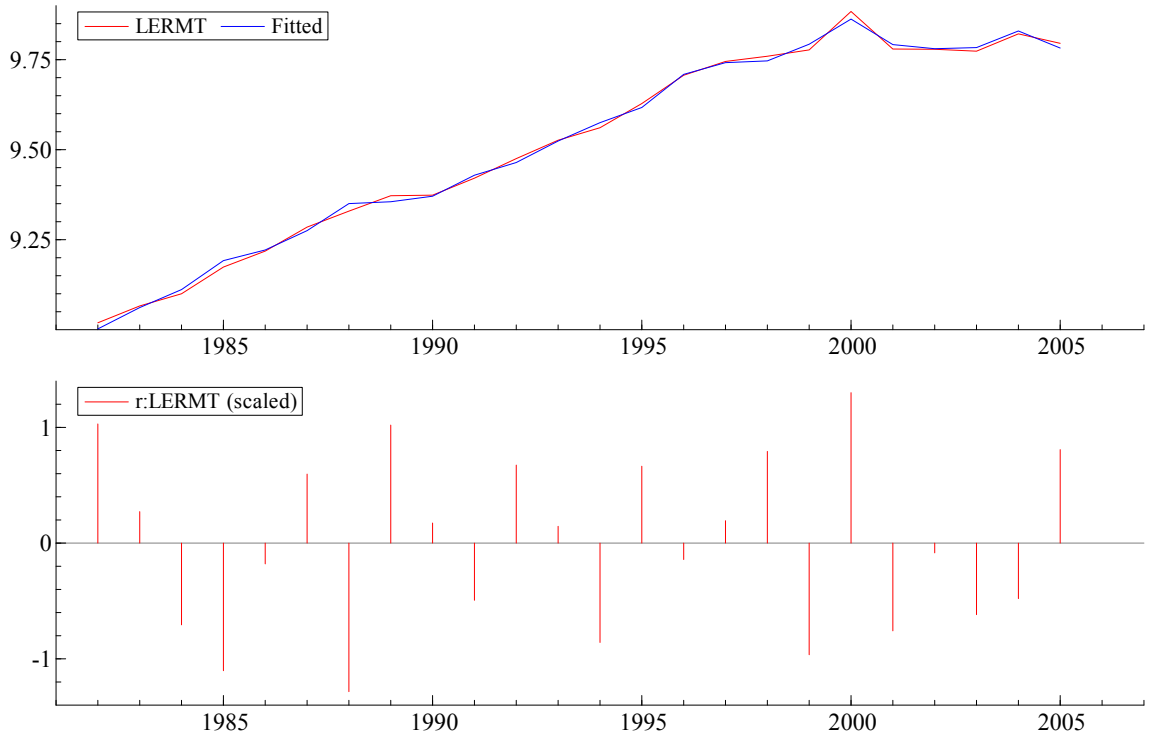
The estimated coefficient of $LGDP_{t-2}$ has got a positive sign with a magnitude of 1.5 which implies that one percentage increase in two years back per capita income of parent increases 1.5 percent propensity to enrolment of a child and vice versa when other variables remain constant. The result intuitively makes sense. A rise in a parent‘s income this year will motivate him to send his child to school after two years.The estimated coefficient of $LPEE_t$ and $LPEE_{t-2}$ have got a positive and negative sign respectively. The magnitude of the current year primary education expenditure is 0.057, which implies that 1 percent increase in government primary education expenditure increases 0.057 percent of propensity to enrolment in primary level of education and vice versa when other things remain constant; while, a 1 percent increase in the government primary education expenditure two years before reduces 0.07 percent propensity to children‘s enrolment if other things remain constant.

Table 6.4: Estimation results: ADL general and specific models with two and one period lags

Dependent variable $LERMT_t$	ADL General model with two periods lags	ADL Specific model with two periods lags	ADL general model with one period lag	ADL specific model with one period lag
Independent variables	OLS method	OLS method	OLS method	OLS method
$LERMT_{t-1}$ (Std. err.)	0.22 (0.36)		0.47*** (0.13)	0.99*** (0.03)
$LERMT_{t-2}$ (Std.err.)	0.15 (0.28)			
$LGDP_t$ (Std. err.)	1.01 (0.95)		0.46 (0.90)	
$LGDP_{t-1}$ (Std. err.)	-1.99 (1.66)		0.59 (1.11)	
$LGDP_{t-2}$ (Std. err.)	2.55 (1.45)	1.50*** (0.37)		
$LPEE_t$ (Std. err.)	0.03 (0.07)	0.057*** (0.02)	0.0067 (0.03)	
$LPEE_{t-1}$ (Std. err.)	-0.035 (0.075)		-0.043 (0.03)	
$LPEE_{t-2}$ (Std. err.)	-0.07 (0.09)	-0.07** (0.027)		
$LSAC_t$ (Std. err.)	-1.48 (2.72)		-1.91 (1.77)	
$LSAC_{t-1}$ (Std. err.)	5.67 (6.038)	2.07*** (0.02)	2.94* (1.67)	0.13*** (0.026)
$LSAC_{t-2}$ (Std. err.)	-2.43 (4.61)			
$LNPT_t$ (Std. err.)	0.11 (0.76)		-0.20 (0.26)	0.39*** (0.08)
$LNPT_{t-1}$ (Std. err.)	-1.60*** (0.27)	-1.63*** (0.02)	-1.18 (0.23)	-0.85*** (0.11)
$LNPT_{t-2}$ (Std. err.)	-0.34 (0.75)	-0.62*** (0.19)		
$LNSC_t$ (Std. err.)	0.052 (0.27)	0.19 (0.08)	0.14 (0.16)	
$LNSC_{t-1}$ (Std. err.)	0.89*** (0.17)	0.99*** (0.11)	0.81*** (0.14)	0.34*** (0.08)
$LNSC_{t-2}$ (Std. err.)	0.30 (0.45)	0.598*** (0.11)		
PEA_t (Std. err.)	0.019 (0.057)	0.0049 (0.018)	-0.02 (0.03)	
Cont. (Std. err.)	-8.81** (3.17)	-8.80*** (1.78)	-3.26 (2.12)	
Adjusted R^2-value	0.995	0.997	0.994	
F-value(Prob. Val)	259*** (0.000)	639.4*** (0.00)	350*** (0.00)	
Normality test χ^2-value (Prob. val)	0.052 (0.9741)	1.72(0.42)	0.48(0.79)	1.07(0.58)
Heteroscadasticity test χ^2-value (Prob. val)	Not enough observations	2.87 (0.16)	Not enough observations	Not enough observations
Serial autocorrelation test F-value (Prob. val)	10.79 (0.03)*	1.17 (0.23)	2.34(0.15)	0.40(0.67)

Note: *, ** and *** represent that the co-efficient is significant at 10%, 5% and 1% respectively. —Std. err.” represents standard error of the coefficient. —Cont.” indicates the constant term of the estimated regression model. —Prob. Vale)” indicates the probability value of the corresponding term.

Figure 6.8: Actual fitted and residual graph of specific model



When we look at the recursive estimate of these two parameters, both are very close to zero value throughout the sample period and there isa clear indication of structural break in 1994, 1995, 1999 and 2001. We cannot definitely comment on the impact of primary education expenditure on the number of enrolment of children.

The estimated coefficient of $LSAC_{t-1}$ has got a positive sign with a magnitude of 2.07.We, therefore, can say that 1 percent increase in the number of school aged children in last year raises 2.07 percent demand for the enrolment in primary level school in the current year and vice versa if other things remain constant. The recursive estimate of this parameter indicates that this parameter value strongly differs from zero. So, we can rely on the impact of the last period‘s number of school aged children on the current period enrolment of pupils. The result is intuitively sensible. As the last year‘s number of school aged children rises, this year‘s enrolment of students also rises. The variable is also found positively significant from

the specific ADL model with one period lag though the magnitude is very small and almost zero (please see the recursive estimates of parameters). The results indicate the robustness of the results of the specific ADL model with two-period lag.

The estimated coefficient of both the variable $LNPT_{t-1}$ and $LNPT_{t-2}$ have got a negative sign with a magnitude of 1.63 and 0.62 respectively. A 1 percent increase in the number of primary school teacher of the last year reduces 1.63 percent enrolment in the current year; and similarly, 1 percent fall in the number of primary school teachers two years before increases 0.62 percent of enrolment in the current year and vice versa if other things remain constant. One intuitional reason for this unexpected finding might be that increasing school teacher means spending more public education expenditure for the salary of teachers rather than for the students, which might discourage students‘ enrolment in primary level.

The estimated coefficient of $LNSC_{t-1}$ and $LNSC_{t-2}$ both have got positive sign with a magnitude of 0.99 and 0.6 respectively. We, therefore, can say that 1 percent increase in the last year‘s number of primary schools raises 0.99 percent demand for the current year‘s enrolment and vice versa if other things remain constant; similarly, a 1 percent rise in the number of primary schools two years before rises 0.6 per cent demand for the current year‘s enrolment and vice versa if other things remain constant. Looking at the recursive estimates of these two parameters, we can conclude that last year‘s estimated value more steadily differs from zero than that of the parameter of the variable of two-period before. The sign is as expected and the intuition is that as the number of primary school increases, students can find a closer one which reduces travelling cost of the students. Therefore, parents might feel interested to send his child into the school.

The intuition behind the limited significance of $LGDP$ is that the aggregate per capita income may not perfectly reflect the parents‘ income of a family. The intuition behind the

negative sign of $LNPT_{t-1}$ and $LNPT_{t-2}$ is that increasing school teacher means spending more public education expenditure for the salary of teachers rather than for the students, which might discourage students‘ enrolment in primary level. The insignificance of PEA indicates that public education expenditure does not have enough impact on students‘ enrolment in primary level because a significant proportion of public education expenditure is used for infructural development rather than increasing incentive to attending school in primary level.

The estimated results of ―Impulse Indicator Saturation (IIS)" or the ―dummy saturation" method identify the following years 1984, 1985, 1990, 1992, 1993, 1996, 2000, 2001, 2002, and 2005 to be significantly different from the other years. We, therefore, conclude that before the PEA 1990 being implemented in the country, there are 1984, 1985, 1990 and 1992 time points when the number of enrolment significantly changed; and after the PEA 1990 being implemented, there are 1993, 1996, 2000, 2001, 2002 and 2005 time points when the number of enrolment in the primary level of education significantly differs from the other year. That is why, we believe that the PEA 1990 has not been successfully implemented yet; and thus, it becomes difficult to achieve the universal primary education by 2015.

To check the robustness of our two-period lags ADL model, we have estimated the one-period lag ADL model also. The estimated results of the specific ADL model with one period lag of every variable show that $LERMT_{t-1}$, $LSAC_{t-1}$, $LNPT_t$, $LNPT_{t-1}$and $LNSC_{t-1}$ are statistically significant with two year dummies of 1990 and 2001. We, therefore, believe that the specific ADL model with two-period lags gives us the best prediction about the demand for enrolment in the primary level of education in Bangladesh.

The long run error correction factor (ECF) for the estimated model is given as follows.

$$ECM = LERMT + 8.80 - 1.50 * LGDP - 0.01 * LPEE - 2.07 * LSAC + 2.26 * LNPT - 1.72 * LNSC - 0.005 * PEA$$

$$Long - run\ sigma, \sigma = 0.016 \quad (6.12)$$

The ECF reflects that any deviation of steady state value in the long-run will be corrected. All these variables are statistically significant except the dummy (primary education act). The result indicates that the policy does not have a significant impact on enrolment in the long-run.

To check the consistency of our results we have specified following regression model with ~~–a~~utoregressive distributed lags models" with two periods and one period lag. The dependent variable in the following model is the ratio of log number of enrolment and log number of primary school aged children. Thus the dependent variable represents the growth of enrolment in primary level education and symbolised as ($GERMT_t$). The explanatory variables are PEA 1990 (PEA_t), log of GDP ($LGDP_t$), log of government primary education expenditure as percentage of GDP (PEE_t), log of number of primary school teachers ($LNPT_t$), and log of number of primary school ($LNSC_t$).

The two periods lag auto regressive distributed lags model is given in equation (6.13)

$$\begin{aligned} GERMT_t = {} & \alpha_0 + \alpha_1 GERMT_{t-1} + \alpha_2 GERMT_{t-2} + \beta_1 LGDP_t + \beta_2 LGDP_{t-1} + \beta_3 LGDP_{t-2} \\ & + \beta_4 LPEE_t + \beta_5 LPEE_{t-1} + \beta_6 LPEE_{t-2} + \beta_7 LNPT_t + \beta_8 LNPT_{t-1} \\ & + \beta_9 LNPT_{t-2} + \beta_{10} LNSC_t + \beta_{11} LNSC_{t-1} + \beta_{12} LNSC_{t-2} \\ & + \beta_{13} PEA_t + \varepsilon_t \end{aligned} \quad (6.13)$$

The estimated results for both one period and two periods lag ADL model is given in Table 6.5 in appendix of Chapter Six. The estimated results of growth of enrolment do not differ significantly from the results we have found our original ADL estimation. In this

alternative estimation results, the coefficient of the compulsory primary education act, PEA_t is found insignificant. Thus we can conclude that compulsory primary education act does not change primary school enrolment significantly.

6.1.6 Conclusions for part one

The main objective of the part one of this Chapter is to evaluate the success of implementing the ―(Obligation to) primary education act 1990". Keeping the objective in mind, we have evaluated the existing situation of primary and secondary education system in Bangladesh. We have found that approximately one third of the total education budget has been allocated for primary education during the last fifteen years to implement the PEA 1990 successfully but more than 20 percent of the school aged children are out of the programme till now. At the same time, putting more emphasis on primary education, the GoB is depriving secondary education and making secondary education system almost completely a private choice. Therefore, there is a massive drop-out rate from primary level to secondary level which is unexpected for a sound human resource development.

We have developed a model of demand for education based on family utility maximisation behaviour and have found that a family's demand for schooling positively depends on parent's income and negatively depends on the opportunity cost of child's attending school. In a market economy, any compulsory education act does not always ensure that all school aged children attend and complete the maximum years of compulsory education. The choice of maximum year of schooling depends on the family income, preference parameters and the maximum year limit of attending school.

In the empirical analysis, we have used Hendry (1987) ―general-to-specific" model specification strategy with the help of ―OxMetrics" software for finding the best factors that determine the demand for primary education and for evaluating the success of the PEA 1990.

Using annual data from the period 1980 to 2005, we have chosen ―Autoregressive distributed lags (ADL)" model with two-period lag of each variable. The specific estimated model which is reported in the text shows that per capita income two years before, current period primary education expenditure, school aged children one year before, and all current and lag years number of primary school positively and significantly determine the number of enrolment in the primary level of education. The estimated result shows that the two-period lag of per capita income significantly and positively partially determines the number of enrolment in primary school which is supported by the theoretical model and it is a rational behaviour of a family. The public primary education expenditure of the current year significantly and positively partially determines the number of enrolment in primary school which is also predicted by the model. An increase in public primary education expenditure (via stipend for children) means a decrease in the opportunity cost of attending school, resulting in increasing enrolment in school. The two-period lag of the public primary education expenditure significantly negatively determines the number of enrolment which is intuitively sensible. The intuition behind this result is that a reduction in the current year primary education expenditure (such as stipend) compared to that of the two-year before discourages current period enrolment of student. The number of primary school significantly and positively partially determines students' enrolment in primary level. The result is as expected and it makes sense also - as the availability of primary school increases, a family has more options to choose the nearest school for reducing travelling cost or opportunity cost of attending school. The one and two period lag of the number of teacher in primary school significantly and negatively determines the current period enrolment of students which is not expected. One reason of this unexpected relation might be that increasing the number of teachers may divert the resource of public education expenditure from spending for student to spending for teacher's salary; therefore, the enrolment of student may fall.

The most important objective of the empirical study is to evaluate the success of ―(obligation to) Primary Education Act 1990". For this purpose, a policy dummy has been included in the empirical model and kept fixed throughout the model specification method done by ―Automatic" programme of the ―OxMetrics" software. The result of the specific model shows that the policy dummy does not have significant impact on the enrolment although the coefficient has got positive sign. To check the robustness of this finding, we have conducted ―Impulse Indicator Saturation (IIS)" estimation method and have found that not only the year 1993 is significantly different from other years but also the years 1984, 1985, 1990, 1992, 1996, 2000, 2001, 2002, and 2005 are significantly different from the other years. This result implies that the ―(Obligation to) Primary Education Act 1990" has not made any significant change in the number of enrolment in primary education. This result suggests us to conclude that the ―(Obligation to) Primary Education Act 1990" has not been successfully implemented in Bangladesh since its inception.

PART TWO

Impact of education policies on overall educational development in Bangladesh: An empirical analysis

6.2.1 Introduction

The Government of Bangladesh (GoB) has invested nearly 4 percent of her gross domestic product (GDP) on education every year. Several policies have been attempted to increase the returns to those investments. Among those, two policies are directly related to improve school attendance. These are: the ―(obligation to) Primary Education Act (PEA) 1990" to eradicate illiteracy from primary school aged (6 years to 10 years) children from the country, to enrol all primary aged children into schools and to ensure universal primary education for all the children of the country. According to the Act 27, it is an obligation to the guardians (parents or career) of a child to send their primary school aged children into school unless there are any reasonable causes (such as illness or unavoidable reasons). Failure to follow this Act will cause a punishment of Taka 200 (US$ 3 only in July 2006 conversion rate) for a child. Similarly, the ―Female Secondary School Stipend (FSSS) program 1994" has been implemented all over the country to increase the attendanceof secondary level female students in existing schools, aimed to reduce the gap between male and female school attendance. The Female Stipend Program (FSP) was created as a pilot project in 1982 in Bangladesh and was implemented initially in six villages only to increase the enrolment and retention of girls in secondary schools.These yielded positive results: girls' secondary enrolments increased from an average of 7.9 percent to 14 percent in some project areas and dropout rates fell from 14.7 percent to 3.5 percent (Haq & Haq, 1998, p. 93). Therefore, the GoB extended the program nationwide in 1994 which was called the ―Female Secondary School Stipend (FSSS)" program.Under this program, all girls in rural areas who enter

secondary school are eligible for a monthly sum ranging from Taka 25 in Class 6 to Taka 60 in Class 10 (between US$0.37– $0.88 in July 2006). Girls receive additional payments in Class 9 for new books and in Class 10 for exam fees. The conditions were a minimum of 75 percent attendance rate, at least a 45 percent score in annual school exams and staying unmarried until sitting for the Secondary School Certificate (SSC) examination or turning 18 year old.

Both the policies‘ ultimate target is to increase the total number of student enrolment and to raise literacy rates which are considered as two basic indicators of measuring the educational development of a country. High school attendance, high literacy rate, low gender gap in school attendance, and low urban-rural gap in educational attainment are primary factors of evaluating a country‘s educational performance. After the removal of military government[26] in the year 1991, the GoB has adopted several new policies regarding education, health and judicial services bearing in mind to achieve a sustainable development in every sector of the economy. In this part of the chapter, we are concerned about two major education related policy measures that have been introduced since 1991. These are: (i) ―(Obligation to) Primary Education Act (PEA), 1990" and (ii) ―the Female Secondary School Stipend (FSSS) Programme, 1994".[27] Moreover, the GoB has taken two national education policies since 1990. Not the impact of any specific policy are we going to evaluate in this section but we are attempting to investigate the combined impact of both these education policies on the overall school attendance of population aged between 5 and 24 years, and on the literacy rates of population aged 5 years and over in the country.

While the country made considerable progress in the last decade, primary education still faces a number of serious challenges. Bangladesh is unlikely to achieve universal primary

[26]In the year 1982, military has taken administrative power of the country and continued its ruling thorough several elections till 1991.
[27]Brief discussions about these policies are given in appendix.

enrolment and completion by 2015 if the current trends in access and completion do not improve (World Bank); as in the first part of this chapter, we have found that the compulsory PEA has not yet brought all primary school aged population into school. Although the PEA has not yet been fully successful, the success in female secondary education is tremendous and has already achievedgender parity in primary and secondary schooling, which isone of the key Millennium Development Goals (MDG) (World Bank). Therefore, the FSSS programme of Bangladesh is replicated in other country, like Pakistan (Chaudhury and Parajuli, 2006).

Scholarly research on the educational system of Bangladesh is few. Some studies focus on religious educations of Bangladesh (Asadullah, Chaudhury, & Dar, 2007; Asadullah, & Chaudhury, 2009; Asadullah, & Chaudhury, 2010), some studies focus on performances of primary education and secondary education (Ardt,& et.al. 2008; Mushtaque,& et.al. 2001; Rabbi ; Ahmed, & et.al.), some studies investigate gender inequality in education system of Bangladesh (Asadullah, & Chaudhury, 2009; Blunch & Das 2007). There is hardly any meticulous study regarding the overall impact of educational policies on educational development of Bangladesh.In this part of the chapter, we are investigating the impact of these policies on two major indicators like overall school attendance and literacy rates of the country. *We, therefore, hypothesise that during the period 1991 to 2001, all education policies simultaneously and significantly raise the values of both the indicators of educational development in Bangladesh*.

6.2.2 Estimation method and Data

6.2.2.1 Estimation method

Since our fundamental objective is to evaluate the impact of two educational policies on the values of educational development indicators, we create a policy dummy variable for the year 2001, called $POLICY_{it}$, to assess the combined effect of these policy measures onschool attendance and literacy rates – two basic educational development indicators of a country. We have two-time point panel data set for 62 districts of Bangladesh and the district level characteristics that are often unobserved, such as - agro-climatic endowments, geographical location, cultural diversity etc. The standard solution for this unobserved heterogeneity bias is to assume that it is not time-varying and, therefore, can be controlled in a panel data regression with fixed district effects. For making sure that our unobserved heterogeneity assumption is correctly taken, we have conducted Hausman (1978) test of fixed effects vs. random effects estimation method. In our all estimations, Hausman (1978) test supports fixed effects method. We,therefore, use single equation estimation method to estimate the following two indicators with fixed effects method.

$$LNATTEN_{it} = \alpha_0 + \alpha_1 POLICY_{it} + \varepsilon_{it} \quad (6.10)$$

$$LITERACY_{it} = \alpha_0 + \alpha_1 POLICY_{it} + \varepsilon_{it} \quad (6.11)$$

where, $i =$ district and $t = 1, 2$ (year). The dependent variable in equation (6.10) $LNATTEN_{it}$ is the natural log value of the number of population aged between 5 and 24 years of each district, attending school in 1991 and 2001.

The dependent variablein equation (6.11) $LITERACY_{it}$ is the percentage of population aged 5 years and above is literate in 1991 and 2001.

$POLICY_{it}$ is the policy dummy variable taking value 1 for the year 2001 and zero for the year 1991.

$\varepsilon_{it} \sim N(0, \sigma^2)$ is the random disturbance assuming that normally distributed with zero means and constant variance across districts.

In equation (6.10) and (6.11), we have not included any explanatory variable except policy dummy to see the policy impact specifically on dependent variable; but this estimate might suffer from omitted variable problem and create biased estimates of parameters. We, therefore, have included relevant explanatory variables with policy dummy.

We have included log value of the total geographical area of a district as an explanatory variable because in a big district either the total number of school going population is large or per capita land resource is high. In any case, the demand for school attendance may be positively affected with this variable when other variables are held constant. The variable is symbolised as $LAREA_{it}$ where, $'i'$ represents district and $'t'$ represents time for all variables.

We assume that the higher the number of population, the greater the number of school going people. Thus, the variable has positive partial effect on school attendance. We, therefore, include the log value of total population of a district as an explanatory variable which is symbolised as $LPOPUL_{it}$.

A large family might be less interested to send its school aged children into the school because of the opportunity cost of attending school. Bangladesh is a poor country where more than 40 percent of population lies below poverty line. So, the opportunity cost of schooling is high. In theory, we also have seen that opportunity cost is negatively related to school attendance. We, therefore,expect that the variable has negative relationship with dependent

variable if other variables are held constant and consider it as an explanatory variable, symbolised as $FSIZE_{it}$.

The annual growth rate is considered as the proxy of average income growth of population in a district. We expect that the variable has positive relationship with the dependent variable because in the theory of demand for schooling, we have found that the demand for education is positively related with family income. The variable is denoted as $AGROW_{it}$.

Using –tap-water", –sanitary-toilet" and –electricity" collectively represent the overall development of a district and are considered as complementary factors of demand for education of a district. So, we include these three development factors in our estimation.

The percentage of population using tap-water reflectsthe development status of the district. The higher percentage of population in the district using –tap-water" indicates that the people in the district are more developed than that of the other districts. We, therefore, assume that the variable positively affects school attendance when other variables remain controlled. The variable is symbolised as $WATER_{it}$.

Using –sanitary toilet"is also considered as a proxy of the development indicator of a district. The greater percentage of population using –sanitary toilet" in a district implies that the population in the district is more advanced compared to its counterparts. So, we expect that the partial relationship of this variable with the dependent variable is positive. The variable is represented as $TOILET_{it}$.

Having electricity facility in consumption purpose is also measuredas an indicator of the development status of a district. The higher percentage of population in a district living without electricity means that the population in the district is relatively less developed than

that of other districts. We, therefore, expect that the variable has negative partial relationship with dependent variable, denoted as $NOELECT_{it}$.

Having agricultural land may have ambiguous impact on the school attendance of children. One explanation is that the more agricultural land means the higher level of income which leads to higher demand for attending school. Another interpretation might be that the more agricultural land indicates more demand for agricultural labour; so, the opportunity cost of attending school is high which leads to low demand for school attendance. We, therefore, include the percentage of population possessing agricultural land as an explanatory variable, represented as $ALAND_{it}$.

Religious belief may have an impact on school attendance especially for female children. We, therefore, include the percentage of population in a district belonging to Muslim religionas an explanatory variable to evaluate the effect of religion on school attendance. The variable is represented as $MUSLIM_{it}$.

We have used single equation estimation technique to estimate the following models of both the indicators on policy dummy with those relevant explanatory variables related to economic development through fixed effects method to justify the robustness of policy impact with the other factors of development. We also estimate random effects method for equation (6.12) and (6.13), and conduct the Hausman (1978) test for fixed effects vs. random effects method for checking the appropriateness of our fixed effects estimation results.

$$\begin{aligned} LNATTEN_{it} = {} & \alpha_0 + \alpha_1 POLICY_{it} + \alpha_2 LAREA_{it} + \alpha_3 LPOPUL_{it} + \alpha_4 FSIZE_{it} + \alpha_5 AGROW_{it} \\ & + \alpha_6 WATER_{it} + \alpha_7 TOILET_{it} + \alpha_8 NOELECT_{it} + \alpha_9 ALAND_{it} \\ & + \alpha_{10} MUSLIM_{it} + \varepsilon_{it} \end{aligned} \tag{6.12}$$

$$LITERACY_{it} = \alpha_0 + \alpha_1 POLICY_{it} + \alpha_2 LAREA_{it} + \alpha_3 LPOPUL_{it} + \alpha_4 FSIZE_{it} + \alpha_5 AGROW_{it} + \alpha_6 WATER_{it} + \alpha_7 TOILET_{it} + \alpha_8 NOELECT_{it} + \alpha_9 ALAND_{it} + \alpha_{10} MUSLIM_{it} + \varepsilon_{it} \quad (6.13)$$

where, $LNATTEN_{it}$ is the natural log value of the number of population aged between 5 and 24 years of each district attending schooling the year 1991 and 2001.

$LITERACY_{it}$ indicates literacy rates of the population aged 5 years and over in a districtin the year 1991 and 2001.

$POLICY_{it}$ is the policy dummy variable taking value 1 for the year 2001 and zero for the year 1991.

$LAREA_{it}$ is log value of the land area of a district in 1991 and 2001.

$LPOPUL_{it}$ is log value of the total population of a district in 1991 and 2001.

$FSIZE_{it}$ is the average family size in a district in 1991 and 2001.

$AGROW_{it}$ is the annual growth rate in a district in 1991 and 2001.

$WATER_{it}$ is the percentage of population using tap-water.

$TOILET_{it}$ is the percentage of population using sanitary toilet.

$NOELECT_{it}$ is the percentage of population living without electricity facility in a district in 1991 and 2001.

$ALAND_{it}$ is the percentage of population having agricultural land.

$MUSLIM_{it}$ is the percentage of people belonging to Muslim religious belief in 1991 and 2001.

$\varepsilon_{it} \sim N(0, \sigma^2)$ is the random disturbance assuming that normally distributed with zero means and constant variance across districts.

6.2.2.2 Data

We have used district (locally called as "*Zilla*") level data for the year 1991 and 2001. There are 64 districts in Bangladesh and we have used the data of 62 districts in our analysis. Two districts (Manikgonj and Rajbari) are excluded from the study due to unavailability of information. The third and fourth population censuses were conducted in the year 1991 and 2001 respectively. All the district level data are collected from these two censuses,where primary data are collected and summarised by the Bangladesh Bureau of Statistics (BBS), the only national institution of conducting national survey and census in the country. The web address of data source is http://www.bbs.gov.bd

Our data therefore represent the whole country in two ways: as a cross-section of 62 districts and as a time series of two time periods. Thus, the data set is as *balanced panel* data of two periods. We have chosen two distinct time periods because 1991 is the year before these policy measures were implemented in the country and 2001 is at least 6 years later time period after implementing both these policy measures. The "fifth population census, 2011" was held in May 2011 for the country but results have not been publicly available yet, so we are unable to include those data in our analysis.

6.2.3 Results and discussions

Table 6.5 represents the descriptive statistics of dependent variables and independent variables for all districts in two time periods.

The mean value of the number of students attending school increased more than 35 percent during the decade. The minimum number of student attendance was in Bandarban

district in 1991 that increased more than 67 percent in 2001. In Bandarban district, around 26 percent of total school aged children was attending school in 1991 while more than 32 percent of total children were attending school in 2001. The maximum number of population attending school was in Dhaka district in 1991 which is more than 42 percent of total school aged children in the district and increased more than 27 percent in terms of number of children during the decade. The average literacy rate increased more than 47 percent during the decade. The least literacy rates were in Sherpur district in 1991 and in Cox‘s bazaar district in 2001, while the most literacy rates were in Jhalokati district both in 1991 and 2001.

The mean land area of a district does not change much during the period but the average total population in each district increased around 29 percent during the decade that means the average population growth rate was 2.9 percent per year during the period. The average family size, the number of people in a family, decreased more than 10 percent during the period. The average annual growth rates in district level dropped 0.44 percent from 1991 to 2001. This drop in annual growth rate occurred because growth rate was calculated year to year that means growth rate of the year 1991 was the percentage change in growth between 1990 and 1991; and similarly, the growth rate of the year 2001 was the percentage change in growth between 2000 and 2001. Thus, the drop occurred due to different base year growth but the overall growth during the whole decade was positive for every district.

The average percentage of people using tap-water increased more than 23 percent during the decade. The percentage of people residing in Shariatpur and Patuakhali districts were minimum tap-water user in 1991 and 2001 respectively, while that in Dhaka district was maximum tap-water user in both 1991 and 2001. The average percentage of sanitary-toilet user increased more than 229 percent during the decade. The tremendous success in sanitary-toilet users has a great impact on health sector of the country. The death toll due to water

based epidemic like diarrhoea, typhoid etc was nearly eliminated from the country because of the improvement in sanitary-toilet users. The minimum percentage of people using sanitary-toilet in 1991 was in Potuakhali district which was 2.6 percent, while 23.46 percent of the total population in this district was using sanitary-toilet in 2001. Like tap-water user, the maximum percentage of population was using sanitary-toilet in Dhaka district both in 1991 and 2001.

Table 6.5: Descriptive statistics of variables

Variables	Mean		Std. Dev.		Minimum		Maximum		No. of district
	1991	2001	1991	2001	1991	2001	1991	2001	
Total school attendance	295511.2	400222.4	280878.8	342906.2	25875	45120	1158691	1478048	62
Literacy rates	28.31	41.65	6.90	7.97	17.77	27.72	47.55	65.35	62
Area (Sq. km)	2339.87	2343.14	1181.63	1188.47	716.08	687.76	6116.13	6116.13	62
Population	1733627	2234179	1075270	2901570	246301	250932	6163045	22465468	62
Family size	5.46	4.90	0.33	0.43	4.80	4.13	6.49	6.02	62
Annual growth rates	1.93	1.49	0.55	0.66	0.79	0.41	3.79	4.38	62
% of people tap-water	2.58	3.19	6.45	7.45	0.09	0.41	47.39	56.85	62
% of people Sanitary toilet	10.31	33.998	7.67	16.31	2.60	4.33	53.99	78.62	62
% of people No electricity	88.73	74.27	11.49	14.50	26.03	11.24	97.63	93.10	62
% of people Owned agricultural land	56.03	56.29	7.86	8.06	35.27	33.51	70.87	70.74	62
% of people Muslim	85.91	87.11	11.88	12.12	39.28	36.82	97.77	98.12	62

The average percentage of population residing without electricity decreased more than 16 percent during the decade. The darkest district (in terms of electricity facility) was

Kurigram in 1991 and Lakshmipur in 2001. The brightest district was Dhaka in both 1991 and 2001.

The average percentage of population owning agricultural land (any amount) did not change during the decade but increased 0.46 percent. This is a good signal that the proportion of landless people in the country decreased marginally during this time. The highest percentage of landless people was in Gopalgonj district both in 1991 and 2001 though the percentage reduced in the later years.

The average percentage of Muslim population increased 1.4 percent; as a result,thepercentage of minority religious believers like Hindu, Christian and Buddhists decreased during the decade.

The descriptive statistics of all these important development indicators reflect that all the districts of Bangladesh have developed during the decade. It may be possible that the development in the total number of population attending school and in literacy rate has happened through the tickle-down effects of the overall development of the economy during the decade rather than due to change in educational policies. We, now move from descriptive analysis to fixed effects regression analysis for getting better understanding about the impact of education policies on overall school attendance and literacy rates.

Table 6.6 shows the estimated results of fixed effects models for both log value of the number of population attending school and literacy rate. Models where policy dummy is included as only independent variable, has been found to be highly positively significant at less than 1 percent level while regressing on both log value of the number of population attending school and literacy rates. These results indicate that educational policies have significantly improved educational attainment and literacy rates of the country during the

decade. Despite educational policies having significant impact on educational indicators, we cannot confidently depend on these results because the estimated results might suffer from omitted variable bias problem. We, therefore, discuss regression results in detail in the specified general models where policy dummy and other explanatory variables are considered.

The general model (policy dummy and other independent variables) of the number of population attending school (specified in equation 12) fits very well. The F-statistic of the estimated equation is highly significant below 1 percent level although overall R^2 -value is low which is not unlikely in panel data set. Hausman (1978) test for checking appropriateness between fixed effects and random effects model shows that fixed effect model is preferable. Similar results have been found for the general model of literacy rate (specified in equation 13).

Policy dummy variable has been found to be positively significant in both specified general models. The estimate coefficient of policy dummy for the log value of the number of population attending school is 0.45. We, therefore, conclude that policy dummy increases 45 percent number of population of attending school and vice versa if other variables remain constant. The estimated coefficient of the policy dummy for literacy rates is 8.34. This estimate implies that policy dummy increases 8.34 percent literacy rate of population and vice versa when other variables are fixed. Now, we can confidently say that introducing educational policies after 1990 has made a significant positive impact on overall educational development of Bangladesh during the decade.

Table 6.6: Estimated results of log value of total number of school attendance and literacy rates

	$LNATTEN_{it}$		$LPATTEN_{it}$	$LITERACY_{it}$	
	Policy dummy alone	Policy with other variables	Policy with other variables	Policy dummy alone	Policy with other variables
Const.	12.34***	2.25	1.09	28.31***	-126.07
(Std. err)	(0.03)	(16.28)	(1.21)	(0.34)	(175.11)
$POLICY_{it}$	0.31***	0.45***	0.03***	13.34***	8.34***
(Std. err)	(0.04)	(0.12)	(0.01)	(0.47)	(1.33)
$LAREA_{it}$		2.17	0.15		17.51
(Std. err)		(2.09)	(0.16)		(22.56)
$LPOPUL_{it}$		0.07	-0.06***		0.80
(Std. err)		(0.09)	(0.01)		(0.93)
$FSIZE_{it}$		-0.36**	-0.02*		-5.81***
(Std. err)		(0.17)	(0.01)		(1.88)
$AGROW_{it}$		0.15**	0.01**		1.34*
(Std. err)		(0.07)	(0.005)		(0.80)
$WATER_{it}$		0.01	0.001		0.65***
(Std. err)		(0.02)	(0.001)		(0.24)
$TOILET_{it}$		-0.01***	-0.001***		0.03
(Std. err)		(0.004)	(0.0003)		(0.04)
$NOELECT_{it}$		-0.0001	-0.3E-4		-0.05
(Std. err)		(0.006)	(0.0004)		(0.06)
$ALAND_{it}$		-0.05***	-0.003***		0.38**
(Std. err)		(0.016)	(0.001)		(0.17)
$MUSLIM_{it}$		-0.04	-0.003		0.22
(Std. err)		(0.037)	(0.003)		(0.40)
No. obs.	124	124	124	124	124
No. grps.	62	62	62	62	62
R-sq.					
w.	0.49	0.66	0.75	0.93	0.96
b.	..	0.014	0.001	..	0.0001
o.	0.05	0.02	0.008	0.45	0.09
F –value	57.95***	9.93***	15.31***	797.62***	119.02***
Prob>F	0.000	0.000	0.000	0.000	0.000
Hausman test					
χ^2-value (d.f)		45.01	43.88		45.81
Prob>χ^2-value		0.000	0.000		0.000
Decision		Fixed effects model supported	Fixed effects model supported		Fixed effects model supported

Note:***, ** and * represent significant at 1%, 5% and 10% respectively. Std.err indicates standard error. No. obs. and No. grps. Indicate number of observations and number of groups respectively. R-sq. represents coefficient of determination where, w.,b., and o. represent within, between and overall value of coefficient of determination respectively. (d.f) indicates degree of freedom of Hausman test statistic, χ^2-value.

There are some other factors which may have worked as catalyst with the change in policies. Now we are going to comment on these other factors.

Family size is another significant determining factor of indicators of educational development. It has been found negatively significant at 5 percent and 1 percent level respectively for the number of population attending school and literacy rates. The estimated

coefficient of this variable for the log value of the number of population attending school is 0.36 which implies that one unit decrease in family size increases 36 percent of school attendance and vice versa when other variables are held constant. The estimated coefficient of family size for literacy rates is 5.81. This indicates that a unit decrease in family size increases 5.81 unit of literacy rates for the country. The negative sign of the estimated parameter implies that the larger the family size, the lower the educational development. The result is intuitively logical for a poor country like Bangladesh. A large family has to bear a large total cost (both direct and opportunity cost) of education for the whole family which is not always possible for a low income family; as a result, the demand for school attendance of the members of that low income family tends to be low resulting in a low literacy rate among family members.

The annual growth rate is another positively significant explanatory variable of the indicators of educational development of a country. Annual growth rate variable is included in the models as proxy of income. It has been found to be positively significant at 5 percent and 10 percent level respectively for the number of population attending school and literacy rates. The estimated coefficient of this variable for the log value of the number of population attending school is 0.15. The estimated coefficient indicates that a one unit increase in annual growth of the district increases 15 percent of school attendance and vice versa when other variables are held constant. The estimated coefficient of annual growth rate for literacy rates is 1.34. This estimated value implies that a unit increase in annual growth rate increases 1.34 percent of literacy rates for the country. The positive sign of the estimated parameter matches with the theory and intuition. As income increases, the demand for education either in attending school or in literacy development increases and vice versa which is found in all

education literature. Thus, we can say that the estimated results of this variable support, theoretically as well as intuitively, the poor country, Bangladesh.

The percentage of population owning agricultural land variable has been found to be a negatively significant determining factor of the number of population attending school. The estimated parameter is significant at 1 percent level and the coefficient is 0.05. The estimated coefficient indicates that one unit increase in agricultural land ownership decreases 5 percent of school attendance and vice versa when other variables are held constant. The intuition behind this finding is that as agricultural land ownership increases, the demand for agricultural labour increases; therefore, the opportunity cost of attending school rises. Since most of the family in the country uses family labour for agricultural activities, that means a family uses its school aged child as marginal labour for agricultural production by stopping child‘s school attendance. This type of family behaviour is also rational because the opportunity cost of attending school becomes so high for the poor families which cannot be affordable by them.

The percentage of population owning agricultural land variable has been found to be positively significant determining factor of literacy rates. The estimated parameter is significant at 5 percent level and the coefficient is 0.38. The estimated value of parameter indicates that one unit increase is land ownership increases 0.38 units of literacy rates of a district. The contrasting results of this variable for two indicators – school attendance and literacy rate, are not unusual. Because literacy rate is measured for the population aged 5 years and above but the total number of school attendance is measured only for the population aged between 5 year and 24 year. It is possible that both young children and old parents may like to complete some level of literacy but old parents may not like to go to school. Moreover, gaining some level of literacy does not necessarily need to attend school on working time

(such as adult education, informal education etc.) so that the opportunity cost of gaining literacy is not as much as the opportunity cost of attending school. So, people would like to gain some level of literacy after their regular work. It is also likely that the percentage of population who possesses more agricultural land is richer than who possesses less percentage of agricultural land. The rich people like to gain some literacy to maintain their wealth. Thus, we conclude that the positive relationship between literacy rate and possessing agricultural land is not irrational.

The percentage of population using sanitary-toilet is another negatively significant determining factor of the number of attending school. The variable has been found to be negatively significant at 1 percent level and the estimated coefficient of this variable is 0.01 which implies that one percentage increase in sanitary-toilet user decreases 1 percent of school attendance and vice versa when other variables are held constant. The sign of the estimated parameter is not as expected. The descriptive statistic of this variable shows that there is tremendous progress in sanitary-toilet user because of the GoB health policy. According to the policy, every year government supplies a huge number of sanitary-toilet instruments without any cost for the families without having sanitary-toilet system in every district and its smaller units (Police station, union, and village). This implies that the percentage of people using sanitary-toilet is not a good proxy of evaluating a family‘s economic status nowadays for Bangladesh. The estimated coefficient of this variable has been found to be positive but is an insignificant factor of literacy rates.

All other variables have been found statistically insignificant but have expected sign for each variable. The log values of – the area of a district, the number of total population of a district and the percentage of population using tap-water have got positive sign but are statistically insignificant. The positive sign of each of these variables is expected intuitively.

Similarly, the percentage of population residing without electricity service has got negative sign but is statistically insignificant. The negative sign of this variable is also intuitively expected. We, therefore, rely on the estimated results and comment that specific educational policies have significant impact on the two important indicators of educational development of the country during the decade along with other development factors such as family size, annual growth rate and ownership of agricultural land etc.

It is possible that the time trend might affect the impact of policy dummy in the estimated models. Since there are only two time periods in our data set and we have used a policy dummy for 2001 in the estimation, a time dummy variable is not possible to include in the estimation process due to collinearity. To check the robustness of our estimated results, we have generated a new dependent variable defined as the percentage of log number of school attendance to log population of the district, $\left(LPATTEN_{it} = \frac{LNATTEN_{it}}{LPOPUL_{it}}\right)$. Then estimate the following model. The estimated result is reported in a separate column in Table 6.6.

$$LPATTEN_{it} = \alpha_0 + \alpha_1 POLICY_{it} + \alpha_2 LAREA_{it} + \alpha_3 LPOPUL_{it} + \alpha_4 FSIZE_{it} + \alpha_5 AGROW_{it} + \alpha_6 WATER_{it} + \alpha_7 TOILET_{it} + \alpha_8 NOELECT_{it} + \alpha_9 ALAND_{it} + \alpha_{10} MUSLIM_{it} + \varepsilon_{it} \quad (6.14)$$

The estimated results do not make any difference with the estimation model of equation (6.12), just change the values of estimated parameters without affecting the sign of estimated parameters. This finding helps us to make conclusion confidently about our results.

6.2.4 Conclusions for part two

The objective of this section of the chapter is to evaluate the impact of two important educational policies on the number of population attending school and literacy rate – two major indicators of educational development of the country during the 1991 and 2001 period. Using district level census data from the "third population census 1991" and the "fourth population census 2001", we have used 124 observations of 62 districts of the country. Thus, the study covers around 97 percent area and population of the country. Using fixed effects estimation method also helps us to cover the dynamic of the rate of change in dependent variables due to change in policies and other explanatory variables.

Two educational policies implemented in the early period of the 1991-2001 decade have significant impact on the school attendance of population aged between 5 and 24 years and on literacy rates in the country. Only a change in policies increases 45 percent of school attendance and more than 8 percent of literacy rate in the country.

The annual growth rate is used as a proxy measure of average income of a district that has been found to be a statistically significant factor in determining school attendance and literacy rate of the country. The theory of the demand for school attendance says income positively determines school attendance which is supported by the estimated results.

Family size is another statistically significant determinant of school attendance and literacy rate of the country. The negative correlation between school attendance and family size, and between literacy rate and family size explores the significance of the opportunity cost of attending school in a poor economy.

Similarly, ownership of agricultural land is found as a significant determinant of school attendance and the negative correlation between school attendance and ownership of

agricultural land again highlights the importance of opportunity cost in the demand for education in a poor agriculture-based economy.

Other development indicators also have an impact on school attendance and literacy rate but their effects are not found to be statistically significant in the analysis.

The time series analysis shows that the PEA 1990 has not had a very significant impact on educational outcome once one control for other variables that could be driving it. Our panel analysis shows the combined impact of the PEA 1990 and the FSSS 1994 is significant, this might suggest that the FSSS 1994 policy has contributed to improvement in educational outcome. One reason of the enormous success of the FSSS 1994 program is that it has included cash incentive to female students in attending secondary level of education while no such meaningful cash incentive has been introduced in the PEA 1990 for attending primary level of education. Another reason is that the opportunity cost of male child labour (aged between 8 years and 13 years) is higher than that of the female in a poor country like Bangladesh because male children start working in agricultural field and other income related works at a very early age of life in Bangladesh but female children of that age can do household work only. So it is more important to introduce cash and kind incentives (such as monthly stipends, meal support, food supply program for the family, free study materials, free medical support for the child and their family members etc) in any ~~(~~obligation to) Primary Education Act" to achieve optimum results. Theoretically, the demand for school attendance in any level follows the law of demand in an economy. The law of demand says the opportunity cost of attending school is inversely related to the demand for school attendance. Empirically, we have also found that a policy measure with a sound opportunity cost incentive (such as the FSSS 1994) is more successful than a policy measure without such incentive (for instance, the PEA 1990). We, thus, conclude that for getting a maximum level

of outcome from an educational policy of school attendance, policy makers should introduce both of the income support system and cost support system in their policy measure.

Appendix: Chapter Six

Figure 6.9: Recursive estimates of specific two period lags ADL model

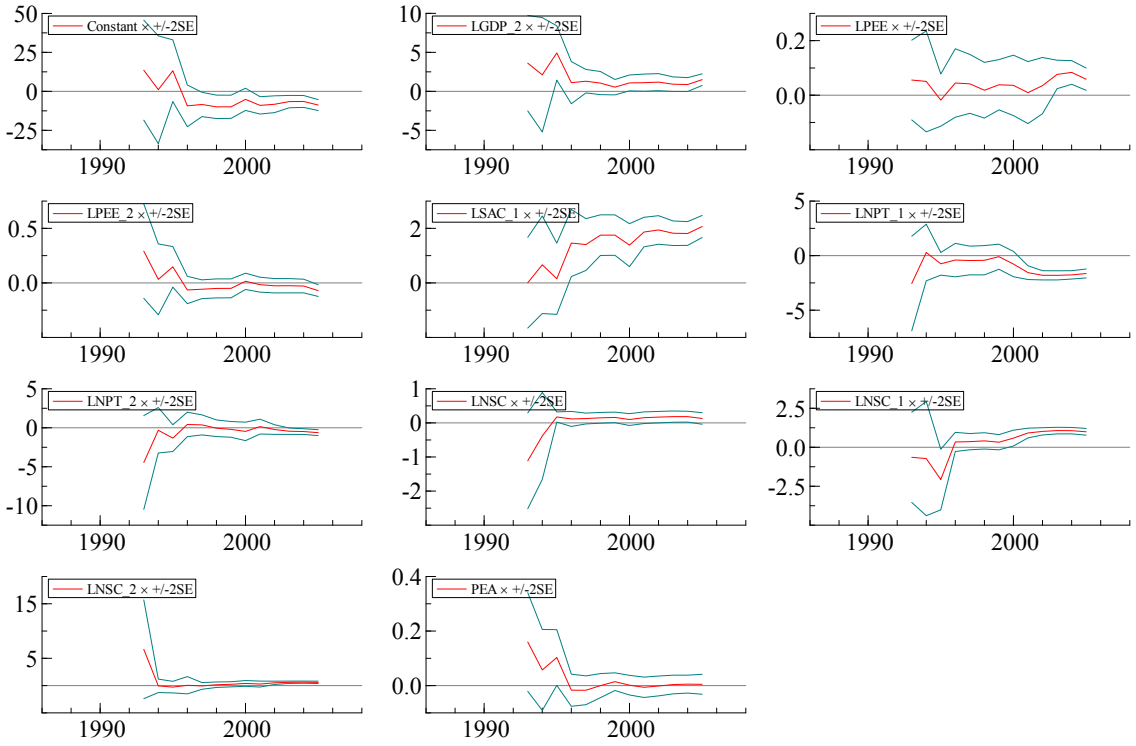


Table 6.7: Estimation results of growth of enrolment: ADL models with two and one period lags

Dependent variable $GERMT_t$	ADL General model with two periods lags	ADL general model with one period lag
Independent variables	OLS method	OLS method
$GERMT_{t-1}$	0.29	0.55**
(Std. err.)	(0.36)	(0.26)
$GERMT_{t-2}$	-0.56*	
(Std.err.)	(0.29)	
$LGDP_t$	0.21	0.15
(Std. err.)	(0.12)	(0.15)
$LGDP_{t-1}$	-0.33	-0.12
(Std. err.)	(0.21)	(0.16)
$LGDP_{t-2}$	0.22	
(Std. err.)	(0.19)	
$LPEE_t$	0.02**	0.007
(Std. err.)	(0.009)	(0.005)
$LPEE_{t-1}$	-0.01	-7.4E-05
(Std. err.)	(0.007)	(0.002)
$LPEE_{t-2}$	0.01	
(Std. err.)	(0.007)	
$LNPT_t$	-0.07	0.006
(Std. err.)	(0.06)	(0.02)
$LNPT_{t-1}$	-0.12***	-0.10***
(Std. err.)	(0.04)	(0.03)
$LNPT_{t-2}$	-0.07	
(Std. err.)	(0.07)	
$LNSC_t$	0.03	-0.005
(Std. err.)	(0.03)	(0.02)
$LNSC_{t-1}$	0.09***	0.06***
(Std. err.)	(0.03)	(0.02)
$LNSC_{t-2}$	0.06	
(Std. err.)	(0.05)	
PEA_t	0.003	0.003
(Std. err.)	(0.004)	(0.03)
Cont.	1.29**	0.52**
(Std. err.)	(47)	(0.23)
Adjusted R^2-value	0.98	0.98
***F*-value(Prob. Val)**	74.36***	123.28***

Note: *, ** and *** represent that the co-efficient is significant at 10%, 5% and 1% respectively. ―Std. err.” represents standard error of the coefficient. ―Cnt.” indicates the constant term of the estimated regression model. ―Prob. Vale)” indicates the probability value of the corresponding term.

Table 6.8: Estimated results of Impulse Indicator Saturation (IIS) method

	Coefficient	Std. Error	t-value	Prob. of t-value	Partial R^2
LERMT_1	1.04838	0.02826	37.1	0.0000	0.9942
LSAC	-3.04945	0.3700	-8.24	0.0000	0.8946
LSAC_1	7.09983	0.6060	11.7	0.0000	0.9449
LSAC_2	-4.05529	0.3321	-12.2	0.0000	0.9491
LNPT	0.381045	0.02100	18.1	0.0000	0.9763
LNPT_1	-0.454872	0.02958	-15.4	0.0000	0.9673
I:1984	-0.0132459	0.002978	-4.45	0.0021	0.7121
I:1985	0.0230273	0.002971	7.75	0.0001	0.8825
I:1990	-0.0434733	0.003085	-14.1	0.0000	0.9613
I:1992	-0.0271240	0.005124	-5.29	0.0007	0.7779
I:1993	0.0172029	0.004053	4.24	0.0028	0.6925
I:1996	0.0597515	0.003016	19.8	0.0000	0.9800
I:2000	0.0490855	0.003982	12.3	0.0000	0.9500
I:2001	-0.158236	0.005159	-30.7	0.0000	0.9916
I:2002	-0.00902932	0.003232	-2.79	0.0234	0.4938
I:2005	-0.0320182	0.003614	-8.86	0.0000	0.9075

sigma = 0.00268098	RSS = 5.75011202e-005
R^2 = 0.999711	F(15,8) = 1844 [0.000]**
Adj.R^2 = 0.999169	log-likelihood = 121.247
no. of observations = 24	no. of parameters = 16
mean(LERMT) = 9.51547	se(LERMT) = 0.272723
AR 1-1 test: F(1,7) = 0.52137 [0.4937]	ARCH 1-1 test: F(1,22) = 0.16700 [0.6867]
Normality test: Chi^2(2) = 13.630 [0.0011]**	RESET23 test: F(2,6) = 0.70146 [0.5324]
Hetero test: not enough observations	
Hetero-X test: not enough observations	

Table 6.9: Objectives and achievements of different five years plans for primary education

First Five Year Plan (1972-73 to 1977-78)		
Objectives	(i)	The percentage of primary age-group (5-10 years) students attending schools will increase from 58% (60 lakh) to 73% (85.94 lakh).
	(ii)	Text-books, writing and instructional materials will be supplied to all children free of cost or subsidised rates.
	(iii)	Drop-out rate will be reduced from 63% to 52%.
	(source: 1st five year plan, p451.)	
Achievements	(i)	The share of resource allocation of primary education declined from 17% to 12% of total allocation in education.
	(ii)	While literacy scene has remained more or less stagnant.
	(iii)	The total enrolment increased to 58% (60 lakh) to 67.67% (70 lakh).
	(iv)	The drop-out rate continued to be high.
	(source: 2nd five year plan p.XVI-3).	
Second Five Year Plan (1979-80 to 1984-85)		
Objectives	(i)	Universal primary education.
	(ii)	Students attending schools will increase from 68% (70 lakh) to 100% (130 lakh).
	(iii)	Text-books, free uniform, writing and instructional materials will be supplied to all children free.
	(iv)	Introduce mass education programme to cover 400 lakh illiterate in the age group 10-45 by 1985.
Achievements	(i)	In the second five year plan accorded top most priority to the introduction of universal primary education by 1985 and about 47% of total allocation to the Education sector was earmarked for this program.
	(ii)	The expansion of enrolment only 6.34 lakh only against the plan target 47 lakh additional children. This means ineffective use of resource.
	(iii)	Drop-out rate was also high.
	(iv)	In mid 1982 evaluation showed that only 7 lakh people could be made literate under the programme.

(Source: 3rd five year plan. pp.336-337)

Third Five Year Plan (1985-86 to 1989-90)	
Objectives	(i) Enrolment target was set 70% of the primary age group children by 1990 (ii) Ensure their retention for completion of primary school cycle. That means reduce the drop-out rate nearly zero percent. (Source: 3rd five year plan. p.340)
Achievements	(i) The primary age-group population to be 149 lakh and enrolment was 119.40 lakh 80% of total children. (ii) About 42% of the total allocation in the education sector was utilised in the second scheme of the universal primary education programme. That means, overall allocation in primary sector is more than 50% of total allocation in education sector. (Source: 4th FYP p. XV-2)

Fourth Five Year Plan (1990-91 to 1994-95)	
Objectives	(i) Introduce compulsory primary education. (ii) Reduce mass illiteracy. (iii) Construction of primary schools to expand capacity. (iv) Mapping the location of primary school to estimate the necessity of school in a location. (v) Expand non-formal primary education by mobilising NGOs activities. (vi) Establish _satellite Schools' to nearby primary schools with classes I and II for distantly located children. (vii) Provide uniform for girl students and feeding program in selective schools. (viii) Enrolling and ensuring regular attendance of children schools supply 15kg of wheat per child and maximum 30kg for a family in some selected area. (Source: 4th FYP p.XV-15)
Achievements	No more five year plan is published after the fourth five year plan.

(Obligation to) Primary Education Act 1990

BANGLADESH

Primary Education (Compulsory) Act, 1990

Act No. 27

An Act made to provide for the obligation to primary education.

Whereas it is expedient to provide for the obligation to primary education;

Therefore the following Act is hereby made.

1. Short title. This Act may be called (Obligation to) Primary Education Act, 1990.

2. Definitions. Unless there is anything repugnant in the context, in this Act-

a) "Guardian" means the child's father or, in his absence, the mother or, in the absence of both parents, any person taking care of the child.

b) "Committee" means Obligation to Primary Education Committee established as under section 4.

c) "Primary Education" means education for children determined or consented to by the Government.

d) "Primary Education Institute" means any governmental or non-governmental educational institute where provision for primary education has been made.

e) "Child" means any boy or girl between 6 and 10 years.

3. Obligation to primary education.

(1) The Government may, by notification in the official Gazette, declare primary education obligatory in whatever area from whenever onwards.

(2) The guardian of any child dwelling permanently in a area where primary education is obligatory shall, in the absence of justified reasons, get his child admitted for the purpose of receiving primary education in a primary education institute of the said area in the vicinity of his place of residence.

(3) The "justified reasons" mentioned in subsection (1) shall be understood as the following reasons, namely:

a) The impossibility of admitting a child in a primary education institute for illness or any other unavoidable reason.

b) The non availability of a primary education institute within 2 kilometres of the dwelling place of the child.

c) The impossibility of admitting a child in a primary education institute even if applied for.

d) The decision of a primary education officer that the education a child is receiving at the time being is equivalent to a primary education.

e) The decision of a primary education officer that it is not desirable to enter a child in a primary education institute on account of it's being mentally retarded.

(4) In the areas where primary education shall be obligatory no person shall keep children engaged in such occupations as may prevent them from attending a primary education institute for the purpose of receiving primary education.

4. Obligatory Primary Education Committee.

(1) Every area where primary education shall be obligatory shall have a Committee called Obligatory Primary Education Committee for every ward of the union or municipal areas.

(2) The Committee for any union ward shall be formed by the following members, namely:

a) a member of the ward nominated by the Chairman of the Upazila Council, who shall be its Chairman too.

b) two patronizers of learning nominated by the Chairman of the Upazila Council after taking the advice of the Chairman of the Union Council.

c) two lady patronizers of learning nominated by the Chairman of the Upazila Council after taking the advice of the Chairman of the union Council.

d) the headmaster or lady principal of a primary education institute, who shall be it's secretary too.

(3) The Committee for any municipal area ward shall be formed by the following members, namely:

a) a ward commissioner nominated by the Mayor of the municipal corporation or the Chairman of the municipal meeting, who shall be it's Chairman too.

b) two patronizers of learning nominated by the said Mayor or Chairman after taking the advice of the ward commissioner.

c) two lady patronizers of learning nominated by the said Mayor or Chairman after taking the advice of the ward commissioner.

d) the headmaster or lady principal of the primary education institute, who shall be the secretary too.

(4) There being more than one primary education institute in a ward, the headmaster or lady principal of any of these shall be member of the Committee and the Chairman of the Upazila respectively the Mayor of the municipal corporation, or the Chairman of the municipal council shall decide who of those shall be secretary of the Committee.

5. Duties and Responsibilities of the Committee.

(1) The Committee shall ensure that all children dwelling permanently in its area be entered in and regularly present at the primary education institute, and shall take for this purpose all measures it deems necessary or which are prescribed by the Government.

(2) The Committee shall prepare a list of all children dwelling permanently in it's area, which shall contain the name of the child, the name of the guardian and the age of the child; the names of the children to be entered in a primary education institute or to be exempted therefrom shall be contained in the list separately.

(3) The list prepared according to subsection (2) shall be rectified every year in the last week of December; the names of those who cease to be children with the beginning of the new year shall be cancelled and the names of those who will be children entered.

(4) A copy of the list mentioned in subsection (2) and the rectified list mentioned in subsection (3) shall be sent to all primary education institutes situated within two kilometres of the primary education officer and the concerned ward.

(5) Every year in the last week of January, the headmaster or lady principal of any primary education institute shall send a list containing the names of all children entered in their institute to the concerned Committee and primary education officer.

(6) The headmaster or lady principal of any primary education institute shall send, in the first week of any month, a list containing the names of all children who had been absent for at least 7 days during the foregoing month to the concerned Committee and primary education officer.

(7) Where the Committee is satisfied that a child entered in its list has, without justified reasons, not been entered in a primary education institute or been absent for at least 7 days within a month without the approval of the headmaster or lady principal of the education institute, it may after hearing the statement of the guardian or, if necessary, investigating the case, give order that the guardian of the child, in case of the child's not having been admitted, admit the child within the term determined by the Committee in a primary education institute, or that, in case of the child's having been absent, he ensure that the child be present regularly at the education institute concerned.

6. Punishment.

(1) If any Committee fails to accomplish it's duties under this Act, any of its members shall be punished with a fine of not more 200 Takas.

(2) If any guardian fails three times in a row to comply with an order given under section 5 (7), he shall be punished with a fine of not more than 200 Takas.

7. Cognizance of an offence.

Without a complaint in written form by the Chairman of the Committee, no Court shall take cognizance of any offence under this Act.

8. Power to make rules.

The Government may, by notification in the official

Female Secondary School Assistance Project in Bangladesh

In order to promote female education in the country, the government of Bangladesh set a goal to raise the female literacy rate from 16 percent to 25 percent in the fourth five-year plan (1990-1995). Previously in early 1980s the Female Education Scholarship program (1982 -1992) had successfully attempted to provide stipends as monetary incentives to girls in secondary school to cover education expenses, and thereby increase the enrolment of girls. The initiation of the Female Secondary School Assistance Project is made by the GOB in mid-1993. The project was supported by the International Development Association (IDA).

The main objective of FSSAP project was to stimulate significant increase in secondary school enrolment of girls, thereby enlarging the stock of educated women capable of participating fully in the economic and social development of the country.

The specific objectives of the project were as follows:

- Increase the number of girls enrolled in grades 6-10 and assist them to pass the SSC (Secondary School Certificate—tenth grade) examination so that they become qualified for employment.
- Increase the number of secondary education teachers in the project schools and raise the proportion of female teachers.
- Provide occupational skills training to school leaving girls interested in entering the labour market.
- Promote a supportive community environment for girls‘ education through widespread public awareness about the merits of female educational, social and economic development.

- Provide a healthier and safer environment for girls by enhancing school attractiveness through community participation in school-based water supply and sanitation programs.
- Strengthen the Directorate of Secondary and Higher Education (DSHE) Ministry of Education (MOE) through support for project implementation and capacity building at national and district levels.

The major components of the project were

- (a) Stipend and Tuition Program;
- (b) Teacher Enhancement Program;
- (c) Occupational Skills Development Program;
- (d) Female Education Awareness Program;
- (e) Water Supply and Sanitation Program; and
- (f) Institutional Development Program.

The Stipend and Tuition program accounted for about 80 percent of the project costs and remained the focus of FSSAP.

The districts for project implementation were identified based on economic impoverishment levels, low female literacy rates and low female attendance levels. Any girl residing in the target area who had successfully cleared Grade 5 was eligible to receive a stipend. In addition, stipend disbursements depended on parents agreeing to the following conditions for their daughters:

- Attend school for at least 75 percent of the school year.
- Obtain at least 45 percent marks on average in final examinations.
- Remain unmarried through completion of SSC.

The tuition fees, as a part of the stipend, were directly issued to the school where the student was enrolled. The rest of the subsidy was paid directly to the girls in two annual installments in the form of deposits to savings accounts in the nearest Agrani Bank branch. The stipend increased by grade.

An inter-ministerial steering committee chaired by the MOE facilitated project implementation and provided policy and decision-making guidance. A Project Implementation Unit (PIU) developed work plans and budgets, assisted with coordination and scheduling activities, contracted technical assistance, services and training programs and processed school applications. At the district level a Thana (subdivision) project office encouraged schools to sign the project agreement and assist them in implementing the project. Finally school management committees (SMCs) and parent teacher associations (PTAs) were formed to coordinate project functioning at the school level.

Each school intending to receive stipends for girl students had to get registered at the Thana project office. Once registered, the schools had to do the following:

- Help create public awareness and encourage girls to enroll.
- Issue warnings to girls not fulfilling the requirements.
- Accept the tuition fees from FSSAP at a rate as decided by the Ministry of Education.
- Discontinue collection of tuition fees from stipend recipients.
- Assign a unique ID number to each beneficiary student and maintain a register to record the same.

Source: FEMALE SECONDARY SCHOOL ASSISTANCE PROJECT, BANGLADESH**.** This case study was prepared by a team comprising Prof. Deepti Bhatnagar and Ankita Dewan at the Indian Institute of Management (Ahmedabad) and Magüi Moreno Torres and Parameeta Kanungo at the World Bank(Washington DC) published in *Empowerment Case Studies: Female Secondary School Assistance Project, Bangladesh Web address: http://siteresources.worldbank.org/INTEMPOWERMENT/Resources/14828_Bangladesh-web.pdf*

CHAPTER SEVEN

Conclusion of the thesis

This thesis has attempted to analyse three different issues of household economic behaviour both theoretically and empirically; these are, the residing arrangements of senior citizens in developing and developed countries, the role of public education expenditure on income distribution of a society and the impacts of the education policies of the Government of Bangladesh on school attendance. There are background literature reviews covering some specific aspects of these three topics. This research fills some of the gaps that are not covered by the literature. The findings of this study have significant implications not only for a specific country but also for any country – particularly for developing economics.

7.1 Summary of Findings

We repeat the main questions to which this thesis tries to find answers and then summarise what we find for each question.

1. What are the determinants of co-residing arrangements of senior citizens in developing countries?
2. What are the determinants of solitary residing behaviour of senior citizens in developed European countries?
3. Can public education expenditure change income inequality of a country?
4. Does the development status of a country help to determine the impact of public education expenditure on income inequality?
5. Why has the government of Bangladesh failed to implement universal primary education for the last nineteen years?

6. What are the consequences of public education policies on school attendance and literacy rates in Bangladesh?

The determinants of the co-residing decision of senior citizens of developing countries have been discussed in **Chapter Three** of this thesis to answer question number 1 which is currently a major issue for policymakers in developing countries. In our theoretical model of this chapter, we have shown how altruism, congestibility issues and negative externality to explain the household behaviour of younger offspring and senior parent in developing countries. Our theoretical model indicates that, as expected, housing price negatively affects the co-residence pattern of senior citizens; income, however, may positively or inversely affect the co-residence pattern depending on the relative importance of altruism and negative externality emerged from co-residence. We also empirically estimate the significant determinants of co-residence pattern of the senior citizens in developing countries, specifically, in Asia and Africa. The estimated results suggest that income has a negative and significant effect on co-residence of the senior citizens with their working children, the magnitude of this effect is slightly higher for male senior citizens compared to their female counterpart. The life expectancy rate has a positive and significant effect on co-residence, the magnitude is higher for female than that of male senior citizens. Religious culture and regional culture significantly influence the co-residence pattern of the senior citizens. Muslim religion and Asian culture have a positive impact on co-residence of the senior citizens.

Chapter Four deals with answering the question number 2 which is a great challenge for the policymakers of the developed countries due to post-war baby-boomers approaching the state of senior citizens pretty soon. The fundamental objective of this study is to find out the most reliable factors affecting solitary residing patterns of senior citizens of these European countries. We develop a theoretical model including the congestion problem of co-

residence that explains the co-residing behaviour of senior citizens and also determines when a senior citizen wants to reside alone. We have found from the theoretical model that a relative increase in senior citizen‘s income to working citizen‘s income encourages a senior citizen to co-reside with working citizen for gaining more consumer surplus from co-residing. We have considered an empirical analysis including life-cycle pensionable wealth of senior citizens, mean real income of working citizens, inflation rates, life expectancy after retirement of senior citizens, average years of schooling of senior citizens, labour force participation rates of working citizens, and religious belief variables. Using two time periodsgender-specific macro-level panel data set, we have conducted random effects and fixed effects model estimation techniques. From the estimated results, we have found that life-cycle pension wealth of senior citizens is significantly and negatively related tothe solitary residing decision of senior citizens although the magnitude is very minor. Religious belief in Christianity is also significantly and negatively related tothe solitary residing pattern of senior citizens which is complementary with prior studies of cultural traits. The mean real income of working citizens significantly and negatively affect solitary residing patterns of the male senior citizens although the magnitude of coefficient is very tiny. Life expectancy after retirement is also a significant variable for female senior citizens in making solitary residing decision.

Chapter Five of the thesis focuses to answer research question number three and four. Two separate theoretical macro-models have been developed for developed countries and developing countries. Theory says that an increase in public education expenditure reduces income inequality in developed countries but amplifies income inequality in developing countries. However, expanding public education expenditure is a Pareto improvement for both developed and developing countries as long as the tax rates imposed on the beneficiary of education expenditure is less than or equal to the marginal rate of return from education. The

empirical findings also support the theoretical findings that public educational expenditure causes change in income inequality through the endogeneity test of empirical model. Public education expenditure reduces income inequality for the highly developed OECD region and increases income inequality for the developing Latin America and the Caribbean region *(LAAM)*, the developing Africa, Asia and east European region *(DAAE)* and the least developed Africa and Asian *(LAA)* region. Not only public education expenditure but also per capita GDP, corruption perception index, political stability affect income inequality of the highly developed OECD countries; and per capita GDP, average years of schooling of the adult population, total population of the country and political stability affect income inequality of the developing *LAAM,* the *DAAE* and the least developed *LAA* regions.

Chapter Six of this thesis has analysed the answer of question number five and six theoretically and empirically. In this chapter, part one covers an evaluation of the ―(Obligation to) Primary Education Act 1990" in Bangladesh. We have developed a model of the demand for education based on family utility maximisation behaviour and have found that a family's demand for schooling positively depends on parent's income and negatively depends on the opportunity cost of child's attending school. In a market economy, a compulsory education act does not always ensure that all school aged children attend and complete the maximum years of compulsory education. The choice of maximum year of schooling depends on the family income, preference parameters and the maximum year limit of attending school.In the empirical analysis, we have used Hendry's (1987) ―general-to-specific" model specification strategy with the help of ―OxMetrics" software for finding the best factors that determine the demand for primary education and for evaluating the success of the PEA 1990. Using annual data from the period 1980 to 2005, we have chosen ―Autoregressive distributed lags (ADL)" model with two-period lag of each variable. The estimated result shows that the two-period lag of per capita income significantly and positively partially determines the number of

enrolment in primary school which is supported by the theoretical model and is a rational behaviour of a family. The public primary education expenditure of the current year significantly and positively partially determines the number of enrolment in primary school which is also predicted by the model. An increase in public primary education expenditure (via stipend for children) means a decrease in the opportunity cost of attending school, resulting in increasing enrolment in school. The two-period lag of the public primary education expenditure significantly negatively determines the number of enrolment which is intuitively sensible. The number of primary schools significantly and positively partially determines students' enrolment in primary level. To evaluate the success of "(o)bligation to) Primary Education Act 1990", a policy dummy has been included in the empirical model and kept fixed throughout the model specification method done by "Automatic" programme of the "OxMetrics" software. The result of the specific model shows that the policy dummy does not have a significant impact on the enrolment although the coefficient has positive sign.To check the robustness of this finding, we have conducted "Impulse Indicator Saturation (IIS)" estimation method and have found that not only the year 1993 is significantly different from other years but also the years 1984, 1985, 1990, 1992, 1996, 2000, 2001, 2002, and 2005 are significantly different from the other years. This result implies that the "(Obligation to) Primary Education Act 1990" has not made any significant change in the number of enrolment in primary education. This result suggests that we may conclude that the "(Obligation to) Primary Education Act 1990" has not been successfully implemented in Bangladesh since its inception.

In this chapter, part two explains the answer of question number six. Using district level panel data and analysing fixed effects estimation technique, we have found that educational policies implemented in the early period of the 1991-2001 decade have significant

impact on the school attendance of population aged between 5 and 24 years and on literacy rates in the country.Only a change in policies increases 45 percent of school attendance and more than 8 percent of literacy rate in the country. Annual growth rates, family size and ownership of agriculture land are statistically significant factor in determining school attendance and literacy rate of the country. The theory of the demand for school attendance is supported by the estimated results.

7.2 Limitations of the Study

Availability of data is the fundamental limitation of the thesis. We have conducted a panel analysis in all Chapters with the observations of only two time periods except Chapter Five. Panel data for the residing arrangement of senior citizens all over the world have observations of only two time periods in the United Nations Population Division, the only publicly available source of this type of data set. The study would be more interesting if observations of more time periods were found. Panel data for public education expenditure and income inequality are also quite scarce for every year for all the countries that are considered in the study. We had to take five year average value of both the variables to conduct panel analysis. Similarly, only two time periods district level panel data for school attendance in Bangladesh is available which is a major limitation of this study. Although the empirical models are predicted on solid microeconomic theoretical foundations, a more comprehensive data set would help us to establish more stronger results.

7.3 Concluding Remarks with policy implications

Since per capita income in developing countries is increasing over time, we conclude that co-residence will fall in developing Africa and Asia over time. Moreover, due to intensive family planning policy in developing countries, there are only one or two earning children in a family nowadays. Consequently, a growing number of senior citizens who are

mainly dependent on their earning children will have to maintain more vulnerable livelihood in near future. Besides, in this era of globalization, growing job opportunities are relocating the earning generation and subsequently breaking the extended family into nuclear families. Hence, governments of developing countries need to be more concerned about residing arrangements for senior citizens and they require planning for a good alternative of the residence system for the senior citizens.

Population aging, increasing life expectancy, zero or negative fertility rate and changing living style of young citizens in developed countries raise a big challenge these days for policymakers to take care of solitary residing senior citizens. Policymakers need to develop suitable policy measures that change the norms and values of young citizens towards senior citizens because our empirical findings indicate that religion and culture have significantly reduced solitary residing attitudes of senior citizens.

Although increased public education expenditure increases income inequality in developing countries, it is a Pareto improvement as long as government properly structure tax system of the country. Moreover, increased public education expenditure reduces income inequality in developed countries; so, we would like to suggest expansion of public education expenditure for the developing countries for building human capital and for raising growth level.

The Government of Bangladesh has wisely introduced several education policies for developing human capital. It is not fully successful because not all the policies consider the importance of opportunity cost of schooling. Being a poor country, the government might consider the opportunity cost of schooling and give appropriate incentives before announcing any educational development policy.

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