CHILD LABOUR AND ECONOMIC GROWTH

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ABSTRACT

This paper examines the relationship between national income and child labour. We are particularly interested in evaluating the economic role of children at different stages of development. Our objective is to show that in the aggregate, at a low level of development the direction of the relationship between the incidence of child labour and per capita income is indefinite. Child labour may increase or decrease with income. Forecasts of the child labour force participation rate as well as per capita gross domestic product are made for each country in the sample. We also forecast future levels of the primary net enrollment ratio in an effort to provide empirical support for our policy recommendations.

Using panel data methodology, we find evidence of an inverted-U, Kuznets-like relationship between the child labour force participation rate and per capita GDP. The relationship is significant for the total sample and the sample for which per capita GDP is above US$1000. Holding all else constant, forecast results suggest that for those countries on upward sloping part of the curve, child labour is a problem that will persist for many years to come. The growth rates of per capita GDP required to reach 10 per cent child labour by the target date, 2029, range from 2 per cent to 15 per cent.

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CHAPTER 1
INTRODUCTION

In the year 2000, the International Labour Organization (ILO) estimated that there were over 200 million child labourers worldwide. Of these 200 million, 180 million are suspected to be engaged in the worst forms of child labour, which can be summarized as, 'those activities . . . [that are] inexcusable under any circumstance and must be eliminated without delay" (ILO, 2002: 1). That is to say, approximately 90 per cent of working children are engaged in labour that is, by nature, detrimental to their psychological and physical well-being. These include,

- labour that is performed by a child who is under the specified minimum age for that type of work,
- hazardous work and,
- children engaged in types of child labour to be abolished.[1]

The elimination of the worst forms of child labour has come to be recognized as crucial for sustainable social and economic development. By 1 February 2002, 115 countries had ratified the Worst Forms of Child Labour Convention No. 182. The convention recognizes that those forms of child work defined as hazardous to a child's well-being or unconditionally at odds with a child's basic human rights should be absolutely prohibited by any person under the age of 18 (ILO, 2002: 11).

Children remain economically active in virtually all economic sectors: in industry, agriculture, the informal sector and in the household. The term 'economic activity' refers to the broad nature of children's work. It includes all productive activities, household or market-oriented, undertaken by a child in a paid or unpaid capacity. In this study, these general forms of economic activity will be referred to as

[1] This includes all economically active children aged 5-14, except those aged 12-14 engaged in light work, as well as children aged 15-17 engaged in hazardous work.

child labour, to be distinguished from the unconditional worst forms for abolition defined as slavery, trafficking, bondage, forced recruitment in armed conflict, other forms of forced labour as well as various illicit activities (ILO, 2002: 9).

The data suggest that child labour and poverty are inextricably linked.[2] At the aggregate level, countries with per capita GDP below US$1000 (adjusted for purchasing power) have child labour force participation rates as high as 40 to 60 per cent, compared to less than 10 per cent for countries with significantly higher per capita GDP (*World Development Report, 1989-2001*; *Yearbook of Labour Statistics, 1989-1999*). However, current data on the decline in child labour force participation over time is less marked. In many low income countries, as national incomes have increased over time, we have observed a substantial decline in child labour. Although, a significant number of lesser developed countries have experienced virtually no change, and in several cases an increase in its incidence between 1989 and 1999.

Since Basu and Van (1998), the theoretical literature on this subject has grown substantially. Most of the research has concentrated on the role of economic growth in reducing the economic dependence of households and firms on children. At the household level, parents send their children to work out of economic necessity. The supply of children to the labour market, in turn, perpetuates a cycle of poverty in two ways,

1. By interfering with the accumulation of human capital, child labour reduces the adulthood labour market productivity of child workers, thereby discouraging economic growth and development.
2. By depressing adult wages, child labour results in households becoming more reliant on children as income earning assets.

Our objective is to explain how, at a low level of development, the initial phase of economic development may result in a decline or a rise in the incidence of child labour. We recognize the positive correlation between poverty and child labour. Theoretically, the rate of child economic activity should decline with income. The

[2] For instance, see Krueger (1996).

empirical evidence supporting this is substantial.[3] The implication is such that policies aimed at stabilizing current and future household income will help to reduce the need for parents to send their children to work. However, in poor settings, we may observe a positive relationship between child labour and income. This may be an indicator of the significance of physical child labour and/or child labour earnings to the survival of households. As the variance in expected household income increases, the number of gainfully employed children could increase as well. Further, we suggest that child labour is not necessarily a facet of poverty but rather a means by which households can improve their standard of living by taking advantage of the labour market opportunities resulting from a greater demand for all labour. Poverty simply ensures a continuous supply of children to the labour market. As household incomes grow and become more stable, families can more easily satisfy their basic consumption needs and are less dependent on the labour (earnings) of their children. They will find that they are better able to invest in the education of their children.

It is well documented that in the long run, economic growth will reduce the need for child labour. It is also possible that these very forces are responsible for the initial increase in the incidence of child labour in development. We recognize the importance of long run economic forces in curtailing the phenomenon; our concern is with how the nature and the scope of child employment changes at different stages of development. The historical experience of advanced, industrial countries suggests that in the early stages of development, child labour may rise with national income. Thus, the effect of economic development on child employment is indefinite. The question is of an empirical nature.

The primary objective of this study is to estimate the effect of economic growth and development, as measured by per capita gross domestic product, on the incidence of child labour. We hypothesize that at the aggregate level, there may exist an inverted-U shaped, Kuznets-like relationship between a country's child labour force participation rate and its per capita income. Using panel data methodology, econometric analyses are carried out on data from 75 developing countries for which child labour is well-documented, over the period 1989-1999. The objective is to determine the validity of

[3] See Anker (2000).

the hypothesis by examining the empirical evidence. Projections are made regarding future child labour levels. More specifically, we predict the number of years required to reach 10 per cent child labour, as defined by the child labour force participation rate; we also determine the growth rate required to reach 10 per cent child labour by the target date, 2029. Forecasts for future primary school enrollment ratios are also made in an attempt to evaluate the effectiveness of current policies or lack thereof.

The remainder of this thesis is organized as follows. We emphasize the relevance of our contribution by providing a review of the theoretical and empirical literature on child labour in economic development in Chapter 2. In Chapter 3, we introduce the theoretical framework for our hypothesis by presenting a model of household choice. Chapter 4 discusses the hypothesis, the estimation procedure and the data. In Chapter 5 we present our results, followed by some concluding remarks in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

In this chapter, we discuss the role of children as economic assets and the nature of children's work at different stages of development. We begin with section 2.1 in which we characterize children's economic value at a low level of development. This is followed by a discussion of the effect of a change in household wealth on the demand for child services in section 2.2. We conclude by presenting a summary of the British and American historical experience in section 2.3.

2.1 On the Role of Children in Development

There are three main categories under which the pecuniary and non-pecuniary economic benefits children provide to their parents fall. Children are a source of old-age security, a source of insurance against the risk of income instability and children provide a source of labour to their parents.

2.1.1 Old Age Income Support

Children are valuable when at least one of the following circumstances hold,

- property rights are insecure,
- credit and insurance markets are imperfect,
- private and public welfare institutions are absent or inefficient,
- there does not exist a well-developed labour market for women, particularly in rural areas.

It is the perception of parents that there exist no other reliable means of support in old-age. Under these circumstances, where mature adults rely on their adult children for financial security, old-age support is expected to be an important motive for fertility.

2.1.1.1 Children as an Alternative to Land Ownership

Children, by virtue of their culturally and economically defined role, can be relied upon to smooth the consumption of their parents when property rights are insecure. Although as a substitute for children, land may not be a perfect security asset. First, there are some things children can provide that land cannot: health care, physical and emotional assistance, as well as psychic benefits. Second, land is costly to maintain, it requires management and is highly labour intensive. Weather induced environmental risks and the associated fluctuations in agricultural yields result in a high variance of expected income. Nonetheless, we would expect land ownership to reduce parental reliance on children as a source of insurance against future disability.[4]

In the context of insecure property rights, parental dependence on children may be as significant as would be the case for landless parents. Nugent and Gillaspy (1983), and DeVany and Sanchez (1978) find that in the ejidal system of farming, whereby farmers are granted usufruct rights over the land as opposed to ownership, increasing ejidal share tends to raise fertility. Uncertainty over future land use results in high fertility as a means of retaining control over the land.

2.1.1.2 Imperfect Capital Markets[5]

Particularly in rural areas, in the case of an adverse shock to current agricultural yield, farmers would like to borrow in the current period against future expected income. Borrowing in a bad season and saving in a good one allows farm families to smooth consumption over time. This will depend on the agent's ability to borrow. Unless agents have access to credit by means of sufficient collateral, it is unlikely that parents can save for their consumption needs in old age. When there are more reliable means of consumption smoothing and accumulating assets for use in old age, children are not as vital for old-age security purposes. Thus, children are valuable assets in the context of imperfect credit and insurance markets as a result of,

[4] The most notable theoretical papers on this subject are Neher (1971), Cain (1983), and Nugent (1985). Cain (1985) provides empirical confirmation of this.
[5]For a complete discussion and review of the literature see Portner (2001), and Rammohan (2001).

- imperfect information on the part of creditors to distinguish the riskiness of potential clients,
- a lack of collateral, which restricts the credit options of the poor, who must then rely on informal sources of credit.

2.1.1.3 The Absence of Welfare Institutions

The development of effective, equitable social security systems can reduce the reliance of parents on their children as providers of old-age security, and reduce the demand for children.[6] If attractive alternative sources of old-age support are available, the pension motive for fertility will decline.

2.1.1.4 The Absence of a Well-Developed Women's Labour Market

Where opportunities for women's employment are not well-developed, the old-age security motive is likely to play a larger role in the household fertility decision. This is particularly true in rural areas where women's primary responsibilities are child rearing, household duties and general subsistence activities. In this regard, women may rely on their husbands for economic support and subsequently their children (Nugent, 1985).

The greater the share of the old-age support parents expect from their children, the greater will be the demand for children to satisfy this motive.[7] In the context of high risk settings – high infant and child mortality, uncertainty regarding child loyalty and the possibility of child default – additional pressures are placed on the household fertility decision. When alternative means of saving or investing are unavailable, it is

[6] Cox and Jimenez (1992) provide empirical confirmation of this in their study of Peru.
[7] For empirical confirmation of this, see Jensen (1990).

rational that fertility will remain high in order to guarantee enough surviving, loyal children to satisfy this need.[8]

2.1.2 Insurance Against Income Instability

In the developing world, many families are concerned with consumption risks. General weather-induced environmental threats such as drought and flooding, property risks, the possibility of unemployment and illness, and other sources of risk can threaten a household's normal consumption stream. In the absence of efficient insurance markets, alternative sources of risk coping mechanisms, such as child labour income, are valuable.

Parents' fertility decisions can be influenced by the presence of such concerns. A larger household can spread the risk over more members. Cain (1981) explores this issue in his study of three Indian villages and one village in Bangladesh. He finds children to be redundant as a source of insurance when alternative means of adjusting are available. In harsh risk environments and when the mechanisms of risk adjustment are ineffective, the insurance value of children acts as an incentive for high fertility.

2.1.3 Children as a Source Labour

Children serve as a source of wage labour; in addition, children contribute their time to household production and maintenance. The potential importance of children's labour and/or their income transfers to the household will be most significant in poor settings.

2.1.3.1 The Vicious Circle Hypothesis

In resource-based subsistence economies, where natural resources are managed as common property, overgrazing, overstocking and exploitation may be a problem.

[8] It should be noted that the types of support children provide range from money remittances to more time-intensive services. For instance, aged parents may live with their children. Thus, children are expected to satisfy a range of parental needs.

When traditional systems of checks and balances that respect the regenerative capacity of the land fail or begin to erode, communities may be faced with the depletion of their natural resource base. This is so because the private cost of using these resources falls short of the full cost. The polluter absorbs the private cost – the time required to collect the good – but the full cost is borne by the entire community in terms of poor soil and water quality, fewer grazing areas and a reduction in firewood availability.[9]

If children contribute to the household by collecting resources from common property sources, physical scarcity of these resources implies that children devote more time to collection activities. This could potentially increase the demand for children. Greater population pressures on the natural resource base will, in turn, further accelerate the rate of environmental deterioration, increasing the demand for children and so on. This is known as the vicious circle hypothesis (Nerlove, 1991; Dasgupta, 1993; Dasgupta and Maler, 1994; Dasgupta, 1995).[10]

When children's tasks are primarily collection and grazing activities, as well as herding and tending to livestock, natural resource scarcity increases the marginal value product of children's time relative to adult's time. If the substitution effect dominates the income effect, worsening environmental conditions will increase the demand for children.

> . . . .as forests recede up the mountain sides, parents may perceive a greater benefit of having an additional child to gather firewood . . . lower quality environments may be associated with a greater livestock component in total production . . . children may have a comparative advantage over adults in tending to livestock in contrast to the heavier labour of planting, tilling and harvesting crops. Thus, environmental deterioration may well enhance the marginal productivity of children, at least relative to total family productivity (Nerlove, 1991: 1341).

Based on this principle, where the polluter does not pay the full cost, parents do not have to pay the full price of child rearing. Rather, they share those costs with the community. If shared access to community resources continues, where traditional

[9] The Tragedy of the Commons, a term originally used by Hardin (1968), essentially describes the nature of this phenomenon.

[10] For empirical confirmation of this see Cleaver and Schreiber (1994), as well as Filmer and Pritchett (2002). It should be noted that the probability of the occurrence of this phenomenon may be very small. There are several empirical studies that contradict the vicious circle argument; McCann (1999) is an interesting example.

methods of control are ineffective, parents may produce too many children which will place pressure on the environmental resource base. As community resources are depleted, the household is provided with an incentive to expand and further depletion of the environmental resource-base ensues.[11]

2.1.3.2 Unpaid Household Work

Particularly among rural families, children are economic assets in developing countries. Parents in peasant societies are less concerned with the child rearing costs. Rather, if the net economic value of children – equal to the economic contribution of children less their consumption costs – is increasing, the demand for children could potentially increase.

Among farm families, children maintain their high economic value the greater the abundance of land. That is to say, for small-scale and subsistence farming, the marginal productivity of child farm labour is increasing in family land size. The most prominent empirical confirmation of this is found in Rosenzweig and Evenson (1977), and Levy (1985). In their study of rural India, Rosensweig and Evenson (1977) empirically test the importance of children's economic contribution on fertility. They find land size to be complementary with child labour in that it had a positive and significant effect on fertility. This may also be indicative of the positive income effect on fertility. At a low level of development, initial increases in income may positively affect fertility behavior.

More land implies more wealth and increases the potential for economic activity. Farmers who cannot afford to hire labour will rely on family labour, particularly those least mechanized. The technology for non-market production and subsistence farming requires only a minimum level of human capital. Reluctantly, children are ideal labour inputs in these sectors. Having more children is a means of increasing household production. Although children cannot be expected to cultivate

[11] However, enclosure of the local commons is not necessarily a solution to the problem. The privatization of natural resources is often difficult to define and enforce; privatization could leave the poor at the mercy of landowners, an even greater disadvantage. Humphries (1990) addresses this issue in her study of Great Britain. Also, see Shiva (1993).

crops, they are well-suited to the less demanding tasks, thereby freeing adult labour for the more strenuous activities and for market work. This is especially true for mothers.

As markets for women's work outside the home become more developed, children assume a greater responsibility for household tasks such as maintenance and child care. Thus, for sufficiently large families, the early stages of development could potentially imply greater market activity for all members and greater household productive activity for children. It follows that households with more children will be economically more successful (Nag et al., 1978). In his study on the economic activities of children in rural Bangladesh, Cain (1977) finds that high fertility is an economically rational choice for parents. Cain estimates that by the age of 12, boys become net producers and compensate for their cumulative consumption by age 15.

2.1.3.3 Children as Income Earning Assets

Where the economy allows for children's participation in the workforce, greater market potential for children will also have an effect on fertility. Children's labour contributions can be an important component of household earnings, amounting to one third of household income in some cases (Lansky, 1997: 233). If there is a child labour market (in agriculture, domestic service, industry and the informal service sector) in which children receive a wage, parents may bear more children. This is so because the net value of child rearing is higher. Several studies confirm this relationship that fertility is higher in high child wage regions. Further, they assert that those variables positively correlated with returns to child labour (such as agricultural productivity and the size of agricultural land holdings) have a positive effect on the demand for children.[12] An increase in the returns to child labour will increase the supply of child labourers and raise fertility.

Decisions on family size and child's time use are jointly made. The importance of this relationship is highlighted in Dessy (2000). Dessy argues that the existence of a

[12] For empirical confirmation of this see Rosenzweig and Evenson (1977), Rosenzweig (1978), Cain (1985), Levy (1985), and Rosenzweig (1990). It should be noted that these economic reasons for having children do not justify having an indefinitely large number of children as it remains unclear whether a child's labour contributions over time compensate for their cumulative consumption. See Cain (1977), and Cain (1982) for a discussion of this.

child labour market would lower the relative cost of children, which in turn, may raise the total fertility rate above the level that would have prevailed in the absence of an earnings potential for children. Fertility is responsive to these economic incentives. When child labour is present, the net economic value of children is determined by the time and commodity costs of child rearing (consumption expenditure and forgone parental income) as well as the associated benefits (child labour earnings, non-market production, domestic help, insurance against risk, as well as old-age security).

2.2 Wealth

Often, a child worker's role in maintaining family income above the poverty line is significant. In their study of child labour in India's urban informal sector, Sharma and Mittar (1990) found that when child labour income is included, 22.2 per cent of households fall below the poverty line. When child labour income is not included in the sample, 77.8 per cent of households fall below the poverty line (for households with 3 to 4 persons). Parents send their children to work out of economic hardship.

The connection between child labour and poverty is empirically well-documented. In his study of Vietnamese agriculturalists, Edmonds (2002) finds that in the poorest households, child labour is fairly inelastic with respect to per capita expenditure. He finds a flat or increasing relationship with per capita expenditure. This is consistent with the significance of child labour income to the survival of households for households below the poverty line. Once a threshold level standard of living is obtained, around 2100 calories per day, child labour begins to decline with expenditure. Similarly, Swaminathan (1998) presents a case in which high economic growth in the Bhavnagar, Western India, has been characterized by the persistence of and an increase in the incidence of child labour over a fifteen year period.[13]

Land ownership and other physical assets are often associated with higher fertility among agricultural populations, particularly among small-scale farmers. Less mechanized farming is more labour intensive. Farmers who rely on their own family's

[13] Some of the most prominent studies of the relationship between child labour and poverty can be found in Rosenzweig and Evenson (1977), Rogers and Standing (1981), Basu and Van (1998), Eswaran (2000), and Ray (2000).

labour will have larger families. Under such circumstances, an increase in income is not offset by an increase in the opportunity cost of parent's time as it is not accompanied by an increase in adult wage rates or greater adult education. Thus, the demand for children can be expected to increase in part due to a wealth effect (with higher wages farm families are able to afford larger families), but largely due to the greater opportunity for child employment on the farm and the higher return to child labour. The marginal productivity of all household members increases. This has been observed in several agricultural societies in India, Bangladesh, Iran, Nepal, The Philippines and Thailand (World Development Report, 1984).[14]

2.3 The Economic History of Child Labour

"…under the early factory system, the employment of masses of children was the foundation of industry" (Hammond and Hammond, 1978: 144).

2.3.1 Early Industrialization and the Employment of Children

To understand the nature of children's work in the context of the British and American experience, we refer to the historical economic literature in which development is considered to be the movement from a pre-industrial to industrial to post-industrial economy. For the remainder of this study, we assume that this movement from a low level of development to a more advanced stage is characterized by a shift away from an economy in which production is primarily within the household for consumption within the household, towards an economy which produces for the market. As such, we have defined national income per capita as being a sufficient indicator of the level of development. It is important to emphasize here that this may, at first, appear to be a narrow definition of what constitutes development as we have neglected both the structure of the economy and the cultural aspects entirely. However, for the purpose of this study, this definition will suffice as our objective is to show that in areas of high output growth, the incidence of child labour may also be high. The

[14] There is also some historical evidence from Canada's early settlement period; see McInnis (1977), especially Table 5.

question then becomes one of identifying the variables which help to explain this phenomenon. We will come back to this question in chapter five.

In today's advanced industrial economies, industrial development was the major factor in the initial increase in the incidence of child labour. For instance, in both the United States and the United Kingdom, women and children composed a significant proportion of the manufacturing labour force during the industrialization period. After the American civil war, the US began a program of rapid industrialization, 1870-1930. The number of gainful workers aged 10-14 grew during the period 1870-1900, peaking at 1.75 million children in 1900, followed by a sustained decline. This is illustrated in Table 2.1 below.

Table 2.1 Child Labour Force Participation Rates for the United States, 1870-1910

Gainfully Employed Children aged 10-14 United States, 1870-1910		
Year	Activity Rate (%)	Real GNP [a]
1870	16.00	23.1
1880	19.60	42.4
1890	21.40	52.7
1900	21.70	76.9
1910	17.80	120.1

a) GNP at market prices is expressed in millions of dollars, 1958.

*Child employment estimates are taken from US Bureau of the Census (1997), series D75-84. Historical estimated of GNP are taken from Kendrick and Kuznets, published in Kendrick (1961).

Similarly, in the United Kingdom, the earnings of women and children became an important component of family earnings. Although it is unknown whether children worked more in the pre-industrial or industrial period, economic historians agree that during the early industrial period, children's share of the workforce in many key industries grew significantly. In other words, the nature of children's work changed with the expansion of the factory system. Not only were children performing their household tasks and contributing their time to household production, but as the economy began to shift from production for consumption within the household to

production in the market, they became significant wage earners. In industrial areas, children's earnings were a central component of family income. Refer to Table 2.2 for some descriptive statistics.

In addition to these data, Nardinelli (1990) presents some statistics specific to the textile industry. In the textile industry alone, the number of children aged 10 to 13 employed in the UK, declined steadily from 1835-1860. There it began to rise, peaking in 1874 when the number of children aged 10 to 13 working in English and Welch textiles reached 122,000 (Nardinelli, 1990: 4). Other interesting results are presented in Horrell and Humphries (1995). In their study of the family economy during the British industrial revolution, Horrell and Humphries found that the number of children working in the labour market increased, and that the age of entry into the labour force decreased.

Table 2.2 Child Labour Force Participation Rates for England and Wales, 1850-1910

Gainfully Employed Children aged 10-13
England and Wales, 1850-1910

Year	Activity Rate (%)	Real GNP [a]
1850	28.30	596
1860	28.60	791
1870	26.30	1,021
1880	19.00	1,379
1890	21.10	1,615
1900	16.90	2,032
1910	14.30	2,328

a) Gross National Product (GNP) at market prices is expressed in millions of pounds, 1900. These data are for the United Kingdom, including Ireland.

*Child Employment estimates are taken from Nardinelli (1990); historical estimates of GNP are taken from Chesnais (1992).

2.3.2 The Child Labour Market

2.3.2.1 The Supply of Child Workers

From the supply side, child employment in key sectors, such as mining and textiles, was the result of the desire of households to improve their standard of living.

In this case, child labour is not necessarily a facet of poverty. Rather, sending children to work is a means by which low income families could supplement household income by taking advantage of the wage opportunities resulting from a greater demand for all labour. Although the nature of children's work during this period is debatable, the current consensus is such that the incidence of child labour increased during the early stages of industrialization.[15]

2.3.2.2 The Demand for Child Workers

The historical experience of today's advanced industrial countries suggests that the structure of demand determines the nature of children's work. Under the early factory system, children's work was crucial to the success of certain key industries. Children were found in labour-intensive sectors, limited to low-skill, menial and often dangerous jobs. Their labour was cheaper, and could potentially drive down adult male wages. As children are substituted for adult male labour, the wages of adult males fall resulting from a decline in the demand for their services.

Thus, the supply of child labour reduced the need for technological advancement. An example of this would be the rural, labour-intensive fruit and vegetable canneries of California and Maryland. Accustomed to family and child labour, these canneries invested only minimally in equipment and plant facilities compared with urban canneries that completely displaced child labour with full mechanization (Brown et al., 1992). In certain industries, children were ideal. They were cheap to employ, more docile and easily coerced.

Goldin and Sokoloff (1982; 1984) describe early American industry as characterized by a high price for adult male labour as a result of greater agricultural mechanization. The initially low relative productivity for female and child labour in agriculture was instrumental in the disproportionate employment of women and children in the early textile factories of the American North-East. Firms substituted relatively cheap female and child labour for adult male labour. Their employment was

[15] The literature on the youthfulness of workers in the first century of British industrialization is massive; see Thompson (1963), Pinchbeck and Hewitt (1973), McKendrick (1974), Hammond and Hammond (1978), and Nardinelli (1990).

characterized by increased mechanization in certain industries and greater organization of labour in others. Consequently, as industrialization proceeded, the relative wages of women and children increased with increasing productivity. Correspondingly, the labour force participation of these groups rose. As the wages of women and children began to approximate those of adult males, firms began to substitute adult male labour for female and child labour.

2.3.2.3 Changing Structure of the Child Labour Market

The reduction in the supply of child workers was a result of an increase in family incomes and the declining demand for children is seen as the result of technological progress and greater capital intensity. Children's wages were no longer crucial to the success of these industries. The nature of production required a more highly skilled workforce, thereby altering the age structure of the labour force.

Similarly, in the United Kingdom, the age structure of the labour force had changed by the late nineteenth century. Children had little to no role in the new industries of the era, namely the chemical industry and electricity (Cunningham, 2000: 412). Children found a demand for their services as messengers and in newspaper delivery. This shift was by and large a result of the same long run economic forces.

Technology changes increased the age of entry into the workforce and the importance of children's economic contribution to the economic well-being of the family declined as a result of rising adult male wages. As standards of living began to rise, the rational choice was to invest in the education of each child to maximize family income when each child eventually enters the workforce with the prospects of finding a better job. A decline in child mortality rates resulted in fewer births, in part because the necessity of having many children to compensate for the high risk of child death diminished. In addition, when the probability of child survival is high, returns to human capital become important. This follows Becker's family strategy explanation for a decline in child labour which will be discussed in Chapter 3.

The relative return to investing in education may have begun to exceed the return from children's market employment. More industrial technologies depreciate the

value of unskilled labour. In addition to the increased opportunity cost of parents' time, compulsory schooling and factory legislation implied a higher cost of having children.

2.3.3 Child Labour Legislation and Compulsory Schooling

Child labour legislation is another means of controlling the nature of children's work as well as the hours they work, provided they can be effectively enforced. Historical evidence suggests that a high incidence of child labour can persist in the presence of child labour laws (Weiner, 1991). In the United States, state laws were largely ineffective due, in part, to poor enforcement and disorganization. Legislation proved effective only once child intensive industries had already begun to decline (Sanderson, 1974).

Goldin (1979) tests for the importance of these laws in curbing the employment of children in the US. She found the laws to be ineffective; a rise in the father's wage was found to reduce the probability of child participation in the labour force. In a related study, Moehling (1999) looks at minimum age legislation in the manufacturing industry in the US. She finds that minimum age restrictions did not limit the occupational choices of children in 1900. Further, she finds that compulsory school attendance laws increased the likelihood of school attendance for children who would have otherwise been at home; they had little effect on children who worked in the labour market. On the other hand, household income and wealth were found to be strongly correlated with the likelihood that a child worked.

In England, while it appears as though the Factory Acts contributed to improving the conditions of children employed in factories, rising family income was instrumental in maintaining the long run decline in child labour.[16] Adult wages below a threshold level will ensure a supply of child labourers, suggesting policies that raise the wages of adults relative to children are more likely to reduce the supply of child workers.[17]

[16] For a more complete discussion of the British Factory Acts see Nardinelli (1990).
[17] Some of the relevant and notable policy papers include Grootaert and Kanbur (1995), Basu (1999), Baland and Robinson (2000), Dessy (2000), Altman (2001), and Hazan and Berdugo (2002).

The most effective and easily enforceable child labour law is compulsory schooling legislation. There is evidence in Britain that the introduction of compulsory schooling in 1880 was associated with a decline in child labour force participation, the reduction in hours worked by children and a rise in the average age of labour force entry (Cunningham and Viazzo, 1996).

2.4 Chapter Summary

In this chapter, we have presented a discussion of the role of children in the household at different stages of development. The value of children, and in turn, the demand for children, will be determined in part by household wealth. The ability of households to smooth consumption over time, and the presence of effective, equitable public welfare institutions are also important determinants.

Drawing upon the historical experience of advanced industrial countries, both legal restrictions and economic factors played a role in reducing child labour, although legislation appears to have been less significant. The process of industrialization may have initially increased the demand for and the scope of children's work, however the long run economic impact of the industrial revolution resulted in its eventual elimination. Thus an increase in the aggregate number of child workers is expected to be transitory.

Based on the empirical evidence of Edmonds (2002) and Swaminathan (1998), as well as the American and British historical experience, there is reason to develop a theoretical model. In Chapter 3, we discuss the household fertility decision in the context of Becker's model of child demand. Taking into consideration the potential for a child labour market, an extended version of the model to include the household time allocation decision is presented.

CHAPTER 3
THEORETICAL FRAMEWORK

Thus far, we have presented a theoretical overview of the possible direction of the relationship between child labour and national income. We have suggested that the incidence of child labour may increase or decrease with income depending on the level of development and the economic relationship between the parents and the child. In this chapter, we begin by discussing the net cost or net economic value of children. Both the money costs as well as the time costs are evaluated and compared at different stages of development. We consider the role of such costs in the household fertility decision. We present a model of household choice. First, we discuss the mathematical model of child demand introduced by Becker which essentially illustrates the case for an advanced stage of development. This is followed by an extension of the model to incorporate child time use in an effort to explain the decision faced by households at a lower level of development, where there exists an earnings potential for children. The objective of this chapter is to illustrate the changing valuation of children at different stages of development.

3.1 The cost of raising children in a developing country

Relative to advanced industrial countries, the cost of raising children in a developing country is low as a result of the low money and time costs. The price of housing and the price of child rearing inputs are relatively low. For instance, in more economically isolated areas where market systems are not fully developed and where transportation costs are high, child rearing inputs, such as food, clothing and shelter are locally produced and relatively cheap. The time cost to parents refers to the cost of the time spent raising children, and in particular, the value of the mother's time. Therefore,

the opportunity cost of child rearing primarily refers to the mother's forgone earnings and leisure, as well as the lost opportunity to accumulate further education. A low level of development is characterized by low human capital and thus, a low level of adult wages, especially for women. In addition, the cost of schooling per child is hypothesized to be high due to the high economic value of children and hence, the high opportunity cost of investing in a child's schooling (Becker and Murphy, 1990).

In economies with the above features, increasing income may not imply declining fertility. An economy at an early stage of development may be characterized by a positive relationship between income and fertility.[18] The low money cost of child rearing inputs coupled with the low opportunity cost of child rearing perpetuates a high fertility rate, especially when children are economically active. At a low level of development, where the main cost to raising children is the money spent on basic child rearing inputs, the demand for children will be higher.[19]

If children's contribution to the family is significant, the net cost of children is further depressed. As discussed, children function as security against future disability, they perform household tasks, and they may work in the home production sector or in the market. When children's time has economic value, the net cost of children is lower relative to an economy in which children have no earnings potential, and the total fertility rate may be higher. The low cost of child rearing coupled with the high productivity of children may result in a large family size as the net cost of children is low.

> *net cost of children = (present value of expected money cost + present value of women's time used to produce and rear children) – (present value of expected money return + present value of child time services in the home)*

At an advanced stage of development, the net cost of raising children is high. Children are a consumer durable, therefore we assume that children have some other

[18] This follows directly from Malthus who predicts that the demand for children is highly responsive to changes in family wealth. However, Malthus refers to households as being able to afford more children, higher fertility rates are not the result of households needing more children to survive.
[19] The money cost of child rearing inputs tends to be low in developing countries, see Mueller (1982).

intrinsic value that they provide to their parents.[20] At a very low level of development, we would expect the net cost of children to be negative. Children are consumer as well as producer durables, therefore families receive income or labour from them, and the money cost of raising children may be very low.

In the long run, with economic development, market production methods become less compatible with child skills, strengths and abilities. From the supply side, children's contribution to the household becomes less significant and the cost of raising children begins to rise. With increases in the rate of return to investment in human capital, greater market opportunities for women which increase the opportunity cost of women's time, and the higher price of child-related goods, there will be pressure for fertility to fall. Families substitute away from having many children to investing more in each child.

3.2 Wealth revisited

The Malthusian theory of population change essentially ignores the quality aspect of child demand. Regardless, it is important in that Malthus predicts the high responsiveness of child demand to changes in income in the early stages of development (Malthus, 1973). This low level of development is characterized by a high birth rate, a high death rate and low per capita income. An abundance of historical evidence from advanced industrial countries confirms this hypothesis, particularly with respect to the rural experience (Knodel, 1974; McInnis, 1977).

Small and middle size farms tend to rely more heavily on manual labour and are usually family operated. Greater wealth will increase the economic value of children. Within this range of farm size, it is expected that fertility will increase. Large-scale, commercial farming requires mechanization or an even greater amount of labour, likely non-familial. Consequently, the benefit of additional children, beyond this range of farming is negligible.

[20] What Becker (1976) terms 'psychic benefit.'

The rural example helps to illustrate the circumstance in which parents cannot afford to have their children not work.[21] Beyond a certain income threshold, parents buy the leisure of their children and withdraw them from the workforce. However, below this threshold parents accept the fact that their children must work.

Parents are not less concerned about the welfare of their children; on the contrary, parents wish to maximize the quality of their children given the available resources, just like their wealthier counterparts. Rather, the costs associated with not having their children work are too high. As such, we would expect income elasticity of child demand to increase with income. Having a child not work can be thought of as a commodity or a luxury good that is purchased once a certain income level is attained.

The hypothesis is that when income per capita is low, the incidence of child labour may grow more rapidly and is potentially an increasing function of per capita income. When per capita income is high, the reverse is true, child labour is a decreasing function of per capita income. The result is a Kuznets curve or an inverted-U shaped function.

As income increases, the variance in expected income increases which may increase the supply of children to the labour market as well as children's contribution to family earnings. At this stage of development, there is a greater demand for all labour; in order to keep costs down, employers in key industries search for a cheap source, namely children. This high demand for child labour is perpetuated by poverty which ensures a continued supply of children to the work force. Children may also be more productive in the non-market sector and their participation in this sector may increase as well.

3.3 A Model of Household Preference

3.3.1 The Quantity – Quality Interaction of Child Demand

The negative relationship between wealth and fertility that is observed at a more advanced stage of development is explained by the quantity-quality theory of child

[21] Basu (2002) refers to this as the 'luxury axiom'.

demand, formalized mathematically by Becker (1976; 1981). Declining fertility with increases in income is essentially an indication that the price of both the quantity and quality of children is increasing, where the child quality component encompasses all aspects of child quality such as, health and nutrition, education, safety and stability.

Assumptions:

1. Child mortality rates are so low that the effect of a change in income on child survival is negligible.
2. All children in the same family have the same quality and that quality is fully produced by each family with its own market goods.

Features of the model:

1. The shadow price or marginal cost of any commodity includes the money cost of the goods used to produce the commodity as well as the time cost in production of that commodity.
2. The shadow price of children with respect to quantity [the cost of an additional child, holding quality constant] is greater the higher their quality.
3. The shadow price of children with respect to quality [the cost of a unit increase in quality, holding quantity constant] is higher the greater the number of children.

It is this rise in both the shadow price of quantity and quality that help to explain declining fertility and the elimination of a supply of children to the workforce.

Each family maximizes the following utility function,

$$U = U(n, q, Z) \tag{3.1}$$

The quantity of children is represented by the variable, n, q refers to the quality of each child and Z denotes the quantity of all other commodities, otherwise referred to as a composite commodity. If we let p represent the constant cost of a unit of quality, then $p \cdot qn$ is the total amount spent on children.

The shadow price of quantity and quality can be explicitly defined as,

$\pi_n = p \cdot q$ is the shadow price or marginal cost of n

$\pi_q = p \cdot n$ is the shadow price or marginal cost of q

The shadow price of quantity is positively related to q. The shadow price of quality is positively related to n. An increase in quality is more expensive for a larger n as the increase must apply to more units. Similarly, an increase in the quantity is more expensive for higher quality children as higher quality children cost more.

The budget constraint, bound by household resources, can be expressed as follows,

$$I = p \cdot qn + \pi_z Z \tag{3.2}$$

where:

I is full income

π_z can be defined as the cost of Z

Household income (both labour and non-labour) and the interaction between the quantity and quality of children will determine the household fertility decision and the nature of child human capital investment. Both the high price of child rearing inputs and the high value of parent's time contribute to the declining demand for children. Parents shift from raising a large number of children to investing in the quality of a few.

The Lagrangian function for utility maximization subject to the budget constraint can be written as,

$$L_{\max} = U(n,q,Z) - \lambda[p \cdot qn + \pi_z Z - I] \tag{3.3}$$

where, λ is the marginal utility of money income

For an interior solution, the first order conditions for maximization yield the following equilibrium conditions,

$$\frac{\partial U}{\partial n} = MU_n - \lambda p \cdot q = 0$$
$$MU_n = \lambda p \cdot q = \lambda \pi_n \tag{3.4}$$

$$\frac{\partial U}{\partial q} = MU_q - \lambda p \cdot n = 0$$
$$MU_q = \lambda p \cdot n = \lambda \pi_q \tag{3.5}$$

$$\frac{\partial U}{\partial Z} = MU_z - \lambda \pi_z = 0$$
$$MU_z = \lambda \pi_z \tag{3.6}$$

The equilibrium values can be solved in terms of the shadow prices and income,

$$n = d_n(\pi_n, \pi_q, \pi_z, I) \tag{3.7}$$

$$q = d_q(\pi_n, \pi_q, \pi_z, I) \tag{3.8}$$

$$Z = d_z(\pi_n, \pi_q, \pi_z, I) \tag{3.9}$$

The empirical evidence confirming a strong negative relationship between the quantity and quality of children is massive.[22] The findings suggest that a higher level of development – higher per capita income – which raises the rate of return to investment in human capital will bring about a response from parents. Parents respond to a reduction in the marginal cost of quality by reducing fertility.

3.3.2 An Extension of the Becker Model

In this section, we present an extension of the Becker model of general household production to include child time use. The model is a continuation of those hypothesized by Ben-Porath (1973), DeTray (1973), Michael (1973), and Willis (1973). The origins to this mathematical approach can be found in Mincer (1963), Becker (1976), and a series of papers collected in Becker (1981). For simplicity, the dynastic approach of Becker and Barro (1988), in which parents' utility depends on the utility of their children is ignored.

The model is based on the following assumptions,

1) Parents are able to exercise choice over the number of children they have.
2) Households are concerned with the optimal stock of children. All lifetime decisions are made at one point on time, the parents' lifetime. In such a case, a one period model will be sufficient to characterize household decision-making.

We assume that households maximize a utility function composed of a number of commodities, including both the quantity and quality of children, which require both time and money as inputs. That is to say, all commodities consumed by the family are first produced by members of the household in such a fashion as to maximize household satisfaction. These commodities may be produced in a goods-intensive or time-

[22] The research of Becker (1981) in the United States, Japan, Taiwan and Great Britain has confirmed this interaction; over time, a large decline in the birth rate has been accompanied by a substantial increase in the level of schooling. Other notable papers include Rosenzweig and Wolpin (1980), Rosenzweig and Schultz (1985), and Rosenzweig and Schultz (1987).

intensive manner and can therefore be referred to as activities. For instance, consider the activity of child care. Parents can either purchase child care services or spend the time required to care for their own children.

The child service component, *c*, is representative of the fact that parents get satisfaction from having children. Not only do children provide some intrinsic benefit to their parents but they may also contribute their time to the production of these 'activities'. Children might engage in household production by directly providing labour to the household; where there is a market for children's work, they may sell their time for a wage rate. Thus, more children and better quality children imply a greater capacity for households to consume.

$$U = U(Z,c) \qquad U_Z > 0, U_c > 0 \tag{3.10}$$

where:

c is the stock of child services

Z denotes consumption of a composite commodity

U_Z, U_c refer to the first order partial derivative

Each commodity component can be decomposed into the following,

$$c = c(q,n) \qquad c_q > 0, c_n > 0 \tag{3.11}$$

$$Z = Z(x_Z, t_Z) \qquad Z_x > 0, Z_t > 0 \tag{3.12}$$

Recall, *q* denotes the quality of children and *n* refers to the quantity of children; c_q, c_n represent the first order partial derivative; x_z denotes the quantity of market goods required to produce the composite consumption good and t_z is the time required for production; Z_x, Z_t refer to the first order partial derivatives.

Families get satisfaction from child time services – which include child time sold to the market to contribute to family earnings and non-market labour – as well as the quality with which children are raised. The household is better off with better quality children. In addition, with more children the household can acquire more child time services. However, utility is constrained by the fact that the quantity and quality of children are substitutes in consumption. Parents must choose their desired combination which will be based on their income and the relative costs of quantity and quality.

In addition, each *Z* commodity has its own production function, which requires both time and money as inputs. The more time and money households have the more market goods they can purchase, the more commodities they can consume and the better off they will be. Household members devote some time to produce certain commodities. Each household member, for which there is a labour market, sells their labour for a given wage in order to purchase the market goods required to produce a given commodity. Similarly, there are monetary as well as time costs associated with the production of the child commodity, $c(q,n)$. The monetary cost of child-rearing inputs tends to be low, particularly when communities are isolated and self-sufficient; local communities also bear some of the costs (refer to Chapter 2, section 2.1.3.1 for a discussion of the vicious circle hypothesis). Nevertheless, child services are also produced using inputs of market goods and parents' time,

$$q = q(x_q, t_q) \qquad q_x > 0, q_t > 0 \tag{3.13}$$

$$n = n(x_n, t_n) \qquad n_x > 0, n_t > 0 \tag{3.14}$$

The variables x_q and x_n represent the market goods required for the production of child quality and quantity, respectively. Similarly, t_q and t_n are the time required to produce child quality and quantity. Depending on the characteristics of a particular household member, wage labour may be significant or insignificant; similarly, the time devoted to household tasks and non-market production can vary. For example, the number of hours adult males spend caring for children may be few, and the amount of time adult females spend in market work may be insignificant. Furthermore, young children are more time-intensive than older children as they require constant supervision. In the presence of young children, it is more likely for adolescent girls to spend a significant proportion of their time caring for their younger siblings (Levinson and Moe, 1998).

In the context for which this model is formulated, children are a source of labour and income stability and there may not be a substitute for their services. In the case of variable income, this is particularly true when access to insurance and credit markets are restricted. Thus, while each family is still faced with the child quality investment decision, it may be insignificant. This is further perpetuated by the assumption that in

this environment, child schooling, assumed to be a sufficient indicator of child quality, yields a negligible pecuniary rate of return. These factors suggest that investment in each child's quality is low.

However, as has already been discussed, parents are also interested in having children to secure their own future consumption needs. This will, in part, be dependent on the quality of children, the amount of time devoted to the accumulation of education and skills as well as the amount of time and resources parents devote to child rearing. More educated children can command a higher wage.

Parents are constrained by the tradeoff between the quality and quantity of children as well as their reliance on children as producer goods. Therefore, although parents would like to invest in the quality of their children, family size is crucial to the survival and success of the household. As a source of old-age security, the risk of child default could be just as high for an educated child as an uneducated one. Further, where poor health and nutrition and inaccessible medical facilities reduce the probability that a child will reach adulthood, having many children might be a more rational choice than investing in a few.

The household is faced with the task of allocating family time, in a single child household each member is constrained by,

$$T^i = t_w^i + t_z^i + t_n^i + t_q^i \qquad i = m, f \tag{3.15}$$

$$T^c = t_w^c + t_z^c \tag{3.16}$$

The superscript, *i*, indicates the parent, mother *m* and father *f* and *c* indicates the child. The time allocation variables represent the following: t_w represents the hours allocated to the market sector, t_z are the hours spent in non-market productive activity, t_n is the time spent producing children (child quantity) and t_q is the time spent engaged in child rearing (child quality).

This is the total time available exclusive of hours spent maintaining and accumulating human capital – which may be negligible, and leisure. In other words, all time is productive. Optimal investment in human capital is assumed to be minimal. The production of children requires some time and money on the part of the mother and father, as does the quality of children. It is assumed that children do not engage in child

rearing in any capacity. Thus, the key measure of a household member's contribution, and subsequently household utility, is the amount of time spent in productive activities whether it is market oriented or not.

For a given market wage rate, the model can be expressed in terms of the household production functions,

$$\max U(Z,c) \quad s.t. \tag{3.17}$$

$$Z = Z(x_Z, t_Z) \tag{3.18}$$

$$c = c(q,n) \tag{3.19}$$

$$q = q(x_q, t_q) \tag{3.20}$$

$$n = n(x_n, t_n) \tag{3.21}$$

and the following resource constraints,

$$I = w^m t_w^m + w^f t_w^f + w^c t_w^c + v = p_Z x_Z + p_n x_n + p_q x_q \cdot n \tag{3.22}$$

$$T^i = t_w^i + t_z^i + t_q^i + t_n^i \qquad i = m, f \tag{3.23}$$

$$T^c = t_w^c + t_z^c \tag{3.24}$$

$$t_Z = (t_z^m, t_z^f, t_z^c) \tag{3.25}$$

$$t_q = t_q(t_q^m, t_q^f) \tag{3.26}$$

$$t_n = t_n(t_n^m, t_n^f) \tag{3.27}$$

The variables, p_Z, p_n, p_q are the price of market goods, the price of child quantity and child quality inputs, respectively; w^m, w^f, w^c is the wage of the mother, father and child. In addition, *v* refers to the family's non-labour income or household wealth, which includes money transfers, property income and income earned from the sale of home produced goods.[23]

Equations 3.22 – 3.24 combine to form the following budget constraint, expressed in terms of the time spent in market activities,

$$\begin{aligned} I &= p_Z x_Z + p_n x_n + p_q x_q \cdot n \\ &= w^m (T^m - t_z^m - t_n^m - t_q^m) + w^f (T^f - t_z^f - t_n^f - t_q^f) + w^c (T^c - t_z^c) + v \end{aligned} \tag{3.28}$$

[23] A given household member will consider the labour income of other household members as part of their own non-labour income. For instance, a rise in the father's wage rate is taken by the child as an increase in the child's non-labour income.

Given the wage rate each household member can command in the market, given their non-labour income and the maximum time available, each family member will decide how to allocate time to different activities. The choice variables are,

$t_w^m, t_z^m, t_n^m, t_q^m$

$t_w^f, t_z^f, t_n^f, t_q^f$

t_w^c, t_z^c

x_Z, x_n, x_q

The maximization problem can be written as,

$$\max U = U\left\{ Z\left[x_Z, t_z(t_z^m, t_z^f, t_z^c)\right], c\left[q(x_q, t_q^m, t_q^f),\ n(x_n, t_n^m, t_n^f)\right]\right\}$$

$$s.t.\quad p_Z x_Z + p_n x_n + p_q x_q \cdot n = w^m(T^m - t_z^m - t_n^m - t_q^m) + w^f(T^f - t_z^f - t_n^f - t_q^f) + w^c(T^c - t_z^c) + v \tag{3.29}$$

For an interior solution, maximization of the utility function subject to the budget constraint yields the following first order conditions,

$$\frac{\partial L}{\partial x_Z} = \frac{\partial U}{\partial Z}\frac{\partial Z}{\partial x_Z} - \lambda p_Z = 0 \tag{3.30}$$

$$\frac{\partial L}{\partial x_n} = \frac{\partial U}{\partial c}\frac{\partial c}{\partial n}\frac{\partial n}{\partial x_n} - \lambda p_n = 0 \tag{3.31}$$

$$\frac{\partial L}{\partial x_q} = \frac{\partial U}{\partial c}\frac{\partial c}{\partial q}\frac{\partial q}{\partial x_q} - \lambda p_q \cdot n = 0 \tag{3.32}$$

$$\frac{\partial L}{\partial t_z^i} = \frac{\partial U}{\partial Z}\frac{\partial Z}{\partial t_z}\frac{\partial t_z}{\partial t_z^i} - \lambda w^i = 0 \qquad i = m, f \tag{3.33}$$

$$\frac{\partial L}{\partial t_z^c} = \frac{\partial U}{\partial Z}\frac{\partial Z}{\partial t_z}\frac{\partial t_z}{\partial t_z^c} - \lambda w^c = 0 \tag{3.34}$$

$$\frac{\partial L}{\partial t_n^i} = \frac{\partial U}{\partial c}\frac{\partial c}{\partial n}\frac{\partial n}{\partial t_n^i} - \lambda w^i = 0 \qquad i = m, f \tag{3.35}$$

$$\frac{\partial L}{\partial t_q^i} = \frac{\partial U}{\partial c}\frac{\partial c}{\partial q}\frac{\partial q}{\partial t_q^i} - \lambda w^i = 0 \qquad i = m, f \tag{3.36}$$

$$\frac{\partial L}{\partial \lambda} = w^m(T^m - t_z^m - t_n^m - t_q^m) + w^f(T^f - t_z^f - t_n^f - t_q^f) + w^c(T^c - t_z^c) + v - p_Z x_Z - p_n x_n - p_q x_q \cdot n = 0 \tag{3.37}$$

Equations 3.30 - 3.32 say that when the price of any market good increases, at the margin, the additional benefit gained from consuming an additional unit of that good falls short of its cost. For instance, when the marginal cost of child schooling increases (such as an increase in the price of child school inputs, transportation costs or enrollment fees for each child) the benefit from investing in an additional unit of schooling for each child is less than the marginal cost. When the price of any market good increases, consumption of that good will decline, holding all else constant. Households will engage in more time-intensive production methods. Equation 3.33 says that when the market wage of the mother or father rises, at the margin, the opportunity cost of an additional unit of time spent engaged in home production increases. Parents will spend more time in good-intensive productive activities and less time in non-market production. Equation 3.35 and 3.36 say that when the wage rate of the mother or father increases, the opportunity cost of the time spent engaged in child production and child rearing activities increases. The production of child quantity and child quality will be more good-intensive as opposed to time-intensive. Equation 3.37 ensures that the budget constraint is satisfied.

Of particular interest is equation 3.34; we are concerned with how a child responds to a change in their market wage rate. In addition, the responsiveness of children to a change in their non-labour income is of interest. In other words, given $t_w^c = \psi(w^m, w^f, w^c, v)$, we would like to evaluate the following comparative static effects,

$$\frac{\partial t_w^c}{\partial w^c} = \frac{\partial (T^c - t_z^c)}{\partial w^c} \text{ and } \frac{\partial t_w^c}{\partial v}$$

1. Refer to Figure 3.1 and Equation 3.34, when the child wage rate increases, ceteris paribus, the opportunity cost of time spent in non-market related activity increases. For a high child wage rate, w_{high}^c (E1), the marginal benefit from an additional unit of non-market activity is less than the marginal cost. Children will spend less time engaged in non-market activity and more time working in the market. If the child wage rate is so low that it falls below the level required to produce the equality *MB=MC*, w_{low}^c, children will not work in the market at

all or they will work fewer hours. The marginal benefit of non-market activity exceeds the child's foregone earnings. In Figure 3.1 we have depicted the case for a child that continues to work in the market, but takes on more household productive work.

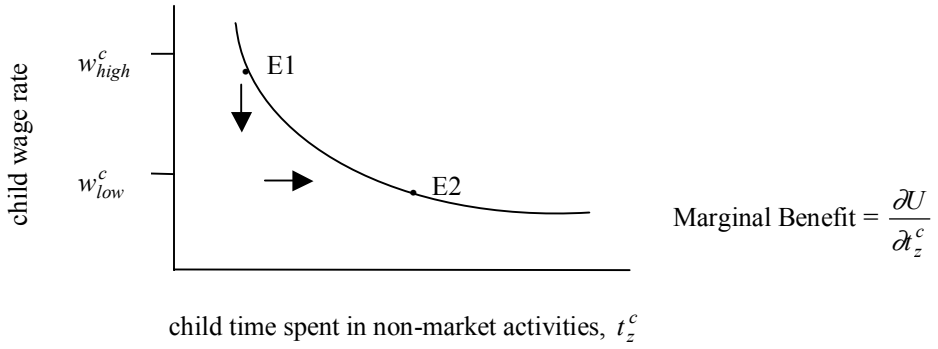

Figure 3.1 Effect of a Change in Child Wage on Child Time Allocation

2. Holding child wage constant, an increase in household wealth or *v* is represented by a parallel rightward shift of the marginal benefit curve; families can consume more *Z* commodities (including children) and increase utility. Refer to Figure 3.2 below. The household is able to purchase more market goods and can afford to spend less time working. For an increase in a parent's wage rate, the implication for children is such that they will spend less time in the market and more time in the household, possibly taking leisure and attending school, a pure income effect.[24]

[24] Recall that children take parents' income as part of their own non-labour income.

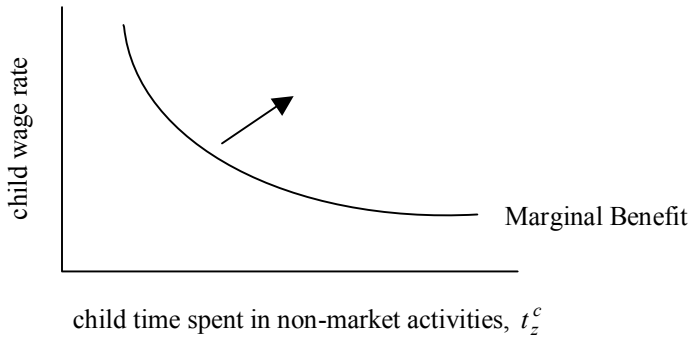

Figure 3.2 Effect of a Change in Non-Labour Income on Child Time Allocation

As a result, children's market work and household productive work may increase or decrease. The direction will depend on the child wage rate offered in the market, the earnings of parents – taken as the child's non-labour income – as well as other components of family non-labour income. Whether a child works in the market or in the household is determined by the child's relative productivity. If the market wage rate that a child can command exceeds the value of the child's non-market time, the child will engage in market production. The principal effect is a rise in family income.

As development progresses, greater market opportunities for children may arise. Further, an increase in expected household income implies greater variation in expected income. Children may become even greater assets. The combination of these factors increase the opportunity cost of investing in a child's human capital. Poverty and greater productivity of child labour ensure a supply of children to the labour force, which further increases the cost of child schooling.

Greater productivity of adult males in certain sectors will lead to more market opportunity for women and children in others. The greater labour market productivity

of women and children in these sectors will increase their labour force participation.[25] A rise in the wage rate of adult women will raise family income, we expect the cost of raising children to rise as the value of women's time increases.

The higher opportunity cost of child rearing will reduce fertility such that the substitution effect dominates the income effect. However, in the case of a large, poor family, even as mother's shift to market production, it is possible that adolescent children (especially girls) take on more household responsibilities to compensate for their mother's lack of presence (Levinson and Moe, 1998). This will increase the opportunity cost of schooling for adolescents.

A sustained rise in income and an improved standard of living (including a decline in infant and child mortality, as well as better health and improved nutrition) will reduce the economic value of children. The return to child education begins to exceed the return to child market employment (a rising opportunity cost of child labour). We would expect the labour force participation rate of children to decline and the demand for higher quality children to rise. When child mortality is low, having a large number of children to ensure the survival of some target is no longer a significant factor in the household fertility decision. Further, if more children can be expected to survive into adulthood to earn a living, the rate of return to investing in a child's human capital and overall quality will increase.

Once a certain level of income is reached, such that an acceptable standard of living is attained, subsequent increases in the wage rate of adult women will further increase the time cost of children. This helps to explain the eventual decline in fertility. This decline in the supply of children to the labour market is accompanied by a declining demand for child labour services resulting from the changing structure of production.

[25] For a discussion of the increase in demand for all labour market participants in early industrialization, see Goldin and Sokoloff (1982; 1984).

3.4 Chapter Summary

The declining importance of children in industry combined with increasing female wage rates and the rising price of child rearing inputs, all contribute to the rising cost of child quantity and the decline in child demand. Moreover, a decline in the economic value of children in the home and in agriculture will increase the cost of children, in turn, reducing the demand for them. These factors also reduce the cost of quality and increase the demand for these commodities relative to quantity. Thus, it is the long-run economic forces of technological change, rising income, the higher price of raising children and the corresponding declining relative cost of child quality that explain the changing economic role of children over time.

Chapter 4 begins our empirical study. Our hypothesis is presented more formally, as well, the estimation procedure is discussed. Some interesting statistics, which further demonstrate the relevance of our theory, are also presented.

CHAPTER 4
THE HYPOTHESIS, ESTIMATION PROCEDURE AND THE DATA

In this chapter we begin by summarizing our hypothesis more formally, followed by a thorough discussion of the estimation procedure. We introduce some descriptive statistics motivating the study in order to demonstrate the relevance of the question at hand.

4.1 Hypothesis

In Chapter 2 and Chapter 3, we have discussed the importance of family income as a determinant of child labour. Our empirical test is based on the subsequent relationship between per capita income and the child labour force participation rate. Thus, the theory is embedded in the following relation,

$$\%\ child\ labour = f\ (per\ capita\ income)$$

Theoretically, there is some uncertainty as to the direction of the relationship. We have explored the conventional view that the incidence of child labour should decline with per capita income; we have accounted for the possibility that child labour may increase with per capita income. Consequently, within a theoretical framework, the direction of the relationship is indeterminate. Our question becomes one of an empirical nature.

The nature of the inverted-U relation is such that at a very low level of development, economic growth implies the opportunity for more market activities for all participants in an economy, including children. By productive activities, I am referring to the productive activities within the home and in the market sector. At a higher level of development, the productive activities of children, excluding the accumulation of human capital, begin to decline and continues on this path as family

incomes grow and become more stable. The direction of the relationship is an empirical question.

4.2 Estimation Procedure

The validity of the inverted-U hypothesis can be tested by estimating the following empirical specifications,

$$\%cl = \beta_1 + \beta_2 Y \tag{4.1}$$

$$\%cl = \alpha Y^{+\beta} \quad \text{[expressed in terms of the natural logarithm, } \ln(\%cl) = \ln\alpha + \beta \ln Y \text{]} \tag{4.2}$$

$$\%cl = \beta_1 + \beta_2 Y + \beta_3 Y^2 \tag{4.3}$$

The dependent variable, $\%cl$, is defined as the aggregate percentage of child labour. The ILO defines this as the number of children aged 10 to 14 active in the labour force divided by the number of children aged 10 to 14, expressed as a percentage. The explanatory variable is per capita GDP (and per capita GDP squared).

We test for three empirical specifications. First, we test for a monotonic relationship (Equation 4.1). The sign of the income parameter is expected to be negative. We test for a negative exponential relationship (Equation 4.2); again, the sign of the income parameter is expected to be negative. If Equation 4.2 is found to provide a better explanation given the data, this indicates that the incidence of child labour exhibits a downward trend and the inverted-U relationship does not explain the available data. Last, we test for a non-linear quadratic relationship (Equation 4.3). For the inverted-U hypothesis to hold, $\beta_2 > 0$ and $\beta_3 < 0$ must be true.

Using panel data methodology, we propose to estimate a fixed effects specification by pooled least squares (Hsiao, 1986; Judge et al, 1988). The cross-sectional specific components are assumed to be fixed parameters. That is to say, each country has a unique constant term which captures the location specific factors. The equations can be written as,

$$\%cl_{it} = \sum_{j=1}^{N} \beta_{1j} D_{jt} + \beta_2 Y_{it} + \mu_{it} \tag{4.4}$$

$$\ln(\%cl)_{it} = \sum_{j=1}^{N} \ln \alpha_j D_{jt} + \beta \ln(Y)_{it} + \mu_{it} \quad (4.5)$$

$$\%cl_{it} = \sum_{j=1}^{N} \beta_{1j} D_{jt} + \beta_2 Y_{it} + \beta_3 Y_{it}^{\ 2} + \mu_{it} \quad (4.6)$$

$\mu_{it} \sim iid(0, \sigma_{\mu}^{\ 2})$

$\forall i = 1, \ldots, N$ where N refers to the number of cross-sectional units

$\forall t = 1, \ldots, T$ the number of annual time periods

β_{1j} are the cross-section fixed effects

The dummy variables take on the value of 0 or 1 corresponding to the country that is being observed,

$$D_{jt} = \begin{Bmatrix} 1 if\ j = i \\ 0 if\ j \neq i \end{Bmatrix}$$

The fixed effects specification is most appropriate to absorb any permanent differences across countries – such as government policy and legislation. Further, because the sample is not randomly drawn, we do not assume the cross-sectional specific effects to differ as a result of sampling error. Equation 4.4 will be referred to as the linear model, we will refer to Equation 4.5 as the log-log model and Equation 4.6 as the quadratic model.

The model is then estimated with an additional component which includes the following covariates,

1. *Population Statistic*: Crude Birth Rate (CBR), a simple statistic which measures the number of live births per 1000 population occurring during that year, usually estimated at mid-year.
2. *Education Statistic*: Primary Net Enrollment Ratio (NER), which is the ratio of number of children of official primary school age – as defined by the national education system – who are enrolled in school to the population of the corresponding official primary school age. Although the literacy rate may have more explanatory power of the basic level of education, our concern is not with the level human capital per se but rather, child time use.

The signs of the coefficients are sensitive to the level of income. In this regard, in order to clearly observe the responsiveness of child employment to aggregate per capita income, it is necessary to group countries according to income level and estimate the model as follows,

1. Estimate the model for the entire sample.
2. Estimate the model for those countries with per capita GDP less than US$1000 (the bottom 20 per cent of the sample).
3. Estimate the model for those countries with per capita GDP greater than US$1000.

To check for stationarity of the time series, we perform the Dickey-Fuller (DF) test for unit roots. If the trend exhibits some stochastic process the GDP time series is non-stationary. It is necessary to carry out a differenced series until we obtain a stationary one.

The model is tested for heteroscedasticity. Although the OLS parameter estimates will no longer be efficient, the presence of heteroscedasticity does not destroy the unbiasedness and consistency properties. In order to ensure reliable inference, if heteroscedasticity does exist, it is necessary to compute a heteroscedasticity-consistent covariance matrix, derived by White.

Provided we do not go too far into the future, the growth rate of per capita GDP is used to forecast future per capita GDP in certain key regions which are then used to predict future child labour levels. These data are then used to determine the time required to reduce the incidence of child labour to 10 per cent, assuming government policy, child labour laws and compulsory schooling legislation remain unchanged. We also forecast future primary school enrollment ratios.

4.3 Data

Panel data for 75 developing countries were taken from the United Nations, the World Bank and the International Labour Organization for the period 1989-1999. Data on the following variables were obtained,

- Per capita GDP, adjusted for purchasing power.
- Percentage of economically active children, aged 10-14.
- Crude Birth Rate
- Net Primary Enrollment Ratio

Data for Gross Domestic Product adjusted for purchasing power and expressed in US dollars are found in *The World Development Report (1989-2001)*, published by the World Bank. A country's child labour force participation rate is defined as the number of children aged 10-14 active in the labour force divided by the number of children aged 10-14, expressed as a percentage. These data are found in *The Yearbook of Labour Statistics (1989-1999)*, published by the International Labour Office. Data for the net enrollment ratio, defined as the ratio of the number of children of official primary school age – as defined by the national education system – who are enrolled in school to the population of the corresponding official school age, are found in *The Human Development Report (1989-1999)*. As well, statistics for the crude birth rate, which measures the number of live births per 1000 population occurring during that year are found in *The Human Development Report (1989-1999),* published by the United Nations Development Programme.

Tables 4.1 – 4.4 below give some descriptive statistics for the data used in the estimation of equations 4.4 - 4.6. Tables 4.1 and 4.2 illustrate the range of child labour force participation rates across countries. Those countries with a very high incidence of child labour tend to have high birth rates and low primary school enrollment ratios. Correspondingly, these are countries for which average per capita GDP is below US$1000. Table 4.2 presents some statistics for countries that have been experiencing a steady decline in the incidence of child labour for a significant amount of time. These countries have much higher average school enrollment ratios, and lower fertility rates. In addition, average per capita GDP is significantly higher.

Table 4.1 Descriptive Statistics, Selected Countries with a High Incidence of Child Labour, 1989-1999

Country	*%cl*	*CBR*	*Primary NER*	*Per capita GDP*
Bangladesh	35	33	66	1148
Burkina Faso	55	46	27	758
Chad	37	45	37	699
Ethiopia	42	48	28	496
Mali	54	51	25	635
Tanzania	40	41	48	818
Uganda	46	47	54	518

* Data is averaged for the period 1989-1999; source: see above.

Table 4.2 Descriptive Statistics, Selected Countries with a Low Incidence of Child Labour, 1989-1999

Country	*%cl*	*CBR*	*Primary NER*	*Per capita GDP*
Argentina	6	20	99	7817
Costa Rica	6	24	89	5092
Ecuador	8	28	96	2809
Iran	5	33	92	4142
Malaysia	3	27	97	6806
Mauritius	3	18	95	6838
Peru	3	28	94	3559

*Data is averaged for the period 1989-1999; source: see above.

Tables 4.3 and 4.4 give some insight into the nature of this empirical question. Table 4.3 provides some statistics which confirm the conventional view that there exists an inverse relationship between income and the incidence of child labour. In Table 4.4 we present some statistics which suggest that this theory does not explain what is happening in all countries and may be incomplete. These data are for countries in which per capita income increases significantly over the period, while the incidence of child labour either increases as well, or remains relatively unchanged. These observations account for 25 per cent of the sample.

Table 4.3 Percentage Change in Per Capita GDP and Percent Child Labour, 1989-1999

Country	*%Δ GDP*	*%Δ cl*	*Country*	*%Δ GDP*	*%Δ cl*
Argentina	+62	-4	Mauritania	+28	-4
Bangladesh	+44	-14	Mauritius	+35	-2
Brazil	+22	-4	Mexico	+26	-6
Burk. Faso	+31	-20	Myanmar	+52	-3
Cambodia	+22	-2	Nicaragua	+32	-5
China	+19	-4	Niger	+13	-2
Costa Rica	+24	-3	Panama	+36	-2
C. d'Ivoire	+11	-5	PNG	+19	-3
Dom. Rep	+5	-3	Paraguay	+35	-17
Gabon	+25	-4	Philippines	+41	-5
Ghana	+44	-2	Portugal	+59	-5
Guatemala	+28	-3	Senegal	+10	-4
Guinea	+66	-3	Sri Lanka	+26	-3
Honduras	+33	-3	Thailand	+36	-2
Indonesia	+17	-4	Togo	+44	-4
Iran	+40	-3	Turkey	+35	-18
Lesotho	+20	-3	Uganda	+56	-3
Madagascar	+10	-4	Uruguay	+30	-18
Mali	+17	-4	Vietnam	+43	-17

*Burkina Faso is abbreviated as Burk. Faso; Cote d'Ivoire is abbreviated as C. d'Ivoire; Dominican Republic is abbreviated as Dom. Rep; PNG refers to Papau New Guinea. Source: author's calculations using data sources described above.

Table 4.4 Percentage Change in Per Capita GDP and Percent Child Labour, 1989-1999

Country	*%Δ GDP*	*%Δ cl*	*Country*	*%Δ GDP*	*%Δ cl*
Bolivia	+30	+3	Haiti	+32	-1
Botswana	+47	+6	India	+58	+6
Chad	+29	0	Malaysia	+29	+1
Colombia	+29	+3	Namibia	+72	+9
Egypt	+41	+2	Nepal	+26	+20
El Salvador	+53	+4	Peru	+38	-1
Ethiopia	+35	-1	Sudan	+26	+14
Gambia	+37	+17	Zimbabwe	+41	+20

*Author's calculations using data sources described above.

Ethiopia and Chad experience a considerable increase in per capita GDP; however the decline in child labour is virtually insignificant. Nepal and Zimbabwe experience a significant growth in the incidence of child labour.

Figure 4.1 and Figure 4.2 plot per cent child labour for 1999 against average per capita GDP. Figure 4.2 illustrates that once a threshold income level is reached, approximately US$1000, the incidence of child labour begins to decline more steadily. As conventional wisdom would suggest, child labour declines with income. For per capita GDP below US$1000, this relationship is not well defined.

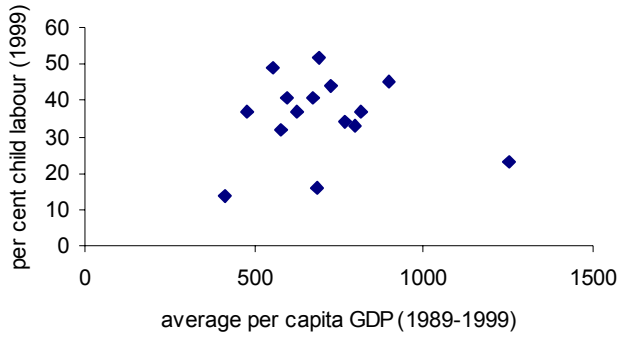

Figure 4.1 Children aged 10-14 in the Labour Force, per capita GDP < US$1000[26]

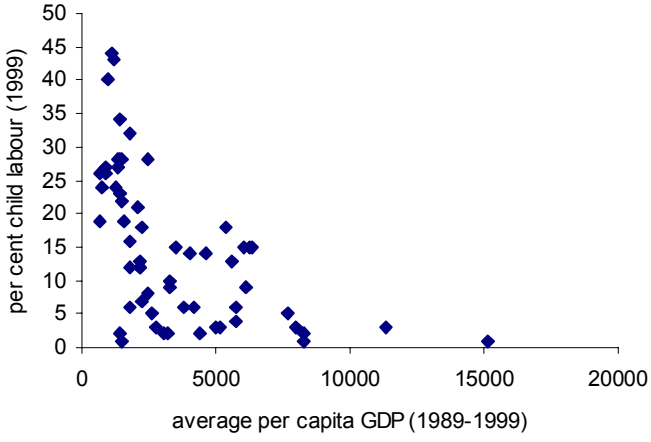

Figure 4.2 Children aged 10-14 in the Labour Force, per capita GDP > US$1000[27]

[26] Author's calculations using data sources described above.
[27] Ibid.

Figure 4.3 summarizes the average incidence of child labour by region. In absolute terms, the Asia-Pacific region accounts for some 127 million working children (approximately 70 per cent of the total), followed by sub-Saharan Africa with 23 per cent of the total (ILO, 2002: 20). In terms of the number of child labourers in relation to the population of children, the problem is most severe in sub-Saharan Africa.

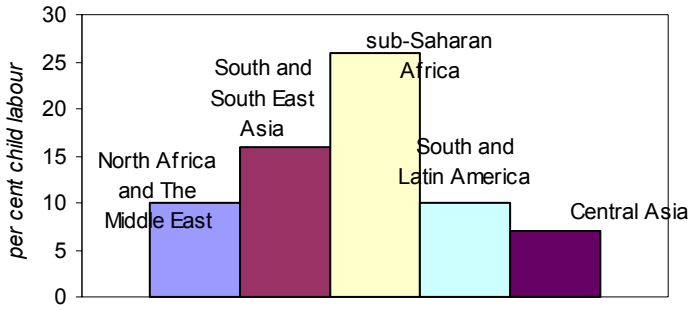

Figure 4.3 Average Incidence of Child Labour, 1989-1999[28]

Compared to Asia and the Pacific where 19 per cent of all children under the age of 15 work, in sub-Saharan Africa 29 per cent of all children are working (ILO, 2002: 20). Table 4.1 above also illustrates this phenomenon. Some of the poorest countries have child labour force participation rates in excess of 40 per cent. In some cases these figures exceed the female labour force participation rates.

Many of the activities that children engage in are crucial to the survival of the household, a significant proportion of which produce no wage income. Several surveys of low-income rural households in the developing world suggest that children often work in the labour force in an unpaid capacity. Many children work within the home and are not part of the labour force, this is particularly true for girls. Consequently, reporting a child wage rate is often unheard of, suggesting that children's work is narrowly defined. As such, the above data which suggests a capacity for child labour to increase could be a reflection of,

[28] Source: author's calculations.

1. Underreporting of the number of children working due to measurement problems.[29]
2. An expansion in the demand for and/or the supply of child workers.

As a result, official data sources may understate not only the scope of the problem but the nature of it as well. For these reasons, time-use studies appear to be the most effective means of evaluating the role of children as producers. That is to say, the most important measure of a child's contribution to the household is the relative amount of time spent in various activities.[30]

However, if we view the official ILO statistics as a subset of the entire child labour phenomenon, these data are not entirely useless. There is no sufficient public data that reflects the true extent of children's participation in the household and in the informal sector. The ILO statistics tend to be more general and representative of what is happening in the market sector. Furthermore, these data may be incomplete in the sense that they reflect what is happening in certain areas more accurately than in others, and hence there is a bias. Whether this bias is systematic or not is unknown. The extreme importance of this question must be emphasized, as policy recommendations will be based on the data.

Swaminathan (1998) has presented a case in which even after accounting for some underestimation, the Census of India reports a significant rise in the absolute number of child workers in Gujarat, Western India between 1981 and 1995. During the period, state domestic product increased by over 200 per cent (Swaminathan, 1998: 1516). In addition to Swaminathan, Edmonds (2002) finds that among Vietnamese agriculturalists, child labour in the poorest households is either increasing in per capita expenditure or remains relatively unchanged as per capita expenditure increases. These examples coupled with the historical experience of today's advanced industrial countries, provide us with reason to investigate further.

[29] For literature on underreporting in the context of children's work, see Bliss (1904); for a discussion of this issue in the context of women's work, see Cloud and Garret (1996), and Goldin (1995). The debate surrounding what should constitute a child worker is ongoing. For an overview of the measurement dispute, see Ashagrie (1993), Basu (1999), Smolin (1999), and Anker (2000).
[30] This is discussed in Moe and Levinson (1998) and Levinson (1991).

4.4 Chapter Summary

In this chapter our hypothesis as well as the motivation behind our choice of model specification is presented and explained. In addition, we have provided some descriptive statistics to illustrate the relevance of this question. In the following chapter we will determine which model provides the best fit for the available data. Our estimation results are summarized followed by a discussion of the policy implication of our findings.

CHAPTER 5
THE RESULTS

In this Chapter, we test the validity of the theoretical discussion presented in Chapter 2 and Chapter 3. Equations 4.4 – 4.6 are estimated, the results obtained from these regressions are interpreted. We determine which model provides the best fit and discuss the policy implications of our results. Projections are made for future levels of child labour and per capita GDP, as well as primary school enrollment. These data are then used to substantiate our hypothesis and to provide support for our policy suggestions, discussed in Chapter 6. We emphasize that the question of the direction of the relationship is indefinite and is a matter of an empirical nature.

5.1 Estimation Results

5.1.1 Discussion of Results

The results presented here were obtained by estimating equations 4.4 - 4.6 for the three categories previously outlined. Equation 4.6 is modified to include the additional covariates introduced in Chapter 4, the crude birth rate (CBR) and the primary net enrollment ratio (NER). Cross-sectional specific fixed effects are also used. Pooled least squares regression results are presented in Tables 5.1, 5.2 and 5.3 below. Recall, Y represents per capita GDP and Y^2 refers to per capita GDP squared. The fixed effects are summarized in Appendix A - C.

Table 5.1 Estimation Results for the Linear Model (Equation 4.4)

Dependant Variable per cent economically active children	Estimated Coefficients [a] Y = per capita GDP [b]	R^2	N	NT	Income Elasticity
Total	-0.120 (-0.95)	0.94	75	825	-0.012
Per Capita GDP<1000	-2.204 (-1.74)	0.95	15	165	-0.047
Per Capita GDP>1000	-0.107 (-0.83)	0.90	60	660	-0.031

a) t-statistics reported in parentheses
b) GDP expressed in thousands

Table 5.2 Estimation Results for the Log-Log Model (Equation 4.5)

Dependant Variable ln per cent economically active children	Estimated Coefficients [a] ln Y	R^2	N	NT	Income Elasticity
Total	-0.017 (-0.38)	0.91	75	825	-0.017
Per Capita GDP<1000	-0.012 (-0.52)	0.97	15	165	-0.012
Per Capita GDP>1000	0.013 (0.23)	0.91	51	561	-0.013

a) t-statistics reported in parentheses

Table 5.3 Estimation Results for the Quadratic Model (Equation 4.6)

Dependant Variable per cent economically active children	Estimated Coefficients [a]				R^2	N	NT	Average Income Elasticity [b]	Turning Point
	Y [c]	Y^2	CBR	NER					
Total									
	0.563	-0.05			0.94	75	825	0.036	$5, 630
	(1.68)	(-2.60)							
	0.772	-0.061	0.096		0.94	75	825	0.052	$6,330
	(2.42)	(-3.31)	(2.51)						
	0.698	-0.055	0.170	-0.029	0.95	60	660	0.046	$6,350
	(1.94)	(-2.78)	(4.48)	(-1.39)					
Per Capita GDP<1000									
	-5.242	1.913			0.95	15	165	-0.047	$1,370
	(-0.81)	(0.50)							
	-6.928	3.210	0.182		0.95	15	165	-0.038	$1,080
	(-1.10)	(0.86)	(2.33)						
	-11.337	5.099	0.140	-0.065	0.92	13	143	-0.073	$450
	(-1.19)	(0.81)	(1.51)	(-2.72)					
Per Capita GDP>1000									
	0.658	-0.056			0.90	60	660	0.039	$5,880
	(1.93)	(-2.83)							
	0.843	-0.065	0.085		0.90	60	660	0.068	$6,490
	(2.59)	(-3.47)	(2.01)						
	0.706	-0.056	0.168	0.005	0.92	47	517	0.070	$6,300
	(1.97)	(-2.87)	(3.90)	(0.12)					

a) t-statistics reported in parentheses
b) evaluated at the mean
c) GDP expressed in thousands

First, consider the linear model. While the sign of the income parameter suggests a negative, monotonic relationship between per cent child labour and per capita GDP, the t-statistics are very small and insignificant at more than the 10 per cent level. The results from the log-log model suggest a downward trend for child labour as per capita GDP increases. However, the income parameters are statistically insignificant. According to this criterion, the evidence for a negative, non-monotonic relation between child labour and per capita GDP is weak.

Upon inspection of the regression results from the quadratic specification, there does appear to be evidence of a non-monotonic relationship between child labour and the level of development. For each sample, a quadratic relationship with per capita

GDP is tested. Although it is difficult to infer much about the individual coefficients due to the presence of multicollinearity, we are able to make some observations.

To begin with, we look at the case in which per capita GDP is below US$1000. For the poorest 20 per cent of the sample, there is a negative correlation between income and the incidence of child labour, a relationship that weakens as income increases for this group. We would expect the incidence of child labour to increase with development, especially for this group. However, the sample size is very small and underreporting is likely to be most prevalent here. In addition, neither income terms are significant. The incidence of child labour displays the opposite, although insignificant, pattern. Therefore, these results do not discredit our theory.

For the total sample, the coefficients of the income parameters have the appropriate signs. The income parameter is significant at the 5 per cent level. The squared income term is significant at less than the 1 per cent level. Taking into consideration that per capita GDP is expressed in thousands, the estimated coefficients are very small and economically insignificant. This brings into question the role of both government as well as different aspects of development in the determination of child labour levels. For instance, consider Figure 4.2. In the middle income range we find countries with virtually the same level of per capita GDP but varying levels of child labour. Formal recognition of where children work and identification of the variables that help to explain why children work will provide us with further insight. The turning point for child labour, as implied by estimated Equation 4.6, occurs at per capita GDP US$5,630.

Consider the group for which per capita GDP is greater than US$1000. The relationship between the incidence of child labour and per capita GDP is positive quadratic, thereby supporting the inverted-U hypothesis. The first income parameter is significant at the 1 per cent level. The squared term is significant at less than the 1 per cent level. Once again, the income coefficients are very small. Approximately 70 per cent of the countries for which growth in GDP is accompanied by growth in the incidence of child labour are in this group. This explains why the relationship is strongest here. Those within this group are among the first to participate in the developmental process. Information regarding labour market opportunities is more

readily available, labour market opportunities are more accessible. It follows that child labour force participation declines a little later than for the total sample. Conditions begin to improve after a per capita income level of US$5,880 is obtained. However, the countries experiencing an increase in the incidence of child labour compose only 24 per cent of this group. This indicates that in areas where child labour persists and continues to grow, we may have to wait a very long time before it begins to decline steadily.

When the population statistic and the education statistic are included, the income parameters remain significant. In particular, the squared income term remains significant for the total sample as well as the group for which per capita GDP is above US$1000. One problem with regard to the inclusion of different aspects of development is that they are highly collinear with GDP, making it difficult to infer about causal direction and impact. Our general results are summarized below.

1. We find that for all income groups, the crude birth rate is positively and significantly related to the pattern of child labour. However, its effects on child labour are likely to be non-linear.
2. The inclusion of the primary net enrollment ratio as an explanatory variable does not provide any explanatory power for the per capita income above US$1000 group. This higher income group is more likely to react to incentives for secondary school enrollment as opposed to primary. For the total sample and the low-income group, child labour and the primary net enrollment ratio are significantly, negatively correlated. Children who spend more hours working in the market will have less time available to devote to the accumulation of human capital. Children who work are effectively less likely to attend school.

The equations provide a better explanation for some groups than for others. As a result, the existence of a threshold value of per capita GDP is sensitive to the sample composition and specific functional form. This is understandable as both the shape and curvature of the U will depend on the policy choices made by relevant parties: firms, governments and households. Therefore, the U hypothesis is not necessarily inevitable but rather a matter of (policy) choice. Eventually, GDP per capita is associated with a decline in child labour.

The income terms in all models are jointly significant at the one per cent level of significance. We perform the following F-test of significance using ESS = explained sum of squares and RSS = residual sum of squares; k denotes the number of parameters and n refers to the sample size,

$$F = \frac{ESS/k-1}{RSS/n-k} \sim F_{\alpha}(k-1, n-k) \tag{5.1}$$

Upon inspection of the t-statistics and the coefficient of determination, the quadratic model appears to be the best fit. Further, given the nature of the data, we would expect neither the linear model nor the log-log model to provide the greatest explanatory power. As the data does appear to exhibit some non-monotonic process, the linear model is not the appropriate choice. Similarly, 25 per cent of the sample experience some growth in child labour force participation, in addition, this study is only for an 11 year period; therefore, the log-log model is also likely to be inappropriate.

For the total sample, the log-log model reports an income elasticity of -0.017. This suggests that a one per cent increase in GDP per capita will result in a decrease in the incidence of child labour by approximately 0.017 per cent. The linear model reports an average income elasticity of -0.012, similar to the log-log results. For the quadratic model, we find an income elasticity of 0.036. This says that if per capita GDP increases by one per cent the incidence of child labour will increase by 0.036 per cent.

5.1.2 Evaluation of Results

5.1.2.1 Dickey-Fuller Tests

Standard inference procedures assume stationarity of the regressors. We run the Augmented Dickey-Fuller (ADF) test of stationarity on the following forms,

$$\Delta cl_t = \alpha_0 + \alpha_1 t + \delta cl_{t-1} + \gamma_i \sum_{i=1}^{m} cl_{t-i} + e_t \tag{5.2}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \delta Y_{t-1} + \gamma_i \sum_{i=1}^{m} Y_{t-i} + e_t \tag{5.3}$$

where:

m denotes the number of lagged terms

t =1, ... ,11 representing 1989-1999

$\delta = \rho - 1$ is the first difference operator

e_t is white noise

We fail to reject the null hypothesis of the existence of a unit root, δ=0, based on MacKinnon's critical value criterion.[31] Consequently, the data should be differenced. First to third differencing results in stationarity for a few of the series; for many of the series, fifth differencing is not sufficient. Differencing to this degree results in errors. Thus, we are constrained by the limitations of the data, in particular, the sample period.

5.1.2.2 Heteroscedasticity Tests

Based on the results of White's test for heteroscedasticity, we find heteroscedasticity to be a problem in our model.[32] As a result, White's heteroscedasticity-consistent covariance matrix is computed in order to obtain accurate standard errors. The corrected t-statistics were reported in Table 5.1 - 5.3 above.

5.1.2.3 Autocorrelation Tests

Upon inspection of the DW statistic (< 1.5 for all samples), specification errors exist, in particular positive serial correlation. If autocorrelation exists the problem can be reduced by first differencing, making inference more reliable. If both heteroscedasticity and autocorrelation exist, the autoregressive conditional heteroscedasticity or ARCH model is generally used. However, our data is for the period 1989-1999, for such a short period serial correlation should not be a problem; moreover, we are constrained by the degrees of freedom.

[31] Refer to Appendix D for a sample of the ADF test results.
[32] Refer to Appendix E for White's Heteroscedasticity test results.

5.2 Projection Results

The middle 60 per cent of the sample comprise approximately 70 per cent of the countries that experience an increase in per capita GDP with a corresponding increase in the incidence of child labour or no change whatsoever. With this in mind, for the total sample, we can forecast future values of per capita GDP which are then used to forecast future child labour levels. The average growth rate of per capita GDP is used to forecast future values of GDP per capita,

$$GDP_t = GDP_0(1+r)^t \tag{5.4}$$

GDP_t is per capita GDP at time t, GDP_0 is the initial value of per capita GDP (base year value) and r is the average rate of growth of per capita GDP.

The natural logarithm of equation 5.4 can be written as,

$$\ln GDP_t = \ln GDP_0 + t\ln(1+r) \tag{5.5}$$

We estimate,

$$\ln GDP_t = \hat{\beta}_0 + \hat{\beta}_1 t \tag{5.6}$$

where:

$\beta_0 = \ln GDP_0$

$\beta_1 = \ln(1+r)$

Our results are as follows,

$$\begin{aligned} &\ln GDP_t = 7.420 + 0.027t \\ &(se) \qquad (0.061)\ (0.009) \qquad r^2 = 0.011 \end{aligned} \tag{5.7}$$

An average growth rate of 2.74 per cent is obtained. Our target level of child labour is 10 per cent. For those countries that have not yet met this goal, we determine what level of GDP is required to do so. Using 1999 as the base year, these computed values are substituted into equation 5.4 to estimate the number of years it will take to reach the target provided each country grows at the average rate and there are no changes in policy. This approach suggests that it could take from 20 to over 150 years. The results are summarized in Table 5.4 below.

Table 5.4 Forecast Time Period for Child Labour to Reach the Target[33]

20-39 years	40-59 years	60-79 years	80-99 years	100-119 years	120-139 years	140-159 years
Botswana	Dominican	India	Cote d'Ivoire	Bangladesh	Angola	Burundi
Brazil	Guatemala	Bolivia	Lesotho	Cambodia	Benin	Ethiopia
El Salvador	Namibia	Ghana	Pakistan	Cameroon	Burkina Faso	G-B [b]
Gabon		Nicaragua	PNG [a]	Gambia	Chad	Malawi
Thailand		Zimbabwe	Yemen	Guinea	Congo	Malawi
				Haiti	Kenya	Mozambique
				Mauritania	Madagascar	Niger
				Myanmar	Nigeria	Rwanda
				Nepal	Sierra Leone	Tanzania
				Senegal	Uganda	
				Sudan	Zambia	
				Togo		

a) Papau New Guinea
b) Guinea-Bissau

For instance, consider the example of Ethiopia, a country that has persistently had one of the highest child labour force participation rates. Using our estimation results from Equation 4.6, we determine what level of GDP is required to reach 10 per cent child labour. Keep in mind that Ethiopia currently has an aggregate child labour force participation rate in excess of 40 per cent, over the 11 year period there has been no significant change in this rate. Moreover, we are assuming that all else remains constant and that the average relationship is a sufficient indicator of what is happening in Ethiopia. We find that at this rate, Ethiopia would require US$29,000 per capita GDP which translates into 146 years assuming the Ethiopian economy grows at the average rate of 2.74 per cent.[34]

This suggest that many countries that lie on the upward sloping part of the inverted-U curve will remain there for a long time provided there are no changes to government policy. Figures 5.1 and 5.2 below illustrate the implication of these results, for selected countries. For instance, Ethiopia will not see a steady decline in child labour until per capita GDP US$6,590, which could take 90 years.

[33] Source: author's forecast results.
[34] We compute the time it takes to reach 10 per cent child labour in Ethiopia as follows,

$$t = \frac{\ln GDP_t - \ln GDP_{1999}}{\ln(1+\hat{r})} = \frac{\ln 29 - \ln 0.6}{\ln(1.027)} = 146$$

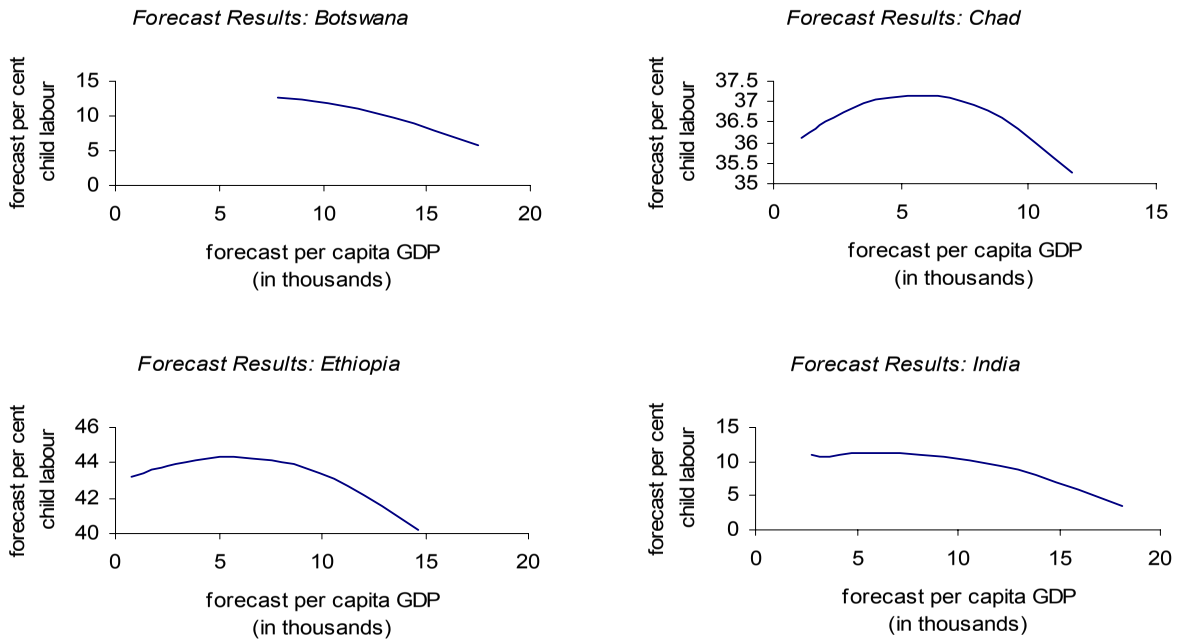

Figure 5.1 Forecast Results for Child Labour and Per Capita GDP, selected countries

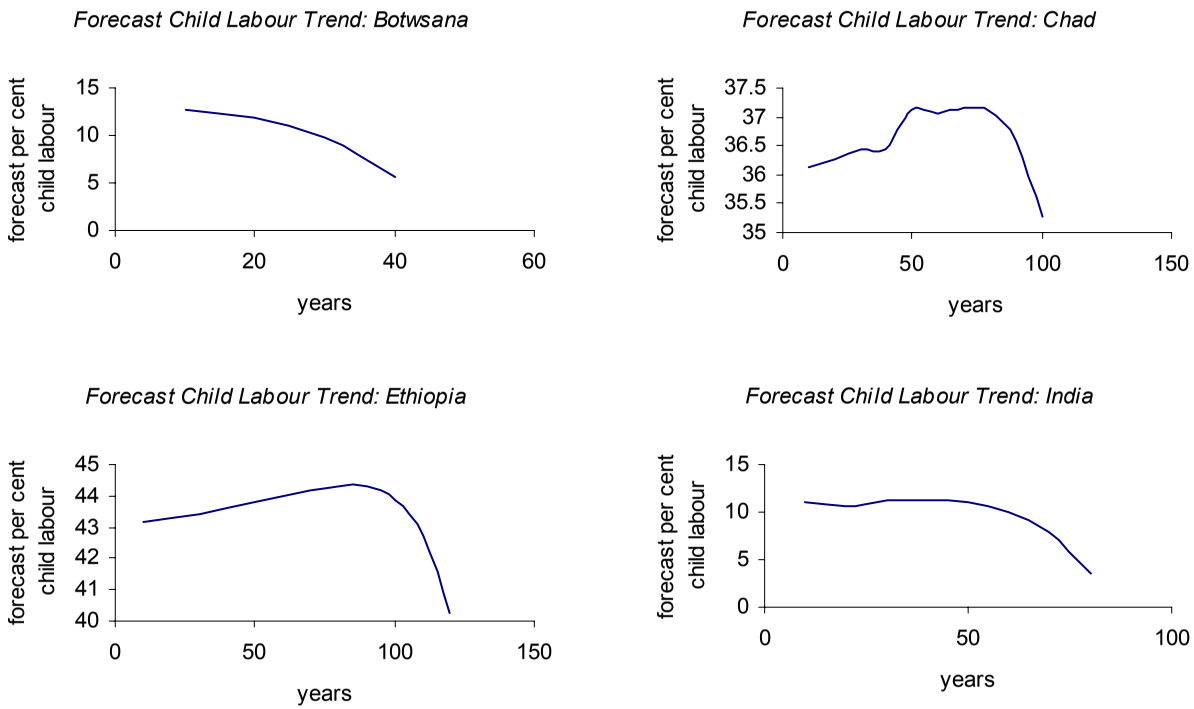

Figure 5.2 Forecast Child Labour Trend, selected countries

The implication is that without any significant change in policy, child labour will persist for decades to come.[35] These results appear to be overly pessimistic and simplistic. Most countries that lie on the upward sloping part of the curve have growth rates that are significantly higher than the average, many in excess of 5 per cent. Contrastingly, on the opposite end of the spectrum, countries with child labour force participation rates between 1 and 5 per cent have much lower growth rates.

In this regard, we calculate the growth rate required to reach the target within 30 years, by 2029. The computed growth rates range from 2 to 15 per cent. The results are summarized in Table 5.5 below. For instance, by setting t =30, we find that the growth rate required to reach 10 per cent child labour in Ethiopia is 14 per cent. However, the target does appear to be attainable for some of the countries, in particular those with estimated growth rates between 0 and 8 per cent, depicted in the first two columns of Table 5.5.

Table 5.5 Estimated Growth Rate Required to Reach the Target by 2029[36]

0-5 per cent	5-8 per cent	8-10 per cent	10-12 per cent	12-14 per cent	14-16 per cent
Botswana	Bolivia	Cameroon	Bangladesh	Angola	Burundi
Brazil	Ghana	Cote d'Ivoire	Cambodia	Benin	Ethiopia
Dominican	India	Guinea	Congo	Burkina Faso	Mali
El Salvador	Nicaragua	Haiti	Gambia	Chad	Mozambique
Gabon	Pakistan	Lesotho	Myanmar	G-B [b]	Tanzania
Guatemala	PNG [a]	Mauritania	Nepal	Kenya	
Namibia	Thailand	Sudan	Senegal	Madagascar	
	Zimbabwe	Yemen	Togo	Malawi	
			Uganda	Niger	
			Zambia	Nigeria	
				Rwanda	
				Sierra Leone	

a) Papau New Guinea
b) Guinea-Bissau

Similarly, we forecast the primary net enrollment ratio for the target date, 2029, for each country. The results are summarized in Table 5.6 below. Primary net

[35] However, it should be noted that we have estimated far into the future, respectively. Forecasting errors increase rapidly.
[36] Source: author's forecast results.

enrollment ratios are rising for all countries, although the average growth rate is quite low, approximately 0.1 per cent. Our estimation results, presented in section 5.1.1, indicate that for the poorest 20 per cent of the sample, a 1 per cent increase in the primary net enrollment ratio will reduce the child labour force participation rate by 0.065 per cent. Using this result, we compute what primary net enrollment ratio is required to reduce child labour to 10 per cent by the target date. For each country in the sample, we compute the level of per capita income in 2029, $t = 30$, using the growth equation. We substitute this into the quadratic equation to determine the child labour force participation rate in 2029. The difference between this result and $\%cl = 10$ is computed. This value and the coefficient of the primary net enrollment ratio are then used to determine the required primary net enrollment ratio to reach 10 per cent child labour by 2029. The estimated values we obtain are very high, in excess of 100 per cent in most cases.[37] Our findings suggest that as a policy instrument, primary school enrollment alone may not be a sufficient means to reach the target.

Table 5.6 Primary Net Enrollment Ratio Forecast Results for 2029[38]

20-39%	*40-59%*	*60-79%*	*80-100%*	
Angola	Benin	Bangladesh	Bolivia	Mongolia
Burkina Faso	Cote d'Ivoire	Cameroon	Botswana	Namibia
Burundi	Guinea Bissau	Gambia	Brazil	Nicaragua
Chad	Senegal	Iran	Colombia	Panama
Ethiopia	Tanzania	Kenya	Costa Rica	Paraguay
Guinea	Uganda	Lesotho	Dom. Rep	Peru
Haiti		Madagascar	Egypt	Rwanda
Mali		Mauritania	El Salvador	Syria
Mozambique		Morocco	Honduras	Turkey
Niger		Nepal	Iran	Uruguay
		PNG	Mauritius	
		Togo		
		Zambia		

*Dominican Republic is abbreviated as Dom. Rep; PNG refers to Papau New Guinea.

[37] For instance, consider the country of Tanzania. Assuming Tanzania's economy grows according to the average rate, per capita GDP is estimated to be US$1,063 in 2029. This is substituted into the quadratic equation from which we obtain a child labour force participation rate of 15.52 per cent, which exceeds the target level by 5.52 per cent. This difference divided by the coefficient of the NER variable, -0.065, gives the required primary net enrollment ratio required to satisfy the target level of child labour by 2029; in this case the required primary NER is 84 per cent.

[38] Source: author's forecast results.

5.3 Chapter Summary

In this chapter we have presented the regression results obtained from estimating equations 4.4 – 4.6. We find the quadratic model to be the best fit. The inverted-U hypothesis is strong and significant for the total sample as well as for the group in which GDP per capita is greater than US$1000.

Our estimated equations and projection results suggest that assuming each country grows according to the average growth rate, without any significant changes in policy, child labour will persist for many years to come. The importance of primary school enrollment and hence, the monitoring of child time use is also highlighted. The results suggest that the poorest 20 per cent are likely to respond to educational incentives, in particular primary school incentives. Our projection results for the net enrollment ratio suggest that increasing NER alone will not sufficiently reduce child labour, incentive based schemes will be more effective. That is to say, educational subsidies must be accompanied by income supplementation programs. Our results also highlight the positive correlation between fertility and child labour. In Chapter 6, we discuss the policy implications of our findings in the context of the current consensus within the field and present some opportunities for further research.

CHAPTER 6
CONCLUSION

In this paper, we develop a theoretical framework for analyzing the nature and scope of child labour at different stages of development. In Chapter 2 we look at the role of children as producer goods in a developing country context, as well as the role of children as consumer goods. Using household utility theory, in Chapter 3 we develop a model of household choice. First, we discuss the role of children at an advanced stage of development using Becker's mathematical formulation of the quantity-quality interaction with regard to child demand. We then modify the model to include household time allocation in order to illustrate the case for a lower level of development. We test the validity of the hypothesis that in the aggregate, we may observe a rise in the incidence of child labour in the early stages of development, until some threshold level of income is achieved. Upon reaching this threshold, the incidence of child labour declines more steadily. The results are presented in Chapter 5.

Regressions are run on different models with percent child labour as the dependent variable and per capita GDP as the explanatory variable. We find that the quadratic model provides the best fit. We find evidence of an inverted-U shaped relation for the total sample as well as for those countries in which per capita GDP is greater than US$1000. Moreover, the income elasticities at the mean suggest that as per capita GDP increases, the incidence of child labour increases provided there are no effective changes in policy. The small size of the income parameters suggests that other aspects of development are important determinants of child labour levels. Government policy may also provide children with a voice until we are able to model the role of children more effectively. For the bottom 20 per cent of the sample, those countries with per capita GDP below US$1000, we find the opposite, though insignificant pattern. That is to say, the child labour force participation rate is inversely correlated with per

capita GDP, although the income parameters are insignificant at more than the 10 per cent level and are therefore of no consequence.

Forecasts for per capita GDP, percent child labour, as well as the net primary enrollment ratio are obtained. Without significant and effective changes in policy, the incidence of child labour will continue to rise in many countries for several decades to come. It follows that, ceteris paribus, in these countries economic growth alone, as measured by per capita GDP, may not be a sufficient means by which to reduce child labour, or eliminate it altogether. It could take more than 150 years to reduce average child labour force participation to 10 per cent. To reach this target by 2029, the required growth rates range from 2 to 15 per cent. It may be impossible to generate an outcome in which the level of child labour is significantly reduced unless measures are taken to stabilize household income. Measures taken towards improving the distribution of income will be most effective. That is to say, increasing the level of income may not reduce the number of gainfully employed children; redistribution efforts are more likely to have the desired effect.

Our results complement the findings of much of the related research which imply that by reducing income variability, policies that raise the wage of adults **relative** to children are more likely to reduce the supply of child workers.[39] Providing some form of assistance to poor households through income supplementation schemes might be a sufficient short term solution when improving conditions in the adult labour market is not an option. This is true only if the resources are available and if parents believe that policymakers are credible. The relaxation of credit constraints and targeting coordination failures within credit markets is important. Credit markets could replace children as a source of insurance against unstable current and future income. [40]

The introduction of a formal system of social security may help to reduce the need for children, a traditional mechanism of support for the elderly. Effective credit markets will provide parents a means by which to save for their consumption needs in old age. The establishment of institutions that substitute for the services children provide to their parents is crucial in order to reduce parental dependence on child

[39] As noted in Chapter 2, refer to Grootaert and Kanbur (1995), Basu (1999), Baland and Robinson (2000), Dessy (2000), Altman (2001), and Hazan and Berdugo (2002).
[40] See Ranjan (2001), and Dehejia and Gatti (2002).

services. Access to credit markets will enable parents to save for their own future consumption needs.

In addition, effective monitoring of child time use is necessary. As Weiner (1991) notes, no country has successfully eliminated child labour without regulating the use of children's time. While the historical experience of Britain and the United States suggests that child labour levels had already begun to decline before compulsory schooling was introduced, such legislation could have a positive impact, provided it is designed appropriately and easily enforceable. However, this must be done in such a way as not to harm families economically. For instance, incentive-based educational opportunities could stimulate child enrollment ratios and reduce the number of gainfully employed children without economically hurting their families. Moreover, while banning, boycotting and bullying have shown to have negative effects on child workers and their families, regulating children's working conditions could prove to be beneficial. Such initiatives will also provide an incentive for firms to adopt better technologies.

Our results also illustrate the positive correlation between fertility and child labour. Studies have shown that higher education for mothers is associated with fewer, healthier children.[41] This could potentially increase household resources devoted to each child. Subsidizing the education of both women and children will substantially benefit households and communities.

There are several opportunities for further research. It would be interesting to test for this relationship using more specialized econometric as well as forecasting models, provided more extensive microeconomic data is available. Specifically, regional analyses of countries that have experienced significant growth in certain key areas would provide us with the means by which to make more relevant inference and hence, more context appropriate policy recommendations. For instance, it would be interesting to observe how this relationship is characterized in Western India – a region of India that has experienced growth in both state domestic product and child labour – compared with other Indian provinces.

[41] See Cochrane (1983), Farooq et al. (1987), Strauss (1990), Ahmad (1991), Thomas (1991), and Ainsworth et al. (1995).

This study also highlights the need for economic models to include children rather than lump them into the category of the household. Those models that do explicitly consider the role of children in the household tend not to accurately reflect the nature of their role; this is particularly true in the context of resource allocation models. The static model presented in this paper is only a first step. We have looked at household utility of child time spent in different activities at a point in time. There are many limitations to this approach, where household decisions regarding child time use, child demand and resource allocation are made at one point in time and by one household member representing the family. For instance, fertility theory and human capital investment theory are modeled such that decision-making takes place over time. Thus, a dynamic model would allow us to combine these ideas in order to develop more relevant and effective policy. It would be interesting to examine this question using a dynamic approach to intra-household bargaining, thereby taking into consideration the role of children as strategic decision-makers over time. Effective evaluation of child time use is important. That is to say, the next step would be to examine the utility of child time use for children and for the household over time.

When children are recognized as producers, it is often perceived as the result of a combination of poverty and their weak economic and social position. Children are rarely considered to be legitimate social and economic actors; rather, they are assumed to be recipients of orders given by the head of household. Even bargaining models, whereby household members and other relevant parties are modeled to act according to some strategic interest, tend to neglect children as having any bargaining power whatsoever. This is another limitation to the approach we have taken. The recognition of children as participants in family decision-making will lead to further insight into childhood and future adulthood wellbeing.

Studies of industrial structures and production processes in different economic sectors are also important. We must explore these issues in order to identify the determinants of child labour. Other concerns include the effects of war and parental illness, and the role of government policy.

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APPENDICES

Appendix A1: Child Labour and Per Capita GDP Fixed Effects Regression Results, Linear Model (Total Sample)

Country	*Fixed Effects*	*Country*	*Fixed Effect*
Angola	27.69	Malaysia	3.77
Argentina	5.41	Mali	54.62
Bangladesh	35.32	Mauritania	24.36
Benin	36.53	Mauritius	5.25
Bolivia	15.28	Mexico	11.86
Botswana	13.47	Mongolia	2.64
Brazil	19.32	Morocco	5.84
Burkina Faso	54.91	Mozambique	34.28
Burundi	42.99	Myanmar	24.75
Cambodia	25.03	Namibia	15.80
Cameroon	25.60	Nepal	35.40
Chad	36.09	Nicaragua	13.87
China	11.87	Niger	45.36
Colombia	5.50	Nigeria	26.05
Congo	26.62	Pakistan	14.77
Costa Rica	6.77	Panama	4.66
Cote d'Ivoire	20.83	PNG	19.77
Dominican Republic	15.36	Paraguay	10.34
Ecuador	7.39	Peru	3.08
Egypt	9.57	Philippines	9.16
El Salvador	11.77	Portugal	3.58
Ethiopia	43.05	Rwanda	42.17
Gabon	18.30	Senegal	31.01
Gambia	27.22	Sierra Leone	15.45
Ghana	13.38	Sri Lanka	2.89
Guatemala	14.58	Sudan	22.60
Guinea	34.08	Syria	6.16
Guinea-Bissau	39.28	Tanzania	39.43
Haiti	24.40	Thailand	14.25
Honduras	10.60	Togo	29.22
India	10.63	Turkey	20.00
Indonesia	9.90	Uganda	45.40
Iran	5.23	Uruguay	8.70
Iraq	3.65	Vietnam	10.07
Kenya	40.87	Yemen	20.49
Lesotho	22.55	Zambia	16.75
Madagascar	36.09	Zimbabwe	19.25
Malawi	34.90		

Appendix A2: Child Labour and Per Capita GDP Fixed Effects Regression Results, Linear Model (per capita GDP< US$1000)

Country	*Fixed Effects*
Burkina Faso	56.55
Burundi	44.32
Chad	37.77
Ethiopia	43.99
Guinea-Bissau	40.89
Madagascar	37.64
Malawi	36.33
Mali	55.84
Mozambique	36.05
Myanmar	26.67
Niger	46.88
Rwanda	43.47
Sierra Leone	16.94
Tanzania	40.65
Zambia	18.63

Appendix A3: Child Labour and Per Capita GDP Fixed Effects Regression Results, Linear Model (per capita GDP> US$1000)

Country	*Fixed Effects*	*Country*	*Fixed Effect*
Angola	27.68	Lesotho	22.53
Argentina	5.30	Malaysia	3.66
Bangladesh	35.31	Mauritania	24.34
Benin	36.51	Mauritius	5.22
Bolivia	15.25	Mexico	11.76
Botswana	13.39	Mongolia	2.61
Brazil	19.24	Morocco	5.79
Cambodia	25.04	Namibia	15.75
Cameroon	25.57	Nepal	35.39
China	11.84	Nicaragua	13.85
Colombia	5.43	Nigeria	26.03
Congo	26.59	Pakistan	14.75
Costa Rica	6.69	Panama	4.57
Cote d'Ivoire	20.81	PNG	19.70
Dominican Republic	15.31	Paraguay	10.29
Ecuador	7.33	Peru	3.02
Egypt	9.53	Philippines	9.12
El Salvador	11.74	Portugal	3.42
Gabon	18.23	Senegal	30.98
Gambia	27.21	Sri Lanka	2.85
Ghana	13.35	Sudan	22.59
Guatemala	14.54	Syria	6.10
Guinea	34.05	Thailand	14.17
Haiti	24.39	Togo	29.21
Honduras	10.57	Turkey	19.93
India	10.60	Uganda	45.38
Indonesia	9.86	Uruguay	8.60
Iran	5.16	Vietnam	10.05
Iraq	3.61	Yemen	20.48
Kenya	40.86	Zimbabwe	19.23

Appendix B1: Child Labour and Per Capita GDP Fixed Effects Regression Results, Log-Log Model (Total Sample)

Country	*Fixed Effects*	*Country*	*Fixed Effect*
Angola	3.44	Malaysia	1.17
Argentina	1.58	Mali	4.11
Bangladesh	3.67	Mauritania	3.31
Benin	3.68	Mauritius	1.52
Bolivia	2.76	Mexico	2.49
Botswana	2.66	Mongolia	0.95
Brazil	3.07	Morocco	1.77
Burkina Faso	4.11	Mozambique	3.65
Burundi	3.86	Myanmar	3.20
Cambodia	3.34	Namibia	2.79
Cameroon	3.36	Nepal	3.64
Chad	3.70	Nicaragua	2.72
China	2.57	Niger	3.93
Colombia	1.67	Nigeria	3.35
Congo	3.40	Pakistan	2.80
Costa Rica	1.94	Panama	1.51
Cote d'Ivoire	3.15	PNG	3.10
Dominican Republic	2.80	Paraguay	2.33
Ecuador	2.05	Peru	1.05
Egypt	2.34	Philippines	2.29
El Salvador	2.55	Portugal	0.66
Ethiopia	3.86	Rwanda	3.84
Gabon	3.01	Senegal	3.55
Gambia	3.35	Sierra Leone	2.85
Ghana	2.70	Sri Lanka	0.91
Guatemala	2.78	Sudan	3.19
Guinea	3.64	Syria	1.85
Guinea-Bissau	3.78	Tanzania	3.78
Haiti	3.31	Thailand	2.74
Honduras	2.45	Togo	3.49
India	2.40	Turkey	3.06
Indonesia	2.38	Uganda	3.93
Iran	1.65	Uruguay	1.63
Iraq	1.30	Vietnam	2.35
Kenya	3.82	Yemen	3.13
Lesotho	3.23	Zambia	2.93
Madagascar	3.70	Zimbabwe	2.87
Malawi	3.66		

Appendix B2: Child Labour and Per Capita GDP Fixed Effects Regression Results, Log-Log Model (per capita GDP< US$1000)

Country	*Fixed Effects*
Burkina Faso	4.07
Burundi	3.83
Chad	3.66
Ethiopia	3.83
Guinea-Bissau	3.75
Madagascar	3.66
Malawi	3.63
Mali	4.07
Mozambique	3.61
Myanmar	3.28
Niger	3.89
Rwanda	3.81
Sierra Leone	2.81
Tanzania	3.75
Zambia	2.89

Appendix B3: Child Labour and Per Capita GDP Fixed Effects Regression Results, Log-Log Model (per capita GDP> US$1000)

Country	*Fixed Effects*	*Country*	*Fixed Effect*
Angola	3.22	Indonesia	2.14
Argentina	1.31	Iran	1.40
Bangladesh	3.46	Iraq	1.06
Benin	3.46	Kenya	3.61
Bolivia	2.53	Lesotho	3.01
Botswana	2.40	Malaysia	0.90
Brazil	2.81	Mauritania	3.09
Cambodia	3.12	Mauritius	1.24
Cameroon	3.13	Mexico	2.22
China	2.34	Mongolia	0.72
Colombia	1.41	Morocco	1.53
Congo	3.17	Namibia	2.54
Costa Rica	1.68	Nepal	3.43
Cote d'Ivoire	2.93	Nicaragua	2.49
Dominican Republic	2.55	Nigeria	3.16
Ecuador	1.80	Pakistan	2.57
Egypt	2.10	Syria	1.25
El Salvador	2.32	Thailand	2.87
Gabon	2.76	Togo	2.09
Gambia	3.14	Turkey	0.81
Ghana	2.48	Uganda	2.05
Guatemala	2.54	Uruguay	0.38
Guinea	3.43	Vietnam	3.33
Haiti	3.10	Yemen	0.67
Honduras	2.23	Zimbabwe	2.97
India	2.18		

Appendix C1: Child Labour and Per Capita GDP Fixed Effects Regression Results, Quadratic Model
(Total Sample)

Country	*Fixed Effects*	*Country*	*Fixed Effect*
Angola	26.93	Malaysia	1.54
Argentina	3.47	Mali	54.23
Bangladesh	34.58	Mauritania	23.48
Benin	35.70	Mauritius	3.84
Bolivia	13.98	Mexico	9.55
Botswana	11.31	Mongolia	1.37
Brazil	17.07	Morocco	4.18
Burkina Faso	54.41	Mozambique	33.74
Burundi	42.57	Myanmar	24.16
Cambodia	24.31	Namibia	14.07
Cameroon	24.45	Nepal	34.72
Chad	35.59	Nicaragua	12.73
China	10.39	Niger	44.89
Colombia	3.27	Nigeria	25.32
Congo	25.42	Pakistan	13.65
Costa Rica	4.53	Panama	2.49
Cote d'Ivoire	19.86	PNG	18.44
Dominican Republic	13.53	Paraguay	8.55
Ecuador	5.50	Peru	1.27
Egypt	7.90	Philippines	7.63
El Salvador	10.33	Portugal	2.75
Ethiopia	42.76	Rwanda	41.76
Gabon	16.26	Senegal	30.06
Gambia	26.55	Sierra Leone	14.99
Ghana	12.41	Sri Lanka	1.36
Guatemala	12.87	Sudan	21.84
Guinea	33.28	Syria	4.18
Guinea-Bissau	38.78	Tanzania	39.05
Haiti	23.72	Thailand	12.03
Honduras	9.45	Togo	28.53
India	9.76	Turkey	17.81
Indonesia	8.33	Uganda	44.74
Iran	3.11	Uruguay	6.45
Iraq	2.01	Vietnam	9.26
Kenya	40.12	Yemen	19.81
Lesotho	21.62	Zambia	16.17
Madagascar	35.61	Zimbabwe	18.04
Malawi	34.46		

Appendix C2: Child Labour and Per Capita GDP Fixed Effects Regression Results, Quadratic Model
(per capita GDP< US$1000)

Country	Fixed Effects
Burkina Faso	57.73
Burundi	45.47
Chad	38.84
Ethiopia	44.96
Guinea-Bissau	42.08
Madagascar	38.83
Malawi	37.50
Mali	56.96
Mozambique	37.20
Myanmar	27.71
Niger	48.07
Rwanda	44.60
Sierra Leone	18.02
Tanzania	41.76
Zambia	19.78

Appendix C3: Child Labour and Per Capita GDP Fixed Effects Regression Results, Quadratic Model
(per capita GDP> US$1000)

Country	*Fixed Effects*	*Country*	*Fixed Effect*
Angola	26.82	Lesotho	21.48
Argentina	3.12	Malaysia	1.14
Bangladesh	34.48	Mauritania	23.35
Benin	35.58	Mauritius	3.49
Bolivia	13.78	Mexico	9.16
Botswana	10.98	Mongolia	1.18
Brazil	16.71	Morocco	3.94
Cambodia	24.20	Namibia	13.80
Cameroon	24.29	Nepal	34.63
China	10.18	Nicaragua	12.56
Colombia	2.91	Nigeria	25.21
Congo	25.25	Pakistan	13.49
Costa Rica	4.17	Panama	2.15
Cote d'Ivoire	19.72	PNG	18.26
Dominican Republic	13.26	Paraguay	8.28
Ecuador	5.21	Peru	1.00
Egypt	7.66	Philippines	7.40
El Salvador	10.12	Portugal	2.45
Gabon	15.95	Senegal	29.93
Gambia	26.45	Sri Lanka	1.13
Ghana	12.28	Sudan	21.73
Guatemala	12.61	Syria	3.88
Guinea	33.16	Thailand	11.68
Haiti	23.63	Togo	28.44
Honduras	9.28	Turkey	17.47
India	9.63	Uganda	44.65
Indonesia	8.09	Uruguay	6.06
Iran	2.78	Vietnam	9.14
Iraq	1.77	Yemen	19.71
Kenya	40.00	Zimbabwe	17.86

Appendix D: Example of an Augmented Dickey Fuller Unit Root Test on Per Capita GDP, Ethiopia

ADF Statistic	-2.42	1% critical value 5% critical value 10% critical value	-5.48 -4.08 -3.49	
Variable	Coefficient	Standard Error	t-statistic	Probability
X3V(-1)	-0.835	0.345	-2.417	0.0603
D(X3V(-1))	-0.322	0.276	-1.165	0.2966
C	0.224	0.102	2.192	0.0799
@Trend (1989)	0.029	0.009	3.292	0.0217
R-squared	0.745			

Appendix E: White's Test for Heteroscedasticity

White's Test: Based on the auxiliary regression of the squared residuals from the initial model on the explanatory variables, their squared values and cross-products,

$$n \cdot R^2 \sim \chi^2_{df}$$

The degrees of freedom correspond to the number of regressors.

We obtain a χ^2 value of 55.34 which exceeds the critical value; therefore we reject the null hypothesis of homoscedasticity.