Understanding Children's Work
An Inter-Agency Research Cooperation Project

Impact of Working Time on Children's Health

September 2004

L. Guarcello

S. Lyon

F. Rosati

ILO-IPEC

International Programme on the

Elimination of Child Labour

Impact of Working Time on Children's Health

September 2004

CONTENTS

1. INTRODUCTION

1. Recommendation 190 accompanying ILO Convention No. 182 calls for “detailed information and statistical data on the nature and extent of child labour” that should be “kept up to date to serve as a basis for determining priorities for national action for the abolition of child labour, in particular for the prohibition and elimination of its worst forms”.

2. The recent ILO-IPEC global count of child labourers found that an estimated 171 million children aged 5 to 17 are involved in hazardous situations or conditions. This points to an urgent need to gather qualitative and quantitative data to address the factors that make children’s work hazardous, in order to guide policies and programmes targeting hazardous work. While some information is available on the general impact of child labour on health (e.g., Graitcer and Lerer, 1998; Fassa, 2003; and O’Donnell, Rosati and van Doorslaer, 2003), little is known about the effect of children’s working time on their health.

3. A recent ILO report looking at adults’ working time found that regularly working in excess of 48 hours constitutes a significant occupational stressor which increases the effects of other stressors and significantly increases the risk of mental health problems, while regularly working more than 60 hours per week appears to increase the risk of cardiovascular disease (Spurgeon, 2003). It can be assumed that children will be affected in similar ways by even less amounts of work. However, data on which to base such thresholds are not yet available for children.

4. This working paper looks in detail at the relationship between the intensity of children’s work (i.e., children’s weekly working hours) and children’s health outcomes, making use of household survey data from Bangladesh, Brazil, and Cambodia. The effect of work hours on health outcomes obviously depends on the nature of the work performed, and, for this reason, sector of work is also included in the analysis. The paper will contribute to a broader effort to identify and target hazardous forms of work more effectively. It will also help provide an empirical basis for recommendations on maximum permissible working time for adolescents aged 14 to 18 years.

5. Given the nature of the data, and the measurement problems associated with comparing the health status of working and non-working children (see Section 2), the paper focuses only on the subset of children at work in economic activity. Even limiting the analysis to working children, the unavailability of panel data does not allow treatment of individual unobservable characteristics, such as health endowments. How much this is likely to affect estimation results is difficult to say. For example, stronger, healthier children might work longer hours and this might bias the estimates downwards. Several other examples could be presented with possible biases running in either direction. However, it is believed that the limits due to individual unobservables are not likely to be large, and in any case smaller than those linked to the measurement of health.

6. As is well-known, satisfactory measures of health status are difficult not only to obtain, but also to define. This paper relies on two sets of measures: self-reported health problems and injuries, as these are the only indicators that can be built for the three countries. The limited information on the severity of ill health is also exploited. But these are far from optimal measures, and it should therefore be kept in mind that results in terms of injury and illnesses do not necessarily translate into conclusions in terms of health. It is obvious that longitudinal studies would be able to provide better information. But such studies are expensive, by nature of limited extent, and unlikely to be representative of a population of working children across sector, regions and other dimensions. Moreover, their level of detail extends beyond what is needed or feasible for identifying broad, likely cross-sectoral, thresholds for permissible working hours. The identification of information gaps that limit the validity and the scope of conclusions concerning working hours and health will be an important by-product of the paper.

7. The paper is structured as follows. Section 2 reviews current literature and research issues relating to child work and health. Section 3 describes the data sets on which the analysis is based and the indicators and other variables used in the rest of the paper. As we will see, the data sets available do not leave us a large choice in terms of indicators to be used and we will mainly rely on occurrence rates, even if the incidence rates (or density) will also be briefly analyzed.

8. Section 4 presents descriptive evidence relating to the nature and extent of children's work in the three countries, as well as the characteristics and distribution of working hours. As working hours are a main ingredient of our analysis, it is necessary to present their characteristics in detail, also to be sure that their distribution is not degenerated. We shall see that this is not the case, but that the estimates of the working hours obtained by the surveys present a reasonable distribution and seems to be well behaved. Finally, we will analyse the cumulative distribution of hours worked, by country and by sector, in order to establish the likely effect of different hours thresholds in terms of the percentage of children affected. Because of the clustering in the distribution of children by working hours, relatively small changes in the level of the hours threshold that define light work might have large consequences in terms of the number of children that can be classified as child labourers.

9. Section 5 is devoted to a detailed descriptive discussion of the relationships between the occurrence of injuries/illnesses (and, where possible, also the incidence), hours of work and other characteristics of the child and his or her sector and modality of employment. This discussion will give us a picture of stylized facts that emerge from the data.

10. Section 6 attempts to identify causal links between working hours, sector of employment and occurrence of injuries / illnesses. The basic estimation strategy is the same for all countries considered. It looks first at the probability of occurrence of the injury, then at the seriousness of the injuries/illnesses occurred and finally at the relative importance of working hours vis-à-vis work sector in determining the level of risk faced by the child. We use a Heckman maximum

likelihood estimator to identify the link among injuries/illnesses, the hours of work and the sector of employment. We also use a set of other control variables in order to ensure, to the extent possible, to have identified the link of interest. Subsequently, we use an ordered probit, in order to estimate the seriousness of the injuries illnesses again as a function of the working hours and sector of employment, given a set of relevant controls. Finally, we map, through some auxiliary estimates, the relative importance of hours of work and sector of employment in determining the health risks faced by the child. We use, as a presentation device, a set of iso-risk curves, i.e. curves that map the combination of working hours and sector of employment that generates the same level of risk for the child.

11. Section 7 is devoted to developing a synthetic indicator for the relationship between working hours and injuries/illnesses, both with and without conditioning on the sector of employment. Disentangling causal relationships can be complex, requiring a set of estimations and evaluations that are not necessarily easy to perform or of immediate impact. For this reason, we suggest the use of a synthetic indicator based on kernel regression. This indicator mimics reasonably well, at least in the cases considered, the causal relationships identified and offers an instrument of immediate evidence. Such instrument, if combined with the use of the density of working hours, can be used with relative ease for an initial identification of possible thresholds for working hours.

12. The conclusions offer a brief summary of the main findings and highlight some of the policy implications that can be derived from the analysis.

2. CHILD LABOUR AND CHILD HEALTH: A REVIEW OF RESEARCH ISSUES[1]

2.1 Negative health effects associated with child labour

13. Concern about the health consequences of child labour derives primarily from the belief that work increases the child's exposure to health hazards that threaten to subject the child to illness or injury. The hazards may be obvious and threaten immediate damage to health, such as those risks arising in construction, manufacturing and mining from the use of dangerous tools and machinery and exposure to high temperatures and falling objects. Alternatively, the hazards may be less perceptible and hold longer-term consequences for health such as risks from contact with dust, toxins, chemicals and pesticides, the lifting of heavy loads and the forced adoption of poor posture. Hazards may also threaten psychological health through exposure to abusive relationships with employers, supervisors or clients (ILO, 1998). The health consequences of child labour will vary with the type of hazards to which the child worker is exposed, and with the average time spent on work. Variation in the nature and intensity of child work across industries and across countries means there is no one relationship between child work and health but a variety of such relationships.

14. A large scale ILO sponsored survey undertaken in the Philippines, found 60 percent of all economically active children to be exposed to hazardous working conditions: 19 percent being exposed to biological hazards, 26 percent to chemical and 51 percent to environmental (NSOP, 1998). Of all child workers, 24 percent were found to suffer work related illness and/or injury, a prevalence rate much higher than that for adult workers. Most common injuries were cuts, wounds or punctures, accounting for 69 percent of the total. Body aches and pains (59 percent) and skin diseases (22 percent) were the most common work related illness.

15. A number of factors raise the health risks which children face from work relative to adults. First, child labour tends to be concentrated in particularly dangerous industries. Globally, agriculture is by far the dominant sector of child employment, accounting for 70 percent of all child workers, and is an industry with a very poor record of safety, with 1 in 8 child workers suffering illness or injury (see Table 1). Relative to agriculture, manufacturing and wholesale/retail trade, which together account for almost 17 percent of all child workers, are less hazardous but, with 1 child worker in 12 in these industries succumbing to illness or injury, safety levels are far from acceptable. Fewer child workers are located in transport, construction and mining (collectively 6.6 percent of the total) but extremely poor safety records in these industries - 1/6 to 1/4 child workers become ill or injured - mean that they account for a disproportionate fraction of all work related child illnesses and injuries.[2] With respect to health

---

[1] This section draws on Owen O'Donnell O., Rosati F.C., and van Doorslaer E., *Child labour and health: Evidence and research issues,* UCW project working paper, December 2001.

[2] See ILO (1998) and Fassa et al (2000) for descriptions of health risks children are exposed to by sector of employment.

hazards, work in transport, construction and mining appear to be the very worst forms of child labour. Marginal gains in child health and safety could be realised most easily by measures targeted at these most hazardous industries. However, given the dominance of agriculture in respect of child labour, significant advances in the average level of child health require policies to improve the safety of child work in that sector.

Table 1. **Distribution of child labour and health hazards by industry for 26 countries**

Sector	**% of all economically active children in industry**	**illnesses / injuries per 100 economically active children**
Agriculture, hunting, forestry and fishing	70.4%	12.2%
Manufacturing	8.3%	9.3%
Wholesale and retail trade, hotels and restaurants	8.3%	8.3%
Community social and personal services	6.5%	7.8%
Transport/ storage/ communications	3.8%	18.1%
Construction	1.9%	25.6%
Mining and quarrying	0.9%	15.9%

Source: Ashagrie, K.. *Statistics on Child labour and hazardous child labour in brief*, Geneva, ILO, 1998.

16. A second factor raising the health risks faced by child labourers relative to adults derives from the fact that children often work in informal, small scale and illegal settings which, by their very nature, are difficult to regulate (Fassa et al, 2000). The substantial number of children worldwide working in domestic services and the sex industry are left particularly vulnerable to physical and psychological abuse.[3] Children working in small scale farming and manufacturing are often not given the protection promised by health and safety regulation. Even when this protection is available, it is likely to be much less effective for children since the measures are usually designed for adult, and not child, workers (ILO, 1998; Fassa et al, 2000). Hence, safety devices and clothing may not be usable by children and permissible exposure limits are usually established for adults and may not be appropriate for children.

17. Given their physiological and psychological immaturity and the biological process of growth, children may be more vulnerable than adults to abuse and to given health risks. Children are more prone to injury through accidents and have been found to be more sensitive to noise, heat, lead and silica toxicity, and ionising radiation (Bequele and Myers, 1995; Forastieri, 1997; ILO, 1998; Fassa et al, 2000; and Woodhead, 2004). Working long hours also takes a greater physical toll on children. Tired children may be at greater risk of contracting disease and have less strength to combat them.

18. The literature is richer in hypothesising negative effects of child work on health than it is in testing these hypotheses. In the absence of comparison with the health experience of a control group of non-working children, prevalence rates of illness and injuries among working children do not constitute evidence of a deleterious effect of work on health. Studies that involve

[3] In Table 2, these sectors fall under domestic and personal services, which account for 6.5% of all child workers.

controlled comparisons tend to be small scale and rather context specific (Parker, 1997). This is understandable given that the rich array of data required in order to unravel the linkages between child labour and health makes large scale studies extremely expensive. One study of a rural part of India reports growth deficits among working boys in comparison with boys in school (Satyanararayanan et al, 1986) but other data from rural India do not support this finding (Cigno and Rosati, 2001). Fentiman et al (2001) find no growth differences between children enrolled and not enrolled in school in rural Ghana. Assuming the non-enrolled children are more likely to be working, this does not support a negative effect of work on child growth. However, the non-enrolled children were found to suffer greater morbidity, apparently deriving from the health hazards of lake fishing, the main occupation of boys not attending school. In Bombay, the prevalence of health problems (e.g. muscular, chest and abdominal pains, headaches) among children working primarily in hotels, restaurants and construction was found to be greater than that among children in school (Naida and Parasuman, 1985 - quoted in ILO, 1998, p.8). In summary, good evidence on the direct effects of child labour on child health is lacking. With respect to the impact of child growth rates, the evidence is mixed. There is more support for deleterious effects of labour on particular forms of morbidity related to the nature of the work undertaken.

2.2 Positive health effects of work

19. While child labourers are exposed to health hazards they would not otherwise encounter, they also generate resources, which help maintain themselves and their families. If a positive impact of a child's labour market participation on the resources at a household's disposal is accepted, then strong empirical support for a positive impact of living standards on health can be cited (Steckel, 1995; Appleton and Song, 1999; Smith 1999) to support the argument that child labour potentially affects child health positively.

20. In conditions of extreme poverty, this is a plausible and persuasive argument. However, several caveats are warranted. First, any positive effect of child labour on health through living standards must be offset against the deleterious effect of occupational health hazards. A child, and its family, might enjoy a few years of fruitful work before suffering an accident and the subsequent loss of both livelihood and health. This potential risk implies a difficulty for empirical work. Contemporaneous correlations between children's work and their health may reveal little of the true impact of child labour on health since those who have suffered severe workplace accidents will be recorded as currently not working and in poor health. Longitudinal, or at least retrospective, data are required to uncover such effects. This leads to the second caveat; much of the relationship between child labour and health is likely to be dynamic. While child labour may raise family living standards and child health in the short run, the long-term health effects of working, and any corresponding loss of education, need to be considered. A third caveat concerns the hypothesis that child labour has a positive impact on household

resources. This seems a reasonable proposition when children are used to supplement the labour input of their parents. However, unemployed parents might be forced to use their children to substitute for their own labour. The final caveat to the argument that child labour may impact positively on child health through a positive contribution to household living standards concerns the distinction between effects at the individual and aggregate level. While a child's work may make a positive contribution to the family's standard of living, it does not necessarily follow that, in the aggregate, child labour raises living standards and consequently health. A large supply of child labour can be expected to reduce market wages and may leave the economy at a low level equilibrium with a large supply of low skilled (child) labour, low wages, low education levels and poor health (see Basu, 1999). Such general equilibrium effects point to a further difficulty with the interpretation of any empirical relationships between child labour and health established from household survey data. Such micro data can only improve our knowledge and understanding of individual level relationships and are not necessarily informative of how population health would change in response to a dramatic change in the aggregate labour input of children.

2.3 Long-run health consequences of child labour: Direct effects

21. While many of the health risks child labourers are exposed to threaten immediate damage to health, others are likely to develop over many years and might only become manifest in adulthood. Exposures to pesticides, chemicals, dusts and carcinogenic agents in agriculture, mining and quarrying and manufacturing increase the risks of developing bronchial complaints, cancers and a wide variety of diseases (Forastieri, 1997; ILO, 1998; Fassa et al, 2000). In India, industries with large proportions of child labourers also tend to have high rates of TB and silicosis; stonecutters and slate workers, for example, have silicosis rates of 35 percent and 55 percent respectively (Parker, 1997). Cancer risks are raised significantly through exposure to asbestos in mining and construction and to aniline dyes in carpet and garment manufacturing (ILO, 1998). Ergonomic factors such as heavy lifting and poor posture raise the chances of musculoskeletal problems developing in later life (Forastieri, 1997; ILO, 1998; Fassa et al, 2000). Individuals who have worked as a child are at particular risk of developing chronic health problems not only because they are exposed to risk factors for longer periods but because the biological process of rapid cell growth reduces the latency period of some diseases (Fassa et al, 2000).

22. On the other hand, the possibility of positive impact of child labour on health in adulthood is not implausible. Working as a child provides resources, which may be crucial to the avoidance of under-nourishment in childhood. This would be expected to have a long-run positive impact on the individual's lifetime health experience.

2.4 Long-run health consequences of child labour: An indirect effect through education

23. An intuitively appealing proposition is that child labour is at the expense of education. If this is true, then, even in the absence of any direct effect of child work activity on health, there can be indirect effect through the sacrifice of education. A lower level of educational attainment might impact negatively on health through two mechanisms. First, an individual entering adulthood with a lower level of education has less human capital and, *ceteris paribus*, can expect a lower stream of lifetime earnings. Reference has already been made to the close positive association between material living standards and health (Steckel, 1995; Appleton and Song, 1999; Smith, 1999). A second channel for a health effect of education operates directly through the accumulation of knowledge of health production mechanisms (Grossman, 1972). Educated individuals are likely to be better informed of the factors which impact on health, to be more productive in the use of their own time to generate health and to be more responsive to health education materials (Schultz, 1984).

24. There is empirical support for a positive effect of education on health (e.g. van Doorslaer, 1987; Wagstaff, 1993; Fassa, 2003). This leaves the issue of whether child labour is indeed a substitute for education. In a simple model in which a child faces the option of either full-time education or full-time work, increased work activity is obviously at a substantial cost to education. However, the child may be able to divide its time more flexibly between work, school and play. In which case, the issue is whether marginal increases in work are at the expense of schooling, play or both. Where schooling choices are severely constrained by family resources, there is the possibility that child labour even has a positive effect on education through providing the resources necessary to pay for schooling.

25. The existence and the degree of any trade-off between child labour and education is an empirical question on which the evidence is mixed. There is growing evidence of a substantial proportion of kids in developing countries combining school and work (Patrinos and Psacharopoulos, 1995; Akabayashi and Psacharopoulos, 1999; Anker, 2000; Cigno and Rosati, 2001). There is, however, substantial heterogeneity across countries in the extent to which child work activity and schooling overlap (Anker, 2000; Heady, 2000). Testing the proposition that child work "crowds-out" schooling is complicated by the fact that child labour and schooling decisions are taken simultaneously and so are potentially influenced by common unobservable factors, which bias the estimated relationship. In order to circumvent this endogeneity problem, the existence of a trade-off has been tested indirectly by examining whether factors that encourage child work activity also tend to discourage school attendance. The weight of the evidence is in support of a trade-off. Analyses of data from Bolivia and Venezuela (Psacharopoulos, 1997), Cote d'Ivoire (Grootaert and Patrinos, 1998), India (Rosenzweig and Evenson, 1977; Cigno and Rosati, 2001) and Zambia (Nielsen, 1998) all support the crowding-out hypothesis. On the other hand, no support is given from another analysis of data from India

(Skoufias, 1994) and in data from Peru (Patrinos and Psacharopoulos, 1997).[4] Work intensity is of particular relevance here. Work for a small amount of time each week undoubtedly has a smaller crowding out effect on schooling than work performed more intensely.

26. A limitation of all the research quoted above is that it concentrates on the trade-off between work activity and time spent in school whereas the central concern is whether child work is at the expense of the educational *achievement* of the child. School attendance may be a poor measure of educational achievement and result in either upward or downward bias in the estimated relationship between child work and education (Heady, 2000). Addressing this limitation, time spent by the child in work has been found to have a negative impact on reading and maths test scores in Ghana (Heady, 2000) and Tanzania (Akabayashi and Psacharopoulos, 1999).[5] In the case of Ghana, this effect does not operate through reduced school attendance. In Tanzania, this is true for boys but for girls the effect is mostly indirect, operating through lost study time.

27. While there remains scope for further analysis of the child labour – education trade-off, there is sufficient support from the literature, and from basic intuition, that child work activity is at the expense of educational attainment. Consequently, there is some support for the proposition of an indirect effect of child labour on health, operating through education.

28. Any relation between child labour and health is not necessarily confined to a single generation. If child labour does come at the expense of education and the child worker's lifetime earnings and health profiles, then the health of offspring can also be expected to suffer. There is a possibility of child labour supporting cycles of poverty and ill-health (Basu, 1999; Baland and Robinson, 2000). There is good evidence that parental, particularly maternal, education is one of the main determinants of child health (Barerra, 1990; Thomas, Strauss and Henriques, 1991; Behrman and Lavy, 1994).

2.5 Evidence on long-run health effects

29. For the obvious reason of the strenuous data requirements, empirical examination of the long-term health consequences of child labour is limited. One small-scale study following children over a 17 year period in a rural region of India finds that children who work in agriculture, small-scale industry and services grow up shorter and lighter than those who attend school (Satyanararayanan et al, 1986). Two larger-scale studies based on different Brazilian data sets provide further support for a negative impact of child labour on health in adulthood

---

[4] Ravallion and Wodon (2000) take a different approach to circumventing the endogeneity problem, examining the impact of a subsidy for school attendance in Bangladesh on time spent in work and school, instrumenting participation in the subsidy programme. The subsidy is successful is raising school attendance, with most of the extra study time coming at the expense of leisure, rather than work.

[5] Both studies control for the potential endogeneity of work (and school) time either through the use of instruments (Akabayashi and Psacharopoulos, 1999) or by the inclusion of a measure of innate intellectual ability in the regressions for test scores (Heady, 2000).

(Kassouf et al, 2001; Guiffrida et al, 2001). Kassouf et al use a cross-section of adults living in both urban and rural settings in north-east and south-east Brazil to examine the correlation between participation in work as a child and self-reported health in adulthood. Simple bivariate analysis reveals that the probability of reporting less than good health in adulthood rises as the age of entry into the labour force falls, although the correlation attenuates with increasing current age. The depletion of the correlation with age could be the result of selective mortality – only the healthiest survive to older ages, whether they have worked or not. In the case that child work activity and schooling are mutually exclusive, age of entry into the labour force will be extremely closely correlated with years of education and it is impossible to conclude whether a simple correlation between age at first job and health reflects a (child) work effect, an education effect or both. If some kids combine work and school, the independent variation in the two factors allows both to be included in the analysis. Any remaining influence of age at entry to the labour force must reflect a direct effect of child labour on health. Kassouf et al find evidence of such an effect but only for males 28-47 years and females 18-27 and 38-47. The dilution of the effect suggests that either the initial correlation between child work activity and health is largely spurious, reflecting the influence of omitted education, or that a substantial proportion of the impact of child labour on adult health is indirect, operating through forgone education.[6] Interestingly, current household income had no additional effect on the gradient, which might indicate that the health impact of lost education operates through reduced knowledge of health production mechanisms rather than through lowering lifetime living standards. Alternatively, it could be that education is simply a better indicator of lifetime income than current income.

30. Guiffrida et al employ a nationally representative cross-section survey of 18-60 year old Brazilian adults. After controlling for age, education, (latent) wealth, housing conditions, unemployment status and race, entry to the labour force at or below the age of 9 has a statistically significant and substantial negative effect on (latent) health in adulthood.[7] Given the inclusion of so many control variables, this result provides even stronger support for a direct effect of child labour on adult health.[8] The magnitude of the effect for women is roughly twice that for men. On average, a 40-year-old woman who started work at or below 9 years of age is estimated to have the health status of a 45-year-old woman who did not work before the age of

---

[6] The omission of other (non-child work) determinants of education from the initial correlation makes it impossible to distinguish between the two possibilities.

[7] Guiffrida et al (2001) estimate a latent variable structural equations model (SEM). That is health status, wealth, health care access are all treated as latent (unobservable) variables, measured, with error, by observable proxy variables. Variations in all three latent variables, plus health care utilisation, are estimated simultaneously with health status specified as a function of (latent) wealth, plus exogenous variables, wealth a function of exogenous variables, health care access a function of health status and wealth and health care utilisation a function of health status, wealth and access. Identification is through exclusion restrictions, normalisations and restrictions on the variance-covariance matrix. Health status is proxied by self-assessed health, chronic conditions and limited activity.

[8] Child labour is not a central focus of Guiffrida et al (2001) and no attempt is made to test for direct and indirect effects of child labour on health and to compare their magnitudes.

9. Reasons for the substantial gender disparity are not immediately obvious and deserve further attention.

31. The two Brazilian studies support the hypothesis that child labour has a long-run negative impact on health. However, as Kassouf et al are careful to point out, caveats need to be placed on a causal interpretation of the relationships. The main weakness of the evidence stems from the cross-sectional nature of the data, in which labour activity as a child is recalled retrospectively. One obvious potential problem is recall bias but a more serious issue is unobservable heterogeneity. It is not possible to rule out the possibility that individual characteristics, not observable in the data set, raise the probability of working as a child and reduce health in adulthood. Examples of such unobservables include the individual's endowed, or initial, stock of health, ability and family background. The control variables and simultaneous modelling utilised by Guiffrida et al ameliorate, but do not remove, the problem. Longitudinal data are required in order to correct for such sources of spurious correlation. The discussion turns to such estimation issues in the next section.

32. In a recent paper, Straub and Rosati (2004) offer more solid evidence on the long-term effects of child labour. By using retrospective information about the age of entry into the labour market, they analyze the effects of child labour on adult health. The estimates are based on a sample of siblings for Guatemala, helping to deal with the role of unobservables. They show that adult health is significantly and negatively affected by having worked as a child.

2.6 Estimation issues

33. The central difficulty confronted in empirical examination of the health consequences of child labour is that of endogeneity. Both child work activity and health, at least to some extent, are the result of household decisions and thus both reflect characteristics of the family that are unobservable to the statistician. These common unobservables induce statistical association between the variables even in the absence of any causal relationships. For example, assuming health is positively associated with labour market productivity, *ceteris paribus*, the healthiest individuals are most likely to offer themselves for employment and to be appointed. In the absence of any causal impact of work on health, the statistical relationship between the two variables would be expected to be positive.

34. In order to avoid the fallacies that can arise from endogeneity, a theoretical framework is helpful in guiding the construction of an empirical model. The household production approach (Becker, 1965) has proven to be particularly useful in empirical analyses of health variations. According to this perspective, health is a final good, which directly generates utility and is "produced" by the household through the selection of inputs of time and market goods, such as food and medical care (Grossman, 1972). Time allocation decisions are made given the realisation of individual specific health endowments, i.e. physiological predisposition to good/bad health, which are observable to the household but not the analyst. As a consequence,

regressing health outcomes on inputs, such as work time, will not render unbiased estimates of the causal impact of the latter since both the inputs and outcomes reflect the value of the unobservable health endowments.

35. The most popular empirical strategy has been to estimate "reduced form demand relations". That is, to regress health outcomes on (exogenous) *determinants* of the health inputs. The resulting coefficients are a reflection *both* of the "technological" relationships between the inputs and outcomes and of preferences. In the context of child labour – health relations, the reduced form effect of the child wage (or appropriate proxies) on child health indicates the total effect of wage variation on health, which comprises both the incentive effect of the wage on household time allocation and the technological impact of work time on health. Consequently, the reduced form approach cannot answer the question of how a child's work activity impacts on its health. Tackling such a question requires resolution of the problems of omitted variables bias and unobservable heterogeneity. The estimated impact of child labour will be subject to omitted variables bias if other determinants of health, correlated with child work activity e.g. education, are left out of the regression. This problem can only be resolved through the use of a sufficiently rich data set. The problem of heterogeneity bias arises from the unobservable child health endowment, which induces correlation between the observable and unobservable arguments in a simple regression of health on child work activity, rendering the estimates biased. With cross-section data, correction of this bias requires the availability of instruments for child work i.e. variables which affect child work activity but not health itself. Potentially valid instruments might include indicators of regional variation in child labour market conditions and opportunities, as well as parental endowments of wealth and human capital established prior to the birth of the child (and so the realisation of its health endowment).[9]

36. Panel, or longitudinal, data have two important advantages with respect to estimation of the health consequences of child labour. First, with data on the same individuals at different points in time, it is easier to account for the effect of individual specific unobservable health endowments, which generate much of the endogeneity problem. For example, the fixed effects estimator eliminates the unobservable effects and is consistent, although not efficient. Efficiency gains can be realised through use of a panel data instrumental variables estimator e.g. Hausman and Taylor (1981), which have the additional advantage of not requiring instruments that must be claimed, perhaps tenuously, to influence child work activity but not health. The second important advantage of panel data is that they allow the time dynamics of the relationships between child work activity and health to be investigated. The determination of health is essentially a dynamic process; health today reflects experiences of the past. An infirm child is not currently working but may have been the victim of a serious workplace accident in the past.

---

[9] The validity of such instruments is weakened, the closer the correlation between the health, and other human capital, endowments of the parents and children.

The education lost by the working child today is likely to have consequences for its health into adulthood. With longitudinal data, the manifestation through time of any influence of work activity in childhood on health can be examined. Retrospective data from a cross-section on work activity in childhood also provide an opportunity to examine the long-run health effects of child labour but with such data instruments must again be relied upon to correct for endogeneity bias.[10] With panel data on health in adulthood, the influence of unobservable individual specific effects on health can be purged and the impact of (time invariant) work experience in childhood estimated using, for example, the estimator of Hausman and Taylor (1981). In short, the availability of panel data is at the top of the "wish list" of any researcher seeking to estimate the health consequences of child labour.

2.7 Measurement issues

37. Whatever the methodology adopted to estimate the relationships between child labour and health, appropriate measures of both factors are required. The definition and measurement of child labour has been discussed elsewhere (*c.f.* Anker, 2000). The most important point to note in the present context is that there is substantial heterogeneity in the nature of child labour and, consequently, in the impact it has on health. The health consequences of helping out on the family farm during the summer months are vastly different from those of working long hours, day after day, in a factory with very little protection against hazardous conditions. If the only measure of child labour available is a discrete indicator of whether any work is undertaken, then only the average association between child work activity and health can be estimated. This may be an average of positive effects, for example where vacation work by children provides an important supplement to the family resources, and of negative effects and not be representative of the health experience of many child workers. Such estimates would not be helpful in the identification of the most harmful forms of child labour. In order to take the analysis further, more detailed measures of child work activity, which provide information both on the intensity of work and the sector of employment, are required. But such detailed measurement must be combined with a large sample of child workers in order for there to be sufficient numbers of various types of child workers to facilitate estimation of heterogeneity in the impact of child labour on health.

38. Of course, large detailed surveys are expensive, a factor that constrains the measures of health available for analyses in relation to child work activity. Detailed clinical measures are unlikely to be available, leaving the researcher with a choice between anthropometric measures and self-reported indicators of morbidity. The latter can relate to acute sickness, chronic illness and assessments of general health status. Indicators of chronic conditions and general health status are preferable for analyses of the long-term health consequences of child work activity,

---

[10] See discussion of Kassouf et al (2001) and Guiffrida et al (2001) above.

acute sickness being a noisier indicator of the individual's underlying health status and better suited to analyses of the short-run impact of child work on health. The most widely available morbidity indicator for children in the developing world refers to any illness or injury experienced in the last 4 weeks. This is the most typical question used in the Living Standards Measurement Study surveys fielded by the World Bank (Grosh and Glewwe, 1995). However, it often does not produce the expected socio-economic gradients. For instance, one study looking at child health status in 100 villages in Indonesia found higher occurance rates of illness in the higher than in the lower expenditure quintiles and higher in urban than in rural areas (Cameron, 2000). It seems likely that such results reflect, at least in part, differences in the conceptualisation of good health. As Sen puts it, "people's perception of illness varies with what they are used to, and with their medical knowledge. In places where medical care is widespread and good, people often have a higher perception of morbidity, even though they may be in much better general health." (Sen, 1998, p. 18).

39. General self-assessed health (SAH), usually available for adults but not so often for children, can be combined with retrospective data on work activity in childhood to examine the long run health consequences of child labour. There is evidence that SAH is closely correlated with underlying morbidity and that, even after controlling for clinically measured physiology, it is a good predictor of future mortality (Kaplan and Camacho, 1983; Idler and Benyamini, 1997). Despite this survival prediction performance, there are persistent worries about the reliability of SAH. Mis-reporting and cut-point shifting would not be a problem if it were random but there is some evidence, particularly from developing countries, that it is correlated with variables, such as income and education, which are potential determinants of true health (Strauss and Thomas, 1998; Sadana et al, 2000). Therefore, the use of subjective health measures like reporting of illness and self-assessed health level remains problematic.

40. Anthropometrics are basically measures of height and weight standardised for age and sex and compared to an international standard for normal child growth.[11] There is good evidence of negative correlation between child anthropometric measures and indicators of ill health (World Health Organisation, 1995). Certain caveats are warranted, however, with respect to the suitability of anthropometrics in examination of the health effects of child work activity. The indicators mainly reflect current or past nutritional status and so, if they are used as health outcomes, a crucial control variable is current or past calorie intake. If this is not available, then omitted variable bias will be a problem if calorie intake is correlated child work activity, as seems likely. A second caveat is that the appropriate indicator must be selected depending upon whether the relationship under examination is short or long run. Weight-for-height is mainly an indicator if acute malnutrition and is not particularly relevant to examination of the health

[11] There are four indicators height-for-age, weight-for-age, weight-for-height and the body mass index. The World Health Organisation recommends standardisation on the US average (de Onis and Habicht, 1996).

impact of child labour. Height-for-age is a better indicator of long-term health experience but mainly reflects health and nutritional exposure in early childhood and is of limited use in estimating the health effects of child work. A particular problem with the use of anthropometrics in the context of child labour is that they are better measures of nutrition and health experience at younger ages. As the child ages, stature is more likely to be a reflection of genetic factors. Many studies using height-for-age and weight-for-height restrict attention to children no older than 10 years, excluding the age range in which child labour is most prevalent.

41. Within the constraints imposed, the body mass index (BMI) and measures of self-reported morbidity appear to be the most promising measures of health. Each has its limitation and, at a minimum, experimentation with a number of health measures is advisable. The best strategy might be to explicitly recognise the measurement problem and model health as a latent (unobservable) variable, which can be measured only imperfectly through a number of indicators, such as BMI, reported health problems and SAH. Supplementing this measurement model with the determination of health by a number of causes, such as child labour, education, etc., gives the Multiple Indicator Multiple Causes (MIMIC) model (e.g. Wagstaff, 1993). The Guiffrida et al (2001) study referred to in section 3 adopted this general statistical framework, incorporating, but not focussing on, child labour as one of the health causes.

2.8 Working hours and health

42. Numerous studies of adult workers point to a relationship between working hours and negative health outcomes. In 16 of 22 studies included in one recent review, overtime hours were associated with poorer perceived general health, increased injury rates, more illnesses or increased mortality. These patterns were more pronounced with very long work shifts or when 12-hour shifts were combined with work weeks greater than 40 hours (National Institute for Occupational Safety and Health, 2004). Other studies point to links between long working hours, negative psychological health outcomes, cardiovascular disease, diabetes and the likelihood of workplace accidents. There is also evidence of links between long hours and dangerous health behaviours such as smoking, and alcohol and drug abuse. Again, these effects were strongest when workweeks exceeded 48-50 hours (Beswick and White, 2003).

43. These studies of adult workers follow a variety of methodologies and rely on a number of different health indicators. Most, however, are based on relatively small sample sizes and target a very specific sector or segment of the adult working population. As such, they are ill-suited to drawing more general conclusions concerning links between working hours and health. At any rate, conclusions relating to adult workers are unlikely to be applicable to child workers, as children are not, of course, simply “little adults”. The many differences between children and adults in terms of anatomy, physiology, and psychology may translate into children facing

unique risk factors for occupational injuries and illnesses. The nature of child and adult work is also different, with children often concentrated in relatively more dangerous industries.[12]

44. Unfortunately, research examining long working hours as a risk factor for child workers remains very limited, a research gap that the current paper is designed to help fill. A two-year population-based incidence study of injuries to child agricultural workers in Wisconsin is one of the very few examples of research on the working hours- health link among children. In this study, a multivariate analysis found that weekly working hours was one of three variables (16 variables were examined in total) to have a statistically significantly relationship to injuries (Layde *et al*, 1996).

[12] More than being in relatively more dangerous activities, children could have lower ability to recognize and assess potential risks and make decisions about them. Moreover, adolescents may undertake tasks on the job to demonstrate their responsibility and independence accepting risks to which they are not ready. We thank Anaclaudia Gastal Fassa for raising this issue.

3. DATA SOURCES AND VARIABLE DEFINITIONS

3.1 Data sources

45. The following sections are based on data from national household surveys conducted in Brazil and Cambodia in 2001 and in Bangladesh in 2002-2003. The surveys are referred to in the remainder of the paper the Brazil *Pesquisa Nacional por Amostra de Domicilios* (PNAD), the Cambodian Child Labour Survey (CCLS) and the Bangladesh National Child Labour Survey (NCLS).

46. PNAD 2001 was part of a survey program aimed at monitoring socioeconomic development trends in the country. The survey was representative at the national level with a total sample size of 378,837 persons. In addition to general information on household assets, education, labour, health, etc., PNAD 2001 contained an additional module addressed specifically to children aged 5-17 years. This module collected information on the past and current educational status of children as well as apprenticeship status. It also looked in detail at children's work, collecting information in areas such as job activities, working hours, job-related risks, injuries and disabilities, relationship with employer, use of earnings, and present and future child preferences.

47. CCLS 2001 was designed to provide information on child labour for applied research in various fields of social and economic study. The survey followed a two-stage sample selection, based on the results of the general population census in 1998. The sample of 12,000 households was representative at the national level, as well as at the urban and rural levels; urban areas were oversampled in order to achieve more representative information on the targeted children aged 5-17 years. CCLS 2001 collected information from all usual residents of a selected household and persons who had been living in the selected household the night before the interview. The survey contained two separate sections based on similar questions about children aged 5-17 years. In one section, the questions are addressed to parents of guardian or to the head of the household. In the other section, the questions are addressed directly to the children in the 5-17 years age group. Through these sections, the survey investigated children's work status, working hours, children's satisfaction in the workplace, injuries/disabilities related to work and use of mechanical equipment.

48. The National Child Labour Survey (NCLS) 2002-03 was designed to provide reliable estimates of child labour at national, urban and rural levels , as well as by region. The survey covered the child population aged 5-17 years living in the households, while children living in the streets or institutions such as prisons, orphanages or welfare centres were excluded. It was a stand-alone survey and the sample size and the coverage of the survey were such that it could furnish reliable key estimates by some administrative units such as divisions and regions of the country. NCLS was undertaken using Integrated Multipurpose Sample (IMPS) design, covering 40,000 household and about 193,000 individuals. The survey

collected information on the economic activity status of children aged 5-17 as well as on children performing household chores. The NCLS reports also information on health and safety for children engaged in economic activities.

3.2 Variable definitions

49. The Bangladesh, Cambodia and Brazil surveys collected information on a set of individual and household characteristics including an additional module on child labour for children in the 5-17 age range, and a module on work related illness\injuries. As most of our attention will be devoted to the relevant variables included in these sections, we will discuss their exact definitions below.

- *Child work:* All surveys contain a set of questions related to the main economic activity carried out during the last seven days. Following the literature on child work, we define as "working children", children involved in economic activity during the last seven days for pay or not, for family or for own final use or consumption. Cambodia was unique in collecting information on the number of months worked during the last year. We did not include children performing household chores in the definition of child work, as we are focusing on identifying a working hours threshold for children working in economic activity.
- *Working Hours:* Information on working hours was collected as the average of the hours worked during the last seven days.
- *Sector of Employment:* The three surveys contain information on the sector of employment classified in accordance with the International Standard Classification System (ISCS). We consider in our analysis the main sectors of employment, i.e., agriculture, commerce, manufacturing, services. Other minor sectors were included in the variable named "Others" (details will be given when discussing the estimates). In order to avoid too small cell size, we have not disaggregated further the sector of activity..
- *Indicators of children's health:* This paper relies on indicators built on self-reported illness and injuries. These are the only information available for the three countries considered in the study. The questions related to the occurrence of illness/injury are similar for the three questionnaires, with differences only in the number and quality of filter questions.

  We define the variable Injury as a dummy variable taking value 1 if a working child has ever experienced any illness\injury at the workplace or because of her job. As is well-known, satisfactory measures of health status are difficult to identify and obtain. Occurrence of illness/injury is far from being the optimal measure and it should therefore be kept in mind, as already discussed, that results in terms of injury and illnesses do not necessarily translate into conclusions in terms of health.

  An additional complication stems from the fact that the reference period for the self reported injury/illness is not clearly defined. Both in the case of Cambodia and Bangladesh, it is not clear from the question whether the reference period is last year, any time in the past or last week.[13] The reference period in Brazil is one year, i.e., from 30 September 2000 to 29 September 2001.

In general, the reference period for hours worked and that for the occurrence of injury illness does not coincide. This creates problems for deriving the standard incidence and occurrence indicators. A series of assumptions are hence necessary to derive the indicators. The indicators used and the assumptions made are described below, while the differences in the results are discussed later on.

Given the information basis just described, we have decided to use two sets of indicators: *occurrence rates* and *incidence density.*[14] The occurrence rate is defined as the number of working children suffering from injury/illness divided the number of working children. The calculation of this indicator is straightforward, but we have to underline that the reference periods for work and injury do not coincide. Unfortunately, there is no way to overcome this problem.

The occurrence rate does not take into consideration that differences in observed occurrence can be due to differences in exposure.

To take exposure into consideration, a standard *incidence density* could be computed as follows:

$$\textit{Incidence Density} = \frac{\text{children injured during a specified period of time}}{\text{total person time}}$$

where "total person-time" is cumulated exposure for all the individuals considered. In our case it should be defined as average weekly working hours multiplied by the number of weeks worked during the reference period (assumed to be one year).

Given the information available, the calculation of the incidence density is rather difficult and requires some strong assumptions. Only in the case of Cambodia do we have information on the number of months, but not the hours of work, worked by the child during the previous year. In the case of Brazil and Bangladesh, the only exposure measure available is the average hours worked during the reference week. Given this information structure, we have computed incidence density for all three countries assuming as individual exposure the average hours worked during the reference week. This amounts to assuming that hours worked during the last year are proportional, for each individual, to the hours worked during last week. This is certainly a strong assumption (but necessary if we were to compute an

[13] The questionnaire for Cambodia asks about "any work related illness/injury at any time in the past" and that for Bangladesh "Has the children ever experienced any injury or illness due to work?" The manuals for both countries do not help to clarify the issue.

[14] For a synthetic definition of these standard indicators refer to www.hc-sc-gc.ca

incidence index at all). In the case of Cambodia, given that information was available also on the number of months worked during last year, we could compute an incidence density that relaxed the assumption of exposure proportional to last week working hours.[15] As shown in Annex D, the results are very similar in terms of patterns to those obtained using hours worked last week as exposure. This offers some support to the hypothesis made, but our incidence density index should nonetheless be considered with some care.

- *Child and household characteristics.* We have employed a set of control variables to take into consideration individual and household characteristics.[16] The control variables include: the age of the child (age, age2); a gender dummy (female); the number of the household members (hhsize); the number of children aged 0-4 in the household (nchild0-4) and the number of adults (nadult); a dummy variable taking value 1 if the household head is male (hhead_sex); and a variable for the education of the household head (heduc).

Summary of variable definitions

female	dummy variable taking the value of 1 if female, 0 otherwise
age	age of the child
age2	age squared
edulev	Educational attainment
hours weekly	weekly hours worked
lnincome	logarithm of income
agriculture	
commerce	
services	
manufacturing	
rural	rural=1 if resident in rural area, 0 otherwise
heduc	level of education of household head
hhsize	household size
hhead_sex	dummy variable taking value 1 if the household head is male
nchild04	number of children in the household aged 0-4
nadult	number of adults in the household
lnwage	logarithm of children's wage

[15] We had to assume, however, constant weekly hours of work for the whole reference period. The only additional variation with respect to the other density index computed stems in this case from the variation in the number of months worked.,

[16] The rationale for the use of these variables is well known in the literature on child work, see Cigno et al, 2001 and the literature cited therein.

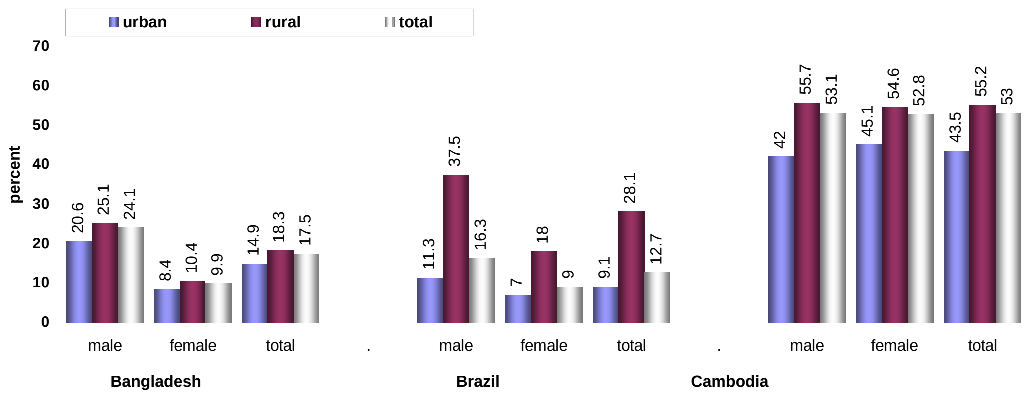
4. DESCRIPTIVE OVERVIEW OF CHILDREN'S WORK

50. This section presents a brief overview of the child labour phenomenon in Bangladesh, Brazil and Cambodia, as background to the discussion on child labour and health presented in the subsequent sections. It will also present an analysis of the distribution of the hours worked to identify the range of variation around the mean. One of the main points of the paper will be to disentangle the sectoral effects on health from those arising from the length of the working day. In order to put this empirical work on a firm basis, we need to analyse the characteristics and distribution of the hours worked.

4.1 Extend and nature of work

51. Child work is very common in Cambodia. More than one in two (53 percent) 5-17 year-olds are economically active, with little difference by sex. This figure that does *not* include children performing household chores in their own homes or children in unconditional worst forms of work. Rural children are more likely to work than their urban counterparts, though child economic activity rates are high in both rural and urban areas. The agriculture sector accounts for by far the largest proportion of working children – 79 percent of male child workers and 74 percent of female child workers. Working children in Cambodia attend school in greater proportion than their non-working counterparts. About three-quarters of economically active boys and two-thirds of economically active girls also attend school, compared to only about 60 percent of non-economically active children. Many of these "non-working" children, however, are likely actually performing household chores.

Figure 1. **Economically active children, 5-17 years age group, by residence, sex and country**

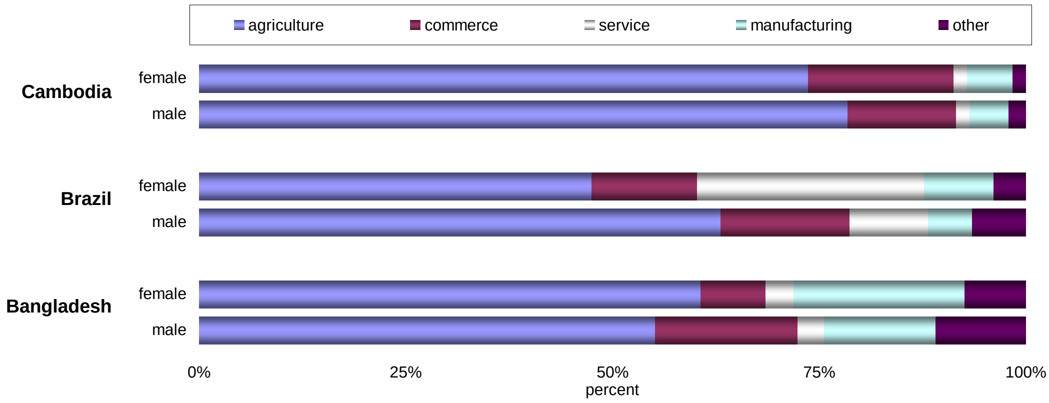


52. In Bangladesh about 18 percent of children in the age group 5-17 are at work in economic activity (Figure 1). Differences in child work involvement by urban and rural location are negligible, but differences by sex are large. The work prevalence of male 5-17 year-olds (24 percent) is more than twice that of females in the same age group (10 percent). As mentioned above, these figure do not include children performing household chores or children involvement in worst forms of work. Over half of male and female child workers, about 60 percent and 55 percent, respectively, are involved in agricultural work. Looking at the other

sectors, girls are more likely than boys to be involved in manufacturing (20 percent) and less likely to be involved in commerce (Figure 2).

53. A smaller but not insignificant proportion of children are at work in economic activity in Brazil. About 13 percent of the total 5-17 year-olds is economically active, though again these estimates do not include household chores or unconditional worst forms of work. Variations in child work incidence by sex and residence are both large in Brazil. The child economic activity rate in rural areas (28 percent) is three times that of urban areas (nine percent), while the rate for boys (16 percent) is almost twice that for girls (nine percent). The agriculture sector also accounts for the largest proportion of both male and female working children in Brazil. There is some specialisation in work by gender, with girls less likely than boys to work in agriculture and much more likely to be involved in services (Figure 2). Working children are less successful than their non-working counterparts in attending school; 80 percent of working children go to school against 91 percent of non-working children.

Figure 2. **Distribution of economically active children, 5-17 years age group, by sector and country**



4.2 Distribution of working hours

54. Working children in Brazil put in longer average working hours than their counterparts in Cambodia and Bangladesh, a weekly average of 29 hours versus a weekly average of 24 hours and 28 hours, respectively. Differences by sex in working hours are small both in Brazil and Cambodia. Bangladesh shows a gender bias in working hours, with boys involved in economic activities for an average of about eight hours per week more than girls. The distribution of working children by hours worked is presented in Figures 3 to 5. In the three countries, the distribution is skewed towards the left side of the mean, in Brazil and Bangladesh peaking at around 20 hours and in Cambodia at around 13 hours. In Brazil, there is another large concentration of working children at around 40 hours, and in Cambodia, at around 20 and 25 hours. In all three countries, the distributions have a long right "tail", highlighting the existence of a group children working exceedingly long hours each week. This group serves to lift the overall mean working hours.

Figure 3. **Economically active Brazilian children aged 5-17: distribution of weekly working hours, by sex**

(a) Male **(b) Female**

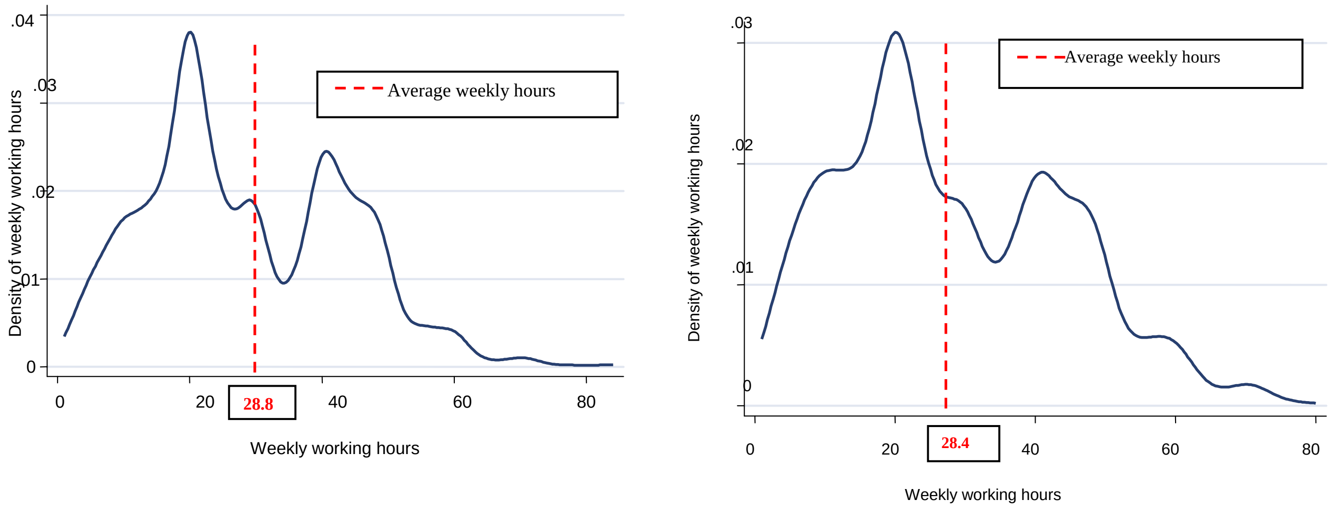


Figure 4. **Economically active Cambodian children aged 5-17: distribution of weekly working hours, by sex**

(a) Male **(b) Female**

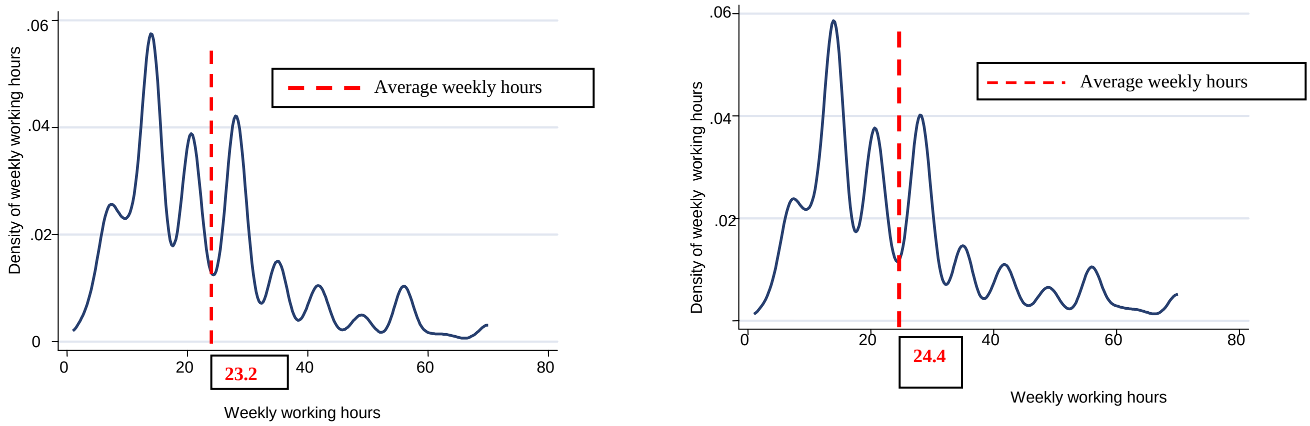
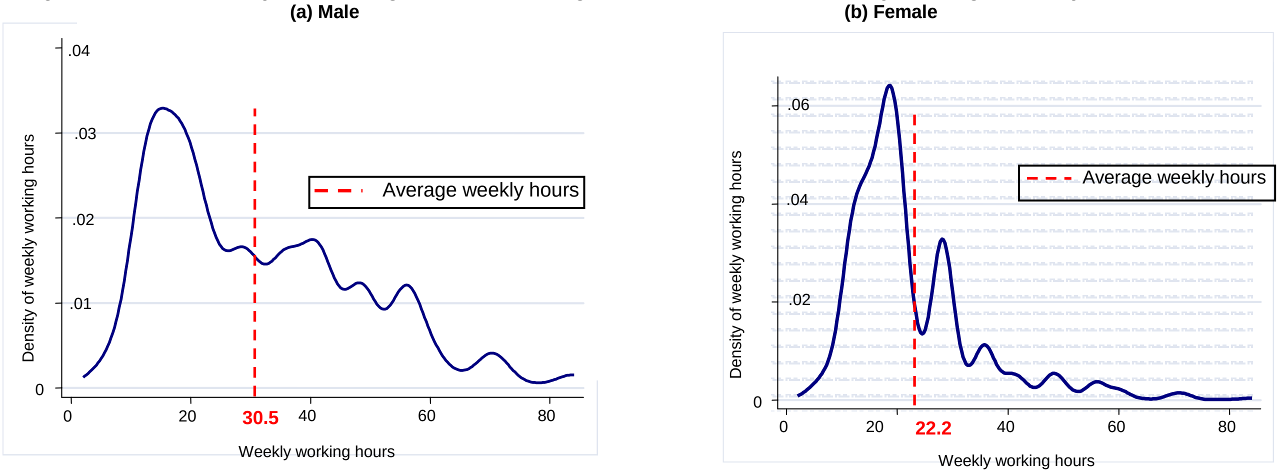


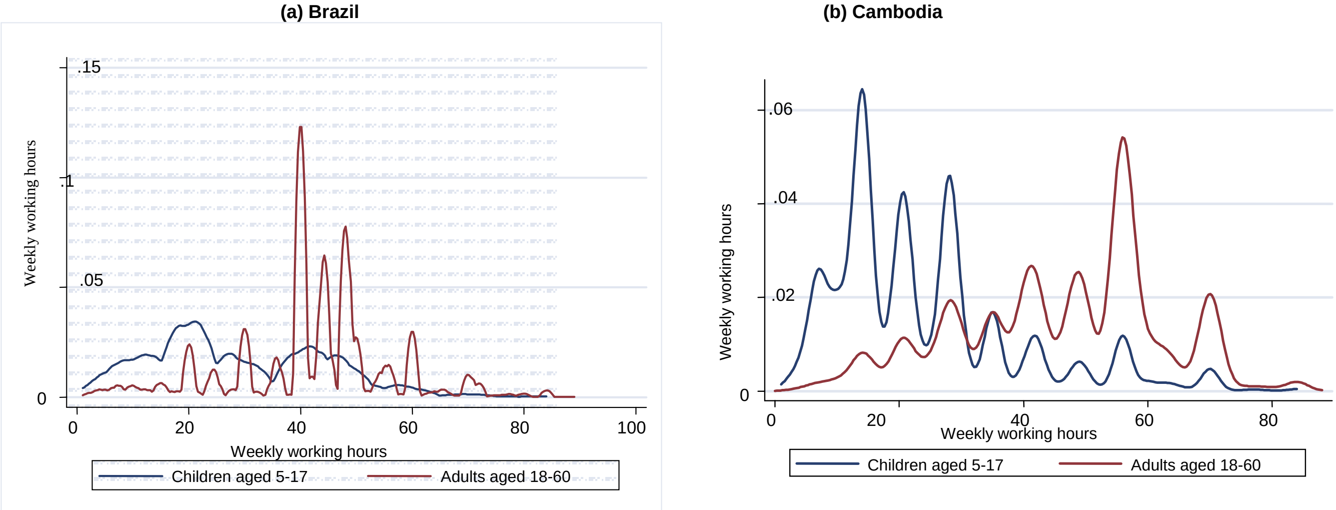
Figure 5. **Economically active Bangladesh children aged 5-17: distribution of weekly working hours, by sex**

(a) Male **(b) Female**



55. Figure 6 contrasts the distributions of child and adult workers by hours worked in Brazil and Cambodia. As expected, there is a greater concentration of child workers at the lower end of the weekly hours spectrum, and a great concentration of adult workers at the higher end.

Figure 6. **Distribution of weekly working hours, children aged 5-17 years versus adults aged 18-60 years, Brazil and Cambodia(1)**



Note: (1) Distribution of working hours for adults is not available for Bangladesh

56. Variation in working hours appears sensitive to the age of the working child as well as to the sector and modality of employment, as summarised below (Table 2).

- *Child age*: In all countries, older working children are more likely to log longer working hours than younger ones. The largest concentration of working children shifts towards the higher hours ranges as children grow older.

- *Work sector:* The distribution of working children by hours worked differs significantly across sectors. In Brazil, long working hours appear to be a particular concern outside the agriculture sector. While the largest concentration of children in agriculture are found in the 11-20 hours range, in the commerce, services and manufacturing sectors the largest concentration of working children are found in the 40 hours or more range. Around one in three working children in the latter three sectors put in a work week of at least 40 hours. In Cambodia, the largest concentrations of children working in manufacturing and services are found in the 40+ hours range, while children agriculture and commerce are concentrated in the 11-20 and 21-30 hours ranges. Data describe a similar picture in Bangladesh. The largest concentration of children working in agriculture and in commerce is found in the 11-20 hours range, while a large percentage of children working in services and manufacturing is concentrated in the 40+ range hours.

Table 2. **Distribution of working children by average weekly working hours, child age and sex, and selected work characteristics**

		Average weekly working hours					
		1-10	11-20	21-30	31-40	40+	Total
(a) Brazil							
Age in years	5-9	37.9	45.2	12.9	2.9	1.2	100
	10-14	19.6	39.7	23.2	9.0	8.5	100
	15-17	7.6	20.5	18.6	20.2	33.1	100
	5-14	22.0	40.4	21.8	8.2	7.5	100
	5-17	13.5	28.6	19.9	15.3	22.7	100
Work Sector	Agriculture	16.7	38.8	21.2	11.8	11.6	100
	Commerce	14.5	23.0	20.1	12.9	29.5	100
	Services	11.1	18.4	19.7	16.5	34.4	100
	Manufacturing	6.2	18.7	17.8	22.4	34.9	100
	Other	9.8	23.6	17.0	24.0	25.6	100
Work Modality	Family	19.5	41.9	23.2	9.1	6.4	100
	Non-family	7.9	16.3	16.8	21.1	37.9	100
Total		13.5	28.6	19.9	15.3	22.7	100
(b) Cambodia							
Age in years	5-9	31.8	35.6	25.3	3.7	3.6	100
	10-14	15.3	36.1	33.6	6.8	8.3	100
	15-17	6.1	24.9	32.6	10.4	26.0	100
	5-14	20.1	36.0	31.1	5.9	6.9	100
	5-17	15.5	32.2	31.6	7.4	13.3	100
Work Sector	Agriculture	14.9	32.8	34.3	7.5	10.5	100
	Commerce	17.5	36.5	28.0	5.9	12.2	100
	Services	15.5	27.0	16.3	8.7	32.5	100
	Manufacturing	18.7	23.3	21.4	8.5	28.1	100
	Other	11.4	19.5	18.1	9.3	41.7	100
Work Modality	Family	15.8	34.2	33.4	7.0	9.6	100
	Non-family	13.0	19.6	20.2	9.8	37.5	100
Total		15.5	32.2	31.6	7.4	13.3	100
(c) Bangladesh							
Age in Years	5-9	33.5	25.6	17.2	4.4	19.3	100
	10-14	3.4	56.1	17.3	6.2	17.0	100
	15-17	2.8	14.6	28.7	14.4	39.6	100
	5-14	5.2	54.3	17.3	6.1	17.1	100
	5-17	4.4	39.7	21.5	9.1	25.4	100
Work Sector	Agriculture	5.2	50.8	23.1	7.9	13.0	100
	Commerce	3.5	34.8	19.9	9.7	32.1	100
	Services	4.3	17.9	24.6	10.4	42.9	100
	Manufacturing	2.6	27.3	18.5	8.0	43.7	100
	Other	3.6	13.6	17.5	16.1	49.3	100
Work Modality	Family	5.8	58.1	21.6	6.6	7.9	100
	Non-family	2.4	15.1	21.2	12.6	48.7	100
Total		4.4	39.7	21.5	9.1	25.4	100

- *Work modality:* Family work appears less time consuming than non-family work. In Cambodia, Brazil and Bangladesh, children in family work are concentrated in the groups working 11-20 and 21-30 hours per week, while the largest concentration of children in the non-family work are found in the group working 40 hours or more per week.

57. Because of the limited number of observations, we have included in our analysis children in the age group 5-17 years. The following graphs indicate that the number of hours worked by 12-14 year-olds does not differ substantially from that of the whole 5-17 years age cohort. We can hence be confident that the results discussed here will apply also to the 12-14 years age group.

Any significant differences with respect to the 12-14 years age group will be identified and discussed separately.

Figure 7. **Distribution of weekly working hours, children aged 5-11 and 12-14 years, by sector, Cambodia**

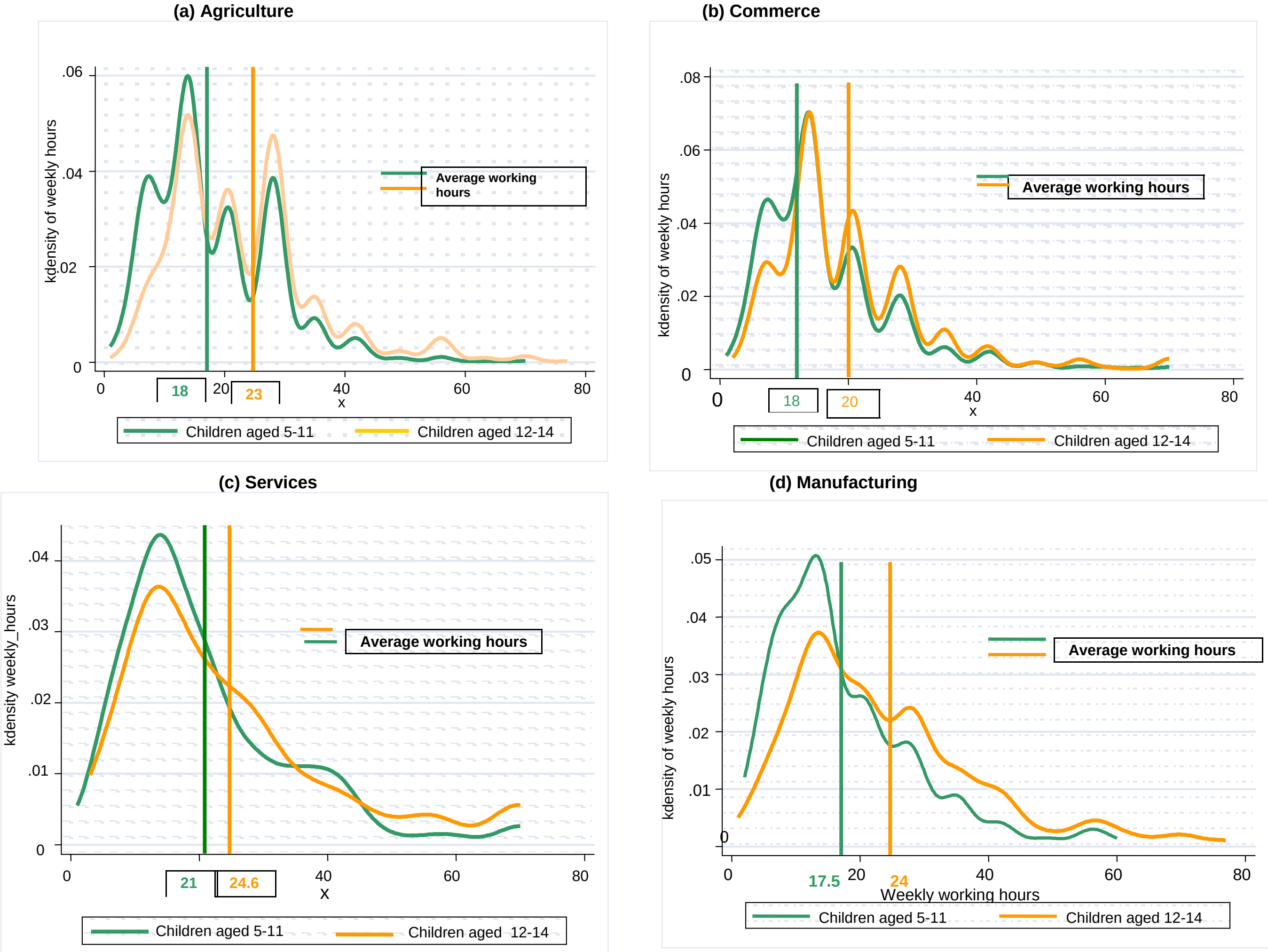


Figure 8. **Distribution of weekly working hours, children aged 5-11 and 12-14 years, by sector, Brazil**

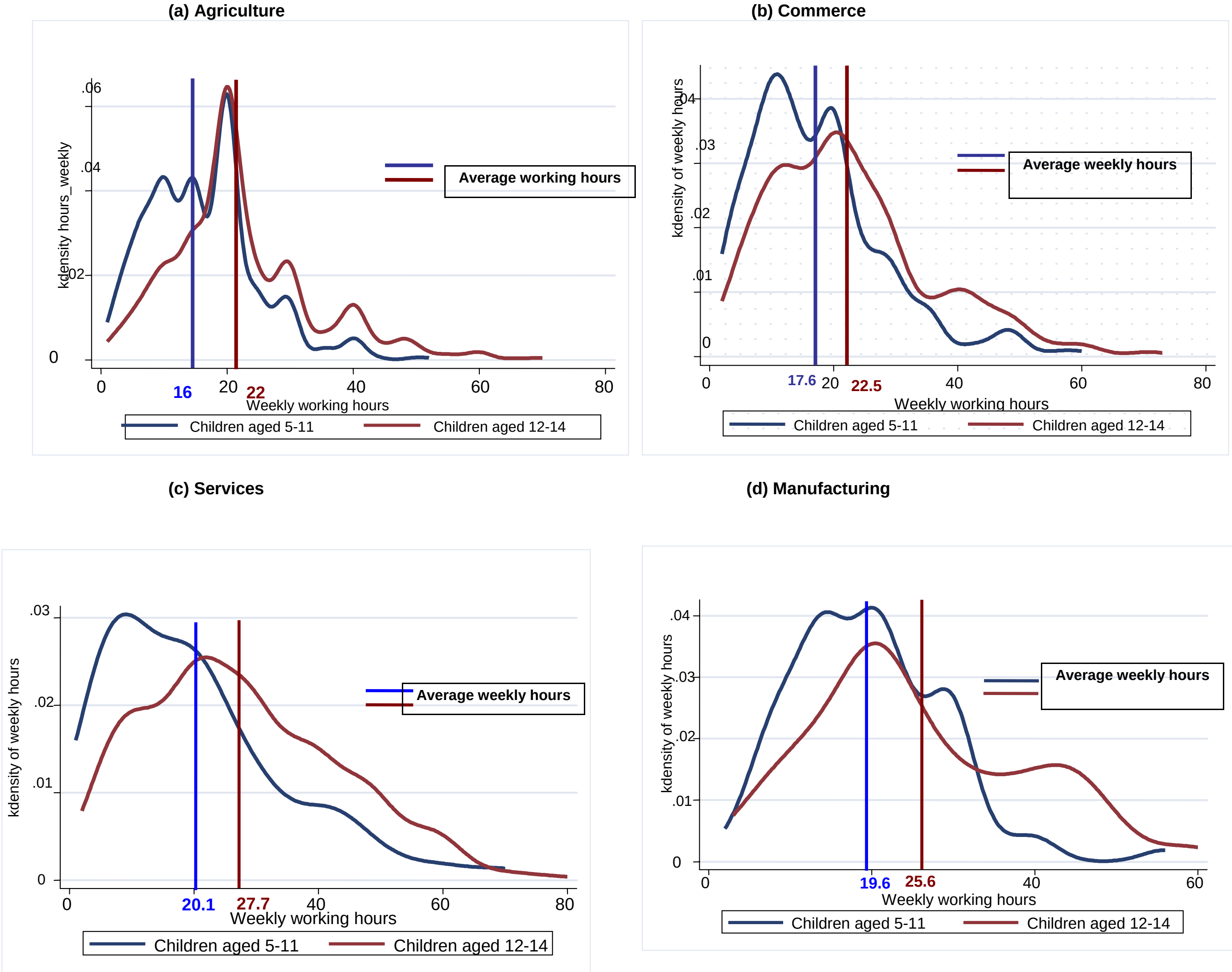
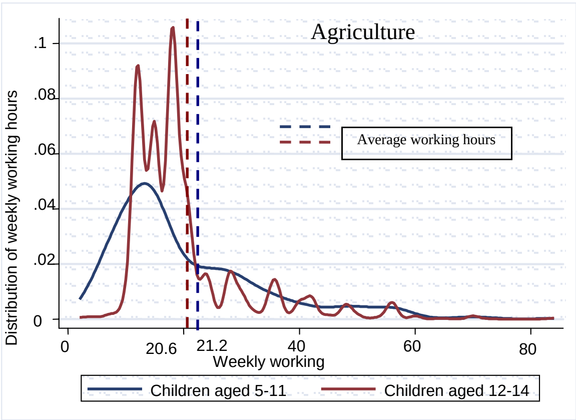
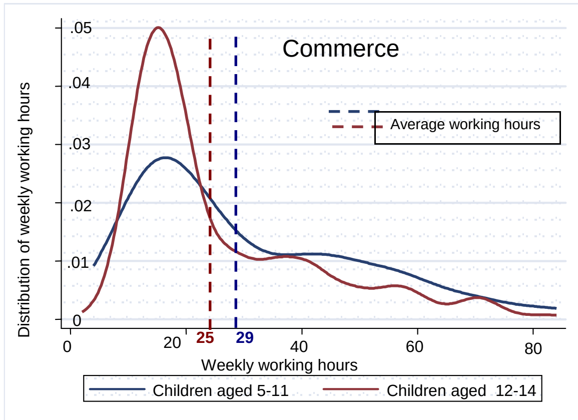


Figure 9. **Distribution of weekly working hours, children aged 5-11 and 12-14 years, by sector, Bangladesh**

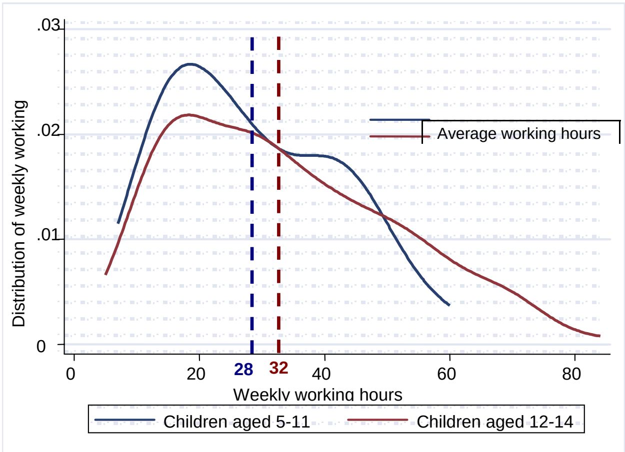
(a) Agriculture



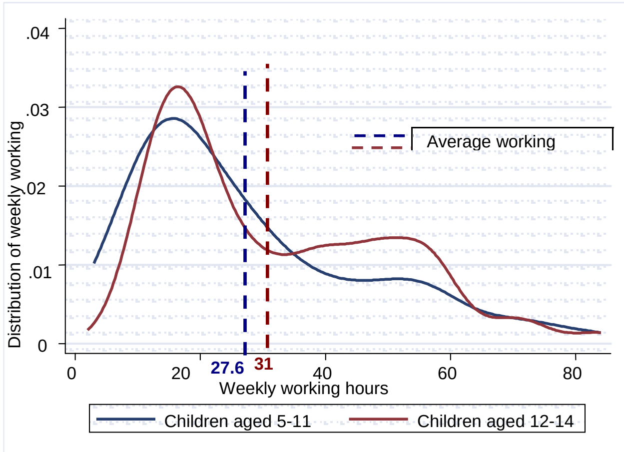
(b) Commerce



(c) Services



(d) Manufacturing



58. Figures 10-12 present the cumulative distributions of 12-14 year-old working children by hours worked. They provide an indication of the proportion of working children that would be affected by the establishment of any specific hours threshold for work, and how this proportion would differ by sector. A weekly hours threshold of 14 hours, for example, would be exceeded by almost two-thirds of 12-14 year-old Cambodian working children in the agriculture, services and manufacturing sectors, and by about half of Cambodian working children in the commerce sector. In Brazil, the same threshold would be exceeded by more than three-quarters of 12-14 year-old working children in the agriculture, services and manufacturing sectors, and by over two-thirds of 12-14 year-old working children in the commerce sector. Observe also that given the clustering of working hours around a limited set of values, small changes in any threshold might generate large changes in the number of children involved.

Figure 10. **Cumulative distribution of working children aged 12-14 years, by sector, Cambodia**

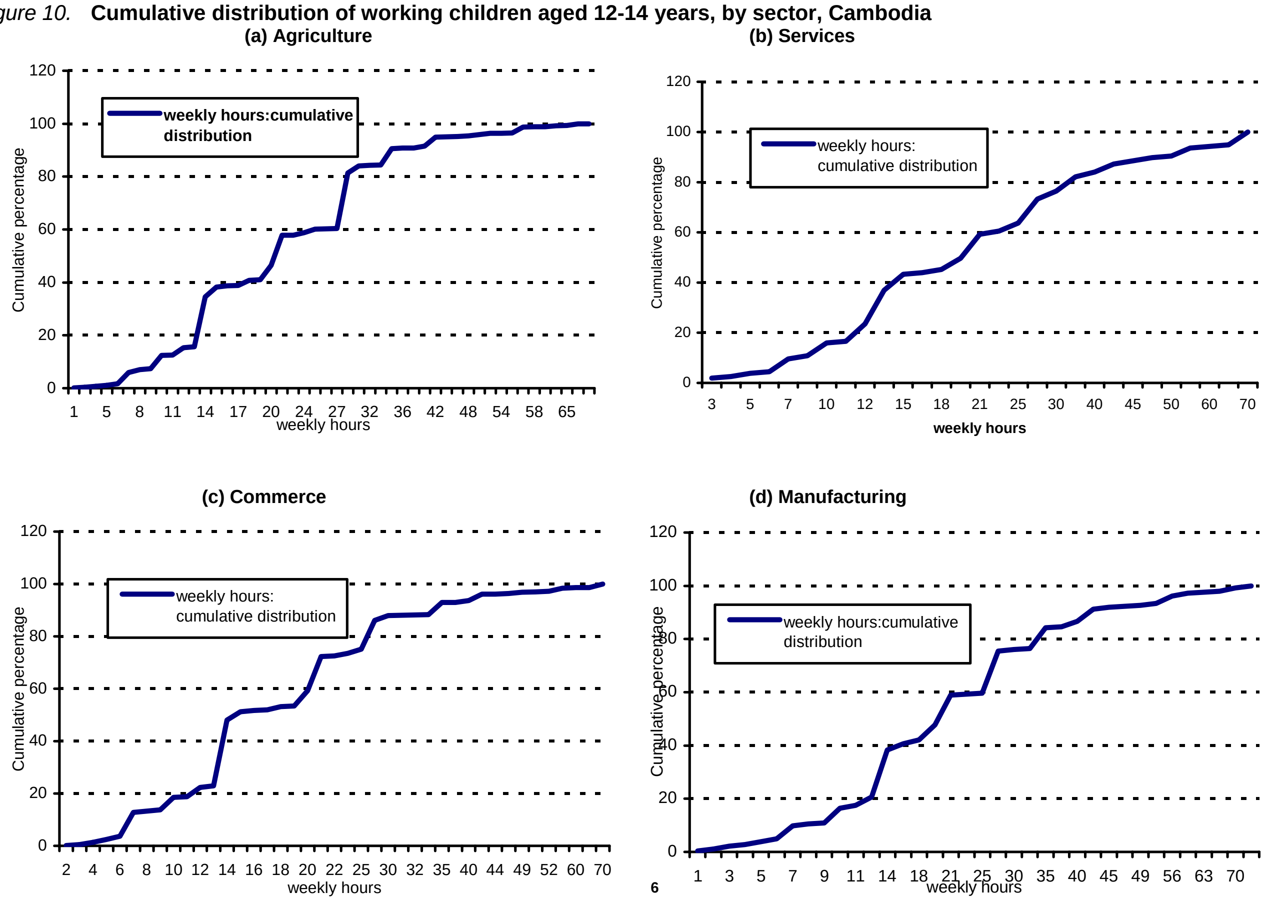


Figure 11. **Cumulative distribution of working children aged 12-14 years, by sector, Brazil**

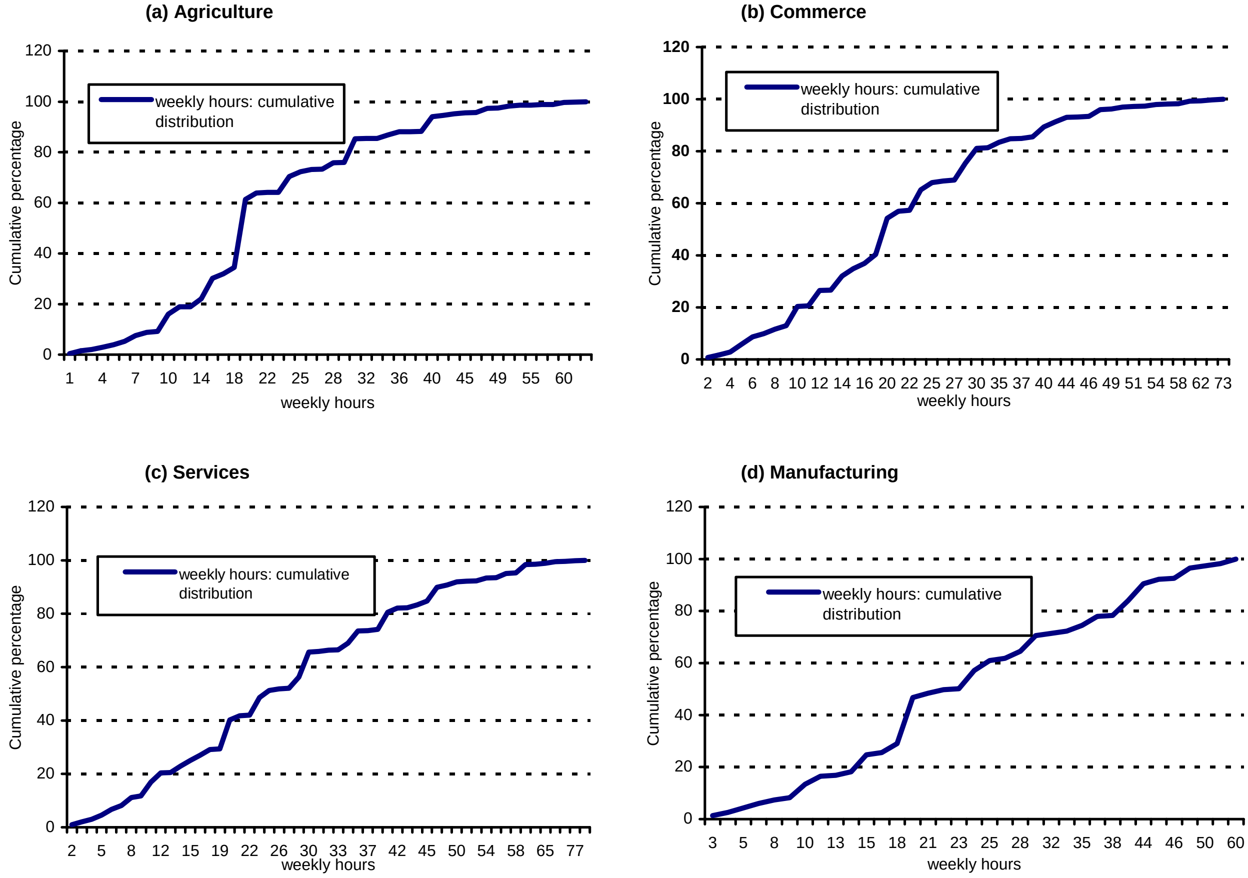
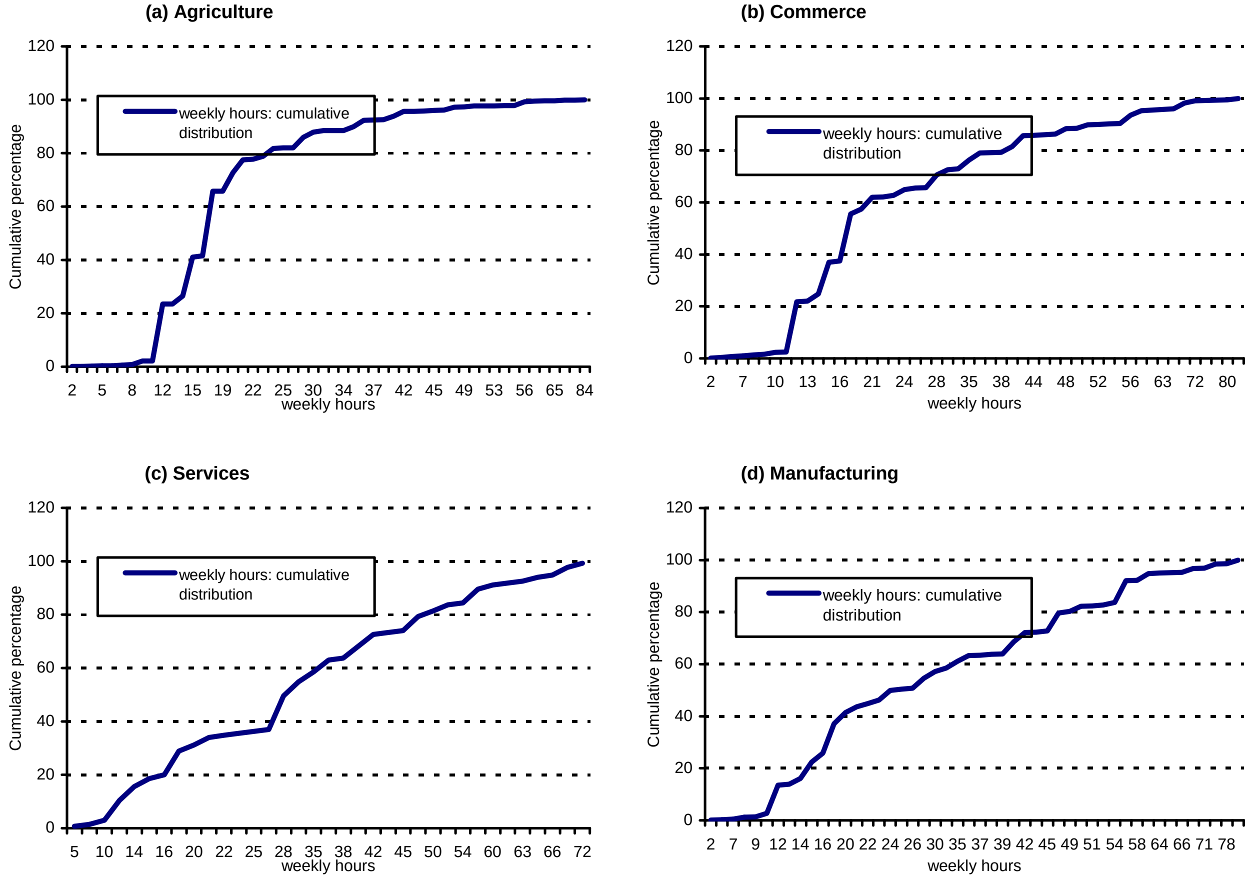


Figure 12. **Cumulative distribution of working children aged 12-14 years, by sector, Bangladesh**



5. WORK HOURS AND HEALTH: DESCRIPTIVE EVIDENCE

59. In this section, we present descriptive evidence relating to children's work and children's health. We first examine simple correlations between indicators of health (reported work-related injury and illness) and key work characteristics (work sector, work modality, workplace safety, and health insurance coverage). We then look in detail at working hours, and correlations between working hours, health outcomes, and school attendance.

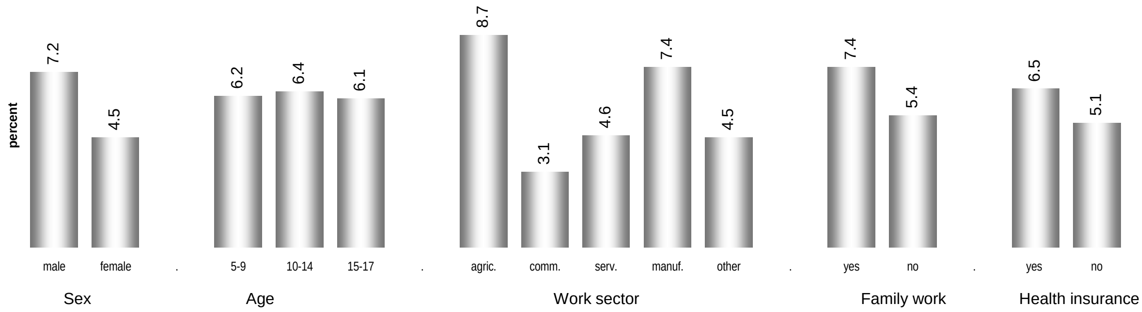
5.1 Work-related ill-health

60. The immediate health consequences of child work appear to differ significantly in Brazil, Cambodia and Bangladesh. Almost half of working children in Cambodia suffer work-related ill-health, compared to just six and eight percent, respectively, of their counterparts in Brazil and Bangladesh. While this in part reflects the different nature of child work in the three countries, it also undoubtedly reflects differences in the survey questions relating to health (see Annex A). In particular, the Bangladesh and Cambodia surveys asked respondents about both illness and injury, but the Brazil survey only about injury. Therefore, even assuming identical populations, the survey question used for Brazil only captures a subset of the ill health episodes captured by the other two surveys. Moreover, while it is easy to relate injuries to work, illnesses such as fever and cold are likely to have a wider range of causes. The Bangladesh survey contained fewer filter questions related to health compared to the other two.

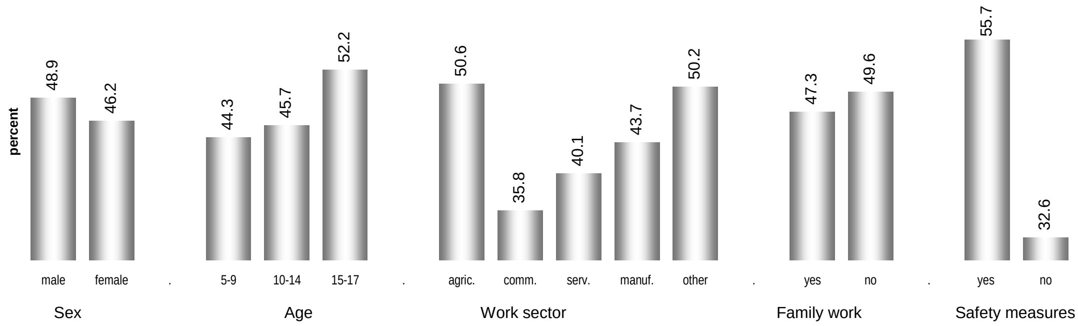
61. The following figures present the occurrence rate and incidence density for the three countries by child and sector characteristics. The results from the two sets of indicators show similar patterns, with the exception of the age profile. This is most likely due to the fact that the incidence density index takes in to account the variations in working hours (exposure) across age groups.

Figure 13.a Work-related ill health – occurrence rate, children aged 5-17 years, by child and work characteristics

(a) Brazil



(b) Cambodia



(c) Bangladesh

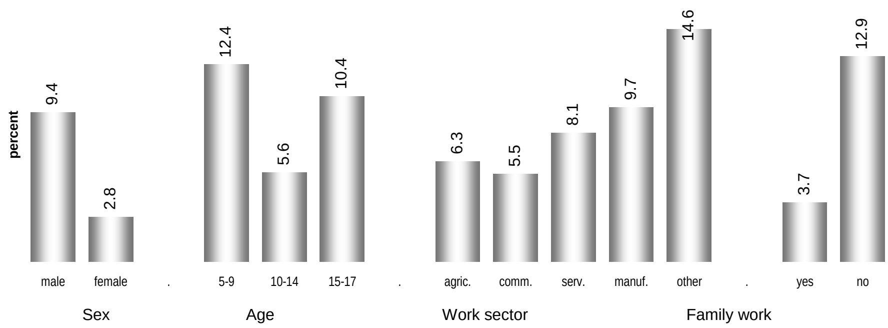
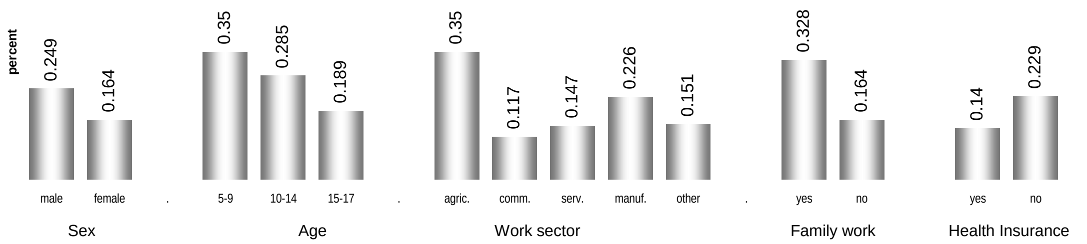
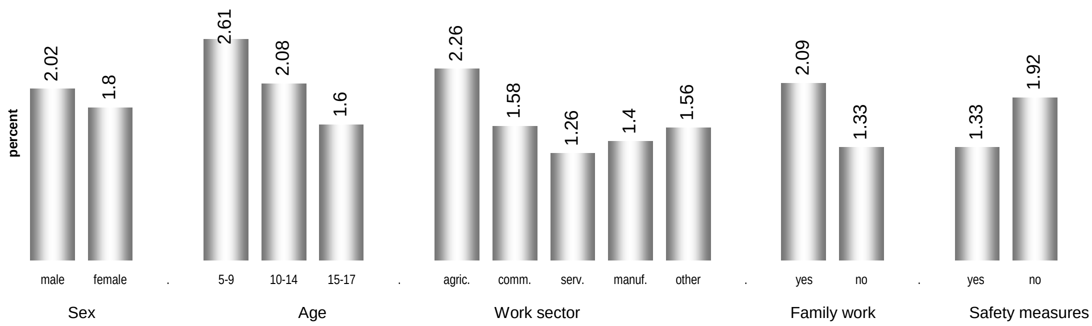


Figure 13.b **Work-related ill health: incidence density indicator, children aged 5-17 years, by child and work characteristics**

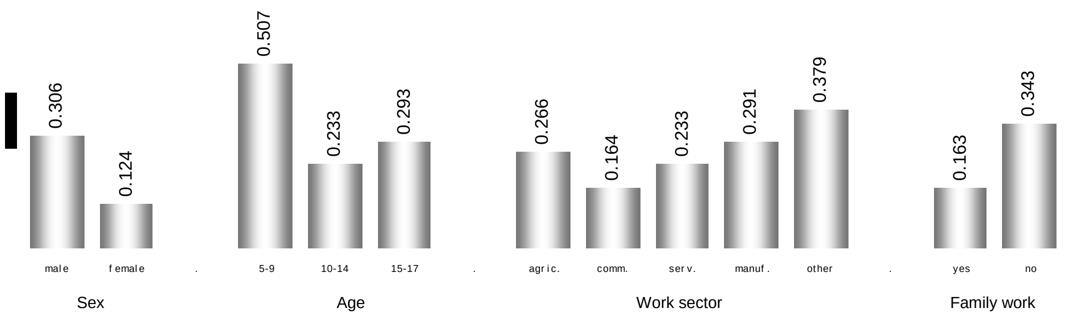
(a) Brazil



(b) Cambodia



(c) Bangladesh



Note: Indicator based on the individual exposure during the reference week.

62. In the analyzed countries, there is some variation in reported ill health by child characteristics (age and sex) and work characteristics (sector, modality, safety measures and health insurance), as shown in Figure 13 a and b and summarised below. Patterns differ somewhat across the countries, although this may be attributable in part to dissimilarities in the survey questionnaires.

- *Child age*: Work-related ill health decreases with age, with the exception of Bangladesh where only marginal differences exists among older children (10 17 years old)[17].
- *Sex:* Reported ill health is higher among working boys than working girls in the three countries, the differences are larger in the case of Bangladesh.

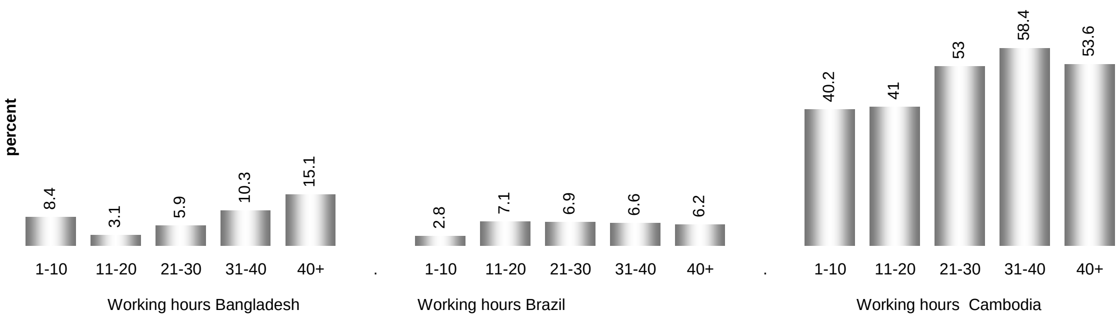
[17] The Bangladesh data show a u-shape pattern for occurrence and incidence rate, for which no clear explanation could be found.

- *Work sector:* Reported ill health varies significantly by sector. In Brazil and Cambodia, reported ill health is highest in the agriculture sector, where most child workers are concentrated, followed by the manufacturing, services and commerce sectors respectively. In Bangladesh, the percentage of children reporting ill health is higher in the manufacturing sector, followed by services, agriculture and commerce sectors[18].
- *Work modality:* In Brazil, reported ill health is slightly higher in family work compared to non-family work, while in Bangladesh reported ill health is much higher in non-family work compared to family work. In Cambodia, reported ill health associated with family and non-family work show almost the same occurrence rate, but non family work has an lower incidence density.
- *Workplace safety measures*: In Cambodia, the incidence density of work-related ill health is lower in workplaces where safety measures are in place. Workplace safety measures were not looked at in the Brazil or Bangladesh surveys.
- *Health insurance*: In Brazil, reported work-related ill health is higher in workplaces in which children have access to health insurance, though the difference is not large. Health insurance was not looked at in the Cambodia or Bangladesh surveys.

5.2 Work hours and ill health

63. Work-related ill health appears related to hours worked in the three countries. In Brazil, there is a large rise in reported ill-health when children move from the 1-10 to 11-20 range of weekly working hours. Work in excess of 20 hours, however, does not appear to further affect health. In Cambodia, the health risk associated with work rises significantly moving from the 11-20 to 21-30 hours range, but additional work time beyond 30 hours has little further affect on health. In Bangladesh, reported ill-health drops moving from the 1-10 to 11-20 hours range, but then rises for each subsequent hours range. However, we are not controlling for the characteristics of the individual, and therefore must await the results of the regression analysis to draw a more complete conclusion concerning weekly hours and reported ill-health.

Figure 13. **Work-related ill health, children aged 5-17 years, by hours worked**



[18] In the case of Bangladesh, the sector named “other” includes children working in transport and construction. sectors.

64. Disaggregating by the characteristics of the working child (age and sex) and the characteristics of child work (sector and modality) offers further insight into the links between working hours and ill health (Table 3).

- *Child age*: In Brazil, the hours threshold beyond which work significantly affects health is lower for younger working children. Ill-health rises dramatically moving from the 1-10 to 11-20 hours ranges for younger (5-14 year-old) working children, while for older (15-17 year-old) working children the increase occurs moving from the 11-20 to 21-30 hours range. In Cambodia, the health risk posed by work increase up to the 31-40 hours range for 5-14 year-old working children, but only up to the 21-30 hours range for 15-17 year-old working children. In Bangladesh the risk of ill-health follows a similar same path for younger and older working children, decreasing moving from 1-10 to 11-20 weekly working hours, but then rising considerably from 11-20 to 40+ hours ranges.

- *Sex:* The sex of the child appears to have little effect on the interaction between working hours and ill-health. For both boys and girls, reported ill-health increases moving from the 1-10 to 11-20 hours range in Brazil and from the 11-20 to 21-30 hours range in Cambodia, but does not show any clear pattern thereafter. For both boys and girls in Bangladesh, ill-health falls moving from the 1-10 to 11-20 hours ranges, but rises consistently thereafter.

- *Work sector:* The interaction between working hours and ill-health differs by sector, although patterns are inconsistent across countries. In the agricultural sector, where most child workers are concentrated, reported ill-health rises dramatically moving from the 1-10 to 11-20 hours range in Brazil, and moving from the 11-20 to 21-30 hours range in Cambodia, before levelling off. In Bangladesh, on the other hand, reported ill-health in agriculture falls moving from the 1-10 to 11-20 hours ranges and then rises until the 31-40 hours range. The link between working hours and ill health is less consistent in other sectors. The health risk posed by work in commerce rises only moving from the 1-10 to 11-20 hours range in Brazil, but rises moving across all hours ranges in Cambodia. Ill health associated with work in services more than doubles moving from the 1-10 to 11-20 hours ranges in Cambodia, while in Brazil the health risk associated with service work appears to have little relationship to working hours. Moving from the 1-10 to 11-20 hours ranges greatly increase the health risk association with manufacturing work in Brazil, but in Cambodia there is no clear link between ill health and hours worked in manufacturing.

- *Work modality:* The relationship between working hours and health also appears affected by whether or not work takes place within the family environment. In Brazil, reported ill health arising from family work rises significantly moving from the 1-10 to 11-20 hours thresholds but levels off thereafter, while reported ill health arising from non-family work increases consistently moving across all hours cohorts. In Cambodia, ill health from family work rises up to the 31-40 hours cohort, while there is no clear pattern between ill health and hours worked for non-family work. In Bangladesh, there is no clear pattern for either family or non-family work.

Table 3. **Reported work-related ill health, by average weekly working hours, child age and sex, work sector and modality**

		Bangladesh					Brazil					Cambodia				
		Average weekly working hours					Average weekly working hours					Average weekly working hours				
		1-10	11-20	21-30	31-40	40+	1-10	11-20	21-30	31-40	40+	1-10	11-20	21-30	31-40	40+
Sex	Male	10.6	4.2	7	11.6	15.5	3.1	7.3	8.5	7.5	7.7	42.0	43.4	51.9	63.7	54.4
	Female	4.6	1.2	3.2	3.4	10.6	2.3	6.7	3.7	4.8	4.2	38.1	38.7	54.2	52.3	52.8
Age in years	5-9	10.4	14.8	9.5	13.2	15.1	3.3	8.1	4.9	6.2	9.0	39.5	34.5	58.4	74.8	53.2
	10-14	7.6	2.3	5.5	8.7	15	3.2	8.6	7.4	5.6	4.8	41.9	41.5	49.3	56.4	48.2
	15-17	7.5	5.9	6.2	11.3	15.1	2.0	5.2	6.8	6.9	6.6	36.0	45.4	55.9	56.8	56.0
	5-14	8.7	2.7	5.7	8.9	15	3.2	8.5	7.2	5.6	5.1	40.8	39.5	51.4	59.9	49.0
	5-17	8.4	3.1	5.9	10.3	15.1	2.8	7.1	6.9	6.6	6.2	40.2	41.0	53.0	58.4	53.6
Work Sector	Agriculture	8.4	3.2	6.2	13.5	13.2	3.3	9.1	10.2	10.3	11.2	42.9	42.5	56.9	62.9	57.5
	Commerce	6.6	1.5	3.6	3.7	11.3	0.4	3.4	3.0	4.0	3.8	30.8	33.0	38.9	49.3	38.1
	Services	9.2	5.0	2.2	7.6	12.8	3.9	3.6	4.5	4.7	5.5	20.4	42.4	54.3	37.3	41.4
	Manufacturing	10.5	2.3	5.0	8.4	16.5	2.1	8.6	5.0	5.9	10.1	43.4	47.1	28.4	40.5	53.6
	Other	8.7	7.8	10.6	9.3	20.1	2.7	4.0	4.5	4.4	5.6	39.0	38.5	45.2	51.9	60.4
Work Modality	Family (unpaid)	8.0	1.4	4.8	10.2	8.1	2.5	8.3	8.0	9.1	11.9	39.2	41.1	53.2	60.9	52.1
	Non-family	9.8	11.6	7.4	10.3	16.6	3.5	4.2	5.5	5.6	6.3	47.5	39.4	50.1	46.8	56.1
Total		8.4	3.1	5.9	10.3	15.1	2.8	7.1	6.9	6.6	6.2	40.2	41.0	53.0	58.4	53.6

5.3 Work hours and school attendance

65. The interaction between work hours and school attendance is important for the purposes of this paper because of the indirect effects of education on health outcomes. As noted above, a lower level of educational attainment might impact negatively on health through two mechanisms. First, an individual entering adulthood with a lower level of education has less human capital and, *ceteris paribus*, can expect a lower stream of lifetime earnings. Second, educated individuals are likely to be better informed of the factors which impact on health, to be more productive in the use of their own time to generate health and to be more responsive to health education materials (see Fig. 14 and Table 4).

66. In both Brazil and Cambodia, there appears to be an hours threshold beyond which work is strongly associated with reduced school attendance. For the 7-14 years age group, work hours appear to have a relatively small impact on school attendance up to the 21-30 hours cohort, but attendance falls of dramatically when children must work greater than 30 hours. In Bangladesh the school attendance rate of working children goes dramatically down when children are involved in work for more than 21 hours per week.

Figure 14. **Work hours and school attendance, children aged 7-14 years, by hours worked**

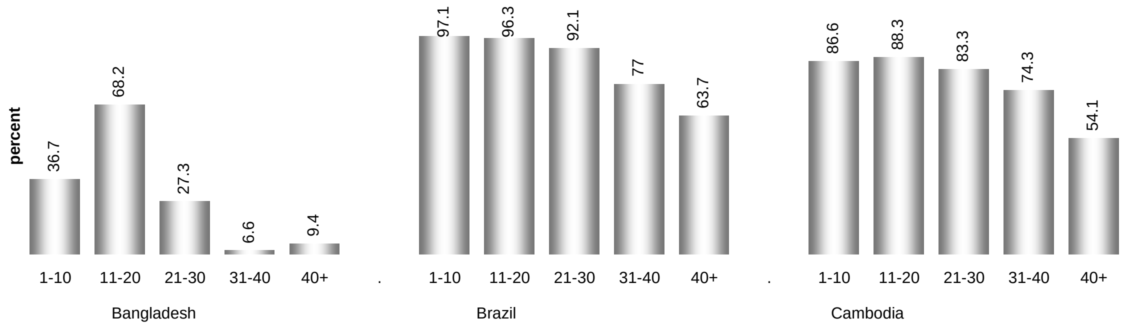


Table 4. **School attendance, by average weekly working hours, child age and sex**

		Bangladesh					Brazil					Cambodia				
		Average weekly working hours					Average weekly working hours					Average weekly working hours				
		1-10	11-20	21-30	31-40	40+	1-10	11-20	21-30	31-40	40+*	1-10	11-20	21-30	31-40	40+
7-14	Male	43.9	77.3	29.1	6.6	8.2	97.9	96.8	92.3	77.2	57.6	86.2	87.4	85.6	78.1	62.9
	Female	26.4	51.3	21.3	7.1	19.8	95.8	95.3	91.5	76.6	75.6	87.0	89.1	80.8	69.8	43.8
15-17	Male	50.7	33.3	14.8	4.8	6.4	83.7	87.1	82.0	68.7	58.9	85.4	76.2	69.6	48.8	24.3
	Female	55.2	6.5	7.7	1.2	7.1	80.1	81.6	80.6	70.9	63.6	71.0	59.5	41.0	29.9	13.8
5-17	Male	43.3	72.7	22.6	5.7	7.1	93.0	93.9	86.7	69.3	55.8	81.9	82.5	79.1	62.3	40.1
	Female	28.6	42.9	13.8	3.4	15.7	89.9	89.5	85.6	70.6	64.8	80.0	79.7	65.8	49.9	25.6

*Estimate should be read with caution, less than 10 observations

6. WORK HOURS AND HEALTH: CAUSAL LINKS

6.1 Estimation strategy

67. This section will move beyond a simple description of the child work–health relationship and attempt to unravel its causal nature. As noted above, this is not an easy task, as it requires dealing with two difficult issues – individuals' health endowments and the endogeneity of the child labour decision. Many of these complications arise when trying to compare the health of working with respect to non-working children. In this study, we take a simpler approach by concentrating only on the relative effects of working hours, sector of employment and condition of work on the health of working children. As discussed in the introduction, the focus of the study is on the effects of working hours and other conditions on the health of working children, and not on the comparison of the health status of working versus non working children. Obviously, even within the group of working children unobserved individual health endowment can play a role. It is reasonable to assume that such effects should be smaller in comparison for example to the classic case of the healthy worker effect.

68. We begin by looking at the effects of working hours on child health by considering the whole sample of working children. This will give us an estimate of the link between sector of activity, working hours and the health status of the child. The data sets we use have different characteristics and the definition of the variable might change from case to case. While the details will be discussed in full below, we give here an overview of the estimation strategy we follow for all the countries concerned.

69. The first step is to define the indicator that proxies the health status of the child. The literature on the subject shows that self reported health status (i.e. the answer to a question like: how do you judge your health status?) is to be considered as one of the best indicators. We do not utilize such an indicator because of data limitation. The data sets available report only information of the occurrence of illnesses/injuries. The use of such a measure, however, should not limit the validity of our analysis. On the contrary, it will help us to focus on the direct effect of hours of work on the health of the child, rather than on the overall effect. In order to clarify this point consider the following example. Assume a wage differential exists between sector of work (or for working extra hours) and that such a differential compensate, partially or fully, for the different hazards faced on the job. The child working in the more dangerous job is more likely to be ill or injured more frequently (this is the direct effect), but as she has an higher income with respect to the child employed in the less risky sector she might use some of this income to look after her bad health (this is the indirect effect). If we have information only on the occurrences of negative health shocks (injuries or illnesses) but not on the overall health status, we can only estimate the direct effect of hours of work on health.

70. Beside the variables measuring the occurrence of an injury/illness, we will use some measures that might proxy for the intensity of the event: number of episodes, severity of the

episode, etc. We assume that the probability of observing an injury depends on individual and household characteristics, on the numbers of hours worked and on the sector of work. Individual characteristics include*: age*, *sex*, the level of education of the child (*Edulev*) and the use of safety equipment. As we control for age and gender, the effect of education should reflect the acquired ability of the child to deal with hazardous situation and to better face the working environment. We also introduce in the estimates the household income. The main reason for introducing household *income* is to control for possible reporting bias. It is a well know fact that reporting of illnesses is not invariant to household income, but that individual belonging to household with higher income are more likely to report bad health or episodes of illness.

71. As our estimates refer only to the sub sample of children working in economic activity, this could generate a selection bias in the estimates. We hence use the Heckman maximum likelihood estimator to control for the selection bias[19]. Beside the functional form, the selection equation is identified by a set of variables relating to the household structure (number of children below 5, number of school age children, number of adults), sector of employment of the parents, and, where available, by the children's wage rate. These variables have a well established effect on the decision of sending a child to work, but there is no reason to believe they have any influence on the probability of a working children falling sick or suffering from injury. Appendix Tables B1-B3 present the descriptive statistics of the variable included in the Heckman model regression estimates, including the variables used to identify the selection equation for the three countries.

6.2 Estimation results

Child and household-related determinants of work and ill health

72. The results from the regression analysis and the marginal effects of the variable estimated at the sample mean are presented in Tables 5 and 6. The selection equations for the three countries, defining the probability that a child works, show estimates that are expected on the basis of the theory. Observe, however, that the coefficient rho is significant only in one of the three countries, indicating that the selection bias does not appear to be relevant. We have re estimated the model also as a simple probit and the coefficient estimates are almost identical. This confirm the previous observation, but also indicates that the results are stable with respect to the possible effects of a mis-specification of the selection equation. The probability of being engaged in an economic activity increases with the age of the child. Children from female-headed households

---

[19] The selection should be on hours worked, as we could imagine that children working different hours might share different characteristics. The selection equation should then be based on a tobit model. However, the selection variable would be either 0 for non-workers and positive for the other observations. One simple way to estimate the model is to reformulate the tobit model as a probit model, selecting on a variable defined as 1 for working children and 0 for non-working children. This is the approach followed in the paper. Theoretically this approach may sacrifice some efficiency by discarding information on the dependent variable. However, this is not necessary true in a finite sample (Green, W.H. 1998).

are more likely to work than their counterparts from male-headed households. The household structure has the expected effects; more adults make it less likely that a child works, while additional young children make it more likely. Children in rural areas are more likely to work than children in rural areas. The educational level of the household head and household income negatively affect the probability that a child works. Boys in Brazil and Bangladesh are more likely than girls to be involved in economic activity, but in Cambodia the opposite holds true.

Table 5. **Estimates of Heckman probit model for injury illness, with probit sample selection for working/ non-working**

	Number of obs = 27567 Censored obs =13927 Uncensored obs= 13640		Number of obs =95664 Censored obs =84116 Uncensored obs= 11548		Number of obs = 60551 Censored obs = 50229 Uncensored obs= 10332	
	Cambodia		**Brazil**		**Bangladesh**	
Dep. var. injury (and ill-health)[1]	**Coef.**	**z**	**Coef.**	**z**	**Coef.**	**z**
female	-0.055	-2.64	-0.152	-3.45	-0.503	-6.33
age	-0.196	-3.67	0.019	0.29	-0.464	-4.54
age2	0.007	4.07	-0.001	-0.31	0.017	5.00
edulev	-0.080	-3.49	-0.070	-2.32	-0.066	-2.92
weekly_hours	0.007	8.59	0.008	5.97	0.014	11.53
protection	0.166	1.75	---	--	--	--
lnexp2	0.056	2.38	-0.008	-1.55	-0.181	-4.07
agricult	0.089	1.63	0.274	3.42	-0.201	-3.46
commerce	-0.323	-5.52	-0.138	-1.71	-0.455	-6.36
services	-0.324	-4.40	0.035	0.48	-0.177	-1.80
manufact	-0.188	-2.94	0.231	2.81	-0.064	-1.00
rural	-0.067	-2.87	0.081	1.47	0.020	0.43
_cons	1.026	3.04	-1.815	-4.14	2.975	4.04
Employ: Selection equation						
age	0.439	25.78	0.365	21.02	0.9184	40.69
age2	-0.011	-14.58	-0.011	-14.93	-0.0283	-31.35
female	0.033	2.01	-0.452	-30.51	-0.6681	-43.88
nchild04	0.086	6.24	-0.414	-0.85	-0.0202	-1.72
nadult	-0.016	-1.73	-4.890	-16.84	-0.0439	-5.06
hhsize	-0.021	-3.44	0.060	18.54	0.0488	8.91
lnexp2	-0.216	-20.41	0.003	1.20	-0.3144	-19.38
heduc	-0.083	-7.08	-0.150	-24.59	-0.2599	-36.15
hhead_se	-0.116	-4.88	--	--	0.2079	6.77
lnwage	--	--	1.115	37.47	--	--
_cons	-0.711	-4.85	-4.006	-37.89	-4.7264	-26.67
/athrho	-0.549	-3.08	-0.020	0.033	-0.0600	-0.55
rho	-0.499		-0.020		-0.0600	

Note: (1) Dependant variable is work-related illness or injury for Cambodia and Bangladesh, but only work-related injury for Brazil.

Table 6. **Marginal effects (on the probability of work-related injury-illness) after Heckman probit estimates**

Variable	Cambodia		Brazil		Bangladesh	
	dy/dx	z	dy/dx	z	Dy/dx	z
female*	-0.019	-2.17	-0.0174	-3.74	-0.0719	-9.46
age	-0.022	-1.87	0.0026	0.38	-0.0564	-5.25
age2	0.001	2.80	-0.0001	-0.38	0.0022	5.32
edulev	-0.035	-3.55	-0.0076	-2.26	-0.0089	-3.04
weekly~s	0.003	9.06	0.0009	4.98	0.0019	8.59
protec~n*	0.072	1.76	--	--	--	--
lnexp2	-0.007	-1.09	-0.0009	-1.53	-0.0267	-4.98
agricult	0.039	1.64	0.0300	3.39	-0.0273	-3.37
commerce	-0.140	-5.74	-0.0151	-1.68	-0.0616	-5.85
services	-0.140	-4.49	0.0039	0.48	-0.0240	-1.77
manufact	-0.082	-2.97	0.0254	2.79	-0.0087	-0.99
rural*	-0.029	-2.90	0.0092	1.46	0.0027	0.43
nchild04	0.012	2.66	-0.0007	-0.55	-0.0001	-0.52
nadult	-0.002	-1.61	0.1644	0.55	-0.0003	-0.54
hhsize	-0.003	-2.45	0.0001	-0.46	0.0003	0.54
heduc	-0.012	-2.79	-0.0002	0.51	-0.0018	-0.55
hhead_se	-0.017	-2.67			0.0015	0.55
lnwage	--	--	0.0018	0.55	--	--

(*) dy/dx is for discrete change of dummy variable from 0 to 1

73. The probability of suffering from an injury decreases with the age of the child in Bangladesh and Cambodia, indicating that younger children are more likely to suffer from carrying out work activities. The effect of age on injury risk is insignificant in Brazil. Girls are less likely to fall ill or to suffer injuries in all three countries. Girls are about two percentage points less likely than boys to suffer ill-health in Cambodia and Brazil, and seven percentage points less likely in Bangladesh. Note that this is a pure gender effect, as we control for the sector of employment and for the rural/urban location. The level of education reached by the child has a negative effect on the probability of falling ill in the three countries, indicating that a higher level of education allows the child to better control the environment in which she has to operate. The effect is strongest in Cambodia, where, for example, a child with completed primary education has a probability of falling ill four percentage points lower than that of a child without complete primary education. Children in rural areas are less likely to be injured or to fall ill than urban in the three countries, suggesting differences in the hazardousness of work performed in rural and urban areas.

74. It is interesting to observe that the use of protective equipment in Cambodia, the only country where this variable was looked at, increases the probability of being injured by almost seven percentage points. This is only apparently surprising. In fact protective equipment is likely to be used in hazardous jobs. A positive sign for this variable indicates that the use of protective equipment is not sufficient to fully compensate for the additional risks relative to the work. As we have not counterfactual information, this result does not tells us much about the efficacy of the protective equipment.

75. It should be kept in mind in interpreting these results that there are differences in the dependant variable in the three countries, as noted earlier. For Brazil, the dependant variable is

work-related injury, while for Cambodia and Bangladesh it is work-related injury *and* work-related illness. Moreover, while the survey questions ask whether the child has suffered the injury or fallen ill *because of the work,* the causal attribution to work, especially in the case of illness, should be treated with care for obvious reasons.

76. Once these characteristics of the child and his or her household have been accounted for, we can concentrate on the relationship between hours of work, sector of employment and health.

Causal links between hours of work and ill-health

77. The estimation results indicate that the number of hours worked exerts a significant effect on the probability of a negative health outcome in the three countries. Each hour of work performed during a week adds about an additional 0.3 percentage point to the probability of falling ill in Cambodia, 0.2 percentage points in Bangladesh and 0.1 percentage points in Brazil. This implies that in Cambodia, for example, a child working eight hours a day for six days a week has a probability of a bad health episode eight percentage points higher than a child working four hours a day. Similarly, in Bangladesh and Brazil, a child working eight hours a day for six days a week faces a five percentage point and three percentage point higher risk, respectively, of injury than a child working six days a week for four hours per day. These results offer a solid empirical rationale for identifying a cut off point in terms of working hours for identifying hazardous form of child labour.

Table 7. **Marginal effects (on the probability of work-related ill health) after Heckman probit estimates, by sector**

Country	Dep. var. injury (and ill-health)**	Agriculture		Commerce		Services		Manufacturing	
		dy/dx	z	dy/dx	z	dy/dx	Z	dy/dx	z
Cambodia	edulev	-0.017	-1.3	-0.032	-1.87	-0.167	-4.26	-0.022	-0.68
	female*	-0.014	-1.23	-0.024	-1.52	-0.013	-0.32	0.010	0.31
	age	-0.029	-2.05	0.026	1.25	0.059	1.01	-0.016	-0.35
	age2	0.002	2.69	-0.001	-0.93	-0.002	-0.72	0.001	0.52
	hours_weekly	0.003	6.92	0.003	4.48	0.000	-0.12	0.003	3.67
	protection*	0.223	3.23	-0.013	-0.12	0.174	1.13	0.042	0.68
	lnexp2	-0.015	-1.81	0.013	1.24	0.035	1.35	0.027	1.5
	rural*	-0.049	-4.14	0.035	1.56	0.001	0.02	0.040	1.05
Brazil	female*	-0.0239	-2.65	-0.0101	-1.25	-0.0184	-1.99	0.024	1.36
	Age	0.0064	0.53	0.0179	1.07	0.0127	0.49	0.024	0.52
	Age2	-0.0003	-0.65	-0.0007	-1.12	-0.0003	-0.36	-0.001	-0.35
	edulev	-0.0185	-2.13	-0.0086	-1.53	0.0077	1.38	-0.011	-1.00
	hours_weekly	0.0017	5.29	0.0009	3.75	0.0004	1.52	0.001	1.88
	lnincome2	-0.0019	-1.79	-0.0016	-1.08	-0.0022	-1.18	0.004	1.92
	rural*	0.0109	1.12	-0.0104	-0.68	0.0047	0.31	0.015	0.63
Bangladesh	female*	-0.053	-10.06	-0.039	-4.11	0.011	0.42	-0.060	-4.46
	Age	-0.049	-6.59	-0.010	-0.52	-0.026	-0.69	-0.015	-0.58
	Age2	0.002	6.32	0.001	0.76	0.001	0.67	0.001	0.63
	edulev	-0.012	-3.83	-0.008	-1.48	-0.006	-0.43	0.005	0.73
	hours_weekly	0.001	5.63	0.001	4.12	0.003	3.89	0.003	7.77
	Ln expenditure	-0.023	-3.97	-0.009	-1.07	-0.011	-0.57	-0.039	-3.1
	rural*	0.003	0.34	0.016	1.73	-0.008	-0.35	-0.023	-1.72

Notes: (*) dy/dx is for discrete change of dummy variable from 0 to 1; (**) Dependant variable is work-related illness or injury for Cambodia and Bangladesh, but only work-related injury for Brazil.

78. We have also estimated the effect of working hours on risk of ill-health separately for each sector (Table 7). The effect of hours on the probability of ill-health varies slightly across sectors

in Bangladesh and Brazil, but is similar across sectors in Cambodia. In Bangladesh, the effect of working hours is largest in the manufacturing and services sectors, while in Brazil it is largest in the agriculture sector. Eight hours of additional work per week in Bangladesh will increase the probability of injury by 2.4 percentage points in manufacturing and services, but by only 0.8 percentage points in agriculture. In Brazil, eight hours of additional work per week will increase the probability of injury by 1.4 percentage points in agriculture and by 0.7 percentage points in commerce, while the effect of additional hours is insignificant in the manufacturing and services sectors.

79. In the case of Cambodia, it was possible to use as regressor not only the hours worked last week, but also the hours worked during the past year (Note: remember these were computed under the assumption the a child would work the same hours as in the reference week during all the weeks he declared to work last year). Such an exposure period is more consistent with the reference periods considered for reporting injury/illnesses. The results of the estimates are very similar to those presented above and, once appropriated scaled, the marginal effects do not differ significantly from those already presented. This result is important because it seems to indicate that assuming weekly hours as a measure of exposure does not change the results in any substantial way (Note: remember that in the case of Bangladesh and Brazil weekly hours are the only measure of exposure available).

Causal links between sector of employment and ill health

80. The effects of the sector of work on the probability of ill health are also significant and quite large in the three countries. The effects are again strongest in Cambodia. Cambodian children working in agriculture, for example, are 12 percentage points more likely to suffer injuries than those working in the manufacturing sector, while those in manufacturing are six percent more likely to get an injury than those working in commerce or services. The difference between commerce (or service) and agriculture is the largest, reaching 18 percentage points. In Brazil, to be involved in manufacturing or agriculture or services increases the probability of injury. Children working in these sectors are 4.5 percentage points more likely to suffer from injuries than children working in commerce, and about three percentage points more likely to be injured children working in the service sector. In Bangladesh, children working in agriculture are 3.4 percentage points more likely to suffer ill-health than children working in commerce, while children working in services are 3.7 percentage points more likely to suffer from ill health than children involved in commerce. The reference sector includes the industries classified as “others”.[20]

[20] These consist of Mining, Construction, Hotel, Transport in Cambodia, Transport and Administrative work in Brazil, Mining, Electricity and Hotel in Bangladesh.

Relative importance of sector and working hours on the probability of ill-health

81. How large is the sectoral effect with respect to the effect of the working hours? This is a very important point as it should shed some light on whether it is more appropriate to target activity by sector or by a combination of both sectors and working hours in order to identify light work. The following graphs and tables address this question. We have computed the iso-risk combinations between hours of work and sector of employment. In other words, the combinations of hours and sector of employment that give the same overall risk of suffering from illness or injury.

82. In order to make the analytical calculation possible, these estimates have been based on the following logistic regressions (Table 8). As can be seen from the results, no substantial differences emerge with respect to the Heckman estimates discussed above. We can hence be confident that the iso-risk curves we have computed are not substantially biased by the fact that we have not taken into consideration the possible selection bias.

Table 8. **Logit estimates**

Dep. Var. Injury	Cambodia		Brazil		Bangladesh	
	Coef.	z	Coef.	z	Coef.	z
female	-0.081	-2.28	-0.325	-3.52	-1.126	-8.79
age	-0.042	-0.93	0.049	0.37	-0.768	-7.02
age2	0.003	1.78	-0.002	-0.36	0.030	6.89
edulev	-0.145	-3.74	-0.141	-2.23	-0.146	-3.34
protection	0.288	1.77				
weekly_hours	0.012	9.19	0.018	6.51	0.027	11.58
lnexp2	-0.016	-0.66	-0.018	-1.50	-0.370	-4.84
agriculture	0.163	1.74	0.571	3.56	-0.360	-3.25
commerce	-0.570	-5.92	-0.289	-1.63	-0.901	-6.34
services	-0.565	-4.54	0.088	0.55	-0.330	-1.74
manufacturing	-0.327	-3.00	0.493	2.87	-0.099	-0.82
rural	-0.117	-2.93	0.154	1.39	0.010	0.11
_cons	0.139	0.36	-3.441	-3.95	5.160	5.62

Table 9. **Marginal effects (on the probability of ill health) after logit estimates**

variable	Cambodia		Brazil		Bangladesh	
	Dy/dx	z	dy/dx	z	dy/dx	z
female*	-0.020	-2.28	-0.0169	-3.68	-0.050	-11.35
age	-0.010	-0.93	0.0026	0.37	-0.042	-7.09
age2	0.001	1.78	-0.0001	-0.36	0.002	6.96
edulev	-0.036	-3.74	-0.0076	-2.24	-0.008	-3.36
lnexp2	-0.004	-0.66	-0.0010	-1.5	-0.020	-4.88
protection*	0.072	1.77				
weekly_hours	0.003	9.19	0.0010	6.64	0.001	11.59
agricult*	0.040	1.75	0.0327	3.36	-0.020	-3.21
commerce*	-0.138	-6.11	-0.0144	-1.78	-0.038	-8.17
services*	-0.134	-4.87	0.0049	0.54	-0.016	-1.99
manufact*	-0.079	-3.09	0.0320	2.43	-0.005	-0.84
rural*	-0.029	-2.94	0.0085	1.36	0.001	0.11

83. The iso-risk curve presented in Figures 16-18 show large differences in the health risks that are associated with each sector of activity. In order to face the same risk across sectors, children would need to log substantially different amounts of working hours. In Cambodia, for example, as shown in Table 11, a child working in manufacturing would need to work about five and a half more hours a day, and a child in commerce about eight more hours per day, than a child

working in agriculture to face the same health risks. Note that in Cambodia the difference in hours needed to compensate for the sector specific risk, does not change in any relevant way according to the risk level. In Brazil, to reach a 10 percent injury risk level, children working in agriculture would need work 45.9 weekly hours, children in manufacturing 52.7 hours, children in commerce 62.9 hours and children in services 75.8 hours. Similarly in Bangladesh, children working in manufacturing would need work 37 weekly hours, children in services 45.5 weekly hours, children in agriculture about 49 hours and children in commerce 70 hours to reach this 10 percent injury risk level.

Figure 15. **Iso risk curves: Probability of injury/illness by industry: Cambodia**

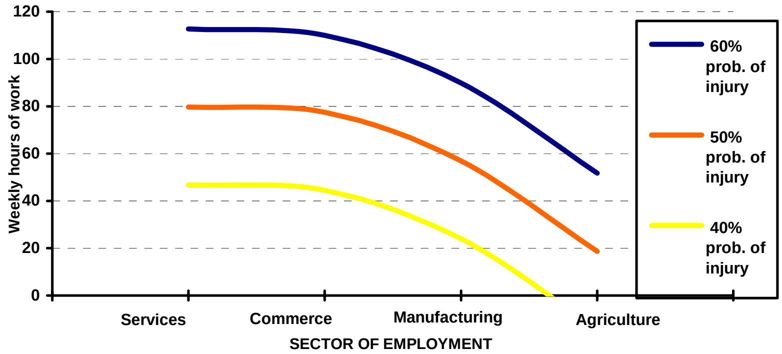


Figure 16. **Iso risk curves: Probability of injury/illness by industry: Brazil**

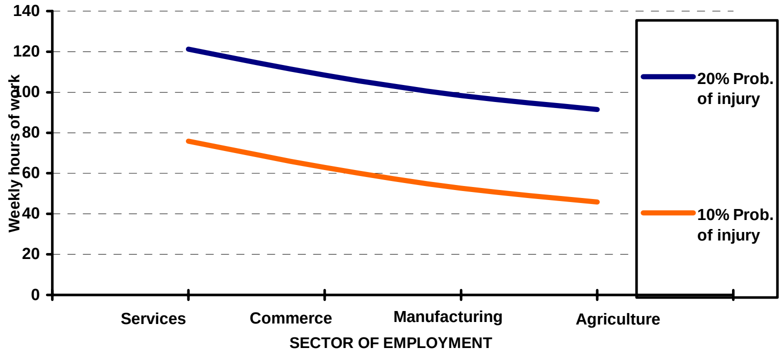


Figure 17. **Iso risk curves: Probability of injury/illness by industry: Bangladesh**

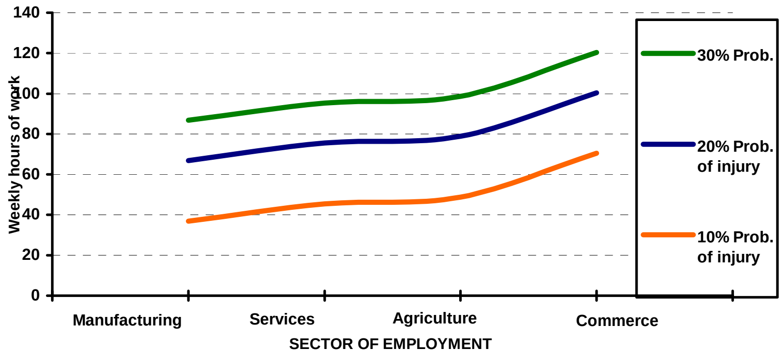


Table 10. **Weekly hours of work necessary for constant probability of injury, by sector**

Sector	Cambodia			Brazil			Bangladesh		
	60%	50%	40%	20%	10%	1%	30%	20%	10%
Agriculture	51.7	18.7	-14	91.5	45.9		98.7	78.8	48.8
Manufacturing	89.9	56.9	23.9	98.3	52.7		86.8	66.9	36.9
Commerce	110	77.4	44.5	108.4	62.9		120.4	100.4	70.4
Service	112.7	79.7	46.7	121.3	75.8		95.4	75.5	45.5

Table 11. **Increase in weekly hours of work necessary to keep the same probability of injury with respect to the agricultural sector**

Sector	Cambodia			Brazil			Bangladesh		
	60%	50%	40%	20%	10%	1%	30%	20%	10%
Manufacturing	38.2	38.2	37.9	6.8	6.8		33.6	33.6	33.6
Commerce	58.3	58.7	58.5	16.9	17		11.9	11.9	11.9
Service	61	61	60.7	29.8	29.9		8.6	8.6	8.6

84. These equivalence estimates must be interpreted with care given the nature of the data and the precision of the estimates. They indicate, however, very clearly that the sectoral dimension of children' work has an important role to play in determining health risk. It is difficult to say whether the sector or the hour effect is predominant, but these results clearly show that also the sector of employment has an important role to play in identifying any boundary for permissible child work.

Seriousness of injury

85. The results just discussed refer to the probability that an injury or illness occurs. Obviously this leaves open the question relative to the seriousness of the event. Unfortunately, it is very difficult to find reliable indications of the seriousness of the health risk and to combine information about the probability of falling sick with the seriousness of the injury.

86. In Cambodia, as a proxy for the "intensity" of the injury we have used the information available on the treatment that followed the episode of injury/illness. In particular, we have identified four possible events that might follow the occurrence of an injury/illness: a) Did not need any medical treatment b) Medically treated and released immediately; c) Stopped work temporarily; and d) Other (Includes: Hospitalised, Prevented work permanently, Other). As can be seen from the bottom part of Table 12, about 70 percent of the accidents are not treated, about 30 percent are treated without hospitalization, and only six percent cause the child to stop working, a very small number suffer from permanent losses.

Table 12. **Ordered Probit regression: Cambodia**

Seriousness of accident	**Coef.**	**z**
Female	-0.082	-2.59
Age	0.026	0.62
Age2	0.000	0.02
Edulev	-0.053	-1.56
Weekly_hours	0.002	1.61
protection	0.186	1.53
lnexp2	0.057	2.62
Agricult	-0.361	-4.84
commerce	-0.070	-0.88
services	-0.218	-2.00
manufact	0.032	0.36
Rural	0.322	9.29
(Ancillary parameters)	Coef	s.d.
_cut1	1.16	0.350
_cut2	2.29	0.351
_cut3	3.28	0.354
Seriousness of Accident	Probability	Observed
Did not need any medical treatment	Pr(xb+u<_cut1)	0.6529
Medically treated and released immediately	Pr(_cut1<xb+u<_cut2)	0.2793
Stopped work temporarily	Pr(_cut2<xb+u<_cut3)	0.0609
Other	Pr(_cut3<xb+u)	0.0069

Table 13. **Marginal effects after ordered probit regression: Cambodia**

	Did not need any medical treatment		**Medically treated and released immediately**		**Stopped work temporarily**		**Other**	
variable	dy/dx	z	dy/dx	z	dy/dx	z	dy/dx	z
edulev	0.01948	1.56	-0.01295	-1.56	-0.00566	-1.56	-0.00087	-1.53
female*	0.03019	2.60	-0.02008	-2.59	-0.00877	-2.59	-0.00135	-2.46
age	-0.00959	-0.62	0.00638	0.62	0.00279	0.62	0.00043	0.62
age2	-0.00001	-0.02	0.00001	0.02	0.00000	0.02	0.00000	0.02
weekly~s	-0.00066	-1.61	0.00044	1.61	0.00019	1.60	0.00003	1.58
protec~n*	-0.07039	-1.49	0.04419	1.59	0.02236	1.37	0.00384	1.23
lnexp2	-0.02085	-2.62	0.01386	2.62	0.00606	2.61	0.00093	2.48
agricult*	0.13458	4.76	-0.08629	-5.01	-0.04139	-4.46	-0.00691	-3.63
Commerc	0.02537	0.89	-0.01705	-0.88	-0.00723	-0.91	-0.00109	-0.92
services*	0.07647	2.10	-0.05349	-2.01	-0.02019	-2.33	-0.00279	-2.47
manufact*	-0.01171	-0.35	0.00772	0.36	0.00345	0.35	0.00054	0.34
rural*	-0.11978	-9.22	0.07727	9.27	0.03651	8.38	0.00601	5.60

87. Obviously this is far from being a perfect proxy for the severity of the ill health episode. The kind of treatment received is the result of a household decision: identical health accidents can be to a certain extent treated in different ways depending on the income, the education, the preferences etc. of the household and on the characteristics of the individual. In order to take these factors into account, we have introduced in the estimates a set of household and individual controls.

88. Given the nature of the dependent variables, with a set of alternative states ranked in increased order of intensity, we have estimated the model using an ordered probit. The results of the estimates are shown in Table 12 and the marginal effects in Table 13.

89. Let us first briefly discuss the results concerning the controls and then look at the working hours and sector of employment effects. Girls and more educated children are less likely to experience serious accident. While the latter effects do not need further comment, the former

might also reflect a gender bias. Girls might also receive less medical attention, not because their injuries are less serious, but because of a gender bias within the household. Income seems to have a positive impact on the seriousness of the health episode. This could be explained by the well known effect that income has on reporting health and by the tact that richer household might try to get more proper treatment following an injury/illness.

90. Hours of work are positively and significantly associated with the seriousness of the health episode. However, the effects are very small: an increase on 10 hours per week of the hours worked decreases the probability of needing any treatment following an injury by about one-half of one percentage point.

91. Among the sectoral dummies only those for agriculture and services are significant: both have a positive sign. This indicates that children working in these two sectors have a lower probability of getting serious illnesses/injuries with respect to the other sector. This fact appears to qualify at least partially the previous results, that showed agriculture as the sector where accidents were most likely. If we were to take our estimates at face values, we should qualify such a conclusion. In agriculture children are more likely to suffer from illnesses/injuries, but such events are less serious than those in other sectors. These obviously would add additional complication to the already difficult task to identify criteria to define light work. However, is our opinion that the conclusion from these last estimates should be taken with care. The variable used is only an indirect proxy for the seriousness of the injury. As already mentioned, reporting and treatment can be influenced by individual and household characteristics, as well as by the sector of work.

Table 14. **Ordered Probit regression: Brazil**

Duration of injury	**Coef.**	**z**
Female	-0.278	-1.66
Age	-0.026	-0.13
Age2	0.003	0.39
Edulev	0.110	1.00
hours_weekly	-0.003	-0.57
lnincome2	-0.007	-0.40
Agriculture	0.206	0.79
Commerce	-0.277	-0.86
Services	-0.280	-0.95
Manufact	-0.170	-0.57
Rural	0.157	0.86
(Ancillary parameters)	Coef.	S.D.
_cut1	0.708	1.264
_cut2	1.124	1.265
Days of injury in category	Probability	Observed
0-7	Pr(xb+u<_cut1) xb+u<_cut1)	0.6235
8-15	Pr(_cut1<xb+u<_cut2))	0.1394
15 +	Pr(_cut2<xb+u) 0.237	0.2372

92. A similar exercise was attempted for Brazil, using the available information on the duration of the injury. In particular, we considered the number of days missed due to injury to estimate an ordered probit model. The coefficients show the expected signs but are not statistically significant (Table 14). This may be due to the limited number of observations.

6.3 Kernel regression estimates

93. The previous analysis has shown how the length of the working day does significantly affect the health of the child, but also how the sector of employment is very important for determining the risk level of the activity carried out by the child. In order to identify the causal link, we have conditioned the estimates on a set of individual and household characteristics. While following this approach we have been able to identify a set of causal links between hours of work, sector of employment and health, the analysis is conditional on the household and individual characteristics considered.

94. In this section we make use of Kernel regressions to offer a more direct and synthetic view of the relationship between hours of work, sector of employment and health. Instruments like Kernel regression are easier to use, but it is important to establish whether they produce results that are more or less consistent with the more complex causal estimates. To clarify this issue, consider the following example. We might observe, through a Kernel regression or similar instrument, that on average the health risk increases with hours worked, over some range, at an increasing rate. We know from our regression analysis that the age of the child, the gender and other characteristics influence the probability of being injured. The observed increase in the probability of being injured might hence reflect the fact that a certain number of working hours is associated with a particular age or gender composition etc.

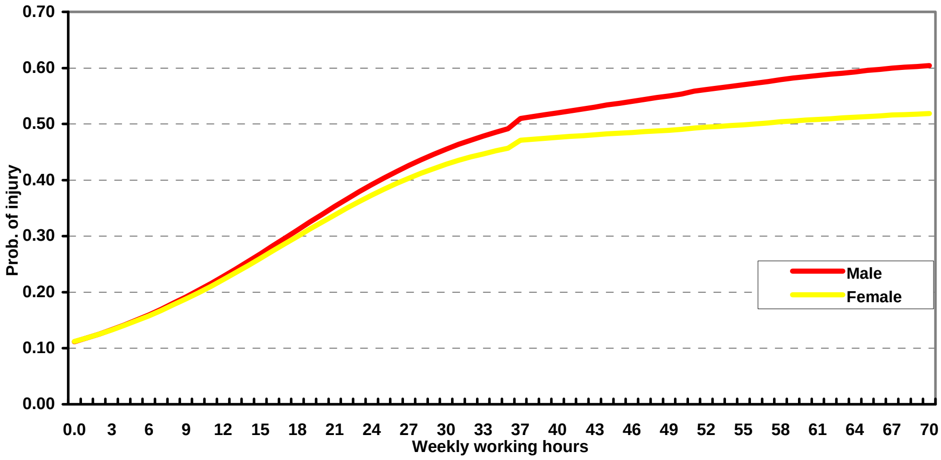
95. For monitoring and policy design purposes, we need a synthetic indicator of such a relationship. It might be difficult, time consuming and not intuitive to analyze the effects of hours worked on health by taking into consideration the different clustering of individual and household characteristics. Also, data might not be available for certain unobserved characteristics like task performed, sub sectoral distribution of work, etc. If such unobserved characteristics are clustered with hours worked, e.g., children working in small car repair shops typically work a certain number of hours, Kernel regression (or similar methods) might offer a bridge to overcome the lack of information. It should be remembered, however, that Kernel regression are basically reduced form estimates. The relationship estimated is subject to change if the underlying structure changes (for example, if the gender distribution of employment changes). They must hence be considered with care.

96. The use of a synthetic indicator of the relationship between Injury/illnesses and hours of work is also necessary because the causal link between hours and health indicators is derived by controlling for individual and household characteristics. If we were to proceed using the multivariate regression approach to determine thresholds, we would need to take into consideration also individual and household characteristics in fixing the threshold. This would be clearly not feasible and hence strengthens the case for the use of a synthetic indicator. Again, however, there is a need first to check that the results from the synthetic indicators are consistent with those obtained with the multivariate approach.

97. Finally, observe that, not surprisingly, results very similar to those described below can be obtained using a probit model with a polynomial on hours. However, mainly for presentation purposes we discuss here the results obtained through the Kernel regressions.

98. Figure 19 offers an overview of the link between working hours and health outcomes across all sectors in Cambodia. The graph clearly shows that the largest increase in probability of having an injury occurs up to 36 hours of work per week, with the highest rate of increase occurring in the range 0 to 24 hours weekly. There is not a large difference between males and females.

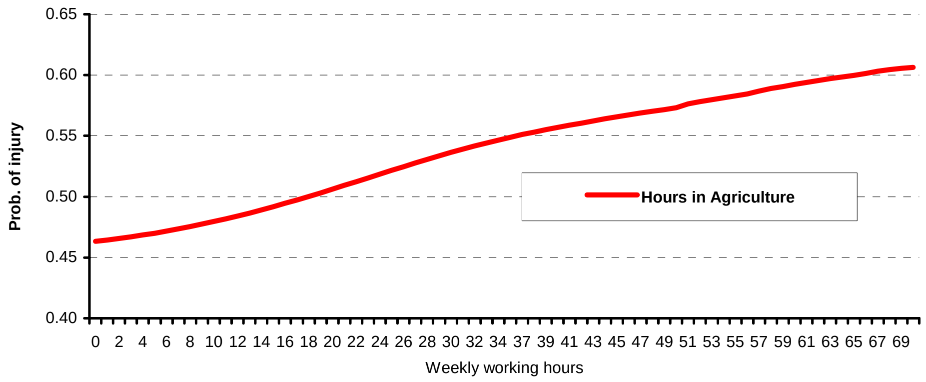
Figure 18. **Kernel regression, ill health versus working hours, Cambodia**



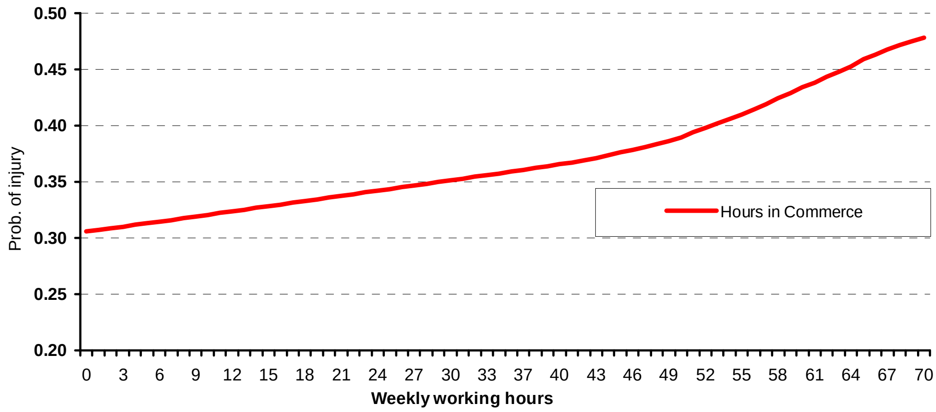
99. This aggregate result is, however, the combination of very different sectoral characteristics. The following graphs illustrate the point in more detail. In agriculture and services, the probability of health risks raises steadily with the hours worked, even if the largest increase occurs in agriculture over the first 20 hours of work. Commerce has similar characteristics, but shows also a sharp increase when working hours exceed about 46 hours per week. In manufacturing, again we have on the contrary the impact of working hours on health is very small up to 36 hours per week and then raises sharply from 36 to 56 hours per week. Also note that, as illustrated above, the difference in health risks is large across sectors. These results illustrate the difficulty of identifying criteria for threshold in terms of working hours only. A composite approach that looks both at sector and at working hours appears necessary.

Figure 19. **Kernel regression, ill health versus working hours, by sector, Cambodia**

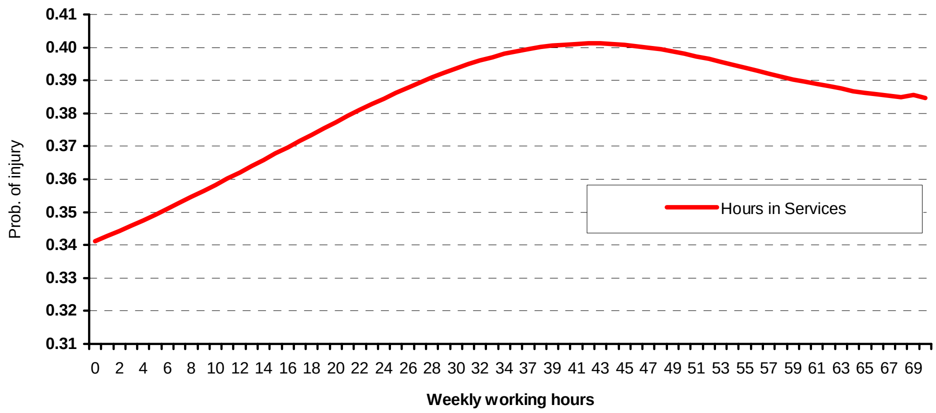
a) Agriculture



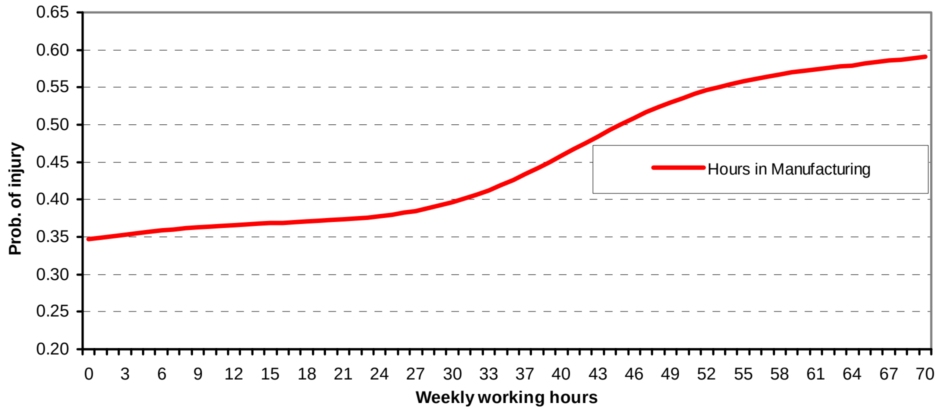
***b)* Commerce**



c) Services



d) Manufacturing



100. In the case of Brazil, we observe similar patterns to Cambodia when we consider all sectors of employment. The probability of suffering from an injury rises up to about 45 hours per week, thereafter the rate of increase declines substantially (Figure 21). In agriculture as well the rate of increase of the probability of being injured (that always increases with hours) is higher up to 18 hours of work and then becomes smaller. Similar patterns, albeit with different thresholds are observed in the construction sector. In manufacturing and commerce, on the contrary, the impact of working hours on the probability of suffering an injury is almost negligible up to about 46 hours of work per week and then rises steadily.

101. Again this confirms the importance of looking at sectoral evidence when trying to identify thresholds that link working hours to health consequences of child work. It also indicates that such sectoral effects are likely to be country specific and that it might be difficult to generalize results from one country to another.

Figure 20. **Kernel regression, injury versus working hours, Brazil**

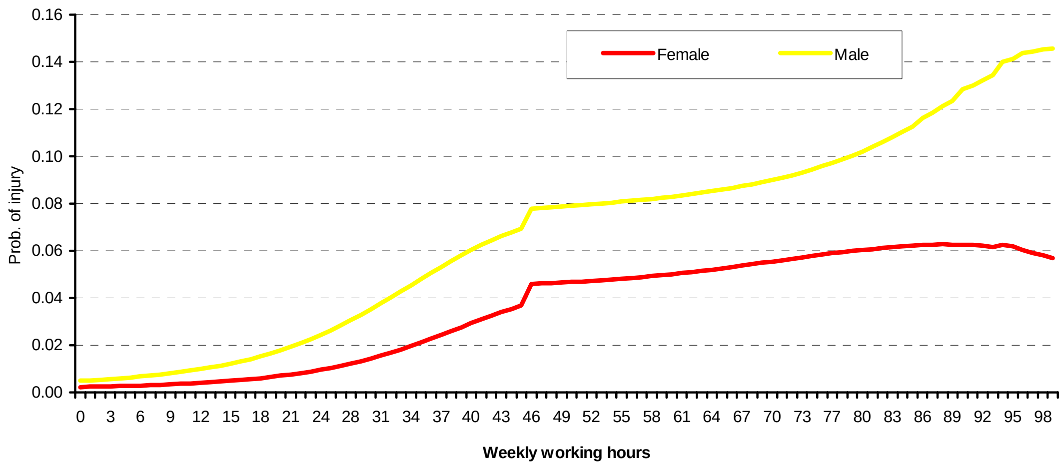
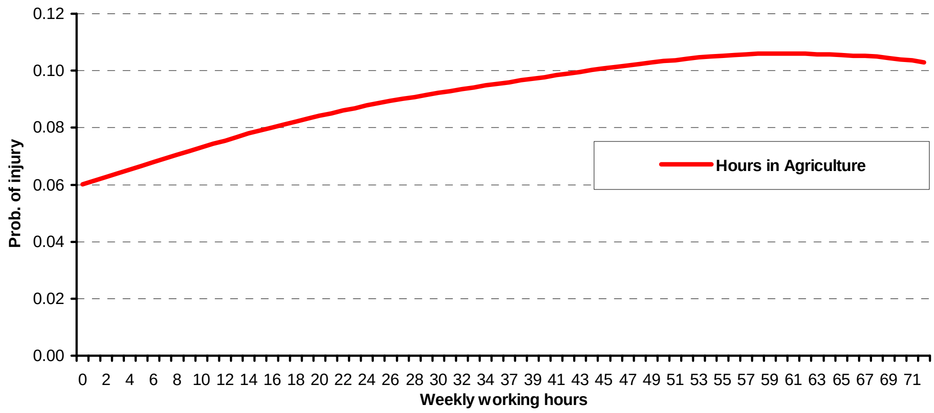
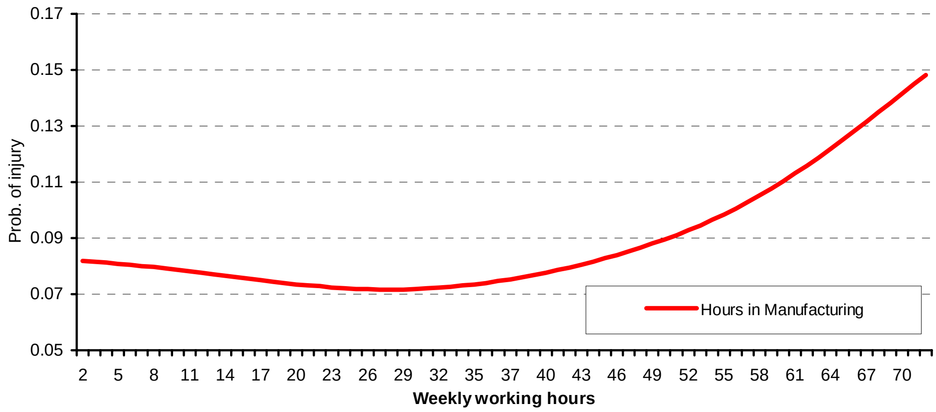


Figure 21. **Kernel regression, injury versus working hours, by sector, Brazil**

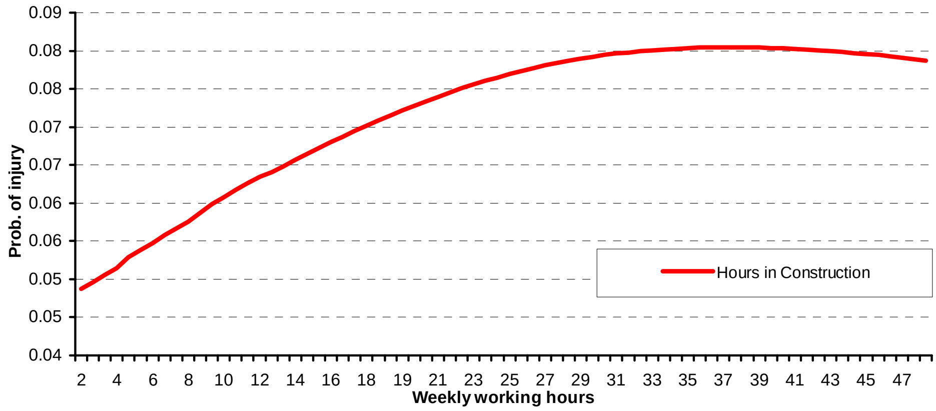
a) Agriculture



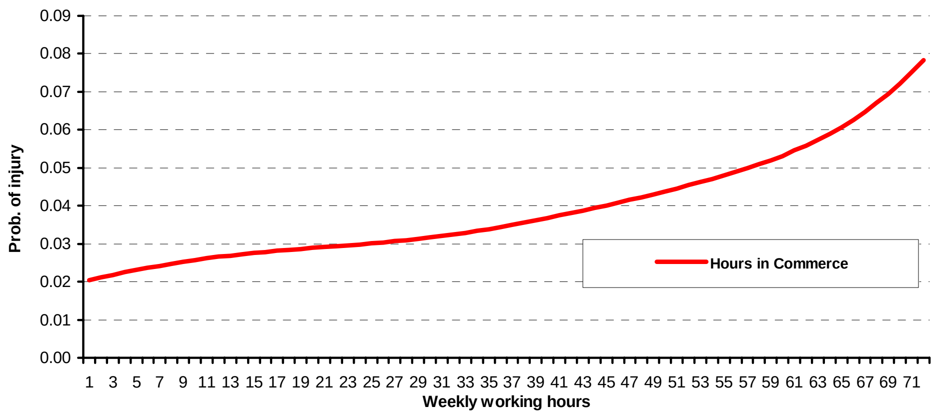
b) Manufacturing



c) Construction

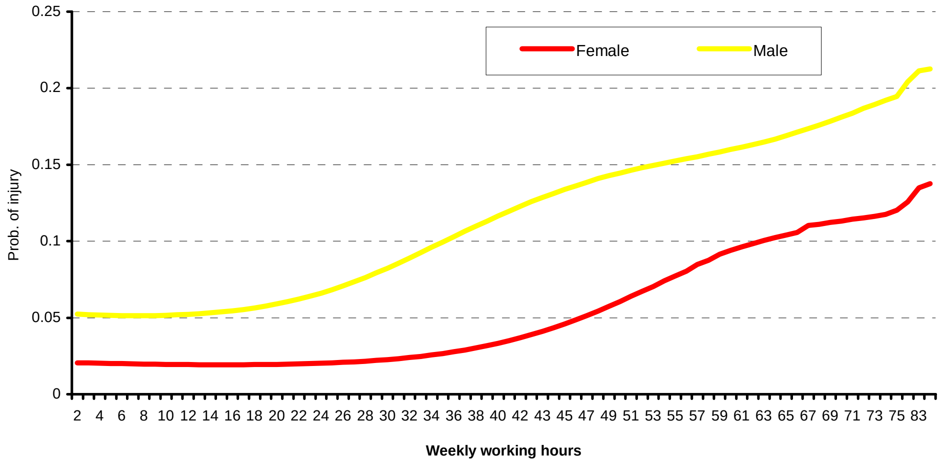


d) Commerce



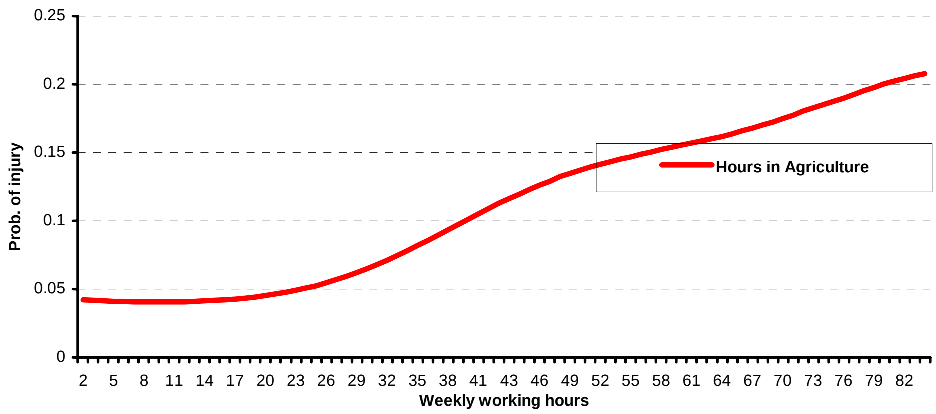
102. In Bangladesh, we also observe patterns similar to those of the other countries analyzed, but with differences by gender (Figure 23). The graph shows that the probability to suffer from an injury for male children is always higher than girls, and starts to increase from 20 hours of work per week. Female children have to work longer hours to reach the same level of probability.

Figure 22. **Kernel regression, injury versus working hours, Bangladesh**

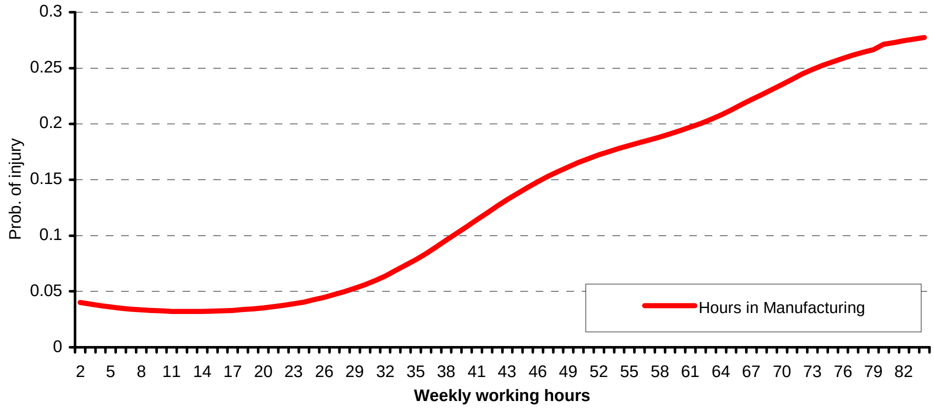


103. This result is however a combination of sectoral characteristics. Agriculture, manufacturing and services sectors seem to have a common pattern, showing a significant increasing of the probability to experience a bad health outcome from 30 hours per week. The sector commerce shows a different pattern, concentrating the rate of increases in the probability of an ill health in the range of 35 – 50 weekly hours.

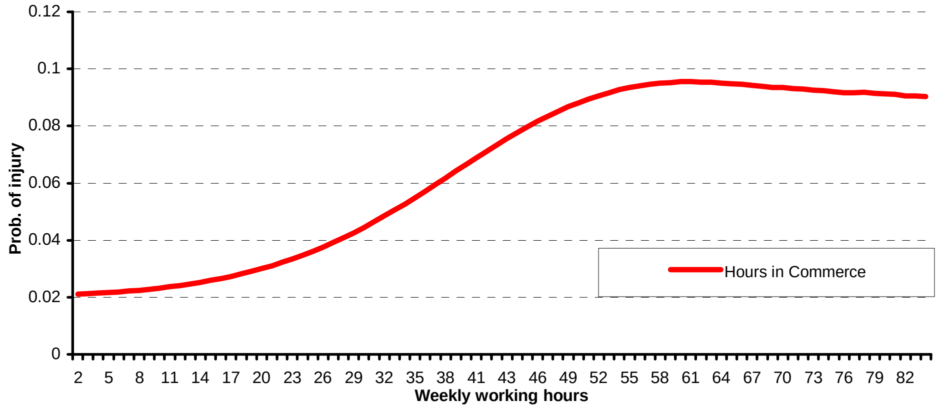
Figure 23. **Kernel regression, injury versus working hours, by sector, Bangladesh**
a) Agriculture



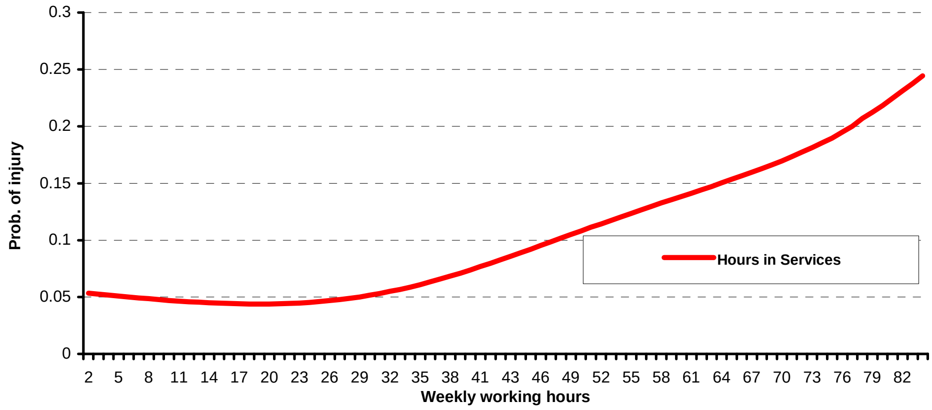
b) Manufacturing



c) Commerce



d) Services



6.4 Hours thresholds based on relative risk

104. The results presented in the paper illustrate how injury risk changes as weekly working hours increase, given the sector of employment and other relevant variables. But where along the working hours continuum should the threshold for maximum working hours be set? It is possible to go beyond the general considerations we have already put forward? We briefly discuss here a possible approach that could be followed to determine guidelines for identification of thresholds.

Such an approach is not the only one possible, but we use it to illustrate how to make operative the analysis we have carried out.

105. One key step in setting thresholds is to determine the level of acceptable risk, which could then be mapped to a corresponding hours threshold making use of synthetic indicators (Kernel, probit etc.). But establishing a criterion based on “absolute” risk does not appear feasible, because of the intrinsic problem to attribute a precise meaning to any absolute level of indicators, and because of the differences in the nature and measurement of risk across countries that would make almost impossible to derive international standard.

106. . It would be better, therefore, to use a criterion based on “relative” risk, following in spirit the approach that is used to define, for example, wasting and stunting[21]. For example, one could define the level of acceptable risk in terms of some standardized distance from the mean (or other measure of central tendency). On the basis of such an “acceptable” level of risk, it could be possible to identify a threshold level in terms of hours. In defining such a threshold, however, care should be taken of the actual distribution of working hours. to reflect the fact that small change in the level of permissible working hours might largely change the number of children who are (not) allowed to work. Obviously, approach based on relative measures bear well known limits, like accepting different absolute risk level by country etc.

107. We present in what follow a brief example of the approach just described. In Figure 24 below, the level of acceptable risk as been defined in relative term and set to minus one Standard Deviation from the mean, in each country. When mapped to working hours, these maximum acceptable relative risk levels result in weekly hours thresholds of about 14 hours per week in Cambodia, of 22 hours in Bangladesh and 12 hours in Brazil.

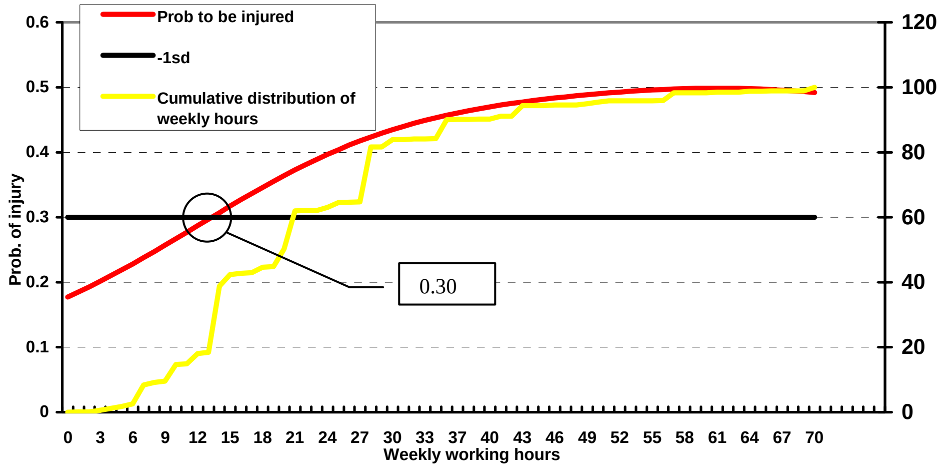
108. The cumulative distribution of working children by working hours, also shown in Figure 24, suggests a large proportion of working children currently exceed these maximum hours thresholds. Also note that in the case of Cambodia, given the distribution of working hours, small changes in the level of the threshold could determine large changes in the number of children for which work is permissible. This is a good example of the need to look also at the actual hours distribution when identifying the threshold for light work.

---

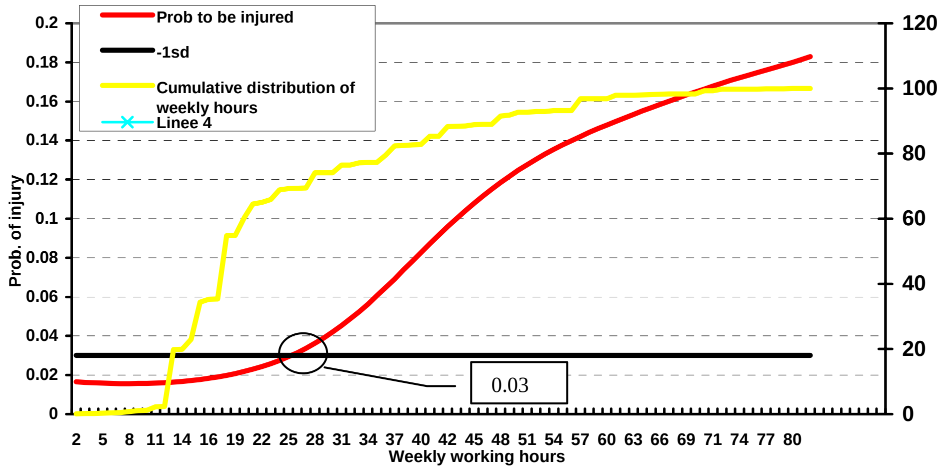
[21] The comparison is obviously only suggestive, as we are far from having the volume of analysis and information that as been the developed for anthropometric information (not to talk about the objectivity of the measurement)

Figure 24. **Kernel regression (injury versus working hours), mean injury risk and cumulative distribution of working children by working hours – age group 12-14 -**

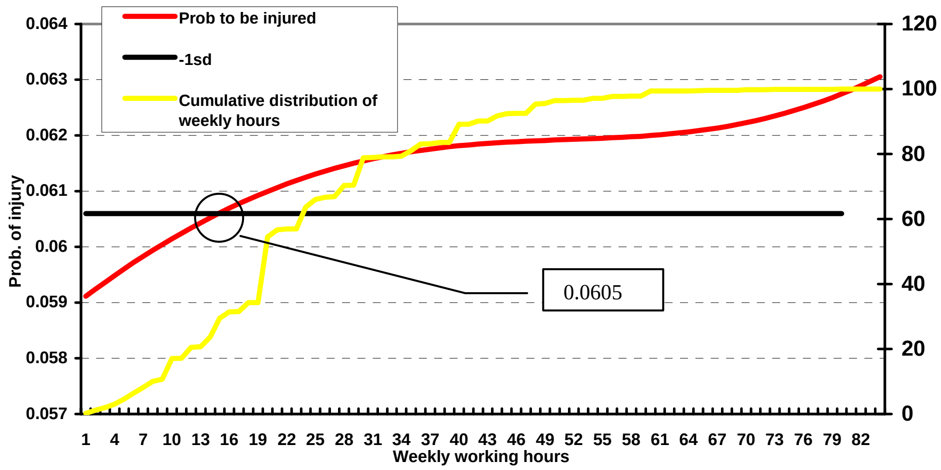
(a) Cambodia



(b) Bangladesh



(c) Brazil



7. CONCLUSIONS

109. The findings presented in the previous sections demonstrate the important causal relationship between working hours, on one hand, and children's health and safety, on the other. Marginal effects calculated after Heckman probit estimates indicated that each additional weekly hour of work adds about 0.3 percentage points to the probability of suffering work related ill-health in Cambodia, and about 0.1 percentage points to the probability of sustaining a work-related injury in Brazil. In both countries, kernel regressions also illustrated how the probability of work-related ill health rises with the length of a child's workweek. These findings provide a solid empirical rationale for using working hours as a main criterion for identifying child labour for elimination among the 12-14 or 15-17 years age groups.[22]

110. But identifying an appropriate hours threshold for permissible work is complicated by the fact that the work sector also appears have an important influence on the health effects of work. In Cambodia, for example, it was found that children in agriculture are 12 percentage points more likely to suffer injuries than those in the manufacturing, and in Brazil, that children in agriculture are almost five percentage points more likely to suffer a work-related injury than children in commerce. To attain similar levels of risk, the paper showed that working children in different sectors must log very different numbers of hours – a child in working in manufacturing must put in 40 hours more per week than a child in agriculture to reach the same (40 percent) level of risk, for example, in the case of Cambodia. The kernel regressions illustrated how changes in risk levels with hours worked also vary by sector.

111. The implication of these findings for establishing child labour standards is clear – both working hours and cross-sectoral differences in risk need in principle to be taken into consideration in distinguishing permissible work from child labour. A single universal hours threshold applied across all sectors would be less justifiable, as such a threshold would offer very different levels of protection for working children depending on their sector of work. The iso-risk curves used in Section 6 (paragraph 65) illustrate this point. Cambodian children working up to a universal weekly hours threshold of 14 hours, for example, would face a 49 percent risk of ill health in the agricultural sector, but only an 33 percent risk of ill health in the commerce sector. Brazilian children working up to the same threshold would face a 8 percent risk of injury in the agricultural sector against only an 3 percent injury risk level in the commerce sector. Sector-specific thresholds for maximum permissible working hours would be needed to help ensure a constant risk level across sectors.

112. However, it might not be feasible to apply different threshold by sectors for two main reasons: first, it might require a too complex administrative and monitoring mechanism; and

---

[22] ILO Convention No. 138 proscribes all forms of economic activity for children under 12 years of age, regardless of number of hours, and therefore discussion of maximum weekly working hours threshold is not relevant for this age group.

second, once sectoral differences are introduced then logically the door is open for the consideration also of intra sectoral differences. In fact, it is likely that health risks vary a lot within the different sector, according to the sub sector of activity and to the actual task carried out by the child. Logic would then require thresholds in terms of working hours differentiated within sub sector and also by task. The information and administrative requirements necessary to implement such an approach would be likely to make it unpractical.

113. The above considerations seem to indicate that a single threshold might be preferable to differentiated thresholds. In such a case it should be born in mind that children working in different sectors would face different risks. Hence a “conservative” approach is required in drawing the line between permissible and not permissible work, so not to expose to excessive risks children working in the more accident prone sectors. One possible approach would be to identify an hours threshold based on relative risk, as detailed in Section 6.4 above. From this point of view, in the light of the empirical evidence analyzed, the threshold of 14 hours proposed/adopted by IPEC does not appears far off the mark.

114. The severity of ill-health also should be considered when establishing child labour standards. Indeed, it could be argued that it is the relationship between working hours and the risk of *serious* episodes of ill-health that should be the focus when attempting to identify maximum permissible hours thresholds. The evidence provided suggests that consideration of ill-health severity changes the relative risk levels of work in different sectors. In Cambodia, for example, while children in agriculture faced the highest of overall risk of ill-health, they faced the lowest risk of suffering serious episodes of ill-health. The data, however, only permitted an indirect proxy for severity – type of medical treatment sought for the ill-health episode – an indicator that can be influenced by individual and household characteristics. Further research, employing direct measures of ill-health severity, is needed to explore this issue further.

115. Finally in establishing the threshold for light work, attention should be paid to the empirical distribution of hours worked and risks. As discussed in the study, the distribution of hours worked is highly concentrated and shows several picks. This implies that marginal changes in the definition of the threshold (a few hours a week more of less) can largely changes the number of children that fall in the category of permissible/not permissible work. For example, in the case of Cambodia, raising the threshold from 14 hours to 21 hours per week would imply that the percentage of children carrying out permissible work would rise from 38 percent to 60 percent. This obviously add and additional complication, that however cannot be overlooked, given the strong policy and monitoring implications that bears. It also points out to the difficulty of establishing international general criteria for the definition of child work to be eliminated and points to the needs of a well-informed national legislation.

116. As a result of the in depth study carried out we have also identified a set of knowledge gap that would need to be addressed in order to improve the scientific support to the identification of thresholds based on hours worked.

117. First, our study has looked in depth at three countries only. It would be important to extend the analysis to additional countries in order to check the robustness of the results obtained. In particular, an extension is required at least for Sub Saharan Africa, where the incidence of child labour is the highest.

118. The quality of information on the severity of the illness/injuries must be improved. An analysis of the available information in the different data sets could be of help in identifying the most promising approach.

119. The health impact of time spent on household chores was not looked at in the study because of data limitations. This, however, should be another focus of future research efforts, as chores also undoubtedly pose health risks and therefore also merit consideration in setting child labour standards.

120. It would also be important to look at children’s total work burden, i.e., time spent on both economic activities and household chores, and at the relationship between total work burden and health and safety outcomes. The findings in the previous sections, in not controlling for household chores involvement, may to some degree reflect the unobservable effects of performing chores.

BIBLIOGRAPHY

Akabayashi, H. and Psacharopoulos, G. 1999. The trade-off between child labour and human capital formation: A Tanzanian case study. *The Journal of Development Studies*, 35(5): 120-140

Anker, R. 2000. The economics of child labour: A framework for measurement. *International Labour Review*, 139(3): 257-280.

Appleton, S. and Song, L. 1999. Income and human development at the household level: evidence from six countries. Mimeo, University of Oxford.

Ashagrie, K. 1998. *Statistics on Child labor and hazardous child labor in brief*.Geneva,ILO.
http://www.ilo.org/public/english/standards/ipec/simpoc/stats/child/stats.htm

Baland, J-M. and Robinson, J. 2000. Is child labor inefficient? *Journal of Political Economy*, 108.

Barrera, A. 1990. The role of maternal schooling and its interaction with public health programs in child health production. *Journal of Development Economics*, 32(1): 69-91

Basu, K. 1999. Child labor: Cause, consequence and cure with remarks on international labor standards. *Journal of Economic Literature*, 37: 1083-1119.

Becker, G. 1965. A theory of the allocation of time. *The Economic Journal*, 75: 493-517.

Bequele A. and Myers W.E. 1995. *First Things First in Child Labour: Eliminating work detrimental to children*. Geneva, ILO.

Behrman, J.R. and Lavy, V. 1994. Child health and school achievement: Causality, association and household allocations. *LSMS Working Paper 104*, Washington D.C., World Bank.

Beswick, J. and White, J. (2003) Working Long Hours, Health & Safety. *Laboratory HSL*/2003/02.

Cameron, L. 2000. The impact of the Indonesian financial crisis on children:an analysis using the 100 Villages Data, *Innocenti Working Paper No. 81*,
Florence, UNICEF.

Caruso C., Dick R., Hitchcock E., Russo J., and Schmidt J. 2004. *Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries and Health Behaviours.* U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, and National Institute for Occupational Safety and Health.

Cigno, A. and Rosati, F.C. 2001. Child labour, education, fertility and survival in rural India. *Pacific Economic Review*.

de Onis, M. and Habicht, J.P. 1996 Anthropometric reference data for international use: Recommendations from a World Health Organization Expert Committee. *American Journal Of Clinical Nutrition* 64: 650-658.

Fassa, A.G., Facchini L.A., Dall'Agnol M.M., Christiani D.C. 2000. Child labor and health: Problems and perspectives, *International Journal of Occupational and Environmental Health*, 6(1): 55-62.

Fassa, A.G. 2003. Health Benefits of Eliminating Child Labour. Geneva: International Labour Organization.

Fentiman, A. Hall, A. and Bundy, D. 2001. Health and cultural factors associated with enrolment in basic education: A study in rural Ghana. *Social Science and Medicine*, 52: 429-439.

Forastieri V. 1997. *Children at Work: Health and Safety Risks*. Geneva, ILO.
Graitcer PL, Lerer LB 1998 November. Child Labor and Health: Quantifying the Global Health Impacts of Child Labor. The World Bank, Human Development Network.

Grootaert, C. and H. Patrinos. 1999. *The policy analysis of child labor: A comparative study*, New York, St. Martin's Press.

Grosh, M.E. and Glewwe, P. 1995. A guide to Living Standards Measurement Study surveys and their data sets, *LSMS Working Paper No 120*, Washington D.C., World Bank.

Grossman, M. 1972. On the concept of health capital and the demand for health. *Journal of Political Economy*, 80: 223-55.

Guiffrida, A., Iunes, R.F. and Savedoff, W.D. 2001. Health and poverty in Brazil: Estimation by structural equation model with latent variables, preliminary draft October 2001, *Mimeo*, Washington D.C., Inter-American Development Bank.

Hausman, J. and Taylor, W. (1981). Panel data and unobservable individual effects. *Econometrica*, 49:1377-1398.

Heady, C. 2000. What is the effect of child labour on learning achievement? Evidence from Ghana. *Innocenti Working Paper No. 79*. Florence, UNICEF Innocenti Research Centre.

Idler, E. L. and Y. Benyamini. 1997. Self-rated health and mortality: a review of twenty-seven community studies. *Journal of Health and Social Behaviour*, 38 (1): 21-37

International Labour Organisation. 1998. *Conference Report VI (1) Child labor: Targeting the intolerable*. Geneva, ILO.
http://www.ilo.org/public/english/standards/ipec/publ/policy/target/index.htm

Kaplan, G.A. and Gamacho, T.1983. Perceived health and mortality: A nine year follow-up on the Human Population Laboratory Cohort. *American Journal of Epidemiology*, 117: 292-8.

Kassouf, A.L. McKee, M. and Mossialos, E. 2001. Early entrance to the job market and its effects on adult health: Evidence from Brazil. *Health Policy and Planning*, 16(1): 21-28.

Layde P., Nordstrom D., Stueland D., and Wittman L. 1996. A population-based case control study of agricultural injuries in children. *Inj. Prev.* 1996 Sep; 2(3):192-6.

Naida, U. and Parasuman, S. 1985. Health situation of working children in Greater Bombay, *Bombay Unit for Child and Youth Research, Tata Institute of Social Sciences, mimeo.*

National Institute for Occupational Safety and Health (NIOSH), 2004. Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries and Health Behaviors.

National Research Council-Institute of Medicine (1998). Protecting youth at work: Health, safety, and development of working children and adolescents in the United States. Washington DC: National Academy Press.

National Statistical Office of the Philippines (NSOP). 1998. 1995 Survey on Children 5 - 17 Years Old (SCL), Manila, Philippines. http://www.ilo.org/public/english/standards/ipec/simpoc/philippines/report/philip1995/index.htm

Nielsen, H.S. 1998. Child labour and school attendance: two joint decisions. *Working Paper 98-15*, Centre for Labour Market and Social Research, University of Aarhus and the Aarhus School of Business.

O'Donnell O., Rosati F.C. and Van Doorslaer E., Child Labour and Health: Evidence and Research Issues, Understanding Children's Work (UCW) Project working paper, December 2001.

Parker, D. 1997. Health effects of child labor. *The Lancet*, 350 (8): 1395-6.

Patrinos, H.A. and Psacharopoulos, G. 1995. Educational performance and child labor in Paraguay. *International Journal of Educational Development*, 15(1): 47-60.

Patrinos, H.A. and Psacharopoulos (1997), G. Family size, schooling and child labour in Peru. *Journal of Population Economics*, 10(4): 387-405.

Psacharopoulos, G. 1997. Child labor versus educational attainment: Some evidence from Latin America. *Journal of Population Economics*, 10(4): 377-86.

Ravallion, M. and Wodon, Q. 2000. Does child labour displace schooling? Evidence on behavioural responses to an enrolment subsidy. *The Economic Journal*, 110: C158-C175.

Rosenzweig, M.R. and Evenson, R. 1977. Fertility, schooling and the economic contribution of children in rural India: an econometric analysis, *Econometrica*, 45(5): 1065-79.

Rosati F.C., Straub R. Does Work during Childhood affect Adult's Health? An Analysis for Guatemala, Understanding Children's Work (UCW) Project Working Paper, March 2004

Sadana, R, CD Mathers, AD Lopez, CJL Murray and K Iburg. 2000. Comparative analysis of more than 50 household surveys on health status, *GPE Discussion Paper No 15*, EIP/GPE/EBD, Geneva, WHO.

Satyanarayana, K. Krishna, T.P. and Rao, B.S. 1986. The effect of early childhood undernutrition and child labour on the growth and adult nutritional status of rural Indian boys around Hyderabad. *Human Nutrition and Clinical Nutrition* 40C: 131-9.

Sen, A. 1998. Mortality as an indicator of economic success and failure. *Economic Journal* 108: 1-25.

Schultz, T.P. 1984. Studying the impact of household economic and community variables on child mortality. *Population and Development Review*, 10: 215-235.

Skoufias, E. 1994. Market wages, family composition and the time allocation of children in agricultural households. *The Journal of Development Studies*, 30(2): 335-60.

Smith, J. 1999 Healthy bodies and thick wallets: the dual relation between health and economic status. *Journal of Economic Perspectives*, 13(2): 145-166

Steckel, R. 1995. Stature and the standard of living. *Journal of Economic Literature*, 33: 1903-40.

Strauss, J. and Thomas, D. 1998. Health, nutrition and economic development. *Journal of Economic Literature,* 36, 766-817.

Thomas, D. Strauss, J. and Henriques, M.H. 1991. How does mother's education affect child height? *Journal of Human Resources*, 26: 183-211.

Van-Doorslaer, E. 1987. *Health, Knowledge and the demand for medical care,* Maastricht, Assen

Wagstaff, A. 1993. The demand for health: an empirical reformulation of the Grossman model. *Health Economics,* 2:189-198.

Woodhead M., Psychosocial impacts of child work: a framework for research, monitoring and intervention, Understanding Children's Work (UCW) Project working paper, February 2004

World Health Organisation. 1995. Physical Status: Use and interpretation of anthropometry. Report of a WHO Expert Committee. WHO Technical Report 854. Geneva, WHO.

ANNEX A: QUESTIONS USED TO DEFINE THE MAIN VARIABLES OF INTEREST

<table>
<tr><th colspan="3">Questions used to define Children Work: Bangladesh</th></tr>
<tr><th colspan="2">Child work</th><th>Working Hours</th></tr>
<tr><td>3.3 Is he/she engaged in any work last week (economic and /or non-economic) either before or after school or training institutions?

1- Yes
2- No</td><td>3.4. If yes in 3.3 which of the following work is he/she mainly engaged during last week?

<u>Economic Activity</u>
1- Work for wages salary
2- Engaged in household enterprise (business, agriculture and other economic activities)
3- Self-employed /own account work
<u>Non Economic Activity</u>
4- Help in household chores/housekeeping/ carrying for young siblings etc
5- For taking care of sick or disabled parents/relatives
6- Others (specify)</td><td>3.30 How many hours did he/she actually work during last week?</td></tr>
<tr><td colspan="3">Source: Bangladesh, National Child Labour Survey</td></tr>
</table>

<table>
<tr><th colspan="3">Questions used to define Children Work: Cambodia</th></tr>
<tr><th colspan="2">Child work</th><th>Working Hours</th></tr>
<tr><td>7.1 Did (name) do any work even for one hour on any day during the past 7 days for paid/unpaid, profit, family gain, or for own final use or consumption?

1- Yes
2- No</td><td>7.2 Although did not work during the past 7 days for some reason (i.e., answered “No” to Q 7.1), did he/she have a job or enterprise, or an attachment to a job/enterprise, such as business, farm, shop, service establishment (whether at a fixed place or mobile) etc.?</td><td>3.30 How many hours did he/she actually work during past 7 days?</td></tr>
<tr><td colspan="3">Source: Cambodia, Child Labour Survey 2001</td></tr>
</table>

Questions used to define Children Work: Brazil				
Child work				**Working Hours**
V9001. Did (name) work during the week of September 23 to 29, 2001? 1- Yes 2- No	V9002. During the week of September 23 to 29, 2001 did (name) have a paid job, although you were absent for some reasons? 2- Yes 4- No	V9003. During the week of September 23 to 29, 2001 did (name) carried out agricultural work, fishing or … for own final use or consumption ? 1- Yes 2- No	V9004. During the week of September 23 to 29, 2001 did (name) was involved in construction for own final use or for the other members of the household? 2- Yes 4- No	V9058. How many hours did he/she work during the reference week?
Source: Brazil, PNAD 2001				

Questions used to define Work Related Illness\Injury: Bangladesh	
Illness/Injury	
SECTION 3(f): HEALTH AND SAFETY OF CHILDREN AGED 5-17 YEARS **(This section is applicable for those children who are engaged in economic activities)** 3.42. Has the children ever experienced any injury or illness due to work? 1- Yes 2- No	
Source: Bangladesh, National Child Labour Survey	

Questions used to define Work Related Illness\Injury: Brazil	
Illness/Injury	**Risk**
Q 11.11 During the year of September 30, 2000 to September 29, 2001 did you suffer from injuries due to your work? 2- Yes 4- No	Q 11.15 During the period of September 30, 2000 to September 29, 2001 how many months did you stop to work because of the occurrence of the injury?
Source: Brazil, PNAD 2001	

Questions used to define Work Related Illness\Injury: Cambodia	
Illness/Injury	**Risk**
Q 11.11 Has (name) ever been hurt at work/workplace or suffered from illness/injuries due to work at any time? 1- Yes 2- No	Q 11.15 Referring to the most serious accident/illness/injury, how serious was it? 1 Did not need any medical treatment 2 Medically treated and released immediately 3 Stopped work temporarily 4 Hospitalized 5 Prevent work permanently 6 Other
Source: Cambodia, Child Labour Survey 2001	

ANNEX B: DESCRIPTIVE STATISTICS OF THE VARIABLES INCLUDED IN THE REGRESSION ANALYSIS

Table B1. **Descriptive statistics of the variable included in the Heckman probit regression analysis: BRAZIL**

Variable	Obs	Mean	Std. Dev.	Min	Max
injury	11590	0.06	0.24	0	1
female	11590	0.35	0.48	0	1
Age	11590	14.43	2.50	5	17
Age2	11590	214.54	65.52	25	289
edulev	11590	1.54	0.78	1	3
hours_weekly	11590	28.55	15.48	1	84
lnincome2	11590	8.32	3.64	3.18	30.20
Agriculture	11590	0.41	0.49	0	1
Commerce	11590	0.17	0.37	0	1
Services	11590	0.21	0.41	0	1
Manufacturing	11590	0.09	0.29	0	1
rural	11590	0.38	0.49	0	1
Selection Equation					
employ	95773	0.12	0.33	0	1
heduc	95773	2.92	1.20	1	4
lnwage	95773	0.29	1.14	0	8.01
nchild04	95773	0.00	0.02	0	1
nadult	95773	0.00	0.03	0	1
hhsize	95773	5.27	2.06	1	21
Age	95773	11.09	3.75	5	17
Age2	95773	137.18	83.61	25	289
female	95773	0.50	0.50	0	1
lnincome2	95773	8.20	3.05	2.08	30.27

Table B2. **Descriptive statistics of the variable included in the Heckman probit regression analysis: CAMBODIA**

Variable	Obs	Mean	Std. Dev.	Min	Max
injury	13640	0.45	0.50	0	1
female	13640	0.50	0.50	0	1
Age	13640	12.92	3.04	5	17
Age2	13640	176.27	74.93	25	289
edulev	13640	1.94	0.55	1	4
weekly_hours	13640	23.98	15.02	1	84
protection	13640	0.01	0.11	0	1
lnexp2	13640	11.19	0.84	4.11	14.84
agricult	13640	0.56	0.50	0	1
commerce	13640	0.28	0.45	0	1
services	13640	0.04	0.20	0	1
manufact	13640	0.08	0.27	0	1
rural	13640	0.35	0.48	0	1
Selection Equation					
employ	27816	0.50	0.50	0	1
Age	27816	11.23	3.63	5	17
Age2	27816	139.37	81.90	25	289
female	27816	0.49	0.50	0	1
nchild04	27816	0.46	0.67	0	4
nadult	27816	2.84	1.20	0	11
hhsize	27816	6.66	1.86	2	20
heduc	27816	2.12	0.73	1	4
hhead_se	27816	0.15	0.36	0	1

Table B3. **Descriptive statistics of the variable included in the Heckman probit regression analysis: Bangladesh**

Variable	Obs	Mean	Std. Dev.	Min	Max
injury	10352	0.08	0.27	0	1
female	10352	0.26	0.44	0	1
Age	10352	13.66	2.21	5	17
Age2	10352	191.47	57.74	25	289
edulev	10352	1.97	0.98	1	4
weekly_hours	10352	28.97	16.45	2	84
lnexpend	10352	8.02	0.52	5.30	11.00
agriculture	10352	0.52	0.50	0	1
commerce	10352	0.16	0.36	0	1
services	10352	0.05	0.21	0	1
manufactur~g	10352	0.16	0.37	0	1
rural	10352	0.71	0.45	0	1
Selec					
employ	60605	0.17	0.38	0	1
Age	60605	10.47	3.62	5	17
Age2	60605	122.63	78.36	25	289
female	60605	0.46	0.50	0	1
nchild04	60605	0.62	0.81	0	7
nadult	60605	2.28	1.09	0	10
hhsize	60605	6.07	2.26	1	20
lnexpend	60605	8.10	0.59	2.48	11.29
heduc	60605	1.94	1.20	1	4
hsex	60605	0.94	0.24	0	1

ANNEX C: PROBIT ESTIMATES BY SECTOR

Table C1. **Marginal effects after probit regression analysis – Female working in Agriculture: CAMBODIA**

		Number of obs = 3562
variable	dy/dx	Z
Age	-0.031	-1.46
Age2	0.001	1.7
edulev	-0.013	-0.68
weekly_hours	0.004	5.43
protection*	0.334	3.86
Lnexp2	-0.028	-2.3
rural*	-0.067	-3.87

Table C2. **Bangladesh -Probit estimates – Sector: Agriculture**

Probit estimates	Number of obs = 5360					
	LR chi2(7) = 236.87					
	Prob > chi2 = 0.0000					
Log likelihood = -1134.6886	Pseudo R2 = 0.0945					
injury	***Coef.***	***Std. Err***	***z***	***P> z***	***[95% Con***	***. Interval]***
female	-0.683	0.089	-7.66	0.00	-0.8584	-0.5086
Age	-0.507	0.077	-6.62	0.00	-0.6566	-0.3565
Age2	0.019	0.003	6.33	0.00	0.0134	0.0253
edulev	-0.126	0.033	-3.80	0.00	-0.1911	-0.0610
weekly_hours	0.012	0.002	5.70	0.00	0.0081	0.0166
lnexpend	-0.235	0.059	-3.95	0.00	-0.3511	-0.1182
Rural	0.030	0.091	0.33	0.74	-0.1484	0.2086
_cons	3.531	0.667	5.29	0.00	2.2233	4.8390

Table C3. **Bangladesh -Probit estimates – Sector: Commerce**

Probit estimates	Number of obs = 1624					
	LR chi2(7) = 50.55					
	Prob > chi2 = 0.0000					
Log likelihood = -311.10262	Pseudo R2 = 0.0751					
injury	Coef.	Std. Err	z	P> z	[95% Con. Interval]	
female	-0.678	0.282	-2.40	0.02	-1.2314	-0.1252
Age	-0.118	0.228	-0.52	0.61	-0.5652	0.3298
Age2	0.006	0.008	0.76	0.45	-0.0102	0.0231
edulev	-0.089	0.060	-1.47	0.14	-0.2076	0.0295
weekly_hours	0.012	0.003	4.11	0.00	0.0063	0.0178
lnexpend	-0.110	0.103	-1.06	0.29	-0.3120	0.0926
Rural	0.193	0.112	1.72	0.09	-0.0264	0.4114
_cons	-0.690	1.720	-0.40	0.69	-4.0620	2.6821

Table C4. **Bangladesh -Probit estimates – Sector: Services**

Probit estimates	Number of obs = 489					
	LR chi2(7) = 17.62					
	Prob > chi2 = 0.0138					
Log likelihood = -132.05222	Pseudo R2 = 0.0625					
injury	***Coef.***	***Std. Err***	***z***	***P> z***	***[95% Con. Interval]***	
female	0.077	0.184	0.42	0.67	-0.2829	0.4375
Age	-0.191	0.276	-0.69	0.49	-0.7311	0.3500
Age2	0.007	0.011	0.67	0.50	-0.0139	0.0283
edulev	-0.041	0.094	-0.43	0.67	-0.2256	0.1441
weekly_hours	0.019	0.005	3.78	0.00	0.0090	0.0284
lnexpend	-0.079	0.139	-0.57	0.57	-0.3508	0.1922
Rural	-0.060	0.172	-0.35	0.73	-0.3975	0.2772
_cons	-0.207	2.048	-0.10	0.92	-4.2201	3.8063

Table C5. **Bangladesh -Probit estimates – Sector: Manufacturing**

Probit estimates	Number of obs = 1675					
	LR chi2(7) = 123.47					
	Prob > chi2 = 0.0000					
Log likelihood = -488.24936	Pseudo R2 = 0.1123					
injury	***Coef.***	***Std. Err***	***z***	***P> z***	***[95% Con. Interval]***	
female	-0.451	0.112	-4.04	0.00	-0.6694	-0.2321
Age	-0.105	0.182	-0.58	0.56	-0.4616	0.2509
Age2	0.004	0.007	0.63	0.53	-0.0091	0.0176
edulev	0.036	0.050	0.72	0.47	-0.0613	0.1331
weekly_hours	0.020	0.003	7.63	0.00	0.0147	0.0249
lnexpend	-0.268	0.087	-3.07	0.00	-0.4395	-0.0967
Rural	-0.157	0.091	-1.72	0.09	-0.3355	0.0214
_cons	0.835	1.377	0.61	0.54	-1.8634	3.5339

Table C6. **Cambodia--Probit estimates – Sector: Agriculture**

Probit estimates	Number of obs = 7690					
	LR chi2(8) = 130.19					
	Prob > chi2 = 0.0000					
Log likelihood = -5262.0011	Pseudo R2 = 0.0122					
injury	Coef.	Std. Err.	z	P>z	[95% Conf.Interval]	
edulev	-0.042	0.033	-1.30	0.19	-0.106	0.021
female	-0.035	0.029	-1.23	0.22	-0.092	0.021
age	-0.074	0.036	-2.05	0.04	-0.144	-0.003
age2	0.004	0.001	2.69	0.01	0.001	0.007
weekly_hours	0.008	0.001	6.92	0.00	0.006	0.011
protection	0.599	0.212	2.83	0.01	0.185	1.014
lnexp2	-0.038	0.021	-1.81	0.07	-0.079	0.003
rural	-0.122	0.030	-4.13	0.00	-0.180	-0.064
_cons	0.680	0.303	2.25	0.03	0.086	1.274

Table C7. **Cambodia--Probit estimates – Sector: Commerce**

Probit estimates	Number of obs = 3794					
	LR chi2(8) = 40.28					
	Prob > chi2 = 0.0000					
Log likelihood = -2405.2854	Pseudo R2 = 0.0083					
injury	Coef.	Std. Err.	z	P>z	[95% Conf.Interval]	
edulev	-0.089	0.048	-1.87	0.06	-0.182	0.004
female	-0.065	0.043	-1.52	0.13	-0.149	0.019
age	0.072	0.058	1.25	0.21	-0.041	0.185
age2	-0.002	0.002	-0.93	0.35	-0.007	0.002
weekly_hours	0.007	0.002	4.48	0.00	0.004	0.010
protection	-0.037	0.315	-0.12	0.91	-0.654	0.581
lnexp2	0.037	0.030	1.24	0.22	-0.021	0.094
rural	0.095	0.060	1.57	0.12	-0.023	0.213
_cons	-1.356	0.492	-2.76	0.01	-2.320	-0.391

Table C8. **Cambodia--Probit estimates – Sector: Services**

Probit estimates	Number of obs = 571					
	LR chi2(8) = 22.33					
	Prob > chi2 = 0.0043					
Log likelihood = -366.52479	Pseudo R2 = 0.0296					
injury	Coef.	Std. Err.	z	P>z	[95% Conf.Interval]	
edulev	-0.443	0.104	-4.25	0.00	-0.647	-0.239
female	-0.035	0.111	-0.32	0.75	-0.253	0.183
age	0.155	0.154	1.01	0.31	-0.146	0.457
age2	-0.004	0.006	-0.72	0.47	-0.016	0.008
weekly_hours	0.000	0.003	-0.12	0.90	-0.007	0.006
protection	0.442	0.387	1.14	0.25	-0.316	1.199
lnexp2	0.093	0.069	1.35	0.18	-0.042	0.228
rural	0.003	0.172	0.02	0.99	-0.334	0.340
_cons	-1.764	1.237	-1.43	0.15	-4.188	0.661

Table C9. **Cambodia--Probit estimates – Sector: Manufacturing**

Probit estimates	Number of obs = 1065					
	LR chi2(8) = 37.66					
	Prob > chi2 = 0.0000					
Log likelihood = -709.74318	Pseudo R2 = 0.0258					
injury	Coef.	Std. Err.	z	P>z	[95% Conf.Interval]	
edulev	-0.057	0.084	-0.68	0.50	-0.221	0.107
female	0.025	0.082	0.31	0.76	-0.136	0.187
age	-0.042	0.120	-0.35	0.73	-0.277	0.193
age2	0.002	0.005	0.52	0.60	-0.007	0.012
weekly_hours	0.009	0.002	3.67	0.00	0.004	0.014
protection	0.106	0.155	0.68	0.49	-0.197	0.409
lnexp2	0.068	0.045	1.50	0.13	-0.021	0.156
rural	0.100	0.096	1.05	0.29	-0.087	0.288
_cons	-1.069	0.911	-1.17	0.24	-2.855	0.717

Table C10. **BRAZIL -Probit estimates – Sector: Agriculture**

Number of obs = 4702						
LR chi2(7) = 45.54						
Prob > chi2 = 0.0000						
Log likelihood = -1345.4219 Pseudo R2 = 0.0166						
inj	Coef.	s.d.	z	P>z	P>z[95% Conf. Interval	
female	-0.167	0.068	-2.47	0.013	-0.299	-0.035
age	0.034	0.080	0.42	0.676	-0.124	0.191
Age2	-0.002	0.003	-0.55	0.583	-0.008	0.005
edulev	-0.072	0.033	-2.16	0.031	-0.137	-0.007
hours_weekly	0.012	0.002	5.29	0.000	0.007	0.016
lnincome2	-0.013	0.007	-1.78	0.074	-0.027	0.001
Rural	0.075	0.069	1.08	0.281	-0.061	0.211
_cons	-1.596	0.507	-3.15	0.002	-2.589	-0.603

Table C11. **BRAZIL -Probit estimates – Sector : Commerce**

Probit estimates Number of obs = 1935						
LR chi2(7) = 19.82						
Prob > chi2 = 0.0060						
Log likelihood = -281.25098 Pseudo R2 = 0.0340						
inj	Coef.	Std. Err.	z	P>z	P>z[95% Conf. Interval]	
female	-0.163	0.129	-1.27	0.205	-0.416	0.090
age	0.273	0.247	1.11	0.269	-0.211	0.757
Age2	-0.011	0.009	-1.17	0.243	-0.029	0.007
edulev	-0.059	0.053	-1.11	0.265	-0.162	0.045
hours_weekly	0.013	0.004	3.6	0.000	0.006	0.020
lnincome2	-0.023	0.021	-1.08	0.279	-0.065	0.019
Rural	-0.177	0.303	-0.58	0.560	-0.770	0.417
_cons	-3.505	1.640	-2.14	0.033	-6.718	-0.291

Table C12. **BRAZIL -Probit estimates – Sector : Services**

Probit estimates Number of obs = 2458						
LR chi2(7) = 15.07						
Prob > chi2 = 0.0351						
Log likelihood = -474.80519 Pseudo R2 = 0.0156						
inj	Coef.	Std. Err.	z	P>z	P>z[95% Conf. Interval]	
female	-0.184	0.089	-2.06	0.039	-0.3580	-0.0090
age	0.136	0.265	0.51	0.608	-0.3840	0.6559
Age2	-0.004	0.009	-0.39	0.695	-0.0221	0.0147
edulev	0.057	0.037	1.52	0.128	-0.0162	0.1293
hours_weekly	0.004	0.003	1.46	0.143	-0.0013	0.0093
lnincome2	-0.023	0.019	-1.18	0.237	-0.0606	0.0150
Rural	0.046	0.146	0.32	0.751	-0.2395	0.3319
_cons	-2.833	1.870	-1.52	0.13	-6.4973	0.8313

Table C13. **BRAZIL -Probit estimates – Sector : Manufacturing**

Probit estimates Number of obs = 1041						
LR chi2(7) = 13.42						
Prob > chi2 = 0.0624						
Log likelihood = -474.80519 Pseudo R2 = 0.0240						
inj	Coef.	Std. Err.	z	P>z	P>z[95% Conf. Interval]	
female	0.1731	0.1239	1.40	0.16	-0.070	0.416
age	0.1779	0.3462	0.51	0.61	-0.501	0.856
Age2	-0.0043	0.0124	-0.35	0.73	-0.029	0.020
edulev	-0.0519	0.0528	-0.98	0.33	-0.155	0.052
hours_weekly	0.0090	0.0047	1.90	0.06	0.000	0.018
lnincome2	0.0272	0.0141	1.93	0.05	0.000	0.055
Rural	0.1067	0.1603	0.67	0.51	-0.207	0.421
_cons	-3.6483	2.4131	-1.51	0.13	-8.378	1.081

ANNEX D: INCIDENCE DENSITY FOR CAMBODIA

In the case of Cambodia, given that information was available also on the number of months worked during last year, it is possible to compute incidence density using both hours worked during the last week and hours worked during the last year. As shown in Figures D1 and D2 below, variations in incidence density by child and work characteristics are broadly similar for the two reference periods. This offers some support to the assumption made in the main text that hours worked during the last year are proportional, for each individual, to the hours worked during last week.

Figure D1. **Incidence density, Cambodia, children aged 5-17 years,**

(a) Reference period of one week

(b) Reference period of 12 months